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STATE OF CALIFORNIA
HAZARD MITIGATION PLAN

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2018 State of California Hazard Mitigation Plan

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CHAPTER 1 – INTRODUCTION

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About Chapter 1

This introduction chapter acquaints the reader with the purpose and organization of the State of California Hazard Mitigation Plan, also known as the State Hazard Mitigation Plan (SHMP).

The chapter also presents the legal context for the SHMP, discusses key terms used throughout the document, and explains the State of California's process for SHMP adoption and assurances regarding the plan.

1.1 PURPOSE OF THE PLAN

The SHMP is the state's hazard mitigation guidance document and provides an updated and comprehensive description of California's historical and current hazard analysis, mitigation strategies, goals, and objectives. More importantly, the SHMP reflects the state's commitment to reduce or eliminate potential risks and impacts of natural and human-caused disasters by making California's families, homes, and communities better prepared and more disaster-resilient.

Hazard mitigation planning is a dynamic process built on realistic assessments of hazards and effective strategies for investing in priority mitigation projects and actions. This process involves multiple stakeholders and allows for the blending of overall mitigation goals, objectives, and actions of all levels of government.

The State of California is required to review and revise its SHMP and resubmit for Federal Emergency Management Agency (FEMA) approval at least once every five years to ensure continued funding eligibility for certain Stafford Act grant programs. (See *Section 1.4.1* for a description of the Stafford Act.) Such FEMA funding programs include the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), Fire Management Assistance Grant (FMAG), and Public Assistance (PA).

For example, FEMA approval of the 2013 SHMP has enabled California to receive over $31 million in HMGP funding and approximately $287,009,346 in PA grant funding between January 2013 and December 2016. Without a FEMA-approved SHMP, California would not have received these funds.

In addition, the approval of the SHMP allows the state to be eligible for the reduced cost share (90/10) for grants awarded under the FMA program, and up to 100 percent for severe repetitive loss properties.

This document is a comprehensive update of the 2013 SHMP. It performs the following functions:

- Describes goals, objectives, strategies, and priorities for future mitigation activities
- Documents statewide hazard mitigation systems implemented in California to reduce risk
- Highlights new hazard mitigation initiatives since the 2013 SHMP
- Describes and illustrates mitigation progress and success stories
- Facilitates integration of local, state, tribal, and private sector hazard mitigation activities into a comprehensive statewide effort

1.1.1 VISION AND MISSION

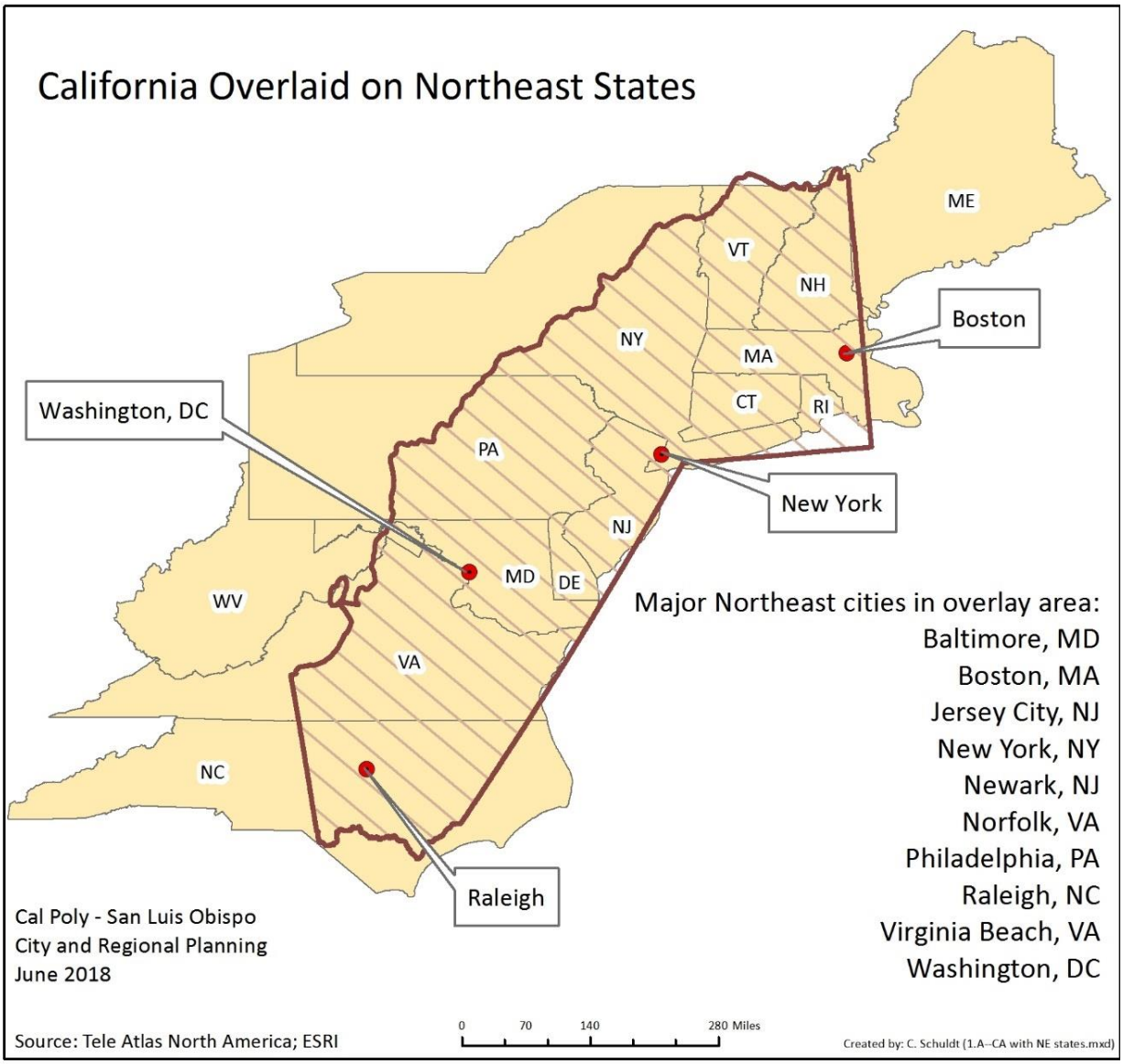
The 2018 SHMP vision is a safe and resilient California through hazard mitigation.

The 2018 SHMP mission is to integrate current laws and programs into a comprehensive hazard mitigation system that will guide the state in significantly reducing potential casualties, damage, and physical, social, economic, and environmental disruption from natural and human-caused disasters.

1.1.2 CALIFORNIA – WHAT'S AT STAKE?

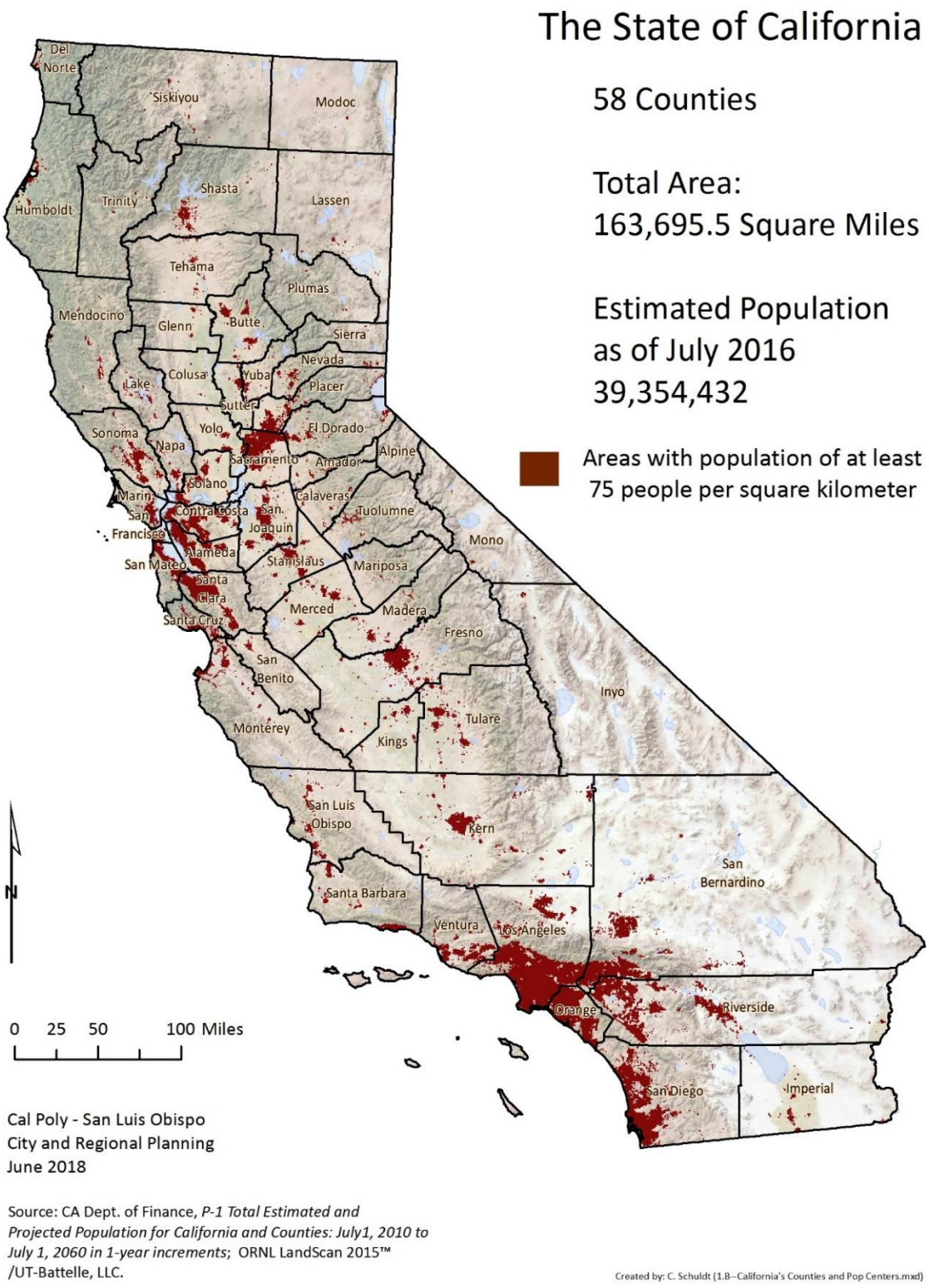
With approximately 39 million people, California is the most populous state in the nation. If it were a separate country, it would have the world's fifth largest economy. It has the nation's largest industrial belt, stretching much of the way from Sacramento to San Diego and including global headquarters for computer, movie-television, and digital-entertainment industries. California is also the nation's largest agricultural producer.

Map 1.A: California's Size Compared to Eastern States



Map 1.A illustrates California's size by superimposing its boundaries on 12 eastern states with examples of major cities within the overlay area.

Map 1.B: California's Counties and Population Centers



Map 1.B identifies key features of California, including areas with at least 75 people per square kilometer.

Most California residents will experience at least one disaster within their lifetimes. No community is immune from disaster. Though wildfires and floods are the most common disasters, earthquakes hold the greatest potential for large-scale destruction. A major disaster would pose significant challenges for restoring people's lives, restarting economic engines, repairing infrastructure, and creating sustainable redevelopment.

Since 1950, California has experienced over 500 state-proclaimed emergencies, many of which were also given a federal disaster declaration. For a description of California's disaster history, including statistics and maps, see *Chapter 4: Profiling California's Setting*. Among other things, it provides a profile of California's assets at risk and outlines issues of climate change affecting natural hazards.

1.1.3 WHAT IS HAZARD MITIGATION?

The 2017 State of California Emergency Plan defines hazard mitigation as "any sustained action taken to reduce or eliminate long-term risk to people and property from natural or human-caused hazards and their effects."[1] FEMA defines hazard mitigation as "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards." For the purposes of the SHMP, hazards include natural, technological/accidental, and adversarial/human-caused events and conditions.

Hazard mitigation is distinguished from other disaster management functions by measures that make development and the natural environment safer and more disaster-resilient. Effective mitigation begins with identifying the threats and hazards a community faces and determining the associated vulnerabilities and consequences. Understanding risks makes it possible to develop strategies and plans to manage them. The purpose of mitigation planning is to identify policies and actions that can be implemented over the long-term to reduce risk and future losses. Mitigation plans form the foundation of a community's long-term strategy to reduce disaster losses and break the cycle of initial disaster damage, reconstruction, and repeated disaster damage.

Hazard mitigation differs from emergency preparedness, which focuses on activities designed to make a person, place, organization, or community more capable to take appropriate action in a disaster with emergency response, equipment, food, shelter, and medicine. Hazard mitigation and emergency preparedness are complementary. While time or financial resources may preclude certain desirable mitigation actions, emergency preparedness can make it possible to respond and recover quickly, despite losses that may be unavoidable.

1.1.4 FEMA REVIEW RESPONSIBILITIES

The FEMA State Mitigation Plan Review Guide, effective March 2016, outlines FEMA's review responsibilities. The Review Guide can be downloaded from FEMA's website: https://www.fema.gov/media-library/assets/documents/101659.

[1] http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/California_State_Emergency_Plan_2017.pdf

1.2 PLAN OVERVIEW: HOW TO USE THE 2018 SHMP

The SHMP is designed to be a reference for a variety of users having specific interests in some aspect of its detailed contents. For those interested in understanding the document as a whole, but not the detailed subject matter covered, this section provides an overview.

Depending on the interests or needs of the users, using the SHMP can be approached in different ways. This section provides an overview of the organization of the document. However, given to length and volume of the 2018 SHMP, *all readers are encouraged to review the Table of Contents at the beginning of the document to gain an understanding of the specific subsections and content presented within each chapter.*

While there is value in reading the SHMP from start to finish, many users will likely use the SHMP as a resource to find specific information related to California's mitigation efforts whether for overall context, for review of state actions, or for a better understanding of various aspects of vulnerability.

1.2.1 QUICK ACCESS TO THE SHMP BY TOPIC GROUPING

To use the SHMP as a resource, where the reader may choose to jump directly to specific information, it is helpful to know that the SHMP chapters are generally grouped into the following topic areas:

TOPIC AREA 1 – Introduction and Context

Chapter 1 sets the context of the SHMP by briefly describing the purpose of the plan and hazard mitigation in California. An introductory discussion of laws and policies influencing hazard mitigation actions and definitions of hazard mitigation terms are presented in this chapter.

TOPIC AREA 2 – Planning Process and California's Mitigation Framework

Chapter 2 describes the approach to updating the SHMP, the schedule, and the stakeholders involved. *Chapter 3* goes into specific detail about the State of California's mitigation goals and objectives, as well as its overall hazard mitigation strategies and actions.

TOPIC AREA 3 – California's Assets, Vulnerability, and Local Capabilities

Chapter 4 provides an extensive overview of California in the context of hazards. It includes a discussion of California's assets to provide an understanding of the complexity of the state and the vulnerabilities that may be exposed during a hazard event. Chapter 4 also includes an expanded overview of climate change and the state's overall adaptation response, creating a basis for the hazard specific discussions of climate influences added to each hazard risk assessment in Chapters 6 through 9.

Chapter 5 brings together various aspects of local hazard mitigation planning and its linkage to state mitigation planning. This chapter also presents information on Local Hazard Mitigation Plan (LHMP) technical assistance as a resource for local jurisdictions.

TOPIC AREA 4 – Hazard Risk Assessments

The hazard-specific risk assessments in Chapters 6 through 9 offer specific information about a specific hazard's history of occurrence within the state, state and local vulnerabilities to a specific hazard, and progress toward mitigating the effects of a specific hazard.

As noted in more detail in *Section 1.2.2*, *2018 SHMP Chapters*, the hazards are grouped by hazard type within these chapters. *Section 1.2.3, Approach for Hazards Identification and Risk Assessment*, explains the hazard risk assessment approach *and* template followed for almost all of the hazards presented in the SHMP.

TOPIC AREA 5 – State Mitigation Capabilities and Grants Management Program

Chapter 10 provides a specific discussion of the state's capabilities to effectively manage mitigation grant programs for implementation of hazard mitigation projects.

TOPIC AREA 6 – Key Resources and Reference Material

The annexes and appendices offer additional material, including detailed summaries of related laws and policies, and an examination of the vulnerability of lifelines infrastructure to hazards.

1.2.2 2018 SHMP CHAPTERS

Compared to the 2013 SHMP, the structure of the 2018 SHMP has been modified as part of document reorganization and streamlining efforts. Each chapter includes a significant amount of new material reflecting modifications, updates, and progress made since 2013. Chapter highlights include the following:

Chapter 1 – Introduction

This chapter acquaints the reader with the overall content and organization of the 2018 SHMP and establishes common terminology used in the SHMP.

Chapter 2 –The Planning Process

Chapter 2 identifies the SHMP preparation and update approach and generally explains how state agencies, private organizations, and the public were involved in the update. This chapter documents the integration of the SHMP with other planning efforts, including climate adaptation programs and describes the ongoing strategy for implementing, monitoring, evaluating, and updating the SHMP.

Chapter 3 – California's Mitigation Framework: Goals, Objectives, Strategies, and Priorities

Chapter 3 presents state mitigation goals and objectives for decreasing life loss and injuries, minimizing damage and disruption, and protecting the environment. It summarizes the institutional context for the SHMP, outlines the basic mitigation strategic action components, and describes progress since 2013. It also identifies federal hazard mitigation funding priorities.

Chapter 4 – Profiling California's Setting

Chapter 4 provides a profile of California's size, population, and assets requiring protection from disaster losses; describes California's disaster history; and provides an overview of the ways in which climate change may affect natural hazards.

Chapter 5 – California Local Hazards Mitigation Planning

Chapter 5 describes the Local Hazard Mitigation Planning Program in California including the California Governor's Office of Emergency Services' (Cal OES) Local Hazard Mitigation Plan (LHMP) technical assistance and training program, local mitigation priorities, and status of local plans.

Chapter 6 – Earthquakes and Geologic Hazards: Risks and Mitigation

Chapter 6 provides an assessment of earthquake and geologic hazards, risks, and population vulnerability in California's 58 counties; describes specific hazards (earthquakes, landslides and other earth movements, and volcanoes); profiles and assesses potential losses to buildings and critical infrastructure; and describes mitigation progress since 2013.

Chapter 7 – Flood Hazards: Risks and Mitigation

Chapter 7 provides an assessment of flood hazards, risks, and population vulnerability in California's 58 counties; describes specific flood hazards (riverine flooding, coastal flooding, erosion, sea-level rise, tsunami and seiche, levee

failure, and dam failure); profiles and assesses potential losses to buildings and critical infrastructure; and describes mitigation progress since 2013.

Chapter 8 – Fire Hazards: Risks and Mitigation

Chapter 8 provides an assessment of fire hazards, risks, and population vulnerability in California's 58 counties; describes specific hazards (wildfire and urban structural fires); profiles and assesses potential losses to buildings and critical infrastructure; and describes mitigation progress since 2013.

Chapter 9 – Other Hazards: Risks and Mitigation

Chapter 9 describes other types of secondary hazards (as discussed in *Section 1.2.3*), which are grouped into three categories, 1) hazards that have the potential to be exacerbated or influenced by climate or weather changes, 2) hazards that are technological in nature, and 3) hazards that stem from purposeful disturbance activities. This chapter provides a brief assessment of these hazards, and describes mitigation progress since 2013.

It should be noted that the hazards grouped in Section 9.1 (Other Climate and Weather-Influenced Hazards) can also occur independent of climate change conditions.

Chapter 10 – Grants Management Capabilities and Enhanced Planning Efforts

Chapter 10 describes integration of the SHMP with other planning initiatives, grants program management, and project implementation capabilities, effectiveness of mitigation actions, and use of available mitigation funding.

Supporting Information in the Annexes and Appendices

The SHMP also includes annexes on specialized topics: *Annex 1: Guide to California Hazard Mitigation Laws*, *Policies, and Institutions*; *Annex 2, Public Sector Funding Sources*; and *Annex 3: Lifelines Infrastructure and Hazard Mitigation Planning*; and appendices providing details supplementing chapter text.

1.2.3 APPROACH FOR HAZARDS IDENTIFICATION AND RISK ASSESSMENT

Hazards Groupings

The 2013 SHMP presented hazards in a hierarchical arrangement that included "primary, secondary, and other hazards," with the "Other Hazards" chapter including a section on "Climate-Related Hazards." In the 2018 SHMP, the arrangement of hazard risk assessments was streamlined by the State Hazard Mitigation Team to more effectively show grouping by hazard type. The 2018 hazard groupings present hazards of similar function together in a chapter or section, but, earthquakes, floods, and fires are still considered primary hazards and are addressed in the first three risk assessment chapters *(Chapters 6, 7, and 8)*. These three are designated as primary hazards because:

- As discussed in *Chapters 6, 7, and 8*, earthquake, flood, and fire hazards have historically caused the greatest human, property, and/or monetary losses, as well as economic, social, and environmental disruptions within the state.
- Past major disaster events have led to the adoption of statewide plans for mitigation of these hazards, including the California Earthquake Loss Reduction Plan, State Flood Hazard Mitigation Plan, and California Fire Plan.
- Together, these three hazards have the greatest potential to cause significant losses and disruptions in the future.

For example, earthquake, while still considered a primary hazard, is now grouped with other geologic hazards including landslides and volcanoes. Flooding is still considered a primary hazard, but the new flood hazards chapter now also includes sections on other types of flood hazards, including coastal flooding, tsunami, levee failure, and dam safety. The third primary hazard, fire, includes both wildfire and structural fires. *Chapter 9: Other Hazards: Risks and Mitigation* addresses all other secondary hazards not included in the primary hazards chapters.

A grouping of secondary hazards influenced by climate and weather, and not addressed in the primary hazard chapters, is also included in *Chapter 9*. *(Note: Some primary hazards discussed in Chapters 6, 7, and 8, such as flooding and wildfire, are influenced by climate change. Hazard-specific discussions of climate change are included for each hazard affected by climate change, both primary and secondary.)*

As noted previously in the 2013 SHMP, it is recognized that the classification of primary hazards and other hazards described here is provisional. It may change with time because the extent, intensity, and timing of meteorological changes associated with climate change are not yet fully predictable.

For purposes of compliance with the Disaster Mitigation Act, as further specified by Rule 44 CFR Section 201.4(c)(2), the 2018 SHMP addresses in substantial detail the hazards of earthquakes, floods, and wildfires. Other hazards are addressed in less detail because, compared to primary hazards, they tend to have relatively fewer impacts, as demonstrated by past disasters and/or by the lack of research and documentation of these other hazards.

Standard Risk Assessment Text Template Categories

Throughout *Chapters 6 through 9*, an effort is made to use standard FEMA hazard and risk assessment criteria. For this reason, each hazard is addressed, to the extent possible given existing data sources, using the following descriptive categories:

1 – Identifying the hazard

What are its main characteristics? What is the nature of the hazard (extent and strength of the hazard) and where is it found (location within the state, i.e., geographic area affected)?

2 – Profiling the hazard

What is the hazard probability? What are the previous hazard occurrences within the state? How likely is it to occur? What are the effects (probability of future events, i.e., chances of recurrence)? How will climate and weather affect hazard occurrence?

3 – Assessing state vulnerability and potential loss to the hazard

What kinds of populations and facilities are at risk? What estimated losses or costs could occur?

4 – Assessing local jurisdiction vulnerability and potential loss to the hazard

At the local level, what are the vulnerabilities and potential losses from that hazard within those localities? Which localities are most directly vulnerable to a particular hazard? Will future changes in development affect vulnerability?

5 – Identifying current hazard mitigation efforts

What are state agencies, local jurisdictions or other stakeholders doing to mitigate hazards?

6 – Additional hazard mitigation opportunities

For some hazards, where applicable, a discussion of other potential opportunities for additional hazard mitigation is included at the end of the risk assessment. Such discussions may include strategies to address increased vulnerability resulting from development.

Featuring Mitigation Progress

Throughout the SHMP, the reader will find boxed features called “Mitigation Process Summaries” and “Best Practices Highlights.” This format is intended to call attention to specific hazard mitigation projects that are a valuable example of progress at either the state or local level.

Mitigation Progress Summaries

Progress as of 2018: The 2010 SHMP introduced summaries of mitigation progress during the preceding three-year period. This feature was continued in the 2013 SHMP to capture substantial hazard mitigation activities. It is continued throughout the 2018 SHMP to highlight new mitigation progress since the 2013 SHMP was approved. Mitigation progress summaries are provided in gold-highlighted text boxes throughout *Chapters 1 through 10*. Material from previous progress summaries has been incorporated into general section text or, in some cases, removed.

Best Practices Highlights

Mitigation Examples: The 2013 SHMP introduced highlights of mitigation initiatives taken at the local, regional, and state levels that represent significant new best practices. The Best Practices Highlights are continued in the 2018 SHMP. An example best practice included in the 2018 SHMP is San Francisco's Mission Creek collaborative adaptation planning efforts, included in *Section 7.2*. The Best Practices Highlights are intended to provide fresh ideas for organizations working on hazard mitigation projects throughout the state. These highlights are provided in light red text boxes in *Chapters 3 through 10*.

For a list of progress summaries and best practices highlights, see the indexes included following the Table of Contents.

The SHMP also includes some information in blue boxes. These boxes are intended to separate or feature the information in the box from standard text.

1.2.4 WHAT'S NEW IN THE 2018 SHMP?

Given the size and complexity of the SHMP, materials explaining the configuration of the plan have been updated and reorganized in this introduction chapter to explain how information is presented throughout the document and how the hazard risk assessments or organized.

The 2018 SHMP provides a variety of new features, including the following:

- A reorganization of some 2013 SHMP content and the addition of some new content in this introduction chapter to provide contextual information on the SHMP, along with a "How to Use the 2018 SHMP" section to better describe the structure of the SHMP and make the plan easier to use.

- A revised and expanded section on the risk factor of climate change, as well as new or expanded hazard-specific discussions on impacts of climate change within applicable hazard risk assessments. California is pursuing climate change adaptation through a wide range of guidance and legislation, such as Safeguarding California Plan: 2018 Update, the California Adaptation Planning Guide, Executive Orders S-13-08 and B-30-15, and Senate Bills 246, 379, 1000, 2800, and others.

- Integration of climate change considerations throughout the document, as climate change has the potential to affect the severity, frequency, and location of hazards events. Climate change is described broadly in *Section 4.3* and discussed more specifically in each of the hazards potentially affected, where consideration of climate change is necessary for assessing risk and devising mitigation measures. *Section 4.3* also briefly summarizes the state's climate change mitigation efforts and more broadly outlines current state adaptation initiatives.

- A reorganization of materials relating to local mitigation capabilities and planning information and LHMP technical assistance into a single chapter.

- Expansion of the drought hazard risk assessment discussion to address subsidence, and the addition of a new risk assessment for tree mortality hazards.

Summary of What's New in the 2018 SHMP, by Chapter

What's New in Chapters 1 and 2

- *Previous Chapter 1* has been split into two chapters. A portion of the material is now part of the new *Chapter 1: Introduction* and the remainder is now in *Chapter 2: The Planning Process*.
- A new section has been added in *Chapter 1* to provide a better explanation of how the SHMP is organized and how to use it.
- The SHMP mission and vision included in Chapter 2 of the 2013 SHMP have been moved to the *Chapter 1: Introduction* and duplicated in *Chapter 3: California's Mitigation Framework* of the 2018 SHMP.
- The legal context section included in 2013 SHMP Chapter 3 has been moved to *Chapter 1: Introduction* of the 2018 SHMP.
- Essential terminology included in 2013 SHMP Chapter 4 has been updated, expanded, and moved to *Chapter 1: Introduction* of the 2018 SHMP.
- The SHMP Assurances, previously included in Appendix Y of the 2013 SHMP, have been updated and moved to Chapter 1.
- Discussion of Cal OES' role in the LHMP process from 2013 SHMP *Chapter 1* was reorganized and consolidated with other local hazard mitigation planning information in the new Chapter 5.
- Information on Cal OES' LHMP training and technical assistance program has been updated.
- The new *Chapter 2: The Planning Process* includes an updated description of the 2014-2018 planning process highlighting preparation of the 2018 SHMP update, and integration and implementation efforts.
- Expanding on the section entitled "Integration with other Planning Efforts," a new section entitled "Integration with Climate Adaptation Efforts" has been added to *Chapter 2: The Planning Process*.
- An updated discussion of the National Preparedness System has been relocated from 2013 SHMP Chapter 4, Section 4.7 to *Chapter 2* in the section entitled "*Integration and Coordination with Other Planning Efforts*."
- 2013 SHMP *Section 7.7*, entitled "*Monitoring, Evaluating, and Updating the SHMP*," has been moved to *Chapter 2* and renamed "SHMP Review, Evaluation, and Implementation" to better align with the concept of plan maintenance as a part of the overall planning process.

What's New in Chapter 3

- *Previous Chapters 2 and 3* have been combined and renamed *Chapter 3: California's Mitigation Framework: Goals, Objectives, Strategies, and Priorities*.
- Minor re-wording to 2013 SHMP Goal 4 has been made. (Goals 1, 2, and 3 remain unchanged from 2013.)
- Some of the 2013 objectives have been significantly reworded or merged, and new objectives have been added.
- New introductory discussion of the goals and objectives has been added to clarify that the objectives are intended to be viewed as interrelated rather than linear and separate.
- The strategies have been updated and a new strategy specifically addressing climate change has been added.
- New information on hazard legislation and associated planning efforts linked to SHMP strategies has been added.

What's New in Chapter 4

- *Previous Chapter 4* has been renamed *Chapter 4: Profiling California's Setting*.
- The discussion of assets at risk has been updated and includes a revised and expanded discussion on growth patterns and trends.
- The discussion of California's disaster history has been updated.
- The discussion on climate change has been fully revised and expanded.
- The "Statewide GIS Hazard Analysis" section that was Section 5.1 in the 2013 SHMP has been revised and moved within a new section in Chapter 4 entitled "Environmental Justice, Equity, and Hazard Mitigation in California."

- The Social Vulnerability model, originally developed in 2010 and used to create the social vulnerability maps in Section 5.1 in the 2013 SHMP has been updated and used to prepare new social vulnerability maps.

What's New in Chapter 5

- *This chapter is new for the 2018 SHMP*. It compiles local planning materials previously included in multiple chapters of the 2013 SHMP, and adds new local hazard mitigation resource material. It is titled *Chapter 5: California Local Hazard Mitigation Planning*.
- Compilation of LHMP-related materials in a single chapter is intended to simplify access to this material for local jurisdictions and other stakeholders looking for local hazard mitigation information and its linkage to state hazard mitigation planning.

What's New in Chapters 6 through 9

- The hazard risk assessments *previously included in Chapters 5 and 6* have been regrouped by hazard type in *Chapter 6: Earthquakes and Geologic Hazards, Chapter 7: Flood Hazards,* and *Chapter 9 Other Hazards* (which includes a subsection on other climate-influenced hazards).
- Updates to *Chapters 6 through 9* include the following:
  - Earthquake hazard risk assessment has been streamlined and revised, including updates on the Great California ShakeOut, mitigation activities for building sub-inventories, California Earthquake Authority (CEA) residential hazard, vulnerability, risk and mitigation assessment update, mitigation activities for utilities and transportation, Seismic Hazards Mapping Projects, and the new California earthquake early warning system (ShakeAlert).
  - The landslide hazard risk assessment has been updated and includes updated progress summaries.
  - The volcano hazard risk assessment has been significantly revised and expanded.
  - The flood hazard risk assessment has been significantly revised, including updates on flood laws and, flood management plan updates, including information on the Central Valley Flood Management Plan, the State Plan of Flood Control, the Flood Protect Corridor Program, California's Flood Future report, Delta/water updates, including information on the California State Water Project, California WaterFix, and California EcoRestore (replacing the Bay Delta Conservation Plan).
  - The levee failure hazard risk assessment and progress summary regarding the Delta Levees Program have been updated.
  - The tsunami hazard risk assessment has been significantly updated and includes updated progress summaries.
  - The wildfire hazard risk assessment has been streamlined and includes updated historical fire event tables and fire code requirements
  - Information in various climate-related hazards sections has been updated, including expanded information and progress summary updates regarding coastal flooding, erosion, and sea-level rise.
  - The drought hazard risk assessment has been significantly updated and a discussion of subsidence risks related to groundwater pumping has been added.
  - A new hazard risk assessment has been added for tree mortality.
  - The terrorism and cyber threats hazard risk assessments have been significantly updated and expanded.

What's New in Chapter 10

- *Previous Chapter 7* has been renumbered and renamed *Chapter 10: Grants Management Capabilities and Enhanced Planning Efforts.*
- A new summary of the Hazard Mitigation Assistance Grant program has been added.
- The project implementation capability section has been revised to capture the operations of the Cal OES Hazard Mitigation Assistance (HMA) grant programs. New detailed descriptions about the current HMGP, PDM, and FMA Notice of Interest, sub-application, and grant administration processes are included.

- The discussion of the State Mitigation Assessment Review Team (SMART) system has been updated with information regarding SMART assessment efforts from 2013 to 2016, including details about outcomes of the 2014 Napa Earthquake field assessment.

Other New Items in the 2018 SHMP

- Previous Annex 1 has been significantly streamlined and incorporated into the new local planning chapter (*Chapter 5*).
- Previous *Annex 2: Guide to California Hazard Mitigation Laws, Policies, and Institutions* has been updated and is now numbered as *Annex 1*.
- *Annex 3: Lifelines Infrastructure and Hazard Mitigation Planning* has been updated.
- Previous *Annex 4: Public Sector Funding Sources* has been updated and is now numbered as *Annex 2*.
- Appendices have been streamlined, edited, and renumbered.
- Previous Appendices C through I have been replaced with an appendix listing hazard mitigation legislation mentioned in the 2018 SHMP and link to the California Legislation Information website where legislation text can be searched and downloaded.
- The 2013 SHMP Appendix W has been merged into the 2013 SHMP Appendix T.

1.3 ESSENTIAL TERMINOLOGY

This section defines common mitigation-related terms used throughout the 2018 SHMP and provides a context for understanding hazard mitigation.

One of the difficulties in mitigation planning is confusion over the meaning of terms. Findings from previous LHMP reviews found that definitions of key terms varied substantially from plan to plan. In addition, certain terms take on different meaning in different planning contexts. In this SHMP, the focus is on using terms consistently and explaining differences when they occur, remembering that mitigation at its core is a loss-prevention activity characterized by changes in the built environment.

For SHMP purposes, the following working definitions are described briefly and, in some cases, accompanied by alternative definitions that lend additional meaning from state and federal law and natural hazards publications.

1.3.1 HAZARD, RISK, VULNERABILITY, AND DISASTER

Four key terms related to potential disaster threats and losses are hazard, risk, vulnerability, and disaster. Though often used interchangeably, each term has its own distinct meaning and should be used with that distinction in mind to avoid confusion.

Hazard

The term "hazard" refers to an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss.

Risk

"Risk," for the purpose of hazards mitigation planning, is the potential for damage or loss created by the interaction of hazards with assets such as buildings, infrastructure, or natural and cultural resources.[2]

Risk can be calculated in two different ways, both of which are used in mitigation planning. For natural hazards, risk tends to be calculated based on evaluation of the probability (likelihood) of a hazard event occurring, vulnerability, and the event's potential consequences. This method uses data from the past to establish the probability and, in the case of climate change, includes future projections of probability.

For cyber or terrorism events, the past may not be a good indicator of the future. Instead scenarios, based on expert information and levels of uncertainty, are used to estimate an event and the possible consequences.

Vulnerability

The term "vulnerability" can have varying meanings. For buildings and other structures, it means susceptibility to damage given the inherent characteristics of a particular structure. Its broader meaning is the level of exposure of human life and property to damage from natural and human-made hazards.

Recently, the term "social vulnerability" has emerged in reference to social factors that influence or shape the susceptibility of various groups to harm and govern their ability to respond. Cutter, Boruff, and Shirley assert that social vulnerability is also the product of place inequalities—those characteristics of communities and the built environment such as the level of urbanization, growth rates, and economic vitality, that make the people who live or work there vulnerable to disasters.[3] Tierney expands on this definition to describe the combination of a particular disaster agent, the physical setting, and population vulnerability (resulting from proximity, resources, demography,

[2] FEMA State Hazard Mitigation Plan Review Guide (2015).
[3] S. Cutter, B. Boruff, and W. L. Shirley. "Social Vulnerability to Environmental Hazards," Social Science Quarterly 84 (1) 2003:242-261.

knowledge, and resource availability). Tierney also notes that human populations are also made vulnerable by steps their governments and institutions take (or fail to take) to protect them before and after disasters strike.[4]

Disaster

The term "disaster" means a detrimental impact of a hazard upon the population and the economic, social, and built environment of an affected area.

A variety of other definitions of the term "disaster" can be found in the natural hazards literature and the law, including the following:

> …an event concentrated in time and space, in which a society or one of its subdivisions undergoes physical harm and social disruption, such that all or some essential functions of the society or subdivision are impaired…[5]

> …the occurrence of a sudden or major misfortune which disrupts the basic fabric and normal functioning of a society (or community)…[6]

For a presidential declaration of disaster, the Stafford Act provides the following definition of the term "major disaster":

> …any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby...

The term "catastrophe" in the Stafford Act definition implies an event of a magnitude exceeding available local and state response and recovery resources. In more recent history, the term "catastrophic" has been redefined by events such as the 9/11 World Trade Center disaster and Hurricane Katrina to mean disasters large enough to stretch national resources.

The State of California uses a definition of disaster that is similar to FEMA's, with the California Disaster Assistance Act defining the term as follows: "'Disaster' means a fire, flood, storm, tsunami, earthquake, terrorism, epidemic, or other similar public calamity that the Governor determines presents a threat to public safety."[7]

Natural vs. Human-Caused Disasters

The term "natural disaster" refers to destructive events involving natural forces such as droughts, earthquakes, floods, hurricanes, landslides, mudslides, storms, tornados, tsunamis, high or wind-driven waters, wildfires, volcanic eruptions, and climate change.

In contrast, "human-caused" disasters include acts of war and terrorism as well as disasters with a technological component such as dams and levee failures, nuclear accidents and radiological releases, major truck and rail transportation accidents, oil and other hazardous materials spills, and airplane crashes.

[4] K. Tierney. "Foreshadowing Katrina: Recent Sociological Contributions to Vulnerability Science." Contemporary Sociology: A Journal of Reviews 35 (3), 2006:207-212.
[5] Charles Fritz. "Disaster," in Contemporary Social Problems, R.K. Merton and R.A. Nisbet, eds. New York: Harcourt Press, 1961: pp. 651-694.
[6] A.W. Coburn, R. J. S. Spence, and A. Pomonis. Vulnerability and Risk Assessment. 2nd edition. Cambridge Architectural Research Limited, United Nations Disaster Management Training Programme. 1994.
[7] California Disaster Assistance Act. Amended by Stats. 2002, Ch. 461, Sec. 4. Effective January 1, 2003. ARTICLE 1. General Provisions and Definitions.

It is important to realize, that distinctions among natural, human-caused, and technological disasters are often artificial when taking into account the human decisions underlying settlement patterns that conflict with natural hazards.

1.3.2 HAZARD MITIGATION, PREPAREDNESS, RESPONSE, AND RECOVERY

The terms "hazard mitigation," "preparedness," "response," and "recovery" are commonly referred to as the four basic functions of emergency management. They are referred to as "phases" because ideally they should occur in the order given. In the worst instances, response and recovery may be the only functions happening sequentially in the absence of mitigation and preparedness. Conversely, in the best instances, mitigation and preparedness are continuously occurring.

Hazard Mitigation

For purposes of this plan, the term "hazard mitigation" means sustained action taken to reduce or eliminate the long-term risk to human life and property. Note that this emphasis on long-term risk distinguishes hazard mitigation from actions geared primarily to emergency preparedness and short-term recovery.[8] Hazard mitigation is said to be the "cornerstone of emergency management."[9]

Hazard mitigation is predicated on the principles that losses are preventable through better community design and that each event can teach us how to reduce losses in the next disaster. Hazard mitigation reduces long-term risk from hazards through predetermined measures accompanying physical development, such as strengthening structures to withstand earthquakes, prohibiting or limiting development in flood-prone areas, clearing defensible space around residences in wildland-urban interface (WUI) areas, or locating new development away from areas of geological instability.

Mitigation is different from emergency preparedness, which concentrates on activities that make a person, place, or organization ready to respond to a disaster with emergency equipment, food, emergency shelter, and medicine.

Preparedness

The term "preparedness" means making preparations before a disaster for what to do immediately after a disaster.

Examples of preparedness include developing pre-disaster plans and information regarding whom to contact and where to go after a disaster, and what food, equipment, and other emergency supplies to have ready and stored to enable quick action. It can also mean preparing for recovery, educating the public on personal and household preparedness, and practicing disaster drills.

Preparedness differs from hazard mitigation by its focus on immediate post-disaster action. Mitigation and preparedness go hand in hand. In situations where time or financial resources preclude long-term hazard mitigation in the natural and social environment, it becomes very important to undertake plans and actions to prepare for emergencies, making it easier to respond to and recover. This interdependency is fundamental to the SHMP.

Response

The term "response" means actions taken to respond to the disaster, such as rescuing survivors, providing for mass evacuation, feeding and sheltering victims, and restoring communications.

[8] The Federal National Mitigation Framework definition is narrower: mitigation being the capabilities necessary to reduce loss of life and property by lessening the impact of disasters.

[9] W. Craig Fugate, FEMA Administrator, in the Foreword to: Hazard Mitigation: Integrating Best Practices into Planning (2010). American Planning Association Advisory Service Report 560. Chicago, IL.

Recovery

The term "recovery" means restoring people's lives and creating new opportunities for the future. It includes such actions as restoration of essential transportation, utilities, and other public services; repair of damaged facilities; provision of both temporary and replacement housing; restoration and improvement of the economy; and long-term reconstruction that improves the community.

1.3.3 SUSTAINABILITY AND RESILIENCE

Two additional terms – sustainability and resilience – have come into the lexicon in the past several years. Emerging from a broader literature base, these terms are more difficult to define.

Sustainability

The term "sustainability" refers to an over-arching concept within which disaster management takes place. A well-known definition of sustainability comes from the World Commission on Environment and Development, which stated that sustainable development was that which meets the needs of the present without compromising the ability of future generations to meet their own needs.[10] This vision was articulated at a finer level by the National Commission on the Environment, which suggested that sustainability is a strategy for improving the quality of life while preserving the environmental potential for the future, of living off interest rather than consuming natural capital.[11]

For purposes of this SHMP, the term "sustainability" adds to these previous definitions the idea of preservation of resources – physical, social, economic, environmental, historical, and cultural – for the benefit of future generations. One of the paths to sustainability is through investment in strong disaster mitigation.

Resilience

The term "resilience" is defined as the ability of a system to absorb shock and maintain its structure and functions with a minimum of loss. Further, a resilient system is one that can resume pre-event functionality in a relatively short time. Thus, a community is resilient when it maintains continuity and recovers quickly despite experiencing disaster events.

This basic concept of resilience is expanded to address two additional factors: 1) connection and dependencies among multiple geographic levels–cities, counties, regions, tribal nations, and the state; and 2) the capacity of a city, county, tribal nation, or state to change and adapt during recovery to meet challenges posed by changed conditions.

For purposes of this SHMP, the term "resilience" refers to the capacity of a community, region, or state to 1) survive a major disaster, 2) retain its essential structure and functions, and 3) adapt to current and future challenges.

Resilience can be developed not only through mitigation, but also through coordinated development and implementation of the other disaster management functions, including preparedness, response, and recovery.[12]

National Presidential Policy Directives (PDD) 8 and 21 speak to resilience. In PPD 8, resilience refers to the ability to adapt to changing conditions and withstand and recovery from disruptions due to emergencies. PPD 21 defines resilience as the ability to prepare and adapt to changing conditions and recover rapidly from disruptions.

[10] World Commission on Environment and Development. 1987.
[11] National Commission on the Environment. 1993.
[12] Topping et al. "Building Local Capacity for Long-term Disaster Resilience." Journal of Disaster Research. May 2010.

1.3.4 CLIMATE CHANGE MITIGATION AND CLIMATE CHANGE ADAPTATION

For the topic of climate change, the terms "mitigation" and "adaptation" have specific definitions.

Climate Change Mitigation

Climate change mitigation refers to actions that seek to limit future climate change by reducing emissions of heat-trapping gases.[13] Rising atmospheric concentrations of greenhouse gas (GHG) emissions have resulted in an increase in average global temperature.[14] The increase in temperature results in a wide range of potential impacts that include exacerbation of hazards by altering the frequency, severity, and location.[15]

In this way, climate change mitigation can be viewed as a type of hazard mitigation, as it seeks to reduce the long-term impact of climate change. It is important to keep in mind that climate change mitigation seeks to reduce GHGs emissions, which makes it distinct from traditionally defined hazard mitigation.

Climate Change Adaptation

Because GHG emissions remain in the atmosphere for a period of decades to hundreds of years, climate change is projected to continue to affect communities regardless of the implementation of climate change mitigation measures. Climate change adaptation describes measures that address the projected impacts on all aspects of community function that may result from climate change. This can include impacts related to hazard events (flood, wildfire, drought, severe storms), as well as slow changes that affect agricultural, forestry, and fisheries productivity; ecosystem structure and function; and public health.[16]

Hazard mitigation is one component of climate change adaptation. Climate change adaptation, similar to hazard mitigation, is focused on long-term threats to human life, property, economic continuity, ecological integrity, and community function. While climate change adaptation efforts prepare communities for longer-term risks, adaptation can also help to address near-term risks.

The difference is that, unlike other types of hazards, climate change is progressive; the past is not an adequate predictor of future risk. The assessment of vulnerability to climate change must build from scientific projections of future change. Cal-Adapt, an interactive website designed to enable exploration of projected climate-related risks at a local level, is available to communities to support local vulnerability assessments and support development of measures.

[13] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program. 2014. 841 pp. doi:10.7930/J0Z31WJ2.

[14] IPCC: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)].2014. IPCC, Geneva, Switzerland, 151 pp.

[15] California Natural Resources Agency. Safeguarding California: Reducing Climate Risk. 2009. Sacramento: author, 344 pp.

[16] California Emergency Management Agency & California Natural Resources Agency. California Adaptation Planning Guide. 2012. Sacramento: author.

1.4 INSTITUTIONAL AND LEGAL CONTEXT

To understand state and local hazard mitigation, it is useful to examine primary laws and policies at each level of the federal and state systems. Development of disaster management systems in the U.S. has been piecemeal rather than systematic and comprehensive. Mitigation planning is conducted within a complex, fragmented, and overlapping context of federal, state, and local laws, institutions, and policies. These are intermingled with a variety of private sector risk reduction and mitigation practices.

For the most part, disaster management laws have been designed to deal very specifically with particular issues as they arise. They have been used mostly to address largely localized emergency events because very few catastrophic events, such as Hurricane Katrina, have occurred within the 60-year period during which most of the laws were adopted. Administrative actions taken to enforce these laws are ultimately evaluated by the courts to deal with questions regarding how reasonable, equitable, or just an enforcement action might be within the framework of the U.S. Constitution.

The following is a summary of federal, state, and local disaster mitigation and emergency management laws. For more complete descriptions of these laws, see *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

1.4.1 FEDERAL LAWS, INSTITUTIONS, AND POLICIES

Among the principal federal statutes guiding disaster management at the state and local levels are the National Flood Insurance Act of 1968, the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) of 1988, and the Disaster Mitigation Act of 2000. These laws comprise the primary foundation of federally guided hazard mitigation throughout the United States, influencing state and local actions in complex ways. Together, they reveal a trend toward comprehensive mitigation planning and implementation at the federal, state, and local levels.

This section is intended to provide brief overviews of key laws, institutions, and policies, rather than comprehensive discussion. For more information on laws and guidelines governing federal disaster management programs, see *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

Flood Insurance Act of 1968

Public Law 90-448 of 1968, known as the National Flood Insurance Act, established the National Flood Insurance Program (NFIP), which provides for federal government backing of flood insurance sold by private companies. The National Flood Insurance Act was modified in 1994 to provide for flood hazard mitigation planning and project grants. The Biggert-Waters Act passed in 2012 was intended to reform the NFIP. To address increased flood insurance premiums resulting from the Biggert-Waters Act, the Homeowners Flood Insurance Affordability Act passed in 2014 with the intent of reducing the financial burden for policyholders.

Stafford Act

Public Law 93-288 of 1988, entitled the Robert T. Stafford Disaster Relief and Emergency Assistance Act (more commonly known as the Stafford Act), is the basic disaster relief law of the country. It provides for a nationwide system of emergency management assistance starting at the local level and progressing to the state level and then to the federal level for deployment of needed resources.

The Stafford Act was amended under the Pet Evacuation and Transportation Standards Act (PETS) in 2006 and by the Sandy Recovery Improvement Act in 2013.

Disaster Mitigation Act of 2000

The most important federal hazard mitigation law is the Disaster Mitigation Act of 2000 (DMA 2000). It amended the Stafford Act and the Public Works Act to require preparation of hazard mitigation plans by local governments as a precondition for receipt of Hazard Mitigation Grant Program project funds. It also established a Pre-Disaster

Mitigation (PDM) grant program to encourage states and localities to invest in mitigation actions in advance of disasters to avoid disaster. The general purpose of DMA 2000 was to reduce preventable, repetitive disaster losses by encouraging states and local jurisdictions to plan more wisely through mitigation of natural hazards, vulnerability, and risk to reduce the impacts of such disasters.

Sandy Recovery Improvement Act of 2013

According to FEMA, the Sandy Recovery Improvement Act (SRIA) signed into law by President Obama is the most significant legislative change to FEMA's authorities since the enactment of the Stafford Act. The law authorizes several significant changes to the way FEMA may deliver federal disaster assistance to survivors. Among other changes, SRIA amended the Stafford Act to provide federally recognized Indian tribal governments the option to make their own request for a Presidential emergency or major disaster declaration independently of a state or to seek assistance under a declaration for a state.

More information about SRIA can be found on FEMA's website: https://www.fema.gov/sandy-recovery-improvement-act-2013.

Administrative Directives

In return for federal emergency resources and post-disaster financial assistance, state and local governments are expected to follow specific federal regulations and guidelines associated with federal mitigation, preparedness, response, and recovery programs.

1.4.2 CALIFORNIA LAWS, INSTITUTIONS, AND POLICIES

For the State of California, there are three ways in which hazard mitigation activities are established and managed. These are: 1) by acts of the legislature, 2) by voter initiative, and 3) by executive order, whereby the governor instructs state agencies to participate in mitigation actions.

The State of California has adopted a variety of laws, policies, and programs dealing with disaster management within the basic framework set out by the federal and state constitutions, together with federal laws and state codes. Examples are found in the California Government Code, Health and Safety Code, and Public Resources Code. This complex mass of rules, policy, and programs represents a powerful resource for reducing losses of lives and property to disasters in the face of the substantial hazards, vulnerabilities, and risks identified in *Chapters 6 through 9*.

Among the more important laws, regulations, and administrative orders governing disaster management are the California Emergency Services Act, California Disaster Assistance Act, and Title 19 of the California Code of Regulations. These laws are administered by more than 50 state agencies, departments, and divisions responsible for their implementation.

These responsibilities and related laws are described in more detail in *Annex 1, Guide to California Hazard Mitigation Laws, Policies, and Institutions*. For more information on the relationship of hazard mitigation to state emergency management programs and Cal OES' role, see Annex 1.

California Emergency Services Act and State Emergency Plan

The California Emergency Services Act provides the legal authority for emergency management and the foundation for coordination of state and local emergencies. In accordance with the California Emergency Services Act, the State Emergency Plan (SEP) describes the California Emergency Organization that coordinates and facilitates state and local agency access to public and private resources during emergencies. (See "Standardized Emergency Management System (SEMS)" below.)

An updated SEP was released in October 2017. For more information on the SEP, see *Chapter 2: The Planning Process, Section 2.3.6* or visit the Cal OES website: http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/state-of-california-emergency-plan-emergency-support-functions.

Standardized Emergency Management System (SEMS)

The Standardized Emergency Management System (SEMS) is the National Incident Management System (NIMS)-compliant system required by California Government Code Section 8607(a) for managing responses to multi-agency emergencies in California. The State Emergency Plan specifies the policies, concepts, and protocols for implementation of SEMS. Law requires the use of SEMS during multi-agency emergency response by state agencies. Local governments must also use SEMS to be eligible for reimbursement of certain response-related personnel costs. SEMS helps unify all elements of California's emergency management organization into a single integrated system.

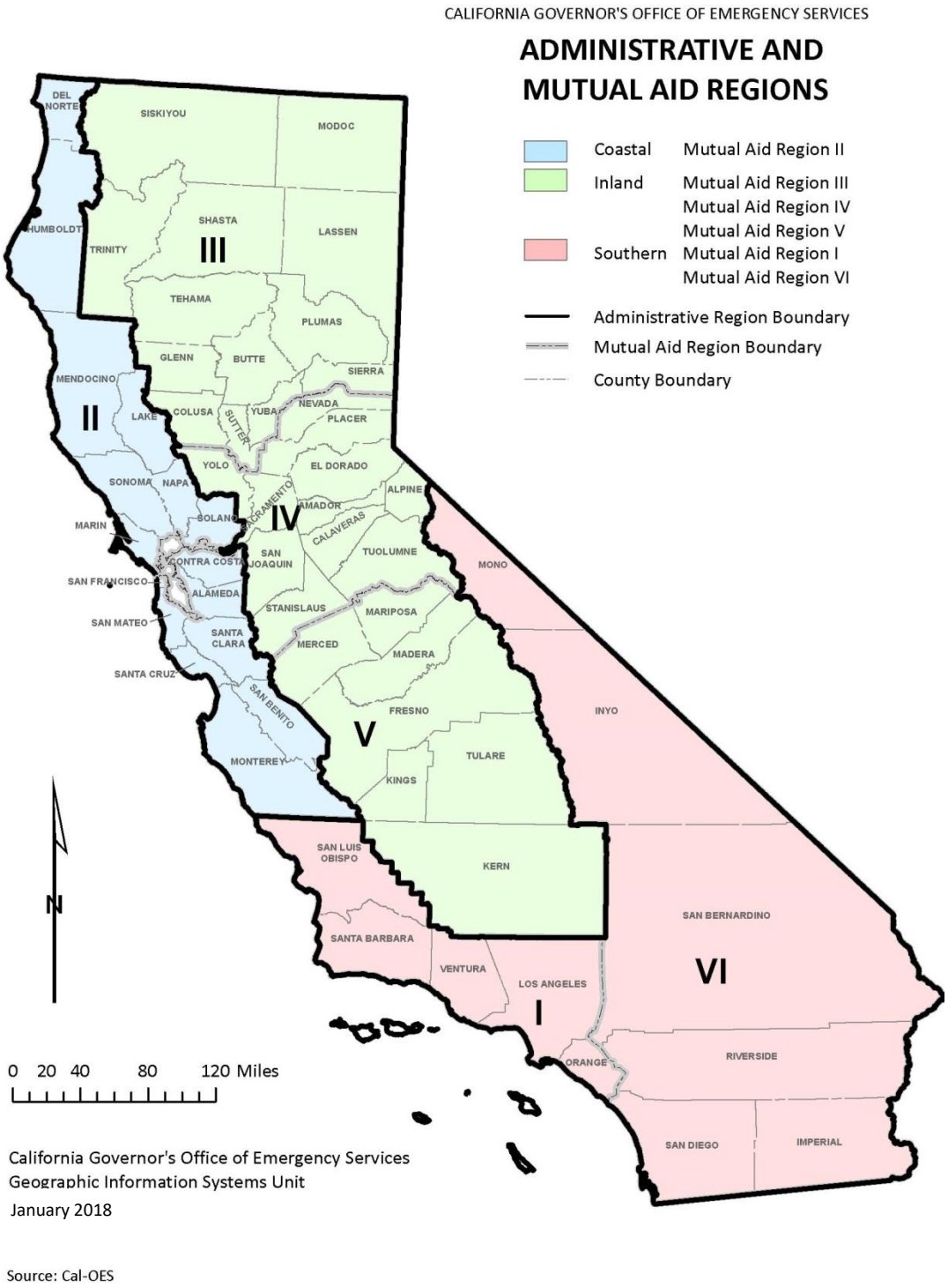
Cal OES Administrative Regions

Cal OES is an Office of the Governor. Its mission is to protect lives and property by effectively preparing for, preventing, responding to, and recovering from all threats, crimes, hazards, and emergencies. Cal OES responds to and coordinates emergency activities to save lives and reduce property loss during disasters and facilitates disaster recovery efforts. As shown in Map 1.C, there are three Cal OES administrative regions (Inland, Coastal, and Southern), six mutual aid regions for fire and general mutual aid coordination, and 58 county operational areas.

Governor's Executive Orders

An executive order functions as a long-standing tool that allows the governor to assemble state resources in a focused manner and direct hazard mitigation efforts.

Map 1.C: Cal OES Administrative Regions



Source: Cal-OES

1.4.3 LOCAL GOVERNMENT LAWS, INSTITUTIONS, AND POLICIES

Adding to federal and state government laws, institutions, and policies are those of local governments in California. As of 2017, there are over 5,000 local jurisdictions in California, including:

- 58 counties
- 482 incorporated cities[17]
- 4,711 special districts (including over 900 school districts)[18]

In addition, there are 109 federally recognized Indian Tribes in California. Sovereign nations by law, tribal governments undertake many functions similar to what a local government provides its citizens, with laws, institutions, and policies separate from state and federal governments.

Under the Disaster Mitigation Act of 2000, local governments and tribal organizations are eligible for federal hazard mitigation planning and project grants. The Sandy Recovery Improvement Act, passed in 2013, authorized tribes to apply directly to FEMA for assistance. Local governments apply for and receive federal mitigation grants through Cal OES. Tribal governments may apply for and receive federal mitigation grants directly from FEMA or through Cal OES in the same manner as a local government. Although tribal hazard mitigation plans are reviewed and approved directly by FEMA, California law requires ongoing consultation between the state and tribal governments on projects affecting reservations and other areas of cultural significance.

Under the California constitution and state codes, many state functions are delegated to local governments. Through this system of delegation, cities and counties are responsible for emergency services as well as hazard mitigation through local general plans, zoning, and building codes. Additionally, a wide array of special districts and school districts are responsible for infrastructure mitigation as well as emergency services. Cities and counties typically adopt ordinances establishing their local emergency organization.

Local hazard mitigation is implemented by cities, counties, and special districts. Each agency is responsible for mitigating hazards within its jurisdiction, as well as for assuring health and safety conditions related to development constructed by the private sector and local government.

For more information on local disaster management programs, see *Chapter 5: California Local Hazard Mitigation Planning*.

1.4.4 PRIVATE SECTOR EMERGENCY MANAGEMENT AND HAZARD MITIGATION

Private sector groups and civic organizations also contribute to California's hazard mitigation effort. This support takes a variety of forms, from small groups of neighbors lowering fire risk in their local communities to large industrial enterprises continually upgrading training and equipment and integrating efforts with Cal OES. This demonstrates vertical integration of effort at different scales and use of public-private partnerships. This section provides a glimpse into these organizations and how they support the State's mitigation goals. For more information on private sector disaster mitigation and emergency management programs, see *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

Private businesses, utilities, hospitals, and other private entities spend billions in infrastructure improvements to increase the resilience of their facilities and systems, in order to facilitate rapid resolution of their operations after disasters.

Executive Order S-04-06, issued on April 18, 2006, addressed emergency preparedness activities including the need for state and local agencies to prepare Continuity of Operations/Continuity of Government (COOP/COG) plans intended to support continuity of government and provision of essential services to the public during and after a

[17] California League of Cities, http://www.cacities.org/Resources/Learn-About-Cities.
[18] State Controllers' Office, https://www.sco.ca.gov/ard_locarep_districts.html.

catastrophic event, as well as California Service Corps responsibility to coordinate volunteer activities related to disaster response and recovery.

Utility Sector

Cooperative emergency management and hazard mitigation efforts with utility companies span more than seven decades. In 1952, the Governor of California chartered the California Utilities Emergency Association (CUEA) as part of the state's Civil Defense Plan. CUEA later received State Tax Exempt status. CUEA is the only utility association with a Memorandum of Understanding (MOU) with Cal OES.

Being co-located at Cal OES headquarters allows CUEA immediate access to regional, state, and federal information. CUEA, via the Executive Director, actively participates in Senior Leadership and Executive level planning sessions and working groups. In 2017, there were 97 CUEA members, including all primary utilities, state agencies, and some cities and special districts.[19]

The CUEA serves as a point-of-contact for critical infrastructure utilities and Cal OES and other governmental agencies before, during, and after an event to:

- Facilitate communications and cooperation between member utilities and public agencies, and with non-member utilities (where resources and priorities allow)
- Provide emergency response support wherever practical for electric, petroleum pipeline, telecommunications, gas, water, and wastewater utilities
- Support utility emergency planning, mitigation, training, exercises, and education[20]

Business Sector

Realizing the need for stronger public-private collaboration, Executive Order S-04-06 gave Cal OES greater authority to partner with private industry. This led to Cal OES signing MOUs with private sector and non-profit organizations creating the Business and Utility Operations Center (BUOC) comprised of the Utility Operations Center (UOC) and Business Operations Center (BOC). The BOC is composed of 15 of California's largest businesses in the finance, home retail goods, and agricultural sectors. The UOC consists of a single member: the California Utilities Emergency Association.

During emergencies, the BUOC is activated to enhance members' capabilities to respond to and recover from emergencies. Beyond involvement in emergency management, utilities are involved in ongoing investments replacing obsolete equipment and facilities. Many of these investments represent improvements in the resilience to natural and human-caused hazards within the utilities' plants and facilities.

Volunteer Sector

Community-based volunteer organizations represent the most extensive source of response resources in an emergency. California Volunteers is the state office that manages programs and initiatives aimed at increasing the number of Californians engaged in service and volunteering.

Following a disaster, volunteer agencies continue to provide services for their constituents as well as for the governmental agencies that might need their unique services. California Volunteers is led by the state's Chief Service Officer and is comprised of four departments: AmeriCorps, Community Partnerships, Disaster Volunteering and Preparedness, and Finance & Administration. For more information, visit: https://californiavolunteers.ca.gov/#.

Executive Order S-04-06 designates California Volunteers as the lead agency for the coordination of volunteers in disaster response and recovery. California Volunteers is designated as the state lead for Volunteers and Donations Management as part of the State Emergency Plan (California Emergency Support Function CA-ESF-17). In this role as the lead coordinator of emergency activities related to volunteer and donations management, California

[19] https://www.cueainc.com/resources/annual-reports/
[20] https://www.cueainc.com/about-us/membership/

Volunteers assigns primary and support roles to those state agencies and departments with the authorities, capabilities, and resources necessary to meet emergency needs.

As part of this role, California Volunteers also engages CA-ESF-17 partner agencies and works with Cal OES related to Voluntary Organizations Active in Disaster (VOAD) personnel to assist in response activities. The VOAD coalition of non-profit organizations supports the emergency management efforts of local, state, and federal agencies and governments by coordinating the planning efforts of a variety of voluntary organizations. VOAD is different from other response groups in that it not only functions during response efforts but also continues to work on disaster recovery activities. For more information about VOAD, visit: www.calvoad.org.

Community Emergency Response Team (CERT) is a program to train and organize localized citizen disaster response groups. Communities or neighborhoods start CERT programs with the intent of 1) facilitating better community preparedness for life threatening hazards, and 2) providing response within the community should there be a disaster. The CERT concept was developed and implemented by the Los Angeles City Fire Department (LAFD) in 1985.[21]

CERT programs serve in more than 2,600 communities nationwide. California CERTs can be located using the directory search at: https://www.ready.gov/community-emergency-response-team.

Red Cross

The American Red Cross (ARC) provides disaster relief to individuals and families, and provides emergency mass care in coordination with government agencies and private organizations. It receives its authority from a congressional charter that cannot be changed by state or local emergency plans and procedures. In providing its services, the ARC will not duplicate the programs of other public or private welfare agencies, nor will it assume financial responsibility for its actions.

Domestic Animals

The California Animal Response Emergency System (CARES) for preparedness, response, and recovery of animals during a disaster is led by the CARES Steering Committee. The committee is comprised of both government and non-government organizations that function as a network to provide services for animals during emergencies. The CARES Steering Committee members and charter can be found at https://cal-cares.com/steering-committee-2/. For an overview of the CARES program visit: https://cal-cares.com/.

Fire Safety

California has an extensive system of civil participation in fire safety. In addition to the state fire agency, California Department of Forestry and Fire Protection (CAL FIRE), relevant organizations include a regional coalition, a statewide non-profit, and locally based non-profits. At the regional scale, the California Fire Alliance (CFA) collaborates with stakeholders to identify wildfire threats to community values, develop, and support strategies to engage communities, and work with them to create fire adapted communities and resilient landscapes.

CFA is composed of 10 member agencies ranging from CAL FIRE to the 35-member Rural County Representatives of California (RCRC) that champions policies on behalf of California's rural counties. The CFA, through its members, will assist communities in the development of fire loss mitigation planning, education, and projects that will reduce the threat of wildfire losses on public and private lands.[22]

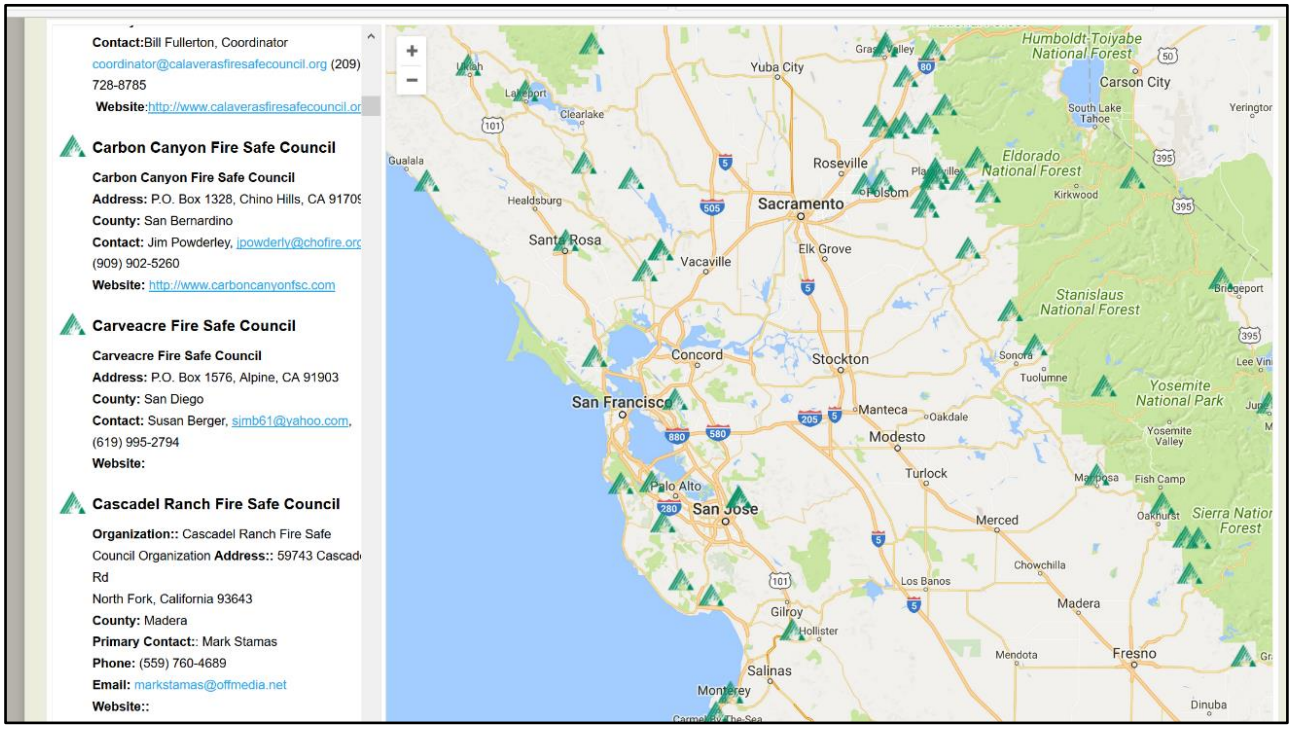
At the sub-regional level is the California Fire Safe Council (CFSC), a 501(c)(3) California non-profit corporation whose mission is to mobilize Californians to protect their homes, communities, and environment from wildfires. The initial focus was to develop and maintain an online, "one-stop-shop" grant clearinghouse where four primary federal

[21] http://www.californiavolunteers.org/index.php/CERT/.
[22] http://www.preventwildfireca.org/Organization-History/.

agencies—the U.S. Forest Service (Department of Agriculture), Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service (Department of the Interior)—could provide large master grants.

The CFSC then selects, manages, and monitors sub-grants to local community groups such as local Fire Safe Councils and homeowners' associations, local governments, fire departments, and other entities focused on wildfire prevention activities such as defensible space, community fire planning, and education. Since that first grant cycle in 2004, the CFSC has provided approximately 842 grants totaling over $81,768,754 to organizations and agencies located throughout California. The CFSC provides technical assistance to local groups with similar missions, assisting them with education on wildfire issues and with organizational issues related to capacity building and sustainability.

Map 1.D: California Fire Safe Council Interactive Local FSC Location Map



There are many local Fire Safe Councils throughout California, each focused on neighborhood level fire mitigation, and there are 92 recognized fire-wise communities in California. The CFSC website provides an interactive map tool for locating local Fire Safe Councils around the state. Map 1.D is an example map from the CFSC interactive local Fire Safe Council location map tool. California fire safe councils are discussed further in *Chapter 8: Fire Hazards: Risks and Mitigation, Section 8.1.5*. For more information about CFSC, visit: http://www.cafiresafecouncil.org/.

1.5 SHMP ADOPTION BY THE STATE

Although leading the coordination and maintenance of the SHMP is the responsibility of Cal OES, the content of the SHMP is the culmination of information provided by numerous stakeholders from local, tribal, state, and federal government agencies, public and private business organizations, and individual citizens. Adoption of the 2018 SHMP is implemented by the Cal OES Director on behalf of the state government as a supporting document to the State Emergency Plan.

The 2018 SHMP provides a thorough description of the state's commitment to significantly reducing or eliminating impacts of natural and human-caused disasters through preparation and implementation of comprehensive hazard mitigation strategies, plans, and actions. This commitment is reflected in the SHMP goals and objectives discussed in *Chapter 3: California's Mitigation Framework: Goals, Objectives, Strategies, and Priorities*, which were reviewed and updated by the State Hazard Mitigation Team (SHMT) Goals and Objectives Strategic Working Group for the 2018 SHMP update. The adopted SHMP communicates the state's priorities and facilitates communication and collaboration among jurisdictions and stakeholders.

Upon conditional approval of the finalized 2018 SHMP by FEMA, the Cal OES Director, acting as the Governor's designated official, formally adopts the SHMP, as required by 44 CFR Section 201.4(c)(6). The Director's letter of adoption is immediately forwarded to FEMA to finalize the approval process. A copy of the adoption letter is included in Figure 1.A, documenting successful completion of this process as part of the 2018 update.

Figure 1.A: 2018 SHMP Statement of Plan Adoption Letter

EDMUND G. BROWN JR.
GOVERNOR

MARK S. GHILARDUCCI
DIRECTOR

Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES

September 28, 2018

STATEMENT OF PLAN ADOPTION

As Director of the California Governor's Office of Emergency Services and the Governor's Authorized Representative, I am pleased to formally adopt the 2018 California State Hazard Mitigation Plan (SHMP) for the State of California.

The state is required to review and revise its SHMP for Federal Emergency Management Agency (FEMA) approval pursuant to 44 Code of Federal Regulations §201.4 and §201.5 to ensure the continued eligibility of Stafford Act funding. This includes FEMA's hazard mitigation assistance programs as well as the Fire Management Assistance Grant Program and Public Assistance grants (Categories C-G). Additionally, the state remains eligible for the increased federal cost share for grants awarded under the Flood Mitigation Assistance programs.

In the five years since the 2013 SHMP was approved and adopted, California has experienced some of the largest and most destructive disasters in the state's recorded history. Disasters are becoming more frequent and resulting in greater impacts, and this trend is expected to increase. With the state's continued population growth combined with prevailing climate projections, California must continue to enhance and invest in mitigation activities and take actions to reduce risks and support resilient communities.

The 2018 SHMP update continues to build upon California's commitment to reduce or eliminate the impacts of disasters caused by natural and human-caused hazards. The SHMP also builds on prior versions for the most comprehensive inclusion yet of the state's climate mitigation and adaptation strategies.

In adopting the 2018 SHMP, the state agrees to comply with all applicable state and federal statutes and regulations as stipulated in the assurances enclosed in the 2018 SHMP, and will update the SHMP at least once every five years. Through implementation, monitoring, and meaningful integration across government and private sectors, the SHMP continues to ensure a safer and more resilient California.

Sincerely,

MARK S. GHILARDUCCI
Director

EMAP Accredited
EMERGENCY MANAGEMENT ACCREDITATION PROGRAM

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1.6 2018 SHMP ASSURANCES

In accordance with 44 CFR Section 201.4(c)(7), the State of California assures that it will manage and administer FEMA funding and comply with all applicable federal statutes and regulations in effect with respect to the periods for which the state receives grant funding. These efforts will comply with the following:

- 2 CFR Part 200 (Office of Management and Budget [OMB] Guidance: Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards)
- 2 CFR Part 3002 (Department of Homeland Security [DHS] adoption of the OMB Guidance listed in 2 CFR Part 200, giving regulatory effect to the OMB guidance and supplementing the guidance as needed for DHS)

The State of California also assures that it will amend the California State Hazard Mitigation Plan as required by 44 CFR 13.11(d) to reflect: 1) new or revised federal statutes or regulations, and/or 2) a material change in any state law, organization, policy, or State agency operation. If an amendment is completed, the State of California will obtain approval for the amendment and its effective date (but need submit for approval only the amended portions of the plan).

The SHMP assurances were reviewed and updated for the 2018 SHMP.

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CHAPTER 2 – THE PLANNING PROCESS

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About Chapter 2

Chapter 2 outlines California's overall hazard mitigation planning process with specific details about preparation of the 2018 State Hazard Mitigation Plan (SHMP) update, as well as SHMP implementation and maintenance efforts. Integration of hazard mitigation with other planning efforts and climate adaption efforts is also detailed. *Section* 2.2, *Preparing the 2018 SHMP Update,* includes information on who was involved in the planning process and how the SHMP Planning Team worked with the State Hazard Mitigation Team (SHMT) to review, analyze, and update the SHMP.

2.1 CAL OES SHMP COORDINATION ROLE

The mission of the California Governor's Office of Emergency Services (Cal OES) is to protect lives and property, build capabilities, and support local communities for a more resilient California.

The foundation for Cal OES' coordination of state agency hazard mitigation efforts is Governor's Executive Order W-9-91, issued in 1991, which authorized the Director of the former OES to assign specific emergency support functions to state agencies through standing administrative orders that are operational until superseded. A letter to agency secretaries on September 12, 2000, by then-Governor Davis initiated the updating of all standing orders related to emergency management and included hazard mitigation for the first time.

Standard hazard mitigation provisions in the standing administrative order included the following:

- Identify, document, and, when practical, implement those activities that potentially could reduce or lessen the impact of an emergency
- Establish hazard mitigation as an integral element in operations and program delivery as appropriate
- During a Presidential declaration of a major disaster, participate in the hazard mitigation planning process

Additionally, the State of California Emergency Plan further assigns mitigation duties to Cal OES and other state agencies under various emergency support functions and mandates support of the SHMP. As part of these mitigation duties, per the 2017 State Emergency Plan, Section 13.3 Emergency Management Activities, the lead agency for each California Emergency Support Function (CA-ESF) will:

- Identify stakeholders and engage them in the development and maintenance of the CA-ESF
- Complete a vulnerability assessment and prioritize actions to reduce vulnerabilities within the scope of the CA-ESF
- Collaborate to pool CA-ESF resources to prevent hazards and reduce vulnerability (leveraging funding, resources, and people)
- Develop strategies and processes to prevent or reduce the impact of events and reduce the need for response activities
- Support the California State Hazard Mitigation Plan (SHMP)

Cal OES' Hazard Mitigation Program is divided between two directorates: the Planning, Preparedness, and Prevention Directorate and the Response and Recovery Directorate. The Hazard Mitigation Planning, Pre-Disaster Mitigation, Flood Mitigation Assistance, and Dam Safety Planning divisions together make up Cal OES' Mitigation and Dam Safety Program, which is within the Planning, Preparedness, and Prevention Directorate. Chart 2.A shows the organization of the Planning, Preparedness, and Prevention Directorate. The Hazard Mitigation Grant Program is within the Response and Recovery Directorate.

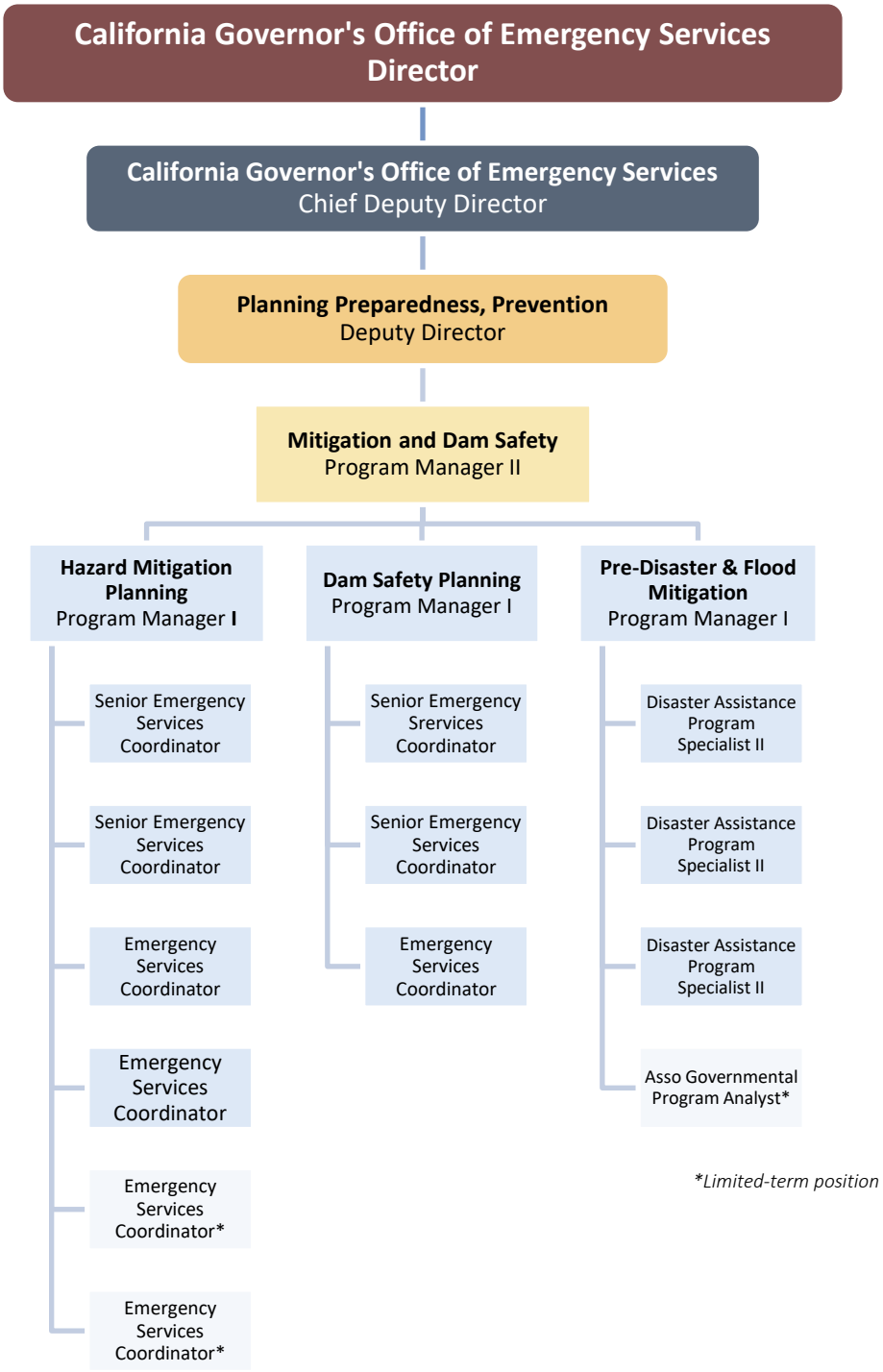
The Cal OES Hazard Mitigation Planning Division within the Planning, Preparedness, and Prevention Directorate leads the preparation of the SHMP. While Cal OES is the lead for SHMP preparation, content updates in the 2018 SHMP include significant input and participation from both Cal OES Directorates and members of the State Hazard Mitigation Team (SHMT).

The primary responsibilities of Cal OES in preparing and implementing the SHMP are to:

1. Ensure that the SHMP meets Federal Emergency Management Agency (FEMA) requirements and is approved by FEMA.
2. Coordinate the continued development of the SHMP with the SHMT, strategic working groups, and outreach to other local, tribal, public/private, state, and federal agencies.
3. Provide ample opportunities for stakeholder involvement in the update of the SHMP.
4. Administer FEMA hazard mitigation assistance programs, including the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA).
5. Support integration of local, regional, and tribal hazard mitigation efforts with the SHMP.

While the Cal OES mitigation program, through the SHMP update and implementation efforts, works to track progress of statewide hazard mitigation activities, many specific mitigation actions and activities are part of programs administered by other state agencies and departments such as the California Coastal Commission, California Geological Survey, California Seismic Safety Commission, California Department of Forestry and Fire Protection (CAL FIRE), Department of Housing and Community Development, Department of Water Resources, and the Governor's Office of Planning and Research. These agencies, and many others, play a key role in providing mitigation progress information as part of the update of the SHMP. A detailed discussion of the SHMT is included in *Section 2.2.2, Coordination Among Agencies and Departments*.

Chart 2.A: Cal OES Planning, Preparedness, and Prevention Directorate Organization



Source: California Governor's Office of Emergency Services (Cal OES)

2.2 PREPARING THE 2018 SHMP UPDATE

The SHMP is a "living" document that reflects the state's ongoing commitment to a comprehensive statewide mitigation program. Monitoring, evaluating, and updating the SHMP every five years is critically important to the effectiveness of hazard mitigation in California by setting the mitigation goals, objectives, and strategies for the state and ensuring the state continues to remain eligible for Stafford Act funding.

Many stakeholders—including Cal OES Directorates, member agencies in the SHMT, local and tribal governments, the state and federal governments, and the public and private sectors—are involved in updating the SHMP. The 2018 SHMP Planning Team, which coordinated with SHMT members, was comprised of Cal OES staff and a support team of faculty and staff from California Polytechnic State University San Luis Obispo (Cal Poly).

To facilitate hazard mitigation progress monitoring and support hazard mitigation efforts around the state, SHMT meetings are held on an ongoing basis, where possible. These include both SHMT meetings as well as multiple strategic working group meetings (e.g. the Geographic Information Systems Technical Advisory Working Committee [GIS TAWC]), as described in detail later in this chapter.

2.2.1 2018 PLAN UPDATE PROCESS

An overall goal of the 2018 SHMP update process has been to facilitate mitigation action across the boundaries of federal and state agencies, local governments, tribal organizations, business and industry, and non-profit organizations. While Cal OES has lead responsibility for the development and maintenance of the SHMP, this document has been produced in collaboration and through engaged partnerships with multiple state agencies and other groups.

2018 SHMP Update Preparation Schedule

During the implementation and monitoring phase begun after 2013 SHMP approval in September 2013, the SHMP Planning Team began to develop an implementation and maintenance schedule, which included a 2018 SHMP Update Preparation Schedule. This schedule was developed based on SHMT feedback and lessons learned during the 2013 SHMP update process. The schedule was updated again in early 2016 by the SHMP Planning Team a few months after a new SHMP coordinator was hired in the Cal OES Hazard Mitigation Planning Division.

An addition to the 2018 Update Preparation Schedule, which was part of SHMP update efforts, is the inclusion of an "Internal Draft of the Public Review Draft to the SHMT." This draft allowed for a second opportunity for internal review and comment by SHMT members before the Public Review Draft was issued to the public. Milestones included in the 2018 Update Preparation Schedule were also specifically selected to ensure sufficient time for internal document processing and online posting (as applicable) prior to draft releases.

Following initial development of the 2018 Update Preparation Schedule by the SHMP Planning Team, the schedule was submitted to the Cal OES Management and Executive Teams for review and confirmation. Development and approval of the 2018 SHMP Update Preparation Schedule, as shown in Table 2.A, was the primary step taken to begin the 2018 update process. At the 2018 SHMP kick-off meeting in December 2016, the 2018 Update Preparation Schedule was released to the SHMT.

Table 2.A: 2018 SHMP Update Preparation Schedule

September 30, 2013	*2013 California State Hazard Mitigation Plan (SHMP) is approved as an enhanced SHMP*
2016	**Action**
December 13, 2016	2018 SHMP Project Kick Off Meeting (State Hazard Mitigation Team [SHMT] members)
December 13, 2016	Geographic Information Systems Technical Advisory Working Committee (GIS TAWC) 2018 Progress Meeting
2017	**Action**
February 22, 2017	SHMT/GIS TAWC Progress Meetings – *POSTPONED due to severe winter storms and Oroville Dam emergency*
April 11, 2017	SHMT Progress Meeting
July 11, 2017	California Polytechnic State University San Luis Obispo support team (Cal Poly) submits Internal Review Draft to the California Governor's Office of Emergency Services (Cal OES) for Cal OES staff review
August 11, 2017	Deadline for Cal OES to submit Internal Draft Review comments to Cal Poly
September 12, 2017	Cal OES releases Administrative Draft for SHMT review
October 12, 2017	Deadline for comments on Administrative Draft to be submitted to Cal OES/Cal Poly
November 2017	SHMT/GIS TAWC/Other Working Group Progress Meeting – *POSTPONED due to statewide fire response*
December 13, 2017	Cal OES provides internal draft of Public Review Draft to SHMT for brief internal review *(internal comments from SHMT due no later than January 10, 2018, but SHMT can also comment during public review)*
2018	**Action**
January 10, 2018	Deadline for SHMT comments on internal Public Review Draft
February 9, 2018	Cal Poly completes Public Review Draft and provides files to Cal OES for posting to Cal OES Hazard Mitigation Division web page
April 16, 2018	Cal OES releases Public Review Draft on web page to initiate 30-day public comment period
May 16, 2018	Deadline for public comment to be submitted to Cal OES
June 12, 2018	Federal Emergency Management Agency (FEMA) Review Draft completed. *Plan Review Tool/Crosswalk* finalized.
June 15, 2018	Cal OES delivers FEMA Review Draft to Region IX to initiate 45-day formal review/comment period ending July 30, 2018
By August 10, 2018	Cal OES receives FEMA Region IX comments
September 10, 2018	Cal OES sends revised SHMP back to FEMA for final review/approval
September 21, 2018	Cal OES director approves and adopts finalized 2018 SHMP; adoption letter sent to FEMA for final approval
September 28, 2018	**FEMA Region IX final approval of the 2018 SHMP**
September 2018-2023	*Implementation of selected 2018 SHMP components*

Note: Milestone dates after June 15, 2018 subject to modification based on final review process

Key Components of the Update Process

While the 2018 SHMP Update Preparation Schedule features milestone dates for SHMT and Strategic Working Group meetings and draft and final plan releases, it does not attempt to describe specific update efforts by both the SHMP Planning Team and the SHMT. Following is a brief description of the key update efforts undertaken from July 2016 to May 2018. (*In some cases, key component efforts occurred simultaneously; therefore, the efforts are not described in chronological order.*)

In the summer of 2016, multiple meetings and phone calls between SHMP Planning Team members were held to define priorities and objectives for updating the 2018 SHMP. These priorities and objectives were presented to the Cal OES Executive Team members for review and direction. Feedback was received and incorporated leading up to the 2018 SHMP kick-off meeting, in December 2016, which helped to define the key components of the update process.

Plan Reorganization

In the fall of 2016, the SHMP Planning Team began evaluating the organization and content of the 2013 SHMP.

The first reorganization step was consideration of the overall chapter structure of the document and arrangement of subsections within chapters of the 2013 SHMP. Initial review determined that guidance should be included at the beginning of the SHMP to explain how the plan is organized and how to navigate the document given its length. A new introduction chapter (Chapter 1) was created for the 2018 SHMP that pulled forward some existing 2013 SHMP information on document organization and content and expanded on those topics in a new section called "Plan Overview: How to Use the 2018 SHMP."

Further assessment of the overall chapter organization determined that the SHMP goals and objectives chapter should be merged with the strategies and actions chapter to present "California's Mitigation Framework." Additionally, information on local hazard mitigation planning that was included in Chapters 1, 2, 3, 4, and 7 as well as Annex 1 of the 2013 SHMP have been merged and redeveloped into a single chapter (2018 SHMP *Chapter 5: California Local Hazard Mitigation Planning*). The intention of the new *Chapter 5* is to act as a resource for local hazard mitigation planning; facilitate stronger connections and integration among public/private, local, state, regional, tribal, and federal hazard mitigation planning; and support alignment of mitigation priorities across all levels of government.

Review and Update of Hazards Organization

A hazard-specific organizational assessment was also conducted. This assessment reviewed the prioritization and grouping of hazards presented in the 2013 SHMP and earlier versions of the SHMP and considered modifications to how the hazards discussions were organized within chapters. It was determined by the 2018 SHMP Planning Team that, rather than grouping the "big three" primary hazards that affect California (earthquake, flood, and fire) in one chapter and the remaining hazards in a separate chapter, hazards would be grouped by "type" into separate chapters. See *Section 1.2* for a plan overview or review the *Table of Contents* for the updated hazard organization.

The proposed new chapter organization for hazard grouping was outlined and presented to the SHMT at the December 2016 kick-off meeting for discussion and consideration. Comments were received from SHMT members during the meeting and in follow-up emails sent by SHMT team members to the Cal OES SHMP Coordinator. Based on this feedback, an updated hazard organization structure was then presented to the SHMT for final review and confirmation.

Review and Update of SHMP Goals and Objectives

At the outset of the 2018 update process, the 2013 goals and objectives were put forth for consideration by the SHMT. This consideration included asking the SHMT to assess each goal and objective to determine if it was still applicable or if modification was needed based on the state's mitigation progress the last few years. After initial discussion of the goals and objectives at the December 2016 SHMP update project kick-off meeting, the SHMT determined that a strategic working group should be formed to revise the language of some of the goals and objectives based on comments provided by team members.

The Goals and Objectives Strategic Working Group participated in multiple conference call meetings over the subsequent months and provided additional feedback via email to help revise the goals and objectives for the 2018 SHMP. The resulting updated goals and objectives were then presented at the April 2017 SHMT meeting and in various document releases to the SHMT for additional feedback and finalization.

Updates to SHMP Strategies

During the April 2017 SHMT meeting, the 2013 SHMP strategies were reviewed and discussed in preparation for the 2018 update. The primary focus of this effort was to begin to determine the continued relevance of the 2013 strategies given the state's recent disasters and updated risk assessment. The overall consensus of this initial effort was an agreement that the 2013 strategies are all still relevant but could be further refined.

Following the meeting, the SHMP Planning Team internally reviewed the 2013 strategies and developed proposed refinement to strategy wording, merged and redeveloped two of the strategies, and developed proposed language for a new strategy to more directly address climate change. SHMT members provided additional feedback on the 2018 SHMP strategies and actions via the release of various 2018 SHMP draft documents for their review, and both SHMT members and the public were afforded an opportunity to provide feedback via the release of the 2018 SHMP Public Review Draft in April/May 2018. Feedback on the strategies received throughout the 2018 SHMP planning process was incorporated as appropriate before the plan went to FEMA for their initial 45-day review.

Social Vulnerability Model Review and Update

The 2010 SHMP originally developed and introduced raster-based Geographic Information Systems (GIS) modeling to analyze vulnerability of California's population to disasters. A social vulnerability base map was developed and then combined with three separate hazard maps for earthquake, flood, and wildfire. The social vulnerability model used information from the 2010 U.S. Census to identify where vulnerable populations live using a selection of social vulnerability factors. For the 2018 SHMP update, the social vulnerability model was updated to use current data and the social vulnerability factors were evaluated by a strategic working group formed with members of the GIS TAWC—resulting in the Social Vulnerability Strategic Working Group.

Updates to Vulnerability and Risk Assessment

Beginning in the fall of 2016 and throughout 2017, coordination efforts increased with SHMT members and other stakeholders regarding updating the risk assessment for the 2018 SHMP. Information gathered during the 2013 SHMP implementation and maintenance phase was incorporated into the 2018 draft SHMP, and communication with stakeholders increased to support efforts to gather known information that would help to update the risk assessment. Additional refinements to the risk assessment information occurred during the review and comment periods for the various document drafts provided to both SHMT members and the public.

Gathering Mitigation and Progress Information from Stakeholders

The SHMP Planning Team solicited updates for each chapter from SHMT members following the 2018 SHMP kick-off meeting in December 2016. To facilitate the mitigation progress tracking effort, revisions were made to the Progress Tracking forms first developed in 2013. These updated forms were distributed at numerous SHMT meetings and posted on the Cal OES Hazard Mitigation Planning Division website. SHMT members were also asked to submit chapter and section updates for editorial integration by the SHMP Planning Team.

Initial response to requests to complete progress reporting forms was slower than expected due to SHMT members' workloads, competing obligations, and multiple large disaster events in the state in 2017. Beginning in January 2017, the SHMP Planning Team began a direct contact outreach campaign to collect mitigation status updates. Extensive phone and email communications were conducted with many SHMT members and other stakeholders to ensure complete updates on various vulnerability assessments, outreach efforts, and mitigation actions, projects, and legislation that have occurred since 2013.

In the 2018 SHMP, over 60 Progress Summaries track significant mitigation initiatives, strategies and actions underway or completed since approval and adoption of the 2013 SHMP.

SHMT Administrative Drafts – Review and Comment

Two separate administrative review drafts were issued to the SHMT in 2017 to allow multiple opportunities for SHMT review and feedback prior to release of the public review draft. Numerous SHMT members and agencies provided feedback on these drafts, which was incorporated into the document before release for public review and comment.

Public Review Draft

For release of the public review draft, an outreach strategy was developed to ensure the draft reached a very wide cross-section of stakeholders (in addition to previous drafts released only to SHMT members), including agency staff that are not on the SHMT, local jurisdictions, special districts, tribal organizations, and private citizens, and/or the public. The SHMP Planning Team reached out to and coordinated with the following agencies and organizations to send out an announcement of the public review draft release to their respective stakeholders and/or support distribution of the public review draft announcement:

- Governor's Office of Planning and Research
- California Natural Resources Agency
- California Silver Jackets
- California Department of Water Resources, FloodSAFE program (included posting through their quarterly Floodplain Management Association newsletter)
- California Volunteers
- California Department of Public Health, Office of Health Equity
- Cal OES Office of Private Sector and Non-Governmental Organizations (NGOs) Coordination
- Cal OES Pre-Disaster Mitigation and Flood Mitigation Assistance (PDM/FMA)
- Cal OES Tribal
- Cal OES Office of Crisis Communications and Media Relations (posting to social media sites) and webmasters (posting announcement on Cal OES main web page and internal intranet site)
- Climate collaboratives (including the Alliance of Regional Collaboratives for Climate Adaptation and the Local Government Commission)
- Various associations of cities, counties, councils of governments, and special districts (including the California Association of Councils of Governments, the League of California Cities, etc.)
- The State Hazard Mitigation Team (SHMT) included 800 members from public, private, local, tribal, state, and federal agencies

The public review draft and instructions for providing feedback to the SHMP Planning Team were posted on the Cal OES Hazard Mitigation Planning Division website for a 30-day public review and comment period. Additional efforts to share the public review draft and socialize the 2018 SHMP can be found *Section 2.2.3, Outreach to Stakeholders*.

Comments received from SHMT members and other stakeholders for the public review draft were reviewed, analyzed, and incorporated by the SHMP Planning Team, as applicable, before the plan was submitted to FEMA for their initial 45-day review.

Final Submission for FEMA Review and Approval

A FEMA Review Draft was submitted to FEMA for its formal initial 45-day review in June 2018. A two-level review of the 2018 SHMP was conducted by both a team of FEMA Region IX (FEMA RIX) reviewers as well as by a FEMA Regional Panel made up of volunteers from other regions. Following response to FEMA's initial comments and incorporation of its feedback, a final draft was submitted back to FEMA RIX for its consideration for approval of the 2018 SHMP.

2.2.2 COORDINATION AMONG AGENCIES AND DEPARTMENTS

This section describes how state and federal agencies and other stakeholders were involved in the process to update the 2018 SHMP. Coordination among all engaged stakeholders is essential for both updating the SHMP and implementing it successfully.

The State Hazard Mitigation Team (SHMT)

Background

During implementation of the 2010 SHMP, stakeholders were recruited to work with Cal OES in monitoring, evaluating, and updating the SHMP. This group of stakeholders is collectively known as the State Hazard Mitigation Team (SHMT). Initial establishment of the SHMT was intended to promote active participation of key agencies and other stakeholders in the SHMP update process to help integrate hazard mitigation with preparedness, response, and recovery efforts.

The SHMT itself is a "living" group that expands and contracts over time. The current team is composed of ongoing members who have participated in the SHMT for many years, as well as other members who are new to the SHMT for the 2018 update process. The SHMP Planning Team, consisting of Cal OES Hazard Mitigation Planning Division staff and a support team from California Polytechnic State University San Luis Obispo (Cal Poly), continuously works to create new connections with stakeholders and bring new members into the SHMT, as well as maintain strong connections with existing members. As awareness of the need for coordinated hazard mitigation and climate adaptation and resilience efforts grows, the cross-connections fostered by SHMT members from different sectors become even more important. The SHMP is only as comprehensive and as updated as the feedback and direction received from SHMT members and stakeholders, which is why it is so important for stakeholders to remain engaged with supporting SHMP update and implementation efforts.

During the implementation period following the approval of the 2013 SHMP, Cal OES Hazard Mitigation Planning Division staff worked to review and update the SHMT roster to ensure that contact information would be current and applicable for the start of the 2018 SHMP update effort. Cal OES staff continues to maintain and manage this SHMT roster, as new stakeholder contacts are added by the SHMP Planning Team. The SHMP Planning Team also encourages current SHMT members to "recruit" new members to join the SHMT, either from within or outside of their organization. The intent of outreach efforts by the SHMP Planning Team and SHMT members is to ensure that the SHMP update process is inclusive to all stakeholder groups or sectors.

The SHMT consists of over 300 agencies and organizations. The SHMT meets periodically (quarterly, if possible) to discuss hazard mitigation progress and SHMP planning efforts. Some member agencies have responsibility for state-mandated hazard mitigation activities that provide the basis for the SHMP update. The 2018 SHMP update has had robust participation and input from federal, state, tribal, regional, and local SHMT members. Additionally, FEMA RIX representatives routinely attend SHMT meetings and Cal OES also schedules regular internal meetings with FEMA RIX staff to discuss both specific and broad topics related to LHMPs and the SMHP.

The SHMP Planning Team continues to expand the SHMT roster by identifying and recruiting new organizations and entities that may not yet be represented. For a complete list of member agencies, see *Appendix A*.

Role in the 2018 SHMP

The SHMT has been instrumental in the development of the 2018 SHMP, which contains substantial new information about individual agency mitigation program responsibilities. The SHMT has assessed, evaluated, and carried out the following activities and functions related to the 2018 SHMP coordination efforts:

- Assessed state agency hazard mitigation roles
- Identified new legislative initiatives
- Actively worked together to maintain a sustainable statewide hazard mitigation program

- Reported on changes in hazards, agency progress toward achieving mitigation goals and ongoing projects, and new opportunities arising through advancements in technology, knowledge, or completed work
- Worked to keep current on significant changes, and new technologies in mitigation
- Encouraged cross-sector mitigation communication and knowledge-sharing
- Maintained and supported MyPlan, an online GIS hazards Internet Mapping Service (IMS) supporting local hazard mitigation planning
- Participated in strategic working groups to provide input on updates to SHMP content
- Reviewed the administrative drafts of the 2018 SHMP and recommended refinements

Following approval of the 2013 SHMP, the SHMT continued to meet annually in 2014, 2015, and 2016 to facilitate implementation of the SHMP and maintain communication and integration between agencies and stakeholders. While the Geographic Information Systems Technical Advisory Working Committee (GIS TAWC) continued to meet largely on the same schedule as the SHMT (see Table 2.B), the other strategic working groups initially established in 2010-2012 were not continued. However, other new strategic working groups were developed to support the 2018 SHMP update. The strategic working groups are discussed further in the next section.

Beginning in December 2016, the SHMT met to kick off the 2018 SHMP update process. The SHMT then met multiple times during 2017 and 2018 to initiate, review, and update various elements and drafts of the 2018 SHMP. These efforts helped to produce administrative drafts, a public review draft, a FEMA review draft, and a final 2018 SHMP for adoption by the Cal OES Director on behalf of the Governor and the State of California.

To ensure that the 2018 SHMP reflects current and ongoing mitigation efforts around the state, input to content updates come directly from SHMT members. For example, the California Department of Water Resources (DWR) provides input on flood hazards, the California Geological Survey (CGS) provides updates on earthquake and geologic hazards, and so on.

Recommendations for 2018 SHMP revisions and actions were based on:

- Adjustments or changes in federal or state laws, regulations, and/or policies and creation of new state laws, regulations, or policies
- New information from state agencies with scientific and/or regulatory responsibilities for hazard mitigation (e.g., additional CGS seismic mapping, CAL FIRE periodic wildfire fire map updates, and new DWR flood maps and user handbook)
- New technologies, such as use of the interactive hazard online map viewers (e.g., CAL FIRE's tree mortality viewer)
- New priorities such as emphasis on social vulnerability and environmental justice, and efforts to further integrate with the state's climate adaptation planning strategies

Local Stakeholder Participation

Also contributing to the 2018 SHMP update is the local preparation and adoption of 502 FEMA-approved Local Hazard Mitigation Plans (LHMPs) as of February 28, 2018, including those of 258 cities and counties and 244 special districts. As of February 28, 2018, according to FEMA, another 20 LHMPs covering a total of 99 additional jurisdictions were approvable pending adoption. Local governments are in a unique position to encourage grassroots organizations, public and private organizations, and the general public to directly participate in planning for increased safety and sustainability of their own communities through the LHMP update process. Overall trends and patterns in these updates are in turn reflected in the 2018 SHMP.

The LHMP preparation and approval process provides a source of local hazard mitigation planning contacts to Cal OES. The SHMP Planning Team also increased efforts as part of the 2018 SHMP update to add local stakeholders to the SHMT so they can help to offer local perspective during the SHMP update and implementation processes.

In 2017, the SHMP Planning Team assessed the linkage of the SHMT to local planning efforts and found that many more local jurisdictions and tribal governments could be invited to participate in the SHMT. In part, this need

stemmed from local government personnel changes resulting in many of the SHMT contacts for local jurisdictions being outdated and no longer active. To address this the SHMP Planning Team began a focused outreach effort to local jurisdictions and tribal governments to obtain updated information for jurisdictions' staff contacts for their LHMPs. Cal OES Hazard Mitigation and Cal OES Tribal Office continue to work toward strengthening integration between tribal governments and state mitigation planning and grant funding opportunities.

For additional information on local and tribal hazard mitigation planning, see *Chapter 5*. For additional information on hazard mitigation grant funding, see *Chapter 10*.

Facilitating Collaboration through the SHMT Strategic Working Groups

The strategic working group concept was initially implemented in the fall of 2009 to address various SHMP-related issues pertaining to interagency coordination, mitigation progress, and strategy implementation by bringing together SHMT members from different agencies in smaller focused topic groups to allow for in-depth discussion. These strategic working group efforts are key action steps in supporting 2018 SHMP Goal 4: *Promote Integrated Mitigation Policy.* (For detailed information about the 2018 SHMP goals, see *Chapter 3, Section 3.3*).

While the SHMT meetings have provided a positive forum for engaging team members in the SHMP update and revision process as a whole, the strategic working groups engage in a direct and more meaningful way where more detailed review or input is needed in the update process. The strategic working groups are held on a voluntary participation basis, with SHMT members encouraged to participate in the groups about which they feel knowledgeable and interested. Strategic working group meetings can range in size from 5 to 40 people.

Strategic working groups activated for the 2018 SHMP update effort included the groups described below.

Geographic Information Systems Technical Advisory Working Committee (GIS TAWC)

The Geographic Information Systems Technical Advisory Working Committee (GIS TAWC) provides ongoing guidance for hazard data integration and open platform dissemination. The GIS TAWC's primary function is to provide technical context and framework for assembling hazards information that may then be used by citizens and municipal governments for all planning purposes.

The GIS TAWC was created jointly by Cal OES, the California Natural Resources Agency (CNRA), and other interested entities to advance GIS in hazard mitigation and to assist in the SHMP update process. It has met since 2009. In the fall of 2011, the GIS TAWC helped developed and launch MyPlan, a new online GIS hazards data Internet Mapping Tool (IMT). The MyPlan IMT was originally intended to assist local governments in preparing GIS-based hazards maps to support local hazard mitigation planning and hazard mitigation grant projects.

The GIS TAWC continues to meet to support further refinement and development of MyPlan and to advise on SHMP maps and other related GIS/hazard mitigation issues. For more information about MyPlan, see *Chapter 3, Section 3.11*. As shown in Table 2.B, GIS TAWC meetings were often scheduled following SHMT meetings.

Table 2.B: SHMT and GIS TAWC Strategic Working Group Meetings 2014-2018

Meeting Type	Date of Meeting	Meeting Objective
State Hazard Mitigation Team (SHMT)	October 15, 2014	2013 State Hazard Mitigation Plan (SHMP) implementation and progress tracking
Geographic Information System Technical Advisory Working Committee (GIS TAWC)	October 15, 2014	MyPlan II development
SHMT	December 4, 2015	2013 SHMP implementation and progress tracking
GIS TAWC	December 4, 2015	MyPlan II development/2013 SHMP implementation and progress tracking
SHMT	May 10, 2016	2013 SHMP implementation and progress tracking
GIS TAWC	May 10, 2016	MyPlan II development/2013 SHMP implementation and progress tracking
SHMT	December 13, 2016	2018 SHMP update kick off meeting
GIS TAWC	December 13, 2016	2018 SHMP update kick off meeting/social vulnerability model update
SHMT	April 11, 2017	Assessment of SHMP goals, objectives, strategies
GIS TAWC	April 11, 2017	Social vulnerability model update

2018 SHMP Goals and Objectives Strategic Working Group

This working group was formed at the outset of the 2018 SHMP update process as a result of initial discussions about the current relevance of the 2013 SHMP goals and objectives. Following SMHT discussion, a working group was tasked with soliciting input and preparing a draft set of revised goals and objectives for review by the entire SHMT.

The working group members were drawn from a broad cross-section of agencies involved in hazard mitigation risk assessment, policies, and programs, including Cal OES, Governor's Office of Planning and Research, California Earthquake Authority, California Seismic Safety Commission, Department of Water Resources, Board of Forestry, California Coastal Commission, California Department of Public Health, Bureau of Land Management, and a tribal planning consultant.

This working group met via a series of teleconferences and communicated via email from December 2016 to May 2017 to evaluate and update the SHMP goals and objectives.

Social Vulnerability Model Update Strategic Working Group

This working group was developed from the GIS TAWC to provide input for the update of the social vulnerability model originally developed for the 2010 SHMP. During preliminary discussions about social vulnerability model redevelopment at the December 2016 GIS TAWC meeting, the GIS TAWC determined that a separate working group should be formed to provide specific feedback to the model update process. This working group met via a series of teleconferences and communicated via email from December 2016 to May 2017 to assess the 2010 model structure, weighting, and inputs.

The working group members were drawn from Cal OES (Office of Access and Functional Needs), California Coastal Commission, California Department of Public Health, California Department of Public Health Office of Health, Bureau of Land Management, a tribal planning consultant, and Four Twenty Seven, a private sector consulting firm. The results of the meetings produced an updated hazard analysis and social vulnerability model that took into consideration social equity and environmental justice elements, as well as vulnerable populations. The modeling results were used to help inform maps included in *Section 4.4, Environmental Justice, Equity, and Hazard Mitigation in California*, and prepared for some of the 2018 SHMP risk assessments found in *Chapters 6 through 9*. For additional information on the updated social vulnerability model, please refer to *Appendix N*.

Additional Strategic Working Groups under Development

Additional strategic working groups were initially proposed to support the development and implementation of the SHMP and will be convened as time and resources allow. While the SHMP Planning Team will provide initial startup support for these strategic working groups, the long-term vision is that they could be self-sustaining and chaired by participating agencies.

Mitigation Integration Strategic Working Group

This strategic working group is proposed by Cal OES to provide a forum for integrating efforts among state, local, regional, and tribal jurisdictions to support implementation of hazard mitigation programs. Potential topics that this working group may cover include local mitigation planning efforts and LHMP linkages to the SHMP; integrating hazard mitigation more closely with Threat and Hazard Identification and Risk Assessment (THIRA), the Emergency Management Accreditation Program (EMAP), and Cal OES catastrophic planning efforts; sharing information about the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) grant programs; and working to link mitigation strategies more closely with recovery actions.

This strategic working group will also support climate information sharing among all levels of government. Working with existing collaborative groups already sharing climate information throughout the state (such as the Safeguarding Climate Action Team [SafeCAT] and the Integrated Climate Adaptation and Resiliency Program Technical Advisory Committee [ICARP TAC]) would be an effective way to track climate adaptation efforts that can specifically feed into future SHMP updates and facilitate LHMP and SHMP integration. Deliverables from this group could also support related updates for the California Adaptation Planning Guide (APG).

Drought Information Strategic Working Group

The initial intent of this strategic working group is to share mitigation activity progress and lessons learned from California's prolonged drought event.

Seismic and Geologic Hazard Integration Strategic Working Group

The intent of this strategic working group is to provide opportunities for information sharing and cross-referencing of mitigation actions underway or planned by agencies and other stakeholder groups concerned with seismic and geologic hazards.

Strategic Working Groups before 2013

Three strategic working groups met between 2009 and 2011: Cross-Sector Communications and Knowledge-Sharing Strategic Working Group, Mitigation Progress Indicators and Monitoring Strategic Working Group, and Land Use Mitigation Strategic Working Group. The result of each of these groups was a set of valuable recommendations to the SHMT that are still applicable. While some recommendations have been implemented, the remaining recommendations are being reviewed for utilization in furthering the state's comprehensive mitigation strategy.

Complete meeting notes from the strategic working groups, including discussion of the recommendations for action, are included in Appendix K of the 2013 SHMP.

Cal OES Coordination with FEMA

Overview

In addition to the SHMT and its strategic working groups, state-federal coordination is facilitated through various ad hoc consultation processes, including catastrophic event preparedness planning, as well as federal-state coordination related to emerging and continuing hazard mitigation issues involving climate change, tsunamis, dam and levee failure, flood hazards, drought and subsidence, tree mortality, and extensive fires in wildland-urban interface (WUI) areas.

Cal OES and FEMA regional mitigation staff communicate regularly, on an informal basis, regarding the state's mitigation program.

FEMA Mitigation Program Consultation

FEMA's 2015 State Mitigation Plan Review Guide, effective March 2016, summarizes FEMA's responsibility for providing technical assistance through review and consultation with the state's hazard mitigation program. The Review Guide also provides detailed guidance on how FEMA interprets the various requirements of the 44 Code of Federal Regulations (CFR) for all standard and enhanced state mitigation plan reviews. Prior to adoption of the 2015 Review Guide, FEMA modified the update and review requirements for state plans to occur on a five-year update cycle, rather than the previous three-year update cycle.

As part of this change, the 2015 FEMA Review Guide adds the responsibility that FEMA conduct annual consultations with states. The purpose of this consultation is to help institute active, ongoing coordination and communication between FEMA and the state to support the state's mitigation programs. The consultation also provides an opportunity for FEMA and the state to discuss the status of the state's mitigation program for both planning and grant elements. The state's first annual consultation with FEMA was held in September 2017 and resulted in an Action Plan developed by the state, working in coordination with FEMA staff, to help address any areas of improvement identified during the consultation process.

Sector Coordination

Successful implementation of mitigation planning efforts requires integration between different sectors to ensure a whole-community approach. The FEMA State Mitigation Plan Review Guide identifies seven sectors that are essential to connecting mitigation planning and preparedness efforts. As previously mentioned, various agencies from each of these sectors are part of the SHMT and play key roles in the SHMP update process by providing feedback and information on mitigation progress. Below are brief examples of some of the agencies involved in the SHMP process by sector.

Emergency Management

- California Department of Water Resources (DWR) – In addition to providing detailed updates on flood hazards, DWR has been instrumental in reviewing and approving dam inundation maps in response to Senate Bill 92, passed in 2017. DWR has also provided updates to the 2018 SHMP regarding dam mitigation measures related to the Oroville Dam and Spillway.
- California Department of General Services (DGS) Office of Risk and Insurance Management – DGS Emergency Management staff worked closely with the SHMP Planning Team to update information regarding state-owned and leased structures and potential vulnerability to those structures.

Economic Development

- Past and New SHMT Members – During an assessment of stakeholder sectors as the 2018 SHMP update project was beginning, it was determined that participation from the economic development sector needed to be stronger. Corrective action was taken by the SHMP Planning Team to search out previous SHMT members from the economic development sector and re-engage with them. Additionally, the SHMP Planning Team worked with current SHMT members to identify new business development sector stakeholders to approach for input and participation on the SHMT, and also reached out to known stakeholders in the economic development sector to recruit them to the SHMT.
- Cal OES Office of Private Sector and Non-Governmental Organization (NGO) Coordination – The SHMP Planning Team consulted with the Chief of this office for guidance on how to further integrate economic development, private, and public sector agencies into the SHMP update process. These efforts resulted in SHMP-related information being shared with stakeholders that work with this Cal OES office, including distribution of the 2018 SHMP Public Review Draft documents.

- Governor's Office of Business and Economic Development (GO-Biz) – The SHMP Planning Team reached out to GO-Biz staff to introduce them to the 2018 SHMP update and invite them to join the SHMT.
- Department of Finance – The SHMP Planning Team reached out to Department of Finance staff to introduce them to the 2018 SHMP update and invite them to join the SHMT.

Land Use and Development

- Governor's Office of Planning and Research (OPR) – OPR was instrumental in supporting the Goals and Objectives Strategic Working Group and also plays an active role in the SHMT, providing guidance and information on such topics as legislation, climate adaptation, land use planning linkage to hazard mitigation, and general plan integration with LHMPs. During the 2018 SHMP update process OPR was closely engaged with Cal OES and the SHMT. This enhanced engagement was due, in part, to the 2017 General Plan Guidelines update, which includes a strong linkage to hazard mitigation. The strengthening of the planning/hazard mitigation linkage is a result of various new mitigation-related legislative requirements and Executive Order B-30-15 (more discussion of which can be found in *Section 4.3.6.1*). These initiatives have resulted in stronger participation by OPR in development and coordination of the SHMP and stronger linkage of hazard mitigation with other state efforts.
- CAL FIRE – CAL FIRE land use planners have been working with Cal OES, FEMA, and OPR staff to support integrating updated land use planning and fire hazard information into LHMP and general plan development. Updated CAL FIRE land use planning information is also being incorporated into the state's LHMP technical assistance and training efforts.

Housing

- California Department of Housing and Community Development (HCD) – HCD provided input to the 2018 Safeguarding California update (an important climate adaptation planning initiative that integrates with the SHMP), and also provided progress updates for mobile/manufactured home mitigation from the HCD Mobile Home Parks Program for the 2018 SHMP update.
- Earthquake Engineering Research Institute (EERI) – In 2015, EERI worked with Cal OES and FEMA to create an informational guide on methods for seismic retrofit of mobile homes. This flyer was translated into Spanish in 2016.

Health and Social Services

- California Department of Public Health (CDPH) – The California Building Resilience Against Climate Effects (CalBRACE) project, based in the Office of Health Equity (OHE), seeks to enhance local and state agencies' efforts to plan for and help reduce health risks from climate change. CDPH OHE has been actively involved in the SHMT and in strategic working groups, providing feedback on updates to the SHMP goals and objectives and input and perspective for updates to the social vulnerability model and various progress updates on the CalBRACE program.

Infrastructure

- California Department of Transportation (Caltrans) and California Public Utilities Commission (CPUC) – Both Caltrans and CPUC are active members of the SHMT, attending team meetings and providing feedback on progress updates for infrastructure hazard mitigation.
- State Water Resources Control Board (SWRCB) – SWRCB is an active member, attending team meetings and providing SHMP feedback, particularly addressing the resilience of the drinking water infrastructure.

Natural and Cultural Resources

- California Natural Resources Agency (CNRA) – CNRA provided information and direction related to the 2018 Safeguarding California update and remains an active member on the SHMT.
- California Coastal Commission (CCC) – CCC provided detailed input to the 2018 effort to update the SHMP goals and objectives and also contributed comments to the update of the social vulnerability model.
- California Board of Forestry (BoF) – BoF provided extensive updates and comments to the wildfire hazard and insect pest risk assessment sections as well as feedback to the new tree mortality hazard section risk assessment.

2.2.3 OUTREACH TO STAKEHOLDERS

Stakeholder Outreach Plan to Track Progress

Following approval of the Enhanced SHMP in September 2013, the SHMP Planning Team began internal discussions on maintaining the plan and tracking implementation. Out of these discussions, a Progress Tracking Outreach Plan was developed in 2016. The Progress Tracking Outreach Plan defined outreach goals and linkage to FEMA's Mitigation Plan Review Guide elements and outlined outreach tasks to be undertaken by the SHMP Planning Team.

The Progress Tracking Outreach Plan was intended to guide outreach efforts in the period between plan updates and provide a lead-in to startup of the 2018 SHMP update effort, which kicked off in 2016.

Progress Tracking Outreach Plan goals are as follows:

- Outreach Goal 1: To track and monitor hazard mitigation progress around the state.
- Outreach Goal 2: To maintain contact and coordinate with state and local agencies undertaking mitigation projects.
- Outreach Goal 3: To communicate mitigation progress between agencies and promote hazard mitigation communication across sectors.
- Outreach Goal 4: To obtain feedback from state and local agencies on the effectiveness of their hazard mitigation projects.

The outreach plan defines the SHMP Planning Team's initial intent for outreach efforts. While some portions of some tasks were undertaken, task progress was slowed due to limited staff availability. Progress continues on these tasks as the 2018 SHMP update and implementation process moves forward. Following approval of the 2018 SHMP, the outreach plan tasks will be re-evaluated and updated to continue momentum on outreach.

A copy of the Progress Tracking Outreach Plan is included in *Appendix D*.

Plan Socialization: Sharing the Plan

The SHMP Planning Team looked at both the successes and lessons learned from the 2013 SHMP update. Part of the need identified was to increase socialization efforts to share this plan with agencies and staff to help them understand how they can use it as a resource for many purposes. For the 2018 SHMP update, the SHMP Planning Team has made a special effort to use as many tools as possible to publicize and encourage discussion of the plan drafts.

2018 SHMP Public Review Draft Outreach

For example, as a result of the public outreach strategy developed for the 2018 SHMP Public Review Draft release, the draft reached a much broader audience though use of social media and expanded coordination with stakeholders to distribute to their contacts (as outlined in *Section 2.2.1, 2018 Plan Update Process*). Along with distributing the Public Review Draft to roughly 800 SHMT members, these increased outreach efforts are estimated to have reached tens of thousands of California citizens to make them aware of the SHMP and to request their review and feedback.

Additionally, the SHMP Public Review Draft was distributed to contacts nationwide, including other state hazard mitigation contacts.

In the spring of 2018, in coordination with the Public Review Draft release, Cal OES Mitigation and Dam Safety Program staff and staff from other state agencies presented information about the 2018 SHMP update to a variety of stakeholders at several workshops and meetings around the state over a two-month period, as shown in Table 2.C. The presentations highlighted the SHMP update process, the importance of the SHMP in guiding mitigation efforts, how local jurisdictions can use the SHMP to support to local hazard mitigation and climate adaptation/resilience planning, and details on how to provide feedback during the Public Review Draft period. Fact sheets about the 2018 SHMP were also distributed at many of these meetings. While the Public Review Draft comment period was 30 days, efforts to socialize the draft began occurring before the documents were even released to the public.

Table 2.C: SHMP Public Review Draft Outreach Workshop Presentations

Presentation Date	Agency Facilitating Meeting	Meeting Details
March 14, 2018	California Governor's Office of Emergency Services (Cal OES)	Mutual Aid Regional Advisory Committee (MARAC)/Mutual Aid Regional Information Exchange Meeting (MARIX) (Rohnert Park)
April 2, 2018	Governor's Office of Planning and Research (OPR)	Integrated Climate Adaptation and Resiliency Program Technical Advisory Committee (ICARP TAC) Quarterly Meeting (Bay Area)
April 4, 2018	OPR	Senate Bill 1000 Workshop (Oakland)
April 4, 2018	Cal OES	MARAC Meeting (Red Bluff)
April 11, 2018	Cal OES	MARAC Meeting (Woodland)
April 12, 2018	Cal OES	Hazard Mitigation Grant Program (HMGP) Workshop (Sacramento)
April 16, 2018	OPR	Climate adaptation and resilience webinar (nationwide)
April 24, 2018	Central Coast Climate Collaborative	Central Coast Region Building Resilience Workshop (San Luis Obispo)
April 25, 2018	Cal OES	MARAC Meeting (Clovis)
April 26, 2018	Cal OES	MARAC Meeting (Rancho Cucamonga)

Cal OES Hazard Mitigation Web Pages

Mitigation and Dam Safety Branch Web Page

This webpage provides a link to the following Divisions under the Mitigation and Dam Safety Branch:

- Dam Safety Planning
- Hazard Mitigation Planning
- Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA)

Also included on the Mitigation and Dam Safety webpage is a GIS application of direct use to individual citizens and property owners. This online Internet Mapping Tool (IMT), known as MyHazards and created jointly by Cal OES and the California Natural Resources Agency (CNRA), provides homeowners, property owners, and residents with natural hazards data, both regulatory (e.g., areas having legal requirements related to real estate transfers such as flood, fault, liquefaction, and landslide zones) and informational, in one location on the web in response to a simple query involving user input of a location or address. For each location and hazard type, hazard mitigation strategies are displayed based on their applicability for that level of hazard. Links are included providing explanations of how to complete property-related mitigation actions. See: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation.

Hazard Mitigation Planning Web Page

Links under the Hazard Mitigation Planning webpage include:

- State Hazard Mitigation Plan
- California Climate Adaptation
- Local Hazard Mitigation Planning
- Documents, Publications, and Videos
- Success Stories

The Hazard Mitigation Planning Division web page serves as a location for local and state hazard mitigation information and resources. The web page is an important tool for communicating with stakeholders and the public and is maintained on an ongoing basis by Cal OES Hazard Mitigation Planning Division staff to ensure that up-to-date mitigation resources are available on the webpage. The webpage provides downloadable portable document file (PDF) copies of the 2018 SHMP either as an entire document or by chapter.

The webpage also provides an easy way for stakeholders and the public to participate in the 2018 SHMP revision process. Downloadable SHMP comment and hazard mitigation progress reporting forms are available on the web page, allowing individuals to update Cal OES staff directly on a wide range of mitigation topics in addition to giving specific comments on the 2018 SHMP. See: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning.

Hazard Mitigation Grant Program (HMGP) Web Page

While not under the Mitigation and Dam Safety Branch, Cal OES' Hazard Mitigation Grant Program (HMGP) provides many grant subapplicant resources and information on NOIs at the following webpage: See: http://www.caloes.ca.gov/cal-oes-divisions/recovery/disaster-mitigation-technical-support/404-hazard-mitigation-grant-program.

Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) Web Page

Located on this website are funding opportunity notices, links to Notice of Interest (NOI) instructions, and links for NOI submittals for PDM and FMA grants. The website provides fact sheets, instructions, application documents, and post obligation documents. See: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/pre-disaster-flood-mitigation.

Dam Safety Planning Web Page

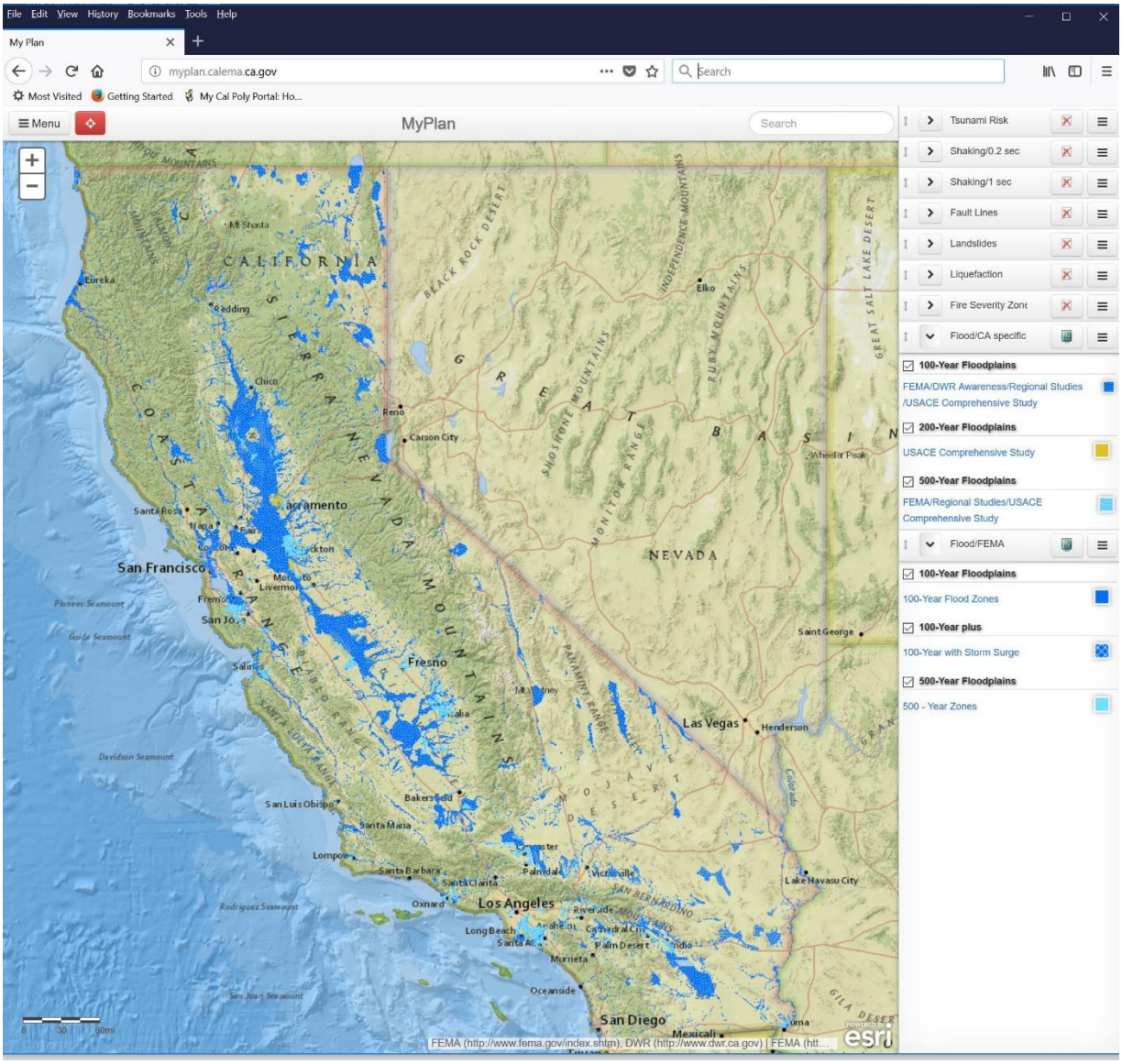
On June 27, 2017, Governor Brown signed Senate Bill 92, which set forth new requirements focused on dam safety. As part of this legislation, dam owners must now submit inundation maps to DWR. After the maps are approved, the dam owner must submit an emergency action plan to Cal OES. DWR's Division of Safety of Dams (DSOD) is responsible for the review and approval of inundation maps while the California Governor's Office of Emergency Services (Cal OES) is responsible for overseeing the review, approval, and ongoing activities associated with Emergency Action Plans under California Government Code Section 8589.5. See: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/dam-emergency-action-planning.

MyPlan Internet Mapping Tool

In 2011, Cal OES initiated MyPlan, an Internet Mapping Tool (IMT) that provides a single online location for Geographic Information Systems (GIS) natural hazards mapping that was previously available from multiple separate locations. The purpose of MyPlan is to make natural hazards risk information and assessments more accessible for hazard mitigation planning and action by local communities and citizens. MyPlan democratizes access to hazards information by making this information openly available, allowing users to determine what information they want to view in the maps.

During implementation of the 2010 SHMP, significant steps were taken to expand on previous progress toward enhanced GIS development. MyPlan is one such step. It builds on previously established enhancements to disaster history tracking, GIS modeling showing a sub-county multi-hazard risk assessment, and upgraded mitigation grant project tracking and location geocoding.

Map 2.A: MyPlan Example Mapping Screen



Key purposes of the MyPlan project are to 1) create a single IMT to give cities, counties, special districts, and state agencies efficient access to existing online GIS hazards datasets acquired from various sites sponsored by multiple

federal and state agencies; and 2) support preparation of higher-quality Local Hazard Mitigation Plans (LHMPs) prepared under the Disaster Mitigation Act of 2000 (DMA 2000), safety elements mandated by California general plan law, Local Coastal Programs (LCPs) prepared under the California Coastal Act, and publicly or privately sponsored hazard mitigation projects.

MyPlan is primarily targeted to users who need to create hazard maps for publication in local planning documents. Output includes high-resolution screenshots of user-created maps. MyPlan provides the ability to create GIS-based, hazard mitigation-related maps without using dedicated GIS software. Users are able to turn on and off base and hazard layers to create a custom map of their local area showing various hazards over a standard base map, adding selected base layers as desired. Map 2.A shows an example of a map generated by MyPlan.

Senate Bill 92 (2017) provided new legislative requirements for owners of state jurisdictional dams, except for those classified as low hazard by the DWR, to develop and submit inundation maps for their dam(s) and critical appurtenant structures to DWR's Division of Safety of Dams for approval. Upon approval of the inundation maps, a dam owner is required to submit emergency action plans based upon the approved map(s) to Cal OES for approval by specific deadlines. Corresponding dam inundation area layers will be created and added to MyPlan, which will allow local planners to better plan for a dam failure incident within their jurisdiction.

2.3 INTEGRATION AND COORDINATION WITH OTHER PLANNING EFFORTS

This SHMP integrates and enhances all state mitigation planning efforts within a statewide comprehensive framework. Various state agencies have been delegated mitigation planning responsibilities through state law or by executive order.

2.3.1 HAZARD-SPECIFIC MITIGATION PLANS – PRIMARY HAZARDS

As a consequence of its experience with disasters, California has initiated a variety of ongoing hazard mitigation efforts for many years. Due to the frequency, intensity, and variety of natural disasters that occur in California and the corresponding statutory responses, mitigation efforts have tended to focus in a piecemeal fashion on mitigation of specific types of hazards. For example, after the 1971 Sylmar Earthquake, a wide variety of legislation was passed focusing on earthquake hazard mitigation. This single-focus legislation has expanded greatly since that time.

The state has previously undertaken significant mitigation planning efforts for California's three primary hazards (earthquakes, floods, and wildfires) to comply with the provisions of the Stafford Act. As an outcome of past efforts, California has a number of hazard-specific mitigation plans in place. These plans include information on state and local risk that helped to form the foundation for the risk assessment in this SHMP. To the extent they are coordinated over time with each other and various other state and local plans dealing with hazard mitigation, they form an excellent foundation for comprehensive mitigation planning.

California Earthquake Loss Reduction Plan

The California Seismic Safety Commission (CSSC) prepared the 2007-2011 California Earthquake Loss Reduction Plan to fulfill the requirements of the California Earthquake Hazards Reduction Act of 1986 (Government Code Section 8870, et seq.). The California Earthquake Loss Reduction Plan is periodically updated on a separate cycle. For more information, visit: http://ssc.ca.gov/legislation/mitigation.html.

California Fire Plan

The 2010 Strategic Fire Plan for California is the most recent version of the California Fire Plan, initially adopted in 1996. It differs from preceding versions in its brevity; it is comprised essentially of a core vision statement, with accompanying sets of goals and objectives comprising a broad statement of the state's priorities for fire protection and wildfire hazard mitigation services. Jointly developed by the California Board of Forestry and Fire Protection and CAL FIRE, the plan was prepared by a broad group of volunteers who served on the Fire Plan Steering Committee. Following comment from various levels of government, the business community, non-profit organizations, and the public, the plan was adopted in 2010.
For more information, visit: http://cdfdata.fire.ca.gov/fire_er/fpp_planning_cafireplan.

State Flood Hazard Mitigation Plan.

The State Flood Hazard Mitigation Plan was developed through a multi-agency collaborative effort that involved all levels of government, the private sector, and other stakeholders. The plan identifies high flood hazard areas and outlines mitigation strategies to address flood risk. FEMA initially approved the plan in 1996 on the condition that the state complete community profiles and state agency capability assessments. These two additional sections were approved by FEMA in 1997. Elements of the plan were updated through the FloodSAFE California initiative and other initiated Delta area levee retrofit programs. The Department of Water Resources manages California's Flood Management Programs, which are discussed in *Section 7.1.5.2*.

2.3.2 RELATED MITIGATION PLANNING EFFORTS

The following cooperative efforts served as models for the development of this SHMP. Cal OES and the SHMT reviewed and incorporated elements from numerous plans and documents in the development of the SHMP, including:

- California Fire Alliance outreach and coordination efforts
- OPR General Plan Guidelines
- OPR technical advice publications
- Sacramento-San Joaquin River Basins Comprehensive Study
- California Floodplain Management Task Force
- Hazardous materials plans
- Integrated Watershed Planning Principles
- Drought Task Force Reports
- State of California Homeland Security Strategy
- Delta Risk Management Study (DRMS) report
- California Climate Change Adaptation Strategy (Safeguarding California)
- California Tsunami Hazard Mitigation and Preparedness Program Action Plan
- State Emergency Plan
- Various climate-related publications and guidance (including state sea-level rise guidance updates, Fourth Climate Change Assessment efforts, climate-vulnerable community resources, and regional climate collaborative efforts and resources)

2.3.3 GENERAL PLAN GUIDELINES

A general plan is the local jurisdiction's long-term blueprint and vision for the community's future growth. The State of California General Plan Guidelines produced by the Governor's Office of Planning and Research (OPR) provide direction to local jurisdictions in the preparation of their local general plans while meeting larger state goals.

In August 2017, OPR issued an update to the 2003 General Plan Guidelines. In addition to updating content included in the 2003 version, the 2017 General Plan Guidelines include new sections on healthy communities, equitable and resilient communities, economic development, and climate change, as well as upgrades to the requirements for the general plan safety element. New tools, such as the "General Plan Guidelines Data Mapping Tool" now provided on OPR's website, provide access to data sets and base maps that can be used to prepare maps for hazard mitigation planning. OPR maintains a database on the status of city and county general plans and posts the information. The 2017 General Plan Guidelines help to strengthen mitigation actions by jurisdiction and support the goals of the 2018 SHMP.

Guidance for preparing a general plan is composed of two types of directives. The first directive is to complete the seven required general plan elements (land use, circulation, housing, conservation, open space, noise, and safety). The requirement for consistency between the elements results in integration of policies. This requirement is important for mitigation planning as the safety element findings and policies will influence other elements. The second directive is to include content on climate change and environmental justice within the general plan.

The safety element is the general plan element most closely linked to hazard mitigation. The goal of the safety element is to reduce the potential short- and long-term risk of death, injuries, property damage, and economic and social dislocation resulting from earthquakes, landslides, fires, floods, droughts, climate change, and other hazards. The safety element must identify hazards and hazard abatement provisions and mitigation efforts to guide local decisions related to zoning, subdivisions, and entitlement permits. A jurisdiction's safety element should contain general hazard and risk reduction strategies that complement those of the jurisdiction's Local Hazard Mitigation Plan (LHMP). Ideally, a jurisdiction's LHMP should be incorporated into its safety element in accordance with provisions of Assembly Bill 2140 (2006) (Government Code Section 65302.6).

As noted above, a jurisdiction's general plan elements are required to be consistent such that the jurisdiction must ensure that policies set forth in one element are integrated and aligned with those in other elements. This consistency model applies to hazard mitigation planning as well. While the safety element may be the primary element with the strongest link to hazard mitigation, hazard mitigation planning should be fully integrated into all elements of the general plan and support safety element policies.

2.3.4 LOCAL HAZARD MITIGATION PLANNING

Local hazard mitigation planning and the SHMP are closely linked. LHMPs help to inform the SHMP by providing an assessment of the mitigation policies, programs, and capabilities of local jurisdictions, and the SHMP provides an important contextual overview to support local hazard mitigation planning. For detailed information regarding local hazard mitigation planning integration with the SHMP, see *Chapter 5: California Local Hazard Mitigation Planning*.

2.3.5 SHMP INTEGRATION WITH EMERGENCY MANAGEMENT

The update process recognized that the SHMP plays a fundamental role in comprehensive, integrated emergency management in California. Among other things, it identifies and analyzes the consequences of the risks associated with human-caused and natural hazards, together with vulnerabilities of people and property associated with such risks and mitigation programs devised to lessen their impact. Timely and effective hazard mitigation has multiple benefits that include:

- Minimizing deaths, injuries, and other negative disaster impacts on the public
- Reducing disaster losses to property, facilities, and infrastructure
- Minimizing negative impacts on the environment and economic condition of the state
- Assuring greater continuity of government operations, including continued delivery of services
- Creating conditions by which recovery can happen more quickly and be less costly
- Educating municipal and county governments regarding hazard mitigation options
- Enabling residents and businesses to recover more quickly, reducing the potential that they will leave the affected area and that the community's essential character will be permanently altered
- Raising civic awareness of the hazards and risks to increase preparedness
- Increasing the state's overall adaptive capability and resilience to disasters

The 2018 SHMP identifies these benefits as an integral part of its various chapters, providing detailed evidence of the value of reducing specific hazards, risks, and vulnerabilities to achieve such benefits. Such benefits are reflected in the SHMP goals in *Chapter 3: California's Mitigation Framework: Goals, Objectives, Strategies, and Priorities*, and in the evaluation of hazards and mitigation progress in *Chapters 6 through 9* and the description of California's comprehensive mitigation program management in *Chapter 10*.

Related Emergency Management Plans

The 2018 SHMP serves as a basis for developing and informing a variety of related operational emergency plans by providing a comprehensive assessment of vulnerabilities and risk from natural and human-caused hazards. The following is a partial list of examples of related current Cal OES plans and guidance documents referencing mitigation:

- Bay Area Earthquake Plan (2016)
- California Catastrophic Incident Base Plan: Concept of Operations (in collaboration with FEMA and U.S. Department of Homeland Security) (2008)
- California State Emergency Plan (2017)
- Cascadia Subduction Zone – Earthquake and Tsunami Response Plan (2013)
- Electric Power Disruption Toolkit (2012)
- Northern California Catastrophic Flood Response Plan (2018)
- Oroville Dam Failure Response Plan (pending approval in 2018)
- Safeguarding California: Implementation Action Plans Emergency Management Sector Plan (2016)
- Safeguarding California: 2018 Update (2018)
- Southern California Catastrophic Earthquake Response Plan (2010, update under development)

Various resources are available on the Cal OES website: www.caloes.ca.gov.

The comprehensive hazard mitigation planning process captured in the 2018 SHMP provided an opportunity to integrate hazard mitigation into these other ongoing Cal OES and statewide planning documents and other state planning efforts, including OPR's 2017 update to the General Plan Guidelines.

Accreditation by the Emergency Management Accreditation Program

The 2018 SHMP has been prepared in a manner meeting contemporary nationwide standards for integration of hazard mitigation with other phases of emergency management, including preparedness, response, and recovery.

In 2012, and again in 2017, California's emergency management program was granted full accreditation by the Emergency Management Accreditation Program (EMAP) and formal notification was sent from EMAP to the Governor. EMAP is a voluntary, standards-based, peer-reviewed assessment and accreditation process for government programs throughout the country. Accreditation is a means of demonstrating that a program meets national professional standards for emergency management.

For more information regarding EMAP, visit: https://www.emap.org/.

2.3.6 STATE OF CALIFORNIA EMERGENCY PLAN

As previously mentioned in *Section 2.1, Cal OES SHMP Coordination Role*, the foundation for state agency coordination of hazard mitigation is Governor's Executive Order W-9-91. The State Emergency Plan (SEP) was developed to implement Executive Order W-9-91 and describes how response to natural or human-caused emergencies occurs in California.

California Government Code Section 8569 requires the Governor to coordinate the SEP and any programs necessary to mitigate the effects of an emergency. Executive Order W-9-91 requires the Director of Cal OES to prepare the SEP and submit to the Governor's office for approval. Cal OES is responsible for a broad set of responsibilities addressing all aspects of emergency management, including hazard mitigation and homeland security concerns.

Cal OES has two directorates, one that handles emergency planning, preparedness, and prevention and another that addresses response and recovery. The Response Division, within the Response and Recovery Directorate, includes law enforcement, homeland security, and the State Threat Assessment Center. The Planning, Preparedness, and Prevention Directorate is responsible for updating the SEP and working with stakeholders to coordinate the California emergency support function (CA-ESF) activities.

Cal OES coordinates activities of all state agencies during the preparedness and implementation of the SEP and for response and recovery activities. Administrative orders are agreements between Cal OES and other state agencies or departments that detail activities for each department related to mitigation, preparedness, response, and recovery activities. Periodic updates to administrative orders are coordinated by Cal OES staff. Standard hazard mitigation provisions in the standing administrative order included the following:

- Identify, document, and, when practical, implement those activities that potentially could reduce or lessen the impact of an emergency
- Establish hazard mitigation as an integral element in operations and program delivery, as appropriate
- During a presidential declaration of a major disaster, participate in the hazard mitigation planning process

State of California Emergency Plan Linkage with the SHMP

The SHMP is an important supporting document to the SEP. The SEP defines and describes the fundamental systems, strategies, policies, assumptions, responsibilities, and operational priorities that California uses to guide and support emergency management efforts.

The SEP and the SHMP are closely linked. Section 8 of the SEP identifies mitigation programs as one of the four emergency management phases and Section 8.1 references the role of the SHMP in describing and mitigating hazards, risks, and vulnerabilities, thereby reducing disaster losses. The SEP describes the hazards, risks, and

vulnerabilities giving rise to emergencies in California. However, it formally acknowledges the SHMP as the overriding comprehensive hazard analysis document that it relies upon for detailed hazard, risk, and vulnerability analysis, and other hazard mitigation-related information and programs.

Further, the SEP integrates mitigation planning into pre-event recovery planning. SEP Section 11, Recovery Concept of Operations, includes provisions for both 1) short-term recovery operations, which begin concurrently with or shortly after commencement of response operations; and 2) long-term recovery operations, which focus on community restoration. Depending on the severity and extent of damages, long-term recovery may continue for a number of years. It includes activities necessary both to restore a community to a state of normalcy and to strengthen the community against repetitive losses. According to the SEP, long-term recovery may include reconstruction of infrastructure, community planning, integration of mitigation strategies into recovery efforts, and administration of eligible disaster-related federal grant programs.

Key State of California Emergency Plan Provisions

Essential elements of the SEP include:

- A description of what response and recovery activities are provided by governmental agencies and how resources are mobilized
- An outline of the methods for carrying out emergency operations and the process for rendering mutual aid
- An overview of the system for providing public information
- Emphasis on the need for continuity planning to ensure uninterrupted government operations

The SEP establishes the CA-ESFs as a key component of California's system for all-hazards emergency management. Cal OES initiated the development of the CA-ESFs in cooperation with California's emergency management community including federal, state, tribal, and local governments, public/private partners, and other stakeholders to ensure effective collaboration during all phases of emergency management. The development of the CA-ESFs involves organization of the participating stakeholders and gradual development of emergency function components. (For a complete list of CA-ESFs, see *Section 1.7* of *Annex 1*.)

The CA-ESFs develop functional annexes that follow an established format to describe discipline-specific goals, objectives, operational concepts, capabilities, organizational structures, and related policies and procedures. The functional annexes are developed separately from the basic plan and make reference to existing agency and department plans and procedures. Subsequent supporting plans and procedures that are developed in support of the SEP, such as mutual aid plans, the SHMP, other hazard-specific plans, catastrophic plans, and related procedures, are incorporated by reference and maintained separate from the SEP.

An updated SEP was released in October 2017. To download the SEP from the Cal OES web page, visit: http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/state-of-california-emergency-plan-emergency-support-functions.

2.3.7 MITIGATION EFFORTS AND DISASTER RECOVERY

As discussed in the SEP, the relationship of mitigation and recovery is often evidenced by mitigation activities that are integrated into post-disaster recovery efforts. Pre-disaster mitigation efforts are also significant to post-disaster recovery efforts. Since effective mitigation reduces vulnerability and increases loss avoidance, well-planned mitigation measures have the potential to influence the severity of a disaster and the required efforts to recover from a disaster. Further, the required recovery efforts of agencies, jurisdictions, and the private sector can be influenced and lessened as a result of effective mitigation.

Especially important to the recovery process are volunteers and volunteer organizations. These organizations often fill important gaps in recovery services provided by federal, state, and local response and recovery agencies. California Voluntary Organizations Active in Disaster (VOADs) help to facilitate essential coordination, collaboration,

and communication among private sector organizations during disaster events. The California State VOAD is comprised of two regional VOADs as well as many local VOADs. California's NorCal and SoCal VOADs each strive to include all non-profit organizations, government agencies, and for-profit companies that provide or coordinate disaster-related services in its service area. VOADs enable their members to share information and coordinate the deployment of resources to improve outcomes for people affected by disasters. Effective mitigation can help to ease the burden on agencies, jurisdictions, and VOADs during disaster events.

2.3.8 THE NATIONAL PREPAREDNESS SYSTEM

A national initiative to integrate various prior and ongoing emergency management statutory and administrative directions from Congress and the President is embodied in Presidential Policy Directive 8: National Preparedness (PPD-8) which was released in March 2011. Its goal is to strengthen the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the nation. PPD-8 defines five mission areas—Prevention, Protection, Mitigation, Response, and Recovery—enhancing national preparedness. The National Preparedness System is an amalgamation of various guidance, programs, processes, and systems for the whole community to build fundamental capabilities that help achieve the PPD-8 goal of a "secure and resilient Nation." The five frameworks included in the National Preparedness System are the National Prevention Framework, the National Protection Framework, the National Mitigation Framework, the National Response Framework, and the National Disaster Recovery Framework.

National Mitigation Framework

The National Mitigation Framework builds on the National Preparedness Goal. The National Mitigation Framework sets the strategy and doctrine for building, sustaining, and delivering the core capabilities for mitigation identified in the National Preparedness Goal. This framework considers the full spectrum of threats and hazards, including those that are natural, technological/accidental, and adversarial/human-caused.

The mission areas for the National Mitigation Framework are consistent with those of Threat and Hazard Identification and Risk Assessment (THIRA): prevention, protection, mitigation, response, and recovery. The framework provides the following definitions of the mission areas:

- Prevention: The capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism. As defined by PPD-8, the term "prevention" refers to preventing imminent threats.
- Protection: The capabilities necessary to secure the homeland against acts of terrorism and man-made or natural disasters.
- Mitigation: The capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- Response: The capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- Recovery: The capabilities necessary to assist communities affected by an incident to recover effectively.

This framework establishes a common platform and forum for coordinating and addressing how the nation manages risk through mitigation capabilities. It describes mitigation roles across the whole community.

The National Mitigation Framework is available on FEMA's website: https://www.fema.gov/national-mitigation-framework.

Threat and Hazard Identification and Risk Assessment (THIRA)

The THIRA follows a four-step process, as described in Comprehensive Preparedness Guide (CPG) 201, Second Edition, available on FEMA's website. The State of California THIRA relies on the mitigation analysis contained in the SHMP to complete THIRA Step 1: Identify the Threats and Hazards of Concern and Step 2: Give the Threats and Hazards Context. FEMA requires the State of California to submit its assessment annually through the Unified Reporting Tool (URT).

2.4 INTEGRATION WITH CLIMATE ADAPTATION EFFORTS

Addressing hazards requires viewing hazard mitigation solutions as long-term practices with the goal of reducing harm from hazards. These hazard mitigation actions are constantly evolving and are enhanced by the participation of all levels of government, non-profit organizations, and the public.

Climate adaptation actions as defined by the Intergovernmental Panel on Climate Change (IPCC) are adjustments in natural or human systems that respond to climatic conditions and moderate harm. Both hazard mitigation and climate adaptation actions ultimately move toward the same goal of long-term risk reduction. Integration of hazard mitigation and climate adaptation planning is particularly applicable to those natural hazards influenced by climate change, such as coastal flooding and sea-level rise, extreme heat, wildfire, and drought.

Climate considerations linked to hazard mitigation are also further discussed in *Chapter 4: Profiling California's Setting, Section 4.3* and in the climate and weather-related hazard risk assessments in *Section 9.1*.

2.4.1 CLIMATE CHANGE AND EMERGENCY MANAGEMENT

There is growing global recognition that experts in emergency management and experts in climate science and climate adaptation benefit from collaborative efforts to share approaches, information, goals, viewpoints, and insights.[23] In California, this collaborative work has begun, and the integration of climate impacts into emergency management efforts builds upon strengths and competencies in California's emergency management agencies and departments. The 2007 SHMP was the first SHMP to address climate change, and the topic has been expanded upon in subsequent updates.

Hazard mitigation in the context of a changing climate can take many different forms, including but not limited to:

- Construction of green infrastructure and other protective structures to address sea-level rise
- Managed shoreline retreat
- Enhanced flood warning instrumentation
- Climate risk communication and education[24]
- Forest fire risk reduction through the removal of certain forest vegetation (or "fuels")
- Defensible space clearance around homes and structures to reduce wildfire risk
- Study and management of pest populations and habitat, particularly in forested regions
- Building codes that require use of fire-resistant building materials in areas prone to wildfire risk
- Promotion of sound land use practices
- Urban forestry, urban greening, and cool pavements and roofs to mitigate the urban heat island effect
- Planned heat alerts and networks of neighborhood cooling centers to alleviate heat-related health impacts during extreme heat events
- Use of state-of-the-art materials in new infrastructure to optimize resilience in light of expected climate impacts
- Improving soil health to reduce erosion and flood risk and build resilience

Attention to the timing and spatial dimensions of hazard mitigation efforts is critical in the era of climate change. The following sections detail a variety of state efforts that serve to further the integration of disaster management and climate adaptation.

2.4.2 EMERGENCY MANAGEMENT STEPS IN SAFEGUARDING CALIFORNIA PLAN: 2018 UPDATE

As California's overarching climate adaptation strategy document, the Safeguarding California Plan: 2018 Update identifies emergency management as a key sector-specific policy area due to potential climate change influences on

[23] See e.g. IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea,K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.

[24] Climate risk communication and education can help shape choices that reduce climate risks by reducing exposure and vulnerability.

hazards. Climate change is anticipated to increase and exacerbate hazards, including extreme heat events, sea-level rise, tsunamis, and flooding associated with atmospheric rivers, as well as slower onset changes like rising temperatures, which have additional impacts. The plan emphasizes the linkage of climate change associated risks with hazard mitigation planning and the need for ongoing efforts to incorporate climate change considerations in local hazard mitigation planning and resiliency strategies. The Safeguarding California Plan: 2018 Update makes four specific emergency management sector recommendations that link climate considerations to mitigation. Cal OES is a member of the state's Climate Action Team (CAT), which works to coordinate efforts to implement emissions reduction programs and the state's adaptation strategy. The approach and actions in the Safeguarding California documents are described in *Section 4.3.6.4*.

2.4.3 ADAPTATION PLANNING GUIDE UPDATE AND SENATE BILL 246 CLIMATE CHANGE ADAPTATION

In 2012, Cal OES and the California Natural Resources Agency (CNRA) worked with other stakeholders, with technical support by Cal Poly San Luis Obispo, to develop and release the California Adaptation Planning Guide (APG) to aid local jurisdictions in addressing projected climate change impacts. The APG provides guidance on local climate vulnerability assessment, strategy development, and prioritization. The strategies that emerge from use of the APG can be integrated into a variety of planning documents, including LHMPs.

In 2015, Governor Brown signed Senate Bill 246, which established the Integrated Climate Adaptation and Resiliency Program (ICARP) and required review and update of the APG within a year of each update of the Safeguarding California Plan. This action assures that the state and associated guidance like the APG will continue to reflect the most recent science and projections regarding climate impacts.

The ICARP is designed to develop a cohesive and coordinated response to the impacts of climate change across the state. The program has two components:

- A centralized source of information that provides the resources necessary to assist decision-makers at the state, regional, and local levels when planning for and implementing climate adaptation efforts in California. The clearinghouse is an evolving resource that OPR is updating as new resources and information become available. OPR is collaborating with state agency partners, local and regional governments, and communities across the state to provide relevant and timely resources that advance climate adaptation and resiliency efforts throughout the state.

- The Technical Advisory Council, which brings together local governments, practitioners, scientists, and community leaders to help coordinate activities that better prepare California for the impacts of a changing climate. (Technical Advisory Council members bring expertise in the intersection of climate change and the sector-based areas outlined in Senate Bill 246 [2015] Public Resources Code Section 71358(b).)

2.4.4 GENERAL PLAN GUIDELINES SUPPORTING CLIMATE ADAPTATION

Responding to the threat of climate change, the state has enacted legislation, regulations, and executive orders that put California on the course to achieve robust greenhouse gas reductions while addressing the impacts of a changing climate. General plan updates are now required to address climate adaptation, and statute calls for the use of feasible methods to avoid or minimize climate change impacts associated with new uses of land.

The 2017 General Plan Guidelines update was the first since 2003 and integrates climate adaptation and hazards management through not only the safety element, but throughout the remaining elements of the mandated local government general plan. California communities need to respond to climate change both through policies that promote adaptation and resilience and by significantly reducing greenhouse gas emissions. To this end, the 2017 General Plan Guidelines climate change chapter summarizes how a general plan or climate action plan can be consistent with California Environmental Quality Act (CEQA) Guidelines Section 15183.5(b) (Plans for the Reduction of Greenhouse Gas Emissions). This chapter can also be used to update older plans so they comply with the criteria in Section 15183.5(b) and associated CEQA streamlining opportunities.

The General Plan Guidelines include two general plan preparation directives, the first of which is preparation of seven required general plan elements. The second directive requires the inclusion of content on climate change and environmental justice within the general plan. This information can take the form of a stand-alone element or can be integrated into other general plan elements. Each jurisdiction may determine which form is most appropriate to local needs.

The recent introduction of climate risk to the discussion in the safety element (see discussion of Senate Bill 379 below) adds a focus on longer-term preparation and adaptation by each community to address a changing climate, which also supports and links to other hazard mitigation efforts by the state. The General Plan Guidelines provide a description of the requirements for climate change adaptation that must be addressed in the safety element.

2.4.5 SENATE BILL 379 (2015) – LAND USE: GENERAL PLAN SAFETY ELEMENT

Senate Bill 379 (2015) establishes a state-mandated climate adaptation requirement for the safety element of general plans and further strengthens the safety element's hazard mitigation content by requiring that climate adaptation and resiliency strategies applicable to the jurisdiction be addressed in its next required general plan element update.

This legislation requires that local jurisdictions review and update their general plan safety elements to address climate change. As part of the required update, goals, objectives, and a vulnerability assessment identifying risks resulting from climate change impacts must be prepared. Preparation of climate change-related vulnerability assessments is a key step toward identifying specific mitigation efforts necessary for each jurisdiction to implement in order to address potential impacts from climate change. The legislation requirements are triggered by revision of a community's LHMP (on or after January 2017) or, in the absence of an LHMP, the general plan safety element must be revised by January 2022.

The required safety element in a general plan includes assessment and measures focused on pre-disaster mitigation actions, which are a primary component of LHMP content. Inclusion of climate change concerns in a general plan safety element is a critical step toward integration of climate change into mitigating community risk to hazards exacerbated by climate change.

2.4.6 REGIONAL CLIMATE ADAPTATION COLLABORATIVES

Regional collaboration efforts that support and align with state mitigation and adaptation goals continue to emerge across the state. Working at the regional scale enables local agencies to work together in designing and implementing projects that appropriately respond to landscape-level climate risks and impacts. Regional climate collaboratives also provide a critical platform for knowledge exchange and collaboration to achieve shared goals in a resource-constrained environment.

Alliance of Regional Collaboratives for Climate Adaptation (ARCCA)

The Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), a coalition program of the Local Government Commission, is a network of leading regional collaboratives across California working to build resilience to climate change impacts in their own regions, as well as to support state efforts to advance adaptation research, policymaking, planning, funding, implementation, and monitoring and evaluation efforts. Collectively, ARCCA regional members encompass over 85 percent of the state's population. ARCCA's purpose is to support members' collective and individual climate adaptation efforts by sharing information on best practices and strategies and facilitating collaborative campaigns and projects.

ARCCA's efforts support stronger coordination and integration across sectors, jurisdictions, and all levels of government. Linkages to state mitigation actions are strengthened by ARCCA's relationships with state agencies, including the Governor's Office of Planning and Research (OPR) and the California Natural Resource Agency (CNRA). These collaborations are crucial for linking actions across biophysical areas where coordinated adaptation efforts

are necessary to be effective and to create partnerships that allow for better funding opportunities and efficient use of resources.

ARCCA's core activities are 1) increasing understanding of climate change risks and adaptation approaches, strategies, and best practices by conducting Learning Session webinars for adaptation practitioners, convening informational workshops, and developing educational materials to advance the state's discourse on adaptation policies and practices; 2) facilitating knowledge exchange and coordination across regions and with the state by convening member network meetings to discuss replicable and scalable adaptation strategies, partnering with key state agencies to ensure regional concerns are reflected in state guidance and programs, working with regional collaboratives to seek regional alignment with State goals and approaches, and conducting joint outreach campaigns with regional collaboratives to amplify ARCCA's voice and impact; and 3) advocating for a regional approach to adaptation that appropriately addresses landscape-level climate change impacts and maximizes impact with limited resources by supporting existing regional collaboratives across the state, providing guidance and technical assistance to emerging regional collaboratives, and engaging at a national level to encourage regional collaboration for climate change.

Local governments are mobilizing to create collaborative partnerships that address climate change at a local scale. ARCCA was developed in 2012 to help prepare California's urban centers for the potential impacts of climate change including extreme events such as flooding, heat waves, and sea-level rise. The Los Angeles Regional Collaborative for Climate Adaptation and Sustainability (LARC) and the San Diego Regional Climate Collaborative (SDRCC) are examples of localized efforts to create opportunities to share resources and leverage funding to implement climate adaptation planning. Current ARCCA membership includes the Capital Region Climate Readiness Collaborative (CRCRC), the Central Coast Climate Collaborative (4C), the LARC, the SDRCC, the Sierra Climate Adaptation and Mitigation Partnership (Sierra CAMP), and the North Coast Resource Partnership (NCRP).

These regional collaboratives provide local jurisdictions opportunities for partnering on analysis, implementation, and, in some cases, resources and can also provide collaborative support in identifying policies and coordinating on implementation of this policies. For more information on regional collaboratives, visit the ARRCA website: http://arccacalifornia.org.

Examples of Regional Collaborative Efforts

The Los Angeles Regional Collaborative for Climate Adaptation and Sustainability (LARC) is comprised of local and regional decision-makers in the Los Angeles County region that seeks to bolster efforts addressing climate mitigation and adaptation. One of the first steps taken by the collaborative was development of a county-wide climate action plan titled "*A Greater L.A.: Climate Action Framework*."[25] The plan details a multi-year process to integrate regional and local efforts to ensure a resilient and vibrant future for the region. The LARC serves to connect the various jurisdictions and entities in its region to each other and assure they can learn from, support, and collaborate on the many efforts occurring in the region. For more information about the LARC, visit http://www.laregionalcollaborative.com/.

The Sierra Climate Adaptation and Mitigation Partnership (Sierra CAMP) was formed in 2014 by the Sierra Business Council. It is a public/private, cross-sector partnership in the Sierra Nevada. Sierra CAMP's primary objectives are to educate and engage Sierra stakeholders on climate policy, convene Sierra stakeholders to discuss and vet policy issues, develop and strengthen connections with urban downstream users of Sierra ecosystem services to build a stronger collective voice for investment in Sierra resources, and catalyze on-the-ground climate demonstration projects in the region. Sierra CAMP connects partners throughout the large region by hosting webinars, publishing reports, convening meetings within the region and with urban partners, and supporting member climate initiatives. For more information about Sierra CAMP, visit http://www.sbcsierracamp.org/.

[25] Los Angeles Regional Collaborative for Climate Action and Sustainability. A Greater L.A.: Climate Action Framework. 2016. Retrieved on December 3, 2017 from http://climateaction.la .

The Capital Region Climate Readiness Collaborative (CRCRC) encompasses the greater six-county Sacramento region and has a broad regional membership base representing the public sector, private sector, non-profit organizations, community-based organizations, and academic institutions. The CRCRC has demonstrated success in helping members secure grant funding for adaptation efforts, facilitating coordination and knowledge exchange between members, and convening Quarterly Adaptation Exchanges to highlight new, regionally relevant research, tools, and strategies. The CRCRC also works to engage a variety of sectors and stakeholder groups including elected officials, small businesses, community-based organizations, public health advocates, and more. Following the near-disaster at Oroville Dam, the CRCRC developed a white paper on green infrastructure solutions in partnership with Sierra CAMP. Additionally, the CRCRC will be working across its six-county region to develop a regional heat pollution reduction plan to identify opportunities to mitigate the urban heat island effect in the transportation sector with funding from Caltrans' Senate Bill 1 Adaptation Planning Grant program. For more information about CRCRC, visit http://climatereadiness.info/.

The San Diego Regional Climate Collaborative (SDRCC) is a network for public agencies that serves the San Diego region to share expertise, leverage resources, and advance comprehensive solutions to facilitate climate change planning. Through funding from the National Oceanic and Atmospheric Administration (NOAA), the SDRCC launched the Resilient Coastlines Project for Greater San Diego to support local jurisdictions with planning for coastal flooding and extreme coastal storms. Additionally, the SDRCC is working to develop partnerships between stormwater managers, watershed managers, land use planners, and public works professionals to advance climate-smart stormwater projects as a resilience and community improvement strategy. The collaborative regularly hosts network meetings to facilitate knowledge exchange and collaboration, as well as trainings to build capacity and expertise of public agency staff. For more information about the SDRCC, visit https://www.sdclimatecollaborative.org/.

The North Coast Resource Partnership (NCRP), which has been in existence since 2004, is an innovative, stakeholder-driven collaboration among local government, Tribes, watershed groups, and interested partners in the North Coast region. The region comprises seven counties, tribal lands, major watersheds, and a planning area of 19,390 square miles – representing 12 percent of California's landscape. The NCRP integrates long-term planning and high-quality project implementation in an adaptive management framework, fostering coordination and communication among the region's diverse interests. The NCRP manages the North Coast Integrated Water Management Plan and has provided grants to over 100 implementation projects. For more information about the NCRP, visit: http://www.northcoastresourcepartnership.org/.

The Central Coast Climate Collaborative (4C), which emerged with support from ARCCA (in the form of ongoing guidance and technical assistance) fosters a network of local and regional community leaders throughout six Central Coast counties to address climate change mitigation and adaptation. The collaborative involved representatives from local and regional government, business and agriculture, academia, and diverse community groups to share information and best practices, leverage efforts and resources, and identify critical issues and needs. In 2017 and 2018, 4C received a technical assistance grant from FEMA and the U.S Environmental Protection Agency (EPA) and helped to co-develop a robust framework to guide local and regional agencies in engaging stakeholders, identifying hazards and assets, developing strategies, taking action, and evaluating progress. This workbook was co-developed by FEMA, the EPA, OPR, the Metropolitan Transportation Commission/Association of Bay Area Governments, the City of Mount Shasta, 4C, and BluePoint Planning. For more information about 4C, visit: http://www.centralcoastclimate.org/.

ARCCA is also working with stakeholders in the San Francisco Bay Area to support the formation of a new local government-focused collaborative and will be launching a process to form a collaborative in the Inland Empire in mid- to late-2018.

In 2009, Sonoma County, nine cities, and multiple agencies formed the Regional Climate Protection Authority (RCPA). RCPA coordinates climate protection, resilience, and hazard mitigation efforts across the region and led development of the regional climate action plan, Climate Action 2020 and Beyond. For more information about RCPA, visit: http://rcpa.ca.gov/.

2.5 SHMP REVIEW, EVALUATION, AND IMPLEMENTATION

Because the SHMP is a living document that reflects the state's ongoing hazard mitigation planning and implementation commitment, the process of monitoring, evaluating, and updating the SHMP is critically important to tracking the effectiveness of hazard mitigation in California.

2.5.1 CAL OES SHMP MONITORING AND EVALUATION RESPONSIBILITIES

Cal OES's Hazard Mitigation Planning Division (within the Planning, Preparedness, and Prevention Directorate) monitors implementation of hazard mitigation and progress made toward SHMP goals and objectives, including FEMA approval of Local Hazard Mitigation Plans (LHMPs), advances in hazards knowledge among other state agencies, changes in federal and state legislation, and performance of mitigation projects during hazard events. Other Cal OES Directorates and SHMT stakeholders are responsible for providing updates to the Cal OES Hazard Mitigation Planning Division on mitigation progress that has occurred on natural and/or man-made hazards throughout the state so that it can be captured in the SHMP.

Cal OES also administers the Hazard Mitigation Grant Program (HMGP) and, the Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) programs, through two separate divisions. Additionally, Cal OES shares information on mitigation actions and tracks specific events such as new federally declared disasters.

The primary responsibilities of Cal OES in tracking the implementation of the SHMP are to:

1. Provide ample opportunity for stakeholder involvement in the progress monitoring of the SHMP
2. Work with stakeholders and FEMA annually to ensure that the SHMP continues to meet the required elements of the FEMA State Mitigation Plan Review Guide
3. Coordinate the continued development of the SHMP, including collaboration with the State Hazard Mitigation Team (SHMT), strategic working groups, and other stakeholders
4. Provide outreach and technical assistance, and educate local jurisdictions regarding the SHMP and the development and implementation of local plans
5. Administer FEMA hazard mitigation grant programs, including HMGP, PDM, and FMA

2.5.2 SHMP IMPLEMENTATION AND MAINTENANCE PLAN

Method for Keeping the Plan Current

The SHMP Planning Team has developed a draft SHMP Implementation and Maintenance Plan (IMP) to support and document the state's ongoing mitigation efforts. The draft IMP presents a list of the tracking and maintenance actions that should be undertaken by the SHMP Planning Team (and to a lesser degree by the SHMT) in each of the five years between SHMP approval by FEMA and the subsequent update.

While the Cal OES Hazard Mitigation Planning Division has the primary responsibility to update and maintain the SHMP, these efforts are not possible without the collaborative partnership with numerous stakeholders from local, regional, tribal, state, and federal government agencies; public and private sector organizations; and the residents of California.

Like the SHMP itself, the IMP is also considered a "living document" that will be revised and refined over time to increase its effectiveness in guiding SHMP implementation and maintenance tracking efforts. The SHMP Planning Team continues to further develop tasks set forth in the initial draft IMP document. Lessons learned from the 2018 SHMP update will be reviewed following approval of the 2018 SHMP and incorporated into the IMP.

The IMP is structured to first present an overview five-year implementation schedule. The overview schedule is then followed by detailed discussions of annual tasks that will occur as part of the implementation and maintenance process for each year. Some tasks, such as tracking new climate change policies and supporting adaptation efforts,

are considered "ongoing" and are anticipated to occur each year. Other tasks, such as GIS TAWC meetings to address updates to MyPlan or MyHazards, may only occur in some years.

System for Monitoring Implementation

Activities that support monitoring the SHMP include, but are not limited to, the submittal of periodic reports by agencies involved in implementing projects or actions; and site visits, phone calls, emails, and meetings conducted by Cal OES or other state agencies.

During the development process of the IMP, it was determined that the task of monitoring SHMP implementation can be strengthened. The IMP lays out the maintenance and tracking tasks that should be done on an annual basis for each of the five years between the SHMP update approvals.

Planning Team Priorities

The SHMP Planning Team is developing a list of priority actions to undertake one year, two years, three years, and four years following the 2018 SHMP approval. Priorities for the 2018-to-2023 period include improving documentation and processes for updating data included in the SHMP in order to make the update process for future SHMPs more efficient.

2.5.3 AGENCIES AND STAKEHOLDERS RESPONSIBLE FOR IMPLEMENTATION

As part of the SHMP, the SHMP Planning Team continually uses and updates a State Agency Responsibility Matrix that identifies all relevant state agencies, the agencies' functions, and relevant legislation that contributes to each agency's responsibilities. This matrix can be used as a tool to assess agencies' capacity to support implementation of SHMP goals and objectives. The matrix also links actions to the strategies, goals, and objectives of the SHMP.

The majority of the state agencies listed in the matrix are also participating members of the SHMT, which is an important venue for communication and integration of mitigation actions. The matrix serves as a guide for comprehensive ongoing maintenance of the SHMT roster. The State Agency Responsibility Matrix is included in *Appendix B* of the 2018 SHMP.

2.5.4 REVIEWING PROGRESS ON ACHIEVING MITIGATION GOALS

Agency Progress Tracking

Because California is a large and complex state, much of mitigation progress tracking on specific hazards is done by individual operating state agencies and departments as they track their major plans and successes. An example of a state agency tracking progress is CAL FIRE's Land Use Planning Program which maintains a list of all local jurisdictions that have complied with the requirements of Senate Bill 1241 (2012), which addresses local hazard mitigation planning in State Responsibility Areas and Very High Fire Hazard Severity Zones. For more information about the CAL FIRE program, see *Chapter 3, Section 3.9*, and *Chapter 8, Section 8.1.5.1*.

Strategy Progress Updates and Hazard Mitigation Progress Summaries

During each SHMP five-year update, the SHMP Planning Team, with input from the SHMT, reviews the SHMP strategies and updates the summary of progress for each strategy included in *Chapter 3: California's Mitigation Framework*. The 2018 SHMP update also includes a series of text boxes summarizing specific project implementation progress since adoption of the 2013 SHMP, as well as highlighting best practices. During the SHMP update process each progress summary is reviewed for updates and new hazard mitigation progress summaries are added. This update process provides an opportunity to evaluate progress. (For a list of progress summaries and best practices highlight features, see the indexes following the *Table of Contents*.)

Updates to Multi-Agency Mitigation Action Matrix

During each SHMP update, the SHMP Planning Team systemically reviews the ongoing and new hazard mitigation progress summaries and updates a Multi-Agency Mitigation Action Matrix that lists specific agency programs and their linkage to SHMP goals, objectives, and strategies. This matrix serves as a tracking tool, organizing specific activities under mitigation action categories. See *Appendix C*.

Proposed Annual Tracking under Five-Year SHMP Approval Cycle 2018-2023

Annually, in the first quarter of the fiscal year (July-September), the SHMP Planning Team will hold a meeting of the SHMT to conduct a goals review that considers whether each goal is being addressed. The review will consider whether progress is being made, and if not, which goals and objectives may need further review and possible revision, or whether additional goals should be added. While large revisions to goals will be made annually, the objectives may be assessed and updated annually. Out of these general comments from the overall SHMT, the Goals and Objectives Strategic Working Group will revise or adjust the SHMP objectives.

CHAPTER 3 – CALIFORNIA'S MITIGATION FRAMEWORK: GOALS, OBJECTIVES, STRATEGIES, AND PRIORITIES

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About Chapter 3

This chapter sets forth the vision, mission, goals, and objectives of the 2018 State Hazard Mitigation Plan (SHMP) and discusses a general strategic framework for mitigation, including specific strategies and actions needed for effective implementation, and overall state mitigation priorities.

This chapter also touches on the state's mitigation capabilities and action program, which are further detailed in *Chapter 10*.

3.1 CREATING A STRATEGIC FRAMEWORK FOR MITIGATION

The content of the 2018 SHMP is governed by rules drawn from the Disaster Mitigation Act of 2000 (DMA 2000). Strategic planning elements such as the vision, mission, goals, objectives, and action statements included in the 2018 SHMP represent a direction-setting framework that considers both short-term and long-term outcomes.

The strategic framework for California's comprehensive mitigation program consists of a combination of actions taken by multiple stakeholders over time, including:

- Legislative mandates for state and local agencies to undertake mitigation
- Governor's executive orders requiring state agencies to work with each other and the private sector on mitigation
- Voter approvals of mitigation bond funding
- Updating of single-hazard risk assessments
- Structural and non-structural mitigation actions taken by state agencies
- Regional agency coordination

Since the adoption of the 2013 SHMP, the state's comprehensive mitigation program was strengthened significantly by legislation such as Senate Bill (SB) 379 (2015) which requires cities and counties to include climate adaptation and resiliency strategies in the safety elements of their general plans upon the next revision of their housing elements beginning January 1, 2017.

A three-bill package (SB 1168, Assembly Bill [AB] 1739, and SB 1319 [2014]), known as the Sustainable Groundwater Management Act of 2014, provides for local management of groundwater supplies with the goal of achieving sustainable management of groundwater basins through development and implementation of groundwater sustainability plans (GSPs) by local agencies within 20 years.

During preparation of the 2018 SHMP, the California Governor's Office of Emergency Services (Cal OES) further formalized the state's comprehensive mitigation program through other means described in this document.

A sustained effort is being made to build on this comprehensive framework by examining and clarifying the SHMP's vision, mission, goals, objectives, strategies, priorities, and action programs. Challenges continue to include systematically measuring and tracking mitigation progress, expanding public and private sector mitigation communications and knowledge sharing, integrating land use mitigation with other types of mitigation on a statewide basis, and assessing mitigation projects (completed prior to a disaster) after the event to establish a record of the effectiveness.

3.2 VISION AND MISSION

As noted in *Chapter 1: Introduction*, the vision of the 2018 SHMP is a safe and resilient California through hazard mitigation. The mission of the 2018 SHMP is to integrate current laws and programs into a comprehensive, multi-hazard mitigation system that will guide the state in significantly reducing potential casualties and damage as well as physical, social, economic, and environmental disruption from natural and human-caused disasters.

3.3 2018 SHMP GOALS AND OBJECTIVES

The updated goals of the 2018 SHMP are to:

1. *Significantly reduce life loss and injuries.*
2. *Minimize damage to structures and property, and minimize interruption of essential services and activities.*
3. *Protect the environment.*
4. *Promote community resilience through integration of hazard mitigation with public policy and standard business practices.*

As part of the 2018 SHMP update process, the 2013 SHMP goals were evaluated by the Goals and Objectives Strategic Working Group and determined to be effective as previously written, with the exception of Goal 4, which was slightly modified to add the phrase "community resilience."

Most 2018 objectives have been modified from the 2013 SHMP version. Generally, the 2018 objectives either 1) contain original language from a 2013 SHMP objective, 2) contain modified language from a 2013 SHMP objective, or 3) are a new objective. A parenthetical note after each objective indicates whether the language is unchanged, modified, or new. Modifications range from simple addition or deletion of words to complex new combinations of phrases. Modified objectives accompany their original 2013 SHMP goal unless otherwise stated in the parenthetical note.

The aim of the Working Group's modifications to the 2013 SHMP objectives was to clarify or expand on their intent, or, in a few cases, to shift them to a more applicable goal.

As used here, the term "goal" refers to an end toward which effort is directed. An objective is a direction for action intended to partially or fully meet that end.

Because of the vast scale of the undertaking of this statewide multi-hazard mitigation planning framework, it is difficult to express an objective in definitive and specific terms. Within this planning context, each SHMP objective is intended to generally describe the framework of actions that can help fulfill the stated goal over time.

Also, it is important to note that fulfillment of each goal depends on upon successful execution of all objectives working in concert. Thus, the numbering of the objectives under each goal does *not indicate their relative importance or applicability*. The objectives are interrelated rather than linear in their relationship, and therefore, no hierarchy or ranking of objectives is implied from their sequencing as presented following each goal.

The sections below detail each of the four hazard mitigation goals and their related groups of objectives.

3.3.1 REDUCING LIFE LOSS AND INJURIES

California is the most populous state in the country with nearly 40 million residents (as of 2018) and has the third largest land area. The sheer number and broad distribution of people make hazard mitigation and emergency management a challenge. *Chapter 4: Profiling California's Setting* identifies growth patterns and assesses variations in risk exposure for all 58 counties.

Flooding has historically been heavy in urbanizing portions of the Central Valley, as well as in Southern California where extensive development has contributed to high volumes of local storm water runoff. Devastating wildfires have been experienced in wildland-urban interface (WUI) areas in the mountainous regions of many counties.

Between 1950 and 2017, California's population more than tripled and the number of disasters grew steadily. It is noteworthy, that the number of deaths did not increase proportionately in relation to population growth (see *Chapter 4, Section 4.2.1*). This can be attributed in part to expanded and sustained mitigation efforts.

As explained in detail in Chapter 4, California's population is concentrated in areas where hazard risk exposure tends to be high. For example, large earthquakes have occurred in both the San Francisco Bay Area and Southern California. Thus, the need for sustained, coordinated hazard mitigation efforts is significant.

California's continues to maintain a strong commitment to minimizing life loss and casualties. Between 2013 and 2018, most fatalities were a result of wildfire/WUI. Until 2017, the fatalities from fires were fewer than six per year. In 2017 alone, there were 67 fatalities due to wildfires. There was only one fatality resulting from an earthquake event between 2013 and May 2018.

There remains a need to more accurately estimate actual life loss, injuries, and property losses avoided through mitigation strategy.

Goal 1: Significantly reduce life loss and injuries.

This goal remains the same as in the 2010 and 2013 SHMPs, with the intended result of reducing potential casualties from disasters through long-term changes that make places and buildings within communities safer through mitigation investments and actions.

The corresponding objectives were substantially revised by the Goals and Objectives Strategic Working Group. As noted above, changes are described in the parenthetical note at the end of each objective.

Objective 1: Improve understanding within all governmental levels, the private sector, and individuals, of the locations, potential and cumulative impacts, and linkages among threats, hazards, risks, and vulnerability; as well as measures needed to protect human life, health, and safety, including those of vulnerable populations. (*Modified*)

Objective 2: Ensure that hazard mitigation measures and allocation of mitigation funds are protective of the state's low-income, underserved, linguistically isolated, minority, access and functional needs, and other highly vulnerable populations so that hazards do not have a disproportionately negative impact on those populations, and improve coordination with those populations to ensure that hazard, risks, and preparedness options are well understood. (*New*)

Objective 3: At all levels of government, promote enforcement of relevant mandates that significantly prevent and reduce life loss and injuries and provide guidance for enabling implementation. (*Modified*)

Objective 4: Encourage the incorporation of mitigation measures into changes in the built environment especially in areas at substantial hazard risk, and strengthen community resilience under present and anticipated future conditions. (*Modified*)

Objective 5: Research, develop, and promote adoption of cost-effective building, land use, and development laws, regulations, and ordinances that exceed current minimum levels needed for life safety and that anticipate future conditions. (*Modified*)

3.3.2 MINIMIZING PHYSICAL DAMAGE AND SERVICE INTERRUPTIONS

Strengthening of laws, regulations, and ordinances applicable to construction of new buildings and facilities and retrofitting of existing buildings and facilities (for government, business, or residence) is critical to protection of property as well as life. Such efforts are also critical to the reduction of massive physical, social, and economic disruption that accompanies disasters.

Transportation routes, utilities, government facilities, and hospitals are essential to the state's ability to provide assistance to the people of California. Protection of property also includes preservation of vital records, valuable operational data, historical information, and other non-structural assets. SHMP stakeholders have encouraged the incorporation of mitigation activities into business and government operations plans.

Regulations and ordinances help communities design and construct new facilities or alter existing facilities to resist the forces of nature and ensure safety. The state's land use laws support this effort by helping to keep buildings and development out of the most hazardous areas through local land use planning. It is essential that mitigation planning be incorporated into all land use planning activities at local and state levels.

Setting priorities for retrofitting of vital infrastructure and lifelines (on the basis of both overall risk and the role of facilities in post-disaster response and recovery) can result in better protection of important buildings and informational records—as well as building occupants—from disaster losses, thus facilitating faster recovery.

It is important to minimize the dislocations of residents of a community affected by a disaster event. Retaining residents close to their place of home and work is a vital aspect of strengthening community resilience. By minimizing damage to the built environment and essential services, rapid resumption of functionality and commerce can occur, which will reduce the chances that residents and businesses will leave the area affected by a disaster.

The state has a responsibility to assess vulnerability of state-owned facilities and infrastructure. Local government can also take a similar approach to evaluate vulnerability of its community's vital infrastructure.

Goal 2: Minimize damage to structures and property, and minimize interruption of essential services and activities.

This goal remains the same as in the 2013 SHMP. It includes structures as an important aspect of both life safety and property damage and reflects the desired outcome of minimizing interruption of essential services and facilities (e.g., transportation, communication, power, gas, water, wastewater, emergency responders) as well as normal day-to-day activities following a disaster event.

The corresponding objectives were substantially revised by the Goals and Objectives Strategic Working Group. As noted above, changes are described in the parenthetical note at the end of each objective.

Objective 1: Encourage new development to occur in locations that avoid or minimize exposure to current and future hazards. (*Modified*)

Objective 2: Encourage adaptive property modifications or protection measures as well as relocation options for all built environments, including structures, infrastructure, and lifelines, located in current, and projected future hazard areas. (*Modified*)

Objective 3: Encourage the incorporation of mitigation measures into system-wide repairs, major alterations, new development, and redevelopment practices, especially in areas subject to substantial current and future anticipated hazard risk. *(Modified, moved from 2013 SHMP Goal 1)*

Objective 4: Reduce repetitive property losses due to flood, fire, and earthquake by updating land use, design, and construction policies. *(Unchanged 2013 SHMP language)*

Objective 5: Establish and maintain partnerships among all levels of government, private sector, community groups, and institutions of higher learning that improve and implement methods to protect property, lifelines, and essential services. (*Modified*)

Objective 6: Support the protection/redundancy of vital records, the strengthening or replacement of buildings and infrastructure, and the protection/redundancy of lifelines to minimize post-disaster disruption and to facilitate short-term recovery and strengthen long-term recovery. (*Modified*)

3.3.3 PROTECTING THE ENVIRONMENT

Californians place a strong emphasis on the quality of the natural environment. It is one of the reasons why people live in California and why government and private sector organizations strive to protect and conserve natural resources.

In addition to destroying the human-made environment, natural disasters can also adversely affect the natural environment. For example, dead and diseased trees create unhealthy forests and provide fuel for wildfires that damage or eliminate habitat necessary for survival of plants and wildlife. Flooding can adversely affect water quality in rivers and streams that support fisheries and can also damage critical spawning habitat. Structures collapsing in an earthquake can cause widespread water and air pollution, similar to that experienced following the New York terrorist attacks and the Northridge Earthquake. Geologic hazards can result in landslides that can block streams and prevent fish migration. If not disposed of properly, debris from natural disasters can pollute the water, damage the land, and diminish air quality.

Since adoption of the 2013 SHMP, greater understanding has been gained about the scientific finding that human-induced global warming from greenhouse gas emissions is creating climate change impacts leading to increased frequencies and magnitudes of natural disasters. Starting with Assembly Bill (AB) 32 in 2006, and more recently with Senate Bill (SB) 32 in 2016, the State of California has pursued a vigorous policy encouraging the reduction of greenhouse gas emissions, especially carbon dioxide (CO_2) into the atmosphere. The state is also promoting various climate change adaptation efforts including California's Fourth Climate Change Assessment, the State Adaptation Clearinghouse, Safeguarding California, the 2018 update to the Climate Adaptation Strategy (CAS), and adaptation legislation such as SB 379 and SB 246 (see *Section 4.3.6.2* for more information on these bills).

Goal 3: Protect the environment.

This goal remains the same as in the 2010 and 2013 SHMPs. The corresponding objectives were substantially revised by the Goals and Objectives Strategic Working Group. As noted above, changes are described in the parenthetical note at the end of each objective.

Objective 1: Provide guidance to all levels of government about mitigation planning and project compliance with the California Environmental Quality Act (CEQA) and all other applicable environmental laws, and facilitate alignment of federal and state regulations across agencies to strengthen mitigation, response, and recovery efforts. *(Modified)*

Objective 2: Encourage hazard mitigation measures that promote and enhance nature-based solutions, natural processes, and ecosystem benefits while minimizing adverse impacts to the environment. *(Modified)*

Objective 3: Encourage mitigation planning programs at all levels of government to protect the environment and promote enforcement of sustainable mitigation actions. *(Modified)*

Objective 4: Coordinate and implement integrated and adaptive hazard mitigation, and watershed and habitat protection strategies, through public and private partnerships. *(Modified)*

Objective 5*:* Coordinate hazard mitigation planning with state and federal programs designed to minimize the release and movement of toxic and hazardous substances in the environment. *(Unchanged 2013 SHMP language)*

3.3.4 PROMOTING INTEGRATED MITIGATION POLICY

Historically, the state and its communities have tended to implement hazard mitigation policies and measures in an ad hoc fashion. New mitigation policies, programs, and projects are often developed in response to the latest disaster. As the population of the state has continued to grow and move into areas more susceptible to natural and human-caused hazards, developing and maintaining a comprehensive hazard mitigation system is becoming more of an imperative. Planning, cross-sector communication, and public outreach are tools for increasing awareness and integration.

State and local multi-hazard mitigation planning efforts and projects represent significant steps that can broaden the general understanding of the importance of mitigation. California laws requiring local general plan safety elements guiding safer land use have proven useful in reducing disaster losses (and all elements of a general plan, whether mandatory or optional, must be consistent with one another). It will take time to document successful compliance with evolving hazard mitigation planning processes. The state has had success with education through programs addressing the three primary natural hazards: wildfire, flood, and earthquakes. Cal OES, the California Seismic Safety Commission, the California Geological Survey, the California Department of Forestry and Fire Protection (CAL FIRE), the Department of Water Resources, and the Department of Education support special programs in schools and communities to raise hazard awareness.

Similarly, many California businesses have begun to pursue hazard mitigation as a standard practice to minimize long-term losses and costs by avoiding business interruption and potential loss of skilled employees. Major companies go beyond insurance to systematically pursue risk management activities such as investments in new facility expansions designed to reduce the impacts of natural hazards. Risk management activities also extend into preparedness to safeguard the health, security, and well-being of employees during disaster incidents.

Goal 4: Promote community resilience through integration of hazard mitigation with public policy and standard business practices.

This goal has been modified from the 2013 SHMP version to support promotion of community resilience and integration of mitigation into policy and practice. The restructuring of this sentence implies that community resilience can result from hazard mitigation actions. It further emphasizes the need for hazard mitigation efforts to be grounded in policy and practice, so in a sense those efforts become a way of life.

The corresponding objectives were substantially revised by the Goals and Objectives Strategic Working Group. As noted above, changes are described in the parenthetical note at the end of each objective.

Objective 1: Create incentives for community resilience through preparation, adoption, and implementation of multi-hazard mitigation plans and projects at all governmental levels. *(New)*

Objective 2: Acknowledge, incorporate, and integrate recognized data on climate change impacts on hazards, risks, and vulnerabilities available from credible scientific sources into state, local, tribal, and private sector mitigation plans, strategies, and actions. *(New)*

Objective 3: Promote, coordinate, and implement hazard mitigation plans and projects that are consistent with and supportive of climate action and adaptation goals, policies, and programs at all governmental levels. *(Modified, moved from 2013 SHMP Goal 3)*

Objective 4: Improve the quality and effectiveness of regional, local, and tribal hazard mitigation plans through effective training and guidance that strengthens linkages between these plans, local general plan

elements, local coastal programs, other local plan initiatives, related land use controls, and the SHMP. *(Modified)*

Objective 5: Engage a broad range of stakeholders, from different sectors and community groups, in hazard mitigation planning processes to improve cross sector-coordination, and emphasize engagement with underserved or vulnerable populations and other underrepresented groups, to ensure that social equity and environmental justice issues are integrated into hazard mitigation planning. *(New)*

Objective 6: Actively promote coordinated hazard mitigation planning and action, disaster preparedness, response, and recovery programs among governmental jurisdictions at all levels, as well as in the private sector, to create resilient communities. (*Modified*)

Objective 7: Develop and share updated information about threats, hazards, vulnerabilities, risks, and mitigation strategies with public and private agencies and groups and build on FEMA's "Whole Community" concept. *(Modified, moved from 2013 SHMP Goal 1)*

Objective 8: Create financial and regulatory incentives to motivate stakeholders, such as homeowners, private sector businesses, and non-profit community organizations, to mitigate and avoid hazards, and encourage new development to avoid hazardous locations and employ enhanced design requirements. (*Modified*)

For an overview of implementation of mitigation goals and objectives see *Appendix C, Multi-Agency Mitigation Action Matrix*.

3.4 TYPES OF STATE MITIGATION STRATEGIES

Strategies for mitigating hazards can be viewed from two perspectives. One is to view mitigation strategies as either direct or indirect. The other is to view them as either mandatory or voluntary.

3.4.1 DIRECT VS. INDIRECT STRATEGIES

Direct strategies are those directly protecting life, property, and the environment, such as physical measures to improve survivability of structures, and design of structures during initial development or through a retrofit process to resist destructive forces. Examples include:

- Bolting walls to foundations to better withstand earthquakes
- Elevating houses to reduce impacts of flooding
- Using asphalt and clay tile roofing to reduce ignition from windblown embers

Indirect mitigation strategies are those that do not make physical changes but facilitate direct mitigation actions by others. They include education, public information, community outreach, and safety campaigns that motivate self-help action.

3.4.2 MANDATORY VS. VOLUNTARY STRATEGIES

A more straightforward perspective is represented by viewing mitigation strategies as either mandatory or voluntary. Mandatory strategies bear two types of cost: the direct cost of implementation and the cost of enforcement. To justify a mandatory strategy, the cost of implementation should be less than the cost of potential losses avoided. The additional cost of public enforcement is necessary to ensure uniform compliance and requires staffing and budgets.

Examples of Mandatory Strategies

Mandatory strategies include statutes and ordinances stimulating uniform mitigation action. Examples of mandatory strategies include:

- *State mandates.*
- *Local and tribal regulations and ordinances linked to an identified hazard.* Examples include fire prevention building codes that require specific roof materials or brush clearance specifications that are required and enforced by a jurisdiction.
- *Restrictions on property use*. These limit or avoid development on hazardous land. Examples include restrictions on building across active faults, on landslide areas, or in floodways.

The essential outcome of mandatory mitigation is general compliance with zoning ordinances or building codes for new development or alterations to existing buildings. Because codes, regulations, ordinances, and their reflected standards are upgraded over time, older facilities in compliance with regulations at the time of construction may no longer be considered reliably safe. Property owners, builders, investors, and other stakeholders cannot choose whether or not to comply.

Examples of Voluntary Strategies

Voluntary strategies are mitigation actions that individuals, businesses, and local and tribal governments choose to take with the intent of reducing future disaster losses to homes and facilities. Examples of voluntary mitigation actions might include retrofitting existing business facilities or investing in improved building designs for new facilities. Strategies encouraging individuals, businesses, and local and tribal governments to take voluntary mitigation actions might include:

- *Publications of advisory plans and technical manuals.* An example might be the "How To" Guides published by the Federal Emergency Management Agency (FEMA) to assist local and tribal governments in Local Hazard Mitigation Plan (LHMP) preparation.
- *Education and awareness programs.* These are intended to persuade people to voluntarily change their behavior to reduce chances of loss and can either have targeted or general audiences.
- *Research and development.* These are efforts supported by either public or private funding that improve knowledge of hazards, vulnerabilities, and mitigation.
- *Construction of protective measures.* These are usually tax-supported and keep destructive forces away from communities or structures. Examples include levees, drainage channels, and firebreaks.

Frequency of disaster loss intervals can be a motivating factor for voluntary mitigation. Property and business owners are more likely to invest in mitigation for frequently recurring disasters such as intermittent flooding or wildland-urban interface (WUI) fire than mitigation for more damaging but infrequently occurring disasters such as earthquakes. Earthquakes provide a less imminent reminder of the value of mitigation, leading stakeholders to postpone mitigation investments in hopes that such disasters will not happen in their lifetime or ownership tenure.

Evaluating Mandatory and Voluntary Strategies

Evaluation of mandatory and voluntary strategies is needed to determine their relative effectiveness over time. Evidence to date suggests that outcomes of discretionary mitigation strategies are less certain. Cost can be a deterrent when revenue sources are insufficient or when the potential loss reduction benefit is not recognized by stakeholders making mitigation decisions.

Need for Combined Approach

Ultimately, a combination of mandatory and voluntary mitigation strategies is needed to bring about substantial changes in physical environments to reduce future disaster losses. This theme is demonstrated throughout the rest of this SHMP in relation to the legal, policy, and institutional framework identified in *Annex 1*, the funding sources identified in *Annex 2*, and the criteria emphasized in *Chapter 10*.

3.5 OVERVIEW OF STRATEGIES FOR IMPLEMENTING STATE-LOCAL MITIGATION CAPABILITIES

The 2018 SHMP includes vision, mission, goals, and objectives statements within a broader strategic framework that identifies the basis for setting mitigation priorities and using state, local, and tribal capabilities to achieve outcomes that are consistent.

The 2018 SHMP maintains and provides for continued progress with the following revised and updated strategies that build on key strategies for hazard mitigation action established by the 2007, 2010, and 2013 SHMPs:

1. Support legislative efforts that formalize California's comprehensive mitigation program
2. Strengthen inter-agency coordination actions, including state, regional, tribal, and local linkages
3. Broaden public and private sector mitigation linkages
4. Assist local and tribal governments in implementing land use guidance and best practices for reducing vulnerability within high hazard zones. *(new in the 2018 SHMP)*
5. Incorporate climate change into local, tribal, regional, and statewide hazard profiles, risk assessments, and mitigation plans *(new in the 2018 SHMP)*
6. Enhance collaboration on the development and sharing of data systems and Geographic Information Systems (GIS) modeling
7. Support and coordinate monitoring of progress on state goals and objectives
8. Establish a mitigation registry for communicating progress
9. Expand mitigation project loss avoidance tracking through the State Mitigation Assessment Review Team (SMART) system

Mutually Reinforcing Strategies

These strategies define the intent of the State Hazard Mitigation Team (SHMT) to support implementation of the SHMP goals and objectives by defining specific areas where SHMT members can facilitate action by their agency or organization.

These strategies are overlapping and cross-cutting through various levels of government and other sectors. Like the SHMP goals and objectives, mitigation actions may meet the intent of more than one strategy simultaneously. Note that the numbering of the 2018 SHMP strategies has been slightly reorganized to better group similar strategies. As with the SHMP objectives, because the strategies are viewed as interrelated, there is no hierarchy or ranking of strategies implied from their numbering as presented.

Along with specific mitigation actions identified in *Chapters 6 through 9*, mitigation progress descriptions included in the *Appendix C: Multi-Agency Mitigation Action Matrix* document implementation of these strategies through the many mitigation actions and specific activities occurring around the state as of early 2018. *Appendix C* also links these actions back to the SHMP goals and objectives and identifies agency collaboration.

The following is a progress description for the nine strategies for action.

3.6 CALIFORNIA STATE STRATEGY 1: SUPPORT LEGISLATIVE EFFORTS THAT FORMALIZE CALIFORNIA'S COMPREHENSIVE MITIGATION PROGRAM

The framework for California's comprehensive mitigation program consists of a combination of legislative and administrative initiatives and actions taken by multiple stakeholders over time. These include:

- Executive orders requiring state agencies to work with each other and with the private sector on mitigation
- Legislative mandates directing state and local agencies and tribal governments to plan and undertake mitigation
- Voter approvals of major mitigation funding through bond elections
- Ongoing updating of risk assessments through all hazard mitigation plans
- Structural and non-structural mitigation actions taken by state agencies and commissions

- Regional agency coordination

California's hazard mitigation laws, regulations, and administrative actions are, in turn, founded in California legislative actions that provide the basic authorities underlying a wide array of state, local, and tribal hazard mitigation policies and actions. The scope of California legislative actions over the past decade has broadened significantly to reflect a more comprehensive mitigation approach, encompassing an increasingly wide variety of activities and impacts. Broad themes emerging through this legislation include flood and fire hazard mitigation, climate change impacts, groundwater management, and environmental justice.

SHMT members carry out roles enabling them both to receive guidance from and provide guidance to lawmakers or executive level agency leaders regarding California's legislative initiatives. During such interactions, SHMT members can educate others on the need for increased and coordinated hazard mitigation efforts that take into account potential future conditions. Particularly, such input ensures awareness of and collaboration with related hazard mitigation projects and local and tribal hazard mitigation planning.

Examples of legislative initiatives enacted by the state legislature enhancing local hazard mitigation capabilities and actions during the past decade include:

- Assembly Bill 2140 (2006) coordinating Local Hazard Mitigation Plans (LHMPs) with local general plans
- Assembly Bill 162 (2007) requiring local general plan elements, including land use, housing, conservation, and safety, to address areas subject to flooding as identified by FEMA flood zone maps
- Senate Bill 5 (2007) requiring local land use decisions consistent with the Central Valley Flood Protection Plan
- Senate Bill 1278 (2012) requiring local governments in the Central Valley to amend general plans in accordance with the Central Valley Flood Protection Plan
- Assembly Bill 1241 (2012) requiring the safety element of the general plan to address the risk of fire in State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs) as identified by CAL FIRE, upon the next required revision of the general plan housing element
- Senate Bill 1168, Assembly 1739, and Senate Bill 1319 (2014), also collectively known as the Sustainable Groundwater Management Act, establishing a new structure for managing California's groundwater resources at a local level by local agencies, and requiring the formation of locally controlled groundwater sustainability agencies (GSAs) in the state's high- and medium-priority groundwater basins
- Senate Bill 379 (2015) requiring safety elements to include climate change assessments and strategies or allowing for jurisdictions to include relevant climate change information into their Local Hazard Mitigation Plan (LHMP) and then adopt the LHMP into the safety element of their general plan
- Senate Bill 246 (2015) establishing the Integrated Climate Adaptation and Resiliency Program (ICARP) to coordinate regional and local efforts with state climate adaptation strategies to adapt to the impacts of climate change
- Senate Bill 1000 (2016) adding an environmental justice element, or related goals, policies, and objectives integrated in other elements, identifying disadvantaged communities within the area covered by the general plan, if the city or county has a disadvantaged community as defined

Further descriptions of these bills are included below and in *Chapters 6 through 9*.

Flood Hazard Legislation

A critically important legislative theme that emerged during the past decade dealt with flood hazard mitigation at multiple geographic levels. Legislation was adopted that set standards for all cities and counties within the state through strengthening of flood mitigation provisions in general plans, while simultaneously specifying flood mitigation requirements for specific areas of the Central Valley.

For example, AB 162 (2007) not only required local general plan land use, housing, conservation, and safety elements to address areas subject to flooding identified by federal and state flood zone maps, but also included flood mitigation provisions for cities and counties in a specific area within the boundaries of the Sacramento-San Joaquin Drainage District. These provisions were included in conjunction with related provisions in companion bill SB 5

(2007), which sought to address problems of flooding in the Central Valley by directing the California Department of Water Resources (DWR) and the Central Valley Flood Protection Board to prepare and adopt a Central Valley Flood Protection Plan (CVFPP). The purpose of the CVFPP was to improve flood management in areas receiving flood protection from existing facilities constructed under the State Plan of Flood Control.

SB 5 (2007) mandated that cities and counties within the boundaries of the Central Valley Flood Protection District amend their general plans and zoning to be consistent with the CVFPP prepared by the Central Valley Flood Protection Board, and to deny subdivisions within flood hazard zones where flood protection is not provided or planned. Another bill, AB 70, provided generally that following the failure of a state flood control project, a city or county may be required to assume a fair and reasonable share of the increased flood liability caused by its unreasonable approval of developments.

Progress Summary 3.A: Regional Flood Management Planning

Progress as of 2018: Following the Central Valley Flood Protection Board adoption of the 2012 Central Valley Flood Protection Plan (CVFPP), the California Department of Water Resources (DWR) launched and funded a regionally led effort to help local agencies develop comprehensive plans that describe local flood management priorities, challenges, and potential funding mechanisms, and define site-specific improvement needs.

Six Regional Flood Management Plans (RFMPs) were completed for regions in the Central Valley by 2015 and subsequently reviewed by DWR in support of the development of the 2017 update of the CVFPP. Each RFMP addressed operations, maintenance, repair, rehabilitation, and replacement (OMRR&R), infrastructure performance, emergency management, governance, environmental compliance, regional priorities, and funding.

Together, the six RFMPs identified over 500 management actions totaling an approximate cost of $14 billion throughout the Central Valley. Despite being restricted to using existing information without new analyses or investigations, the RFMPs represent the most comprehensive thinking about local flood management challenges and opportunities and illustrate a breadth of potential flood management investments.

For more information, visit: https://www.water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan.

Related Delta Environmental Legislation

In November 2009, California legislation known as the Delta Reform Act was passed to address water supply reliability and Delta ecosystem health. The act, effective February 3, 2010, culminated in the creation of the Delta Stewardship Council (DSC) to achieve the state-mandated coequal goals for the Delta. The DSC's coequal goals are 1) providing a more reliable water supply for the state, and 2) protecting, restoring, and enhancing the Delta ecosystem.

Progress Summary 3.B: The Delta Stewardship Council and the Delta Levees Investment Strategy

Progress as of 2018: To facilitate investments in the levee system while advancing progress toward its coequal goals, the Delta Stewardship Council (DSC) has launched the Delta Levees Investment Strategy (DLIS) to identify funding priorities and assemble a comprehensive investment strategy for the delta levees. The DLIS is being developed in collaboration with state agencies, local reclamation districts, Delta landowners, businesses, and other stakeholders.

For more information on the DSC, visit: http://deltacouncil.ca.gov. For more information on the DLIS, visit: http://deltacouncil.ca.gov/delta-levees-investment-strategy.

Fire Hazard Legislation

An example of recent legislation addressing fire hazard is Senate Bill (SB) 1241 (2012), which requires certain actions by local governments in State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs). For more information about SB 1241 (2012), see *Section 3.9* and *Chapter 8, Section 8.1.5.1*.

Climate Change Legislation

Climate change legislation is a major new area of interest brought about by increasing scientific evidence of the cumulative impacts of climate change and public policy focus on implications for natural hazard mitigation. Climate change was first noted as a concern for hazard mitigation in the 2007 SHMP. Subsequently, the 2010 and 2013 SHMPs elaborated on emerging climate change science related to hazards. However, specific strategies for mitigating hazards exacerbated by climate change are rapidly emerging on a legislative level.

The Integrated Climate Adaptation and Resiliency Program (ICARP), authorized by SB 246 (2015), is administered by the Governor's Office of Planning and Research (OPR), which has responsibility under SB 246 (2015) to:

- Develop tools and guidance
- Promote and coordinate state agency support for local and regional efforts
- Inform state-led programs to better reflect the goals, efforts, and challenges faced by local and regional agencies
- Coordinate with Cal OES on updates to the State Adaptation Planning Guide
- Create a Technical Advisory Council and Clearinghouse to support the goals of ICARP

Progress Summary 3.C: Ongoing Progress on Integrated Climate Adaptation and Resiliency Program (ICARP)

Progress as of 2018: In 2015, Governor Brown signed Senate Bill 246 (Wieckowski, Public Resources Code 71354), which directs the Governor's Office of Planning and Research (OPR) to form the Integrated Climate Adaptation and Resiliency Program (ICARP). ICARP is designed to develop a cohesive and coordinated response to the impacts of climate change across the state. Through its activities, ICARP will develop holistic strategies to coordinate climate activities at the state, regional and local levels, while advancing social equity.

ICARP has two components: the State Adaptation Clearinghouse and the Technical Advisory Council (TAC). The State Adaptation Clearinghouse is a centralized source of information and resources to assist decision makers at the state, regional, and local levels when planning for and implementing climate adaptation projects to promote resiliency across California.

The TAC brings together local government, practitioners, scientists, and community leaders to help coordinate activities that better prepare California for the impacts of a changing climate. (TAC members bring expertise in the intersection of climate change and the sector-based areas outlined in SB [246 Public Resources Code 71358(b)].) The TAC supports OPR in its goal to facilitate coordination among state, regional and local adaptation, and resiliency efforts, with a focus on opportunities to support local implementation actions that improve the quality of life for present and future generations. *(Adapted from OPR website retrieved January 2018.)*

The TAC adopted an adaptation vision and principles document in September 2017 and is now working to develop a series of public sector adaptation actions and metrics. ICARP TAC action items/goals for 2018 include:

- *Launch the Adaptation Clearinghouse*: The Adaptation Clearinghouse is a searchable database of adaptation and resilience resources that have been organized by climate impact, topic, and region. OPR began conducting beta testing on the Clearinghouse in early 2018, with a full public launch of the site planned for later 2018. The Clearinghouse is considered an evolving resource and will be updated regularly by OPR, providing practitioners across the state with the most up-to-date adaptation and resiliency resources. Please email ICARP@opr.ca.gov with information on any resources that should be included in the clearinghouse.

- *Finalize the Adaptation Vision Framework*: The ICARP Technical Advisory Council is continuing its effort to develop an Adaptation Vision Framework. The Vision Framework is intended to serve as a blueprint for climate adaptation and resiliency efforts in California by articulating a clear vision of the future we want, the principles that will guide how we get there, and the public sector actions that need to be taken. The Council finalized and adopted a Vision Statement and Guiding Principles in September 2017 (available here: http://opr.ca.gov/planning/icarp/tac/) and is continuing efforts to identify ambitious, yet achievable public sector implementation actions. OPR and the TAC are working to finalize this Vision Framework, including a 2018 Baseline Report on existing adaptation efforts, in late 2018.
- *Release an Adaptation Financing Framework*: OPR, with guidance from the ICARP TAC, is developing an Adaptation Financing Framework for public release in late 2018. At the direction of the ICARP TAC, financing and funding barriers are significant impediments to both planning and implementation of adaptation actions in California. One of the key challenges faced by local government practitioners is a lack of capacity to leverage the existing landscape of funding and financing mechanisms to achieve adaptation and resiliency outcomes. The Financing Framework report—intended for a local government audience—will include a typology of different funding and financing mechanisms, including definitions, and a general overview of stakeholder roles and functions across private, public, and private/public stakeholders.

For more information regarding ICARP and the TAC, visit: http://opr.ca.gov/planning/icarp/tac/.

Sustainable Groundwater Management Legislation

A new area of concern emerging in the past half-decade in conjunction with severe drought conditions is the issue of groundwater management. Historically, groundwater has been managed largely by private sector interests in accordance with California water laws dating back many decades to the prior century. However, with the substantial depletion of groundwater resources in many areas, an urgent need for better public policy and management has emerged.

The Sustainable Groundwater Management Act of 2014 (SB 1168, AB 1739, and SB 1319) empowers local agencies to adopt groundwater management plans that are tailored to the resources and needs of their communities. Good groundwater management will provide a buffer against drought and climate change, and contribute to reliable water supplies regardless of weather patterns. For a more in-depth discussion of the Sustainable Groundwater Management Act, see *Chapter 9, Section 9.1.5* or go to: https://www.water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management.

3.7 CALIFORNIA STATE STRATEGY 2: STRENGTHEN INTER-AGENCY COORDINATION ACTIONS, INCLUDING STATE, REGIONAL, TRIBAL, AND LOCAL LINKAGES

Coordination among state, tribal, and federal agencies is essential both for preparing the SHMP and implementing it successfully. Equally important are the mechanisms that support state, regional, tribal, and local collaboration related to integration of hazard mitigation with other issues of concern.

California embraces both "horizontal and vertical" integration of mitigation actions—that is, coordination between state agencies and at various levels of government. The following discussion presents examples of ongoing and new coordination actions by the state.

Federal-State Coordination

Partnerships between state and federal agencies focused on specific hazards have been a long-standing tradition in California. For example, the California Geological Survey and the U.S. Geological Survey (USGS) have joined forces to develop joint research projects and planning guidance to address earthquake, tsunami, liquefaction, and landslide hazards. The California Department of Water Resources (DWR) partners with the U.S. Army Corps of Engineers (USACE) to design and implement flood control projects. An example of an effective state-federal coordination effort is the partnering of CAL FIRE and the U.S. Forest Service, who work together, with local fire agencies, to address

wildfire hazards in California. This has recently been exemplified by the assembly of close to 8,000 fire personnel to combat the December 2017 Thomas Fire in Ventura and Santa Barbara Counties.

In addition, federal-state coordination is facilitated through various formal and informal ad hoc consultation processes, including catastrophic event preparedness planning that has examined the role of mitigation in easing response and recovery requirements, as well as federal-state coordination related to emerging mitigation issues involving tsunamis, levee failure, flood hazards, and extensive fires in wildland-urban interface (WUI) areas.

A critical federal-state coordination effort is filling the hazardous materials response capability gaps in California. In 1951, the federal government established a program to match state and local funds for the purchase of fire and rescue apparatus and equipment. The Governor's Fire Advisory Committee recommended that the state purchase 100 fire engines through this program. These engines were assigned to local firefighting agencies throughout the state under the auspices of the Fire Advisory Committee. Presently, the fleet of Cal OES Type I and Type III fire engines has grown to 129, with more on the way. Cal OES also maintains search and rescue trailers and swift water rescue. Additionally, Cal OES supports the readiness and operations of California's eight State/National Urban Search and Rescue (US&R) Task Forces and plays a coordinating and support role in the state's system of 12 Regional US&R Task Forces.

Following disaster events, a Joint Field Office (JFO) can be established to strengthen contact between federal (FEMA) and state (Cal OES) emergency services staff assigned to response and recovery efforts. The JFO is a temporary federal multi-agency coordination center established locally to facilitate field-level domestic incident management activities related to mitigation, prevention, preparedness, response, and recovery when agencies are activated. The JFO provides a central location for coordination of federal, state, local, tribal, non-governmental, and private sector organizations with primary responsibility for activities associated with threat response and incident support. The JFO staff focus on providing support to on-scene efforts, incident management and/or disaster response and recovery program implementation, and coordination of broader support operations that may extend beyond the immediate incident site. The JFO does not manage on-scene operations. As an example, after the January 2017 Severe Winter Storms, Flooding, and Mudslides disaster event (FEMA-4301-DR-CA), FEMA and Cal OES worked together to develop a Hazard Mitigation Strategy that addresses the priorities established by the California State Hazard Mitigation Officer (SHMO) and presents joint federal and state hazard mitigation objectives.

The California Silver Jackets Program is another example of an on-going federal-state coordination effort operating in the state, in this case focused on flood mitigation. Headed by the U.S. Army Corp of Engineers (USACE) with support from FEMA, the Silver Jackets Program enables an inter-agency approach to planning and implementing measures to reduce the risks associated with flooding and other natural disasters. USACE formed the program to work with states and other agencies to discuss each state's flood management priorities, build relationships, and improve communication, coordination, collaboration, and cooperation. California's Silver Jackets Program is divided into two regional teams (one in Northern California and one in Southern California), which are coordinated by the California Department of Water Resources (DWR) and also involve local/tribal governments and communities.

The Coastal Zone Management Act, federal legislation enacted in 1972, created a voluntary partnership between the National Oceanic and Atmospheric Administration (NOAA) and the states, and relies on this federal-state partnership to achieve national, state, and local coastal management goals. The California Coastal Management Program, approved by NOAA in 1978, is a combination of federal, state, and local planning and regulatory authorities for controlling the uses of land, air, and water resources along the coast. NOAA and the California Coastal Management Program (which is implemented by California Coastal Commission [CCC], San Francisco Bay, where the San Francisco Bay Conservation and Development Commission [BCDC], and California State Coastal Conservancy [SCC]) partner to address coastal hazards. As part of this implementation partnership, the CCC manages development along the California coast except for BCDC oversees development and is the designated coastal management agency. The third agency, the SCC, purchases, protects, restores, and enhances coastal resources, and provides access to the shore.

The SHMT's Role in Inter-Agency Coordination

At the heart of federal-state coordination is the State Hazard Mitigation Team (SHMT). Comprised of over 300 agencies and related organizations having responsibility for state-mandated hazard mitigation activities, the SHMT has been instrumental in implementation of the 2010 and 2013 SHMPs and parallel development of the 2018 SHMP through contributions of substantial new information about public and private sector hazard mitigation initiatives, programs, and actions.

As summarized in *Chapter 2*, the SHMT met as a whole from December 2016 through the present to provide information regarding new laws, hazard conditions, and mitigation actions taken during the past five years.

Progress Summary 3.D: SHMT Working Group Initiatives

Progress as of 2018: The State Hazard Mitigation Team (SHMT) was strengthened through the ongoing use of strategic working groups. As detailed in the 2013 SHMP, the Cross-Sector Communications and Knowledge-Sharing Working Group examined messaging and communications challenges across public and private sector organizational boundaries; the Mitigation Progress Indicators and Monitoring Strategic Working Group explored methods for enhancing mitigation progress tracking; and the Land Use Mitigation Strategic Working Group formulated recommendations for possible actions that could be implemented through SHMT coordination to strengthen land use mitigation. While these strategic working groups are no longer meeting on a regular basis, many of their recommendations are still considered relevant and actionable.

The Geographic Information Systems Technical Advisory Working Committee (GIS TAWC) continues to meet to facilitate ongoing functionality of MyPlan, an Internet Mapping Tool (IMT) designed to provide local governments convenient single access to GIS hazards mapping otherwise only available on multiple sites.

In 2018, working groups were established to examine and update the SHMP goals and objectives for the 2018 update, to re-evaluate and update strategies, and to inform inputs to updating the model used in the preparation of social vulnerability maps (see *Section 4.4*). These working groups were a collaborative effort between SHMT members from various agencies and sectors that worked together to review and discuss issues related to each working group topic.

State-Local Coordination

Continuing assessment of LHMPs of cities, counties, and special districts has paralleled the SHMT process. Each agency on the SHMT represents a potential link between state and local government. Most state agencies have long-established relationships with emergency managers, city managers, county administrative officers, and other local government officers.

Since adoption of the 2007 SHMP, California has made significant progress in coordination of state and local hazard mitigation planning. Cal OES is interacting with the SHMT and local governments to more closely link hazard mitigation planning definitions, criteria, standards, and best practices between the state and local levels. During preparation of the 2018 SHMP, 261 FEMA-approved LHMPs were reviewed in order to identify ways to assess and further coordinate local and state hazard mitigation planning and improve LHMP quality. Findings regarding the 2017 LHMP review are included in *Chapter 5: California Local Hazard Mitigation Planning*.

Another example of state-local coordination is coordination of hazardous materials response between Cal OES and local jurisdictions. Many local government fire departments and other agencies established Hazardous Materials Response Teams. In 2016, there were 61 "typed" Hazardous Materials Response Teams in California. In order to bolster the state's hazardous materials response capabilities, Cal OES has purchased and equipped 12 Type II Hazardous Materials Response Vehicles and funded Hazardous Materials Specialist training for 17 personnel to staff each of those vehicles. Beginning in May 2018, two Cal OES Type II Hazardous Materials Response Vehicles are being assigned to local government fire departments in each of California's six Mutual Aid Regions.

In 2018, Cal OES and 12 assignee local government fire departments are parties to a contractual agreement permitting the use of the Cal OES Type II Hazardous Materials Response Vehicles for local emergency response, out-of-service Hazardous Materials vehicles, training, exercises, and other needs. In return, the assignee fire departments are required to dispatch the Cal OES Type II Hazardous Materials Response Vehicles anywhere in the state staffed by the required number of hazardous materials-trained personnel as requested through the California Fire and Rescue Mutual Aid System. As of early 2018, this brings the total number of "typed" Hazardous Materials Teams in California to 73.

Regional Coordination and Collaboration

Several regional planning associations operate on a continuous basis in California to address the planning needs of multiple counties. The associations include, the Association of Bay Area Governments (ABAG), the Association of Monterey Bay Area Governments (AMBAG), the Sacramento Area Council of Governments (SACOG), the Southern California Association of Governments (SCAG), and the Tahoe Regional Planning Agency (TRPA). They collaborate with local governments, non-governmental organizations, and the private sector within their geographical area to address common issues of concern, including land use, housing, infrastructure, and economic development.

Along with these traditional planning issues, some regional associations have also taken an interest in developing and implementing programs that address community resilience, hazard mitigation, energy and water efficiency, and climate change.

The Bay Area Regional Energy Network (BayREN), a collaboration of the nine counties that make up the San Francisco Bay Area, is led by the Association of Bay Area Governments (ABAG). BayREN implements effective energy-saving programs on a regional level and draws on the expertise, experience, and proven track record of Bay Area local governments to develop and administer successful climate, resource, and sustainability programs. BayREN is funded by California utility ratepayers under the auspices of the California Public Utilities Commission. One of only two Regional Energy Networks in the state, BayREN represents 20 percent of the state's population.

Planning for the impacts of climate change and building climate resilience in communities are also priorities for the Los Angeles region. For a full understanding of the impacts of climate change and implications for regional planning policies, local governments need a link to the best available scientific tools. Regional AdaptLA: Coastal Impacts Planning in the Los Angeles Region strives to provide this link to local coastal jurisdictions and to develop a community of practice for the Los Angeles region. It is a multi-year project, funded by the state, among a coalition of 11 local municipalities, Los Angeles County, and six supporting organizations. The University of Southern California (USC) Sea Grant provides leadership, technical assistance, training workshops, and webinars. The program advances a regional sea-level rise and coastal impacts planning process and shares critical scientific information to inform planning efforts.

The Western Riverside Council of Governments (WRCOG) has also led regional planning activities, with representatives from 18 cities, county supervisors, water districts, and tribal governments sitting on the WRCOG Executive Committee. The purpose of WRCOG is to unify Western Riverside County to address important issues collectively. WRCOG's efforts include the development of a Subregional Climate Action Plan that provides a road map for Western Riverside County to address climate change at a regional level. Preparation of WRCOG's Subregional Climate Action Plan was funded by a Sustainable Communities Planning Grant through California's Strategic Growth Council.

There are also regional collaboratives in most parts of California that focus on climate adaptation. While many of these collaboratives are connected through the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), each has its own unique structure. The adaptation collaboratives in each region are organized around non-profit, government agency, academic, and business entities in that region with the interest, capacity, and often regulatory requirement to address adaptation and mitigation at the regional scale.

Other Inter-Agency Coordination Efforts

Executive Order B-30-15 Guidance

Executive Order B-30-15 directed state agencies to integrate climate change into all planning and investment, including accounting for current and future climate conditions in infrastructure investment. OPR was directed to convene a Technical Advisory Group (TAG) to develop guidance to support implementation of the executive order.

The TAG included members from nearly every state agency, local and regional governments, non-governmental and community-based organizations, and the private sector. The TAG met from April 2016 through January 2017 and produced a guidance document called "Planning and Investing for a Resilient California: A Guidebook for State Agencies." This document provides high-level guidance on what future conditions to plan for and how state agencies should approach planning differently in light of a changing climate. The guidance document can be found at: http://opr.ca.gov/planning/icarp/resilient-ca.html.

Best Practices Highlight 3.A: State Water Resources Control Board Commitment to Address Climate Change

In 2017, the State Water Resources Control Board (SWRCB) passed Resolution Number 2017-0012, "Comprehensive Response to Climate Change" that summarizes known climate change impacts and the state's actions to address those impacts. The resolution builds on previous climate change work and requires the SWRCB to take a proactive approach to climate change in all Board actions, with the intent to embed climate change consideration into all SWRCB programs and activities. This is an example of how a state agency is incorporating Executive Order B-30-15 into its actions and activities, and link with other state actions such as Safeguarding California Plan: 2018 Update and the Assembly Bill 32, California Global Warming Solutions Act of 2006.

To review the SWRCB resolution in its entirety, visit: https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2017/rs2017_0012.pdf.

California Silver Jackets Outreach to Local Communities through Watershed University

Watershed University is a free event that provides education and networking opportunities for California professionals in floodplain management, water management, emergency management, and related fields. Led by the California Silver Jackets, this event is a cooperative effort that evolved from the recognition that some communities could not afford the investment of time and money to send floodplain managers and other professionals to conferences. It has since grown to address a variety of timely flood risk reduction topics to professionals worldwide. The California Watershed University enables communities to establish local flood risk awareness events and encourage citizens to take action. See: https://www.water.ca.gov/Programs/Flood-Management/Community-Resources/Watershed-University.

Cyber Threat Prevention and Response

The California Cybersecurity Task Force consists of an inter-agency team headed by Cal OES, which coordinates efforts of the California Department of Technology, Cal OES, the California Military Department, and the California Highway Patrol with those efforts grouped into two sectors, external-facing and internal-facing. For more information about the Task Force, see *Section 9.3.2*.

Well Stimulation and Hydraulic Fracturing Regulation and Oversight

As a result of SB 4 (2013), the following five state agencies are now are involved in coordinated oversight and regulation of well stimulation and hydraulic fracturing activities: Division of Oil, Gas, and Geothermal Resources (DOGGR), Office of Environmental Health Assessment, Department of Toxic Substances Control (DTSC), State Water Resources Control Board (SWRCB), and California Air Resources Board (CARB).

California Environmental Health Tracking Program

The California Environmental Health Tracking Program (CEHTP) is a program of the Public Health Institute, in partnership with the California Department of Public Health. CEHTP is primarily funded by the Centers for Disease

Control and Prevention (CDC) National Environmental Public Health Tracking Program. CEHTP works to make environmental health data and information publicly available through the development of a web-based data query system, state-of-the-art data displays, and innovative web tools and services. CEHTP aims to make these data and information accessible and useful to a variety of stakeholders including communities, governments, academia, and private partners.

3.8 CALIFORNIA STATE STRATEGY 3: BROADEN PUBLIC AND PRIVATE SECTOR MITIGATION LINKAGES

During preparation and implementation of the 2018 SHMP, Cal OES extended its outreach to public and private sector organizations through expansion of State Hazard Mitigation Team (SHMT) membership. While progress has been made in strengthening public and private sector mitigation linkages, further efforts are needed to maintain and strengthen linkages. As of early 2018, Cal OES is in the process of reviewing and updating its SHMT roster with the intent of bringing in more private sector members.

Examples of Public-Private Partnerships in California

An example of an ongoing public-private partnership actively involved in earthquake hazard mitigation activities throughout the state is the Great California ShakeOut. This event began in California in 2008 and is held annually each October. Each year state participation has grown and now also includes participation from federal agencies, including the U.S. Geological Survey (USGS), the American Red Cross, and FEMA. In 2017, over 13,000 individuals representing private sector groups, such as neighborhood groups, faith-based organizations, and media organizations, registered to participate.

The growing threat to cyber security has been met in California through public-private partnership efforts. In 2015, the governor designated Cal OES to lead the California Cybersecurity Integration Center (Cal-CSIC) by Executive Order B-34-15. The Cal-CSIC's primary mission is to reduce the likelihood and severity of cyber incidents that could damage California's economy, its critical infrastructure, or public and private sector computer networks. The Cal-CSIC serves as the central organizing hub of state government's cybersecurity activities and coordinates information sharing with local, state, and federal agencies; tribal governments; utilities and other service providers; academic institutions; and non-governmental organizations. The Cal-CSIC encourages private sector partnerships and hopes to foster a community of information sharing and mutual aid. Part of this effort is the California Cybersecurity Task Force, a statewide partnership comprised of key stakeholders, subject matter experts, and cybersecurity professionals from California's public sector, private industry, academia, and law enforcement.

The State Threat Assessment System (STAS) helps safeguard California communities by serving as a dynamic security nexus comprised of the state, four regional Fusion Centers, and a major urban area Fusion Center. The STAS assists in the detection, prevention, investigation, and response to criminal and terrorist activity, disseminates intelligence, and facilitates communications between state, local, federal, tribal agencies, and private sector partners to help them take action on threats and public safety issues.

Extensive collaboration between public and private sector organizations has been stimulated by the 2012-2017 drought and by the compendium of legislation and funding provided by California's focus on reducing greenhouse gases and improving water and energy efficiency. Details of these efforts are found in the drought, energy, and climate change sections of this plan.

ARCCA Activities

Another form of public-private partnering in the state is facilitated through the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA)'s engagement with its private sector affiliate members. ARCCA and its private sector members have engaged in broader adaptation discourse around enhancing partnership efforts with the insurance, technology, and finance industries.

3.9 CALIFORNIA STATE STRATEGY 4: ASSIST LOCAL AND TRIBAL GOVERNMENTS IN IMPLEMENTING LAND USE GUIDANCE AND BEST PRACTICES FOR REDUCING VULNERABILITY WITHIN HIGH HAZARD ZONES.

The Governor's Office of Planning and Research (OPR) is a comprehensive state planning agency that promotes land use planning linked to hazard identification and analysis. California is among the few states in the country to legislatively mandate land use planning as part of its local general plan process. It is among an even smaller number of states that require that local governments to directly address natural hazards through a specific element: the safety element of the local general plan. Combined with multiple state agency reviews, land use planning functions as a strategic method for hazard reduction.

OPR, through various efforts including preparation of the 2017 General Plan Guidelines and facilitation of the Integrated Climate Adaptation and Resiliency Program (ICARP), supports local governments in identifying and assessing hazards and integrating hazard risks into the general plan.

Various state agencies, as well as local municipalities, can be involved in hazard assessment prior to permitting development. For example, to obtain a hydraulic fracking permit, at a minimum a county planning agency and California Department of Conservation Division of Oil, Gas, & Geothermal Resources (DOGGR) are involved. Depending on the permit location, the Department of Water Resources (DWR) may be involved in relation to aquifer protection, and the Department of Toxic Substances Control (DTSC) can conduct air quality and chemical hazards reviews. This multiple review procedure allows for different types of expertise to be used in order to promote hazard reduction using an "as needed" team effort. This, like the California mutual aid system, provides a means for multiple agencies expertise to be applied in the land use planning process.

A basic premise imbedded in the general plan process is the requirement that all elements of the general plan be internally consistent in their policy statements. This provides the opportunity for the safety element, which addresses hazard mitigation to be integrated with other required elements of the general plan including land use, housing, conservation, open space, and environmental justice.

In addition to the general plan process, as required by the Coastal Act (and overseen by the California Coastal Commission), coastal communities also develop local coastal programs as land use planning documents that, similar to general plans, guide development decisions in the coastal zone and ensure development is safe from coastal hazards. Additionally, the California Coastal Commission Sea-level Rise Policy Guidance from 2015 is meant to assist local governments in understanding how to address sea-level rise.

Smaller communities in California face capacity challenges in fulfilling general plan requirements for hazard mitigation. To address these challenges, additional technical assistance is needed by staff in these jurisdictions.

Safety Element

The safety element establishes policies and programs to protect the community from risks associated with seismic, geologic, flood, and wildland and urban fire hazards, as well as from other concerns such as drought (Government Code Section 65302(g)). SB 379 (2015) requires the safety element to include a climate change vulnerability assessment, measures to address vulnerabilities, and a comprehensive hazard mitigation and emergency response strategy. Jurisdictions can meet the requirements of SB 379 by including the relevant information into their Local Hazard Mitigation Plan (LHMP) and adopting the LHMP into the safety element of their general plan.

The safety element must include mapping of known seismic and other geologic hazards. It must also address evacuation routes, military installations, peak load water supply requirements, and minimum road widths and clearances around structures, as those items relate to identified fire and geologic hazards.

Review by multiple agencies is a distinct feature of safety elements in California. Each city and county must provide a draft of its safety element or amendment of its safety element to the California Geological Survey of the

Department of Conservation prior to adoption, for review to determine if all known seismic and other geologic hazards are addressed. A city or county that contains a State Fire Responsibility Area (SRA) or a Very High Fire Hazard Severity Zone (VHFHSZ) must provide a draft of its safety element or amendment of its safety element to the State Board of Forestry and Fire Protection for review before adoption, and the Board may recommend changes regarding uses of land, policies, or strategies for reducing fire risk.

Assembly Bill 2140: Local Hazard Mitigation Plans and the Safety Element

Assembly Bill (AB) 2140 (2006) provided for post-disaster financial incentives for cities and counties that adopt their Local Hazard Mitigation Plans (LHMPs) as part of general plan safety elements. Among other things, this bill:

1. Authorizes cities and counties to adopt LHMPs prepared under the terms of DMA 2000 as part of their mandated general plan safety elements.
2. Authorizes the legislature to provide to such cities or counties a state share of local costs exceeding 75 percent of total state-eligible post-disaster costs under the California Disaster Assistance Act.
3. Requires Cal OES to give preference for grant fund assistance to jurisdictions that are attempting to prepare an LHMP for the first time.

Implementation of AB 2140 has held out promise of several benefits, including 1) a larger number of jurisdictions preparing LHMPs integrated with general plan safety elements, 2) provision of new opportunities for linking state and local policies related to development in hazard-prone areas, and 3) greater support for local governments seeking to reconcile tensions between development pressure and safe land use planning practices.

Progress Summary 3.E: AB 2140 Implementation

Progress as of 2018: Implementation of Assembly Bill (AB) 2140 provides an opportunity to integrate general community planning with mitigation planning. Since it went into effect in 2007, certain key cities, and counties such as the City and County of San Francisco, Santa Barbara County, and San Luis Obispo County have formally jointly adopted their Local Hazard Mitigation Plans (LHMPs) with the safety elements of their general plans. As of May 2017, 41 jurisdictions with approved LHMPs have integrated their LHMPs with their general plan safety elements or adopted the LHMP as part of their safety elements. Another 82 LHMPs are referenced in those jurisdictions' safety elements. AB 2140 compliance is not permanent but expires when the LHMP expires. When an LHMP is updated and approved by the Federal Emergency Management Agency (FEMA) every five years, it must be re-adopted into the safety element of the jurisdiction's general plan in order to continue to receive the benefits of AB 2140.

Collaborative Effort to Support Local Coastal Planning Alignment

During 2017 and 2018, a multi-agency partnership comprised of NOAA's Office for Coastal Management, USGS, FEMA, California Coastal Commission, the Ocean Protection Council, the Governor's Office of Emergency Services, the Governor's Office of Planning and Research, and the State Coastal Conservancy worked together to develop the Coastal Plan Alignment Compass. The Compass focuses on California coastal communities, which are responsible for developing a suite of local plans that include local coastal programs, local hazard mitigation plans, and general plans. The Compass, released in August 2018, assists local governments to make the case for plan alignment and begin to coordinate plans.

Flood Hazard Mitigation and the General Plan

The successful bond election of 2006 was followed in October 2007 by passage of a major flood legislation package supporting integration of local land use planning with state floodplain mitigation actions. The primary bill was AB 162, which among other things required cities and counties to:

- Employ the land use element to identify and annually review areas subject to flooding identified by floodplain mapping prepared by FEMA or the California Department of Water Resources (DWR)
- In the conservation element, identify rivers, creeks, streams, flood corridors, riparian habitat, and land that may accommodate floodwater for purposes of storm water management

- In the safety element (and other elements that must be consistent with the safety element according to state law), establish a set of comprehensive goals, policies, and objectives for protection of the community from unreasonable risks of flooding
- In any updated housing element, review and identify new flood hazard information that was not available during the previous revision of the safety element.

Fire Hazard Mitigation and the General Plan

Senate Bill 1241 (2012) requires local governments in SRAs and VHFHSZs to:

- Update their general plan safety elements (and all elements of a general plan, whether mandatory or optional, must be consistent with one another) to recognize specific wildfire risks in such areas
- Adopt special findings when approving subdivisions in such areas
- Use wildfire safety guidelines and California Environmental Quality Act (CEQA) initial study wildfire hazards checklist updates issued by the Governor's Office of Planning and Research (OPR)
- Submit their safety elements for review to the State Board of Forestry and Fire Protection and to local agencies that provide fire protection to territory in the city or county

Progress Summary 3.F: SB 1241 Implementation Resources

Progress as of 2018: In May 2015, the Governor's Office of Planning and Research (OPR) issued a Fire Hazard Technical Advisory Planning Guide to assist local jurisdictions in developing effective fire hazard policies for their general plans. This advisory is meant to assist city and county planners in cooperation with fire mitigation, preparedness, and response professionals and Fire Safe Councils in developing sound policies for fire hazard mitigation that can be incorporated into city and county general plans and other related planning documents.

A Handbook for Fire Planning in the General Plan was published by the California Board of Forestry and Fire Protection in May 2014. The intent of this handbook is to:

- Assist the Board of Forestry and Fire Protection, the California Department of Forestry and Fire Protection (CAL FIRE), and contract county fire personnel in understanding local planning and development laws
- Provide information to fire personnel to aid in communicating with local government planners and elected officials
- Provide information to assist in coordinating strategic fire planning efforts across jurisdictional and topical plans
- Provide information to assist fire personnel in reviewing general plans and development projects and in developing appropriate comments
- Provide information about development law in the context of fire and resource protection
- Provide information to help develop comprehensive, cohesive plans that integrate local, state, and federal levels of strategic fire planning

CAL FIRE published a fact sheet on its Land Use Planning Program. The CAL FIRE Land Use Planning Program has a dedicated team of fire professionals strategically located throughout California who, in conjunction with the local CAL FIRE unit, act as a resource for local governments in matters related to fire hazard planning. Their services include:

1. Technical guidance related specifically to safety element fire hazard planning
2. Assistance with the safety element submittal process to the Board of Forestry and Fire Protection
3. Guidance on the Subdivision Map Act related to Very High Fire Hazard Severity Zones (VHFHSZ's)
4. Assistance with State Responsibility Area (SRA) Fire Safe Regulation issues

CAL FIRE also produced "Example Goals, Policies and Implementation Measures" to assist cities and counties in developing wildfire hazard plan safety element goals, policies, and implementation measures. In September 2016, the Board of Forestry and Fire Protection issued a guidance document that it uses in its required review of safety elements. CAL FIRE's Land Use Planning Program also issued a compendium of land use planning resources and a guide to local government submittal information.

Climate Change and the General Plan

SB 379 (2015) requires cities and counties to include climate adaptation and resiliency strategies in the safety elements of their general plans upon the next revision of their housing elements beginning January 1, 2017. The bill requires the climate adaptation update to include a set of goals, policies, and objectives for their communities based on the most current information available regarding climate change adaptation and resiliency. Implementation of SB 379 is under way.

Other Examples of California Legislation Influencing General Plans and Land Use Planning

SB 244 Disadvantaged Communities

This 2011 legislation recognized that many disadvantaged unincorporated communities lacked adequate investment in infrastructure such as sidewalks, safe drinking water, and adequate waste processing. This lack of adequate investment threatens both health and safety of residents and creates inequity in access to high-quality services. SB 244 created procedural requirements to identify these areas of risk and update general plan policies to improve conditions.

AB 1739 Groundwater Management

This 2014 legislation requires that, prior to the adoption or any substantial amendment of a general plan, the planning agency review and consider certain specified groundwater plans and refer a proposed action to certain specified groundwater management agencies. This requirement is a linked to drought and long-term water availability.

SB 1168, AB 1739, and SB 1319, Collectively Known as the Sustainable Groundwater Management Act of 2014

This group of bills considers the connections among groundwater management, land use, and flood management and allows local agencies to customize plans to their regional needs.

California Coastal Act of 1976

The California Coastal Act is unique in protecting the environmental integrity of California's coast, except for San Francisco Bay which has its own state planning and regulatory agency with regional authority (the San Francisco Bay Conservation and Development Commission [BCDC]). Implementation of Coastal Act policies is accomplished primarily through the preparation of Local Coastal Programs (LCPs) that are required to be completed by each county and city within the coastal zone and approved by the California Coastal Commission.

The McAteer-Petris Act and the Suisun Marsh Preservation Act

The McAteer-Petris Act, enacted on September 17, 1965, established the San Francisco Bay Conservation and Development Commission as a temporary state agency charged with preparing a plan for the long-term use of the Bay. In August 1969, the McAteer-Petris Act was amended to make BCDC a permanent agency and to incorporate the policies of the Bay Plan into state law. Nejedly-Bagley-Z'berg Suisun Marsh Preservation Act of 1974 recognized the threats to the Suisun Marsh from potential residential, commercial, and industrial developments, and the need to preserve this unique wildlife resource for future generations. The Act directed the BCDC and the Department of Fish and Wildlife to prepare a Suisun Marsh Protection Plan. The Suisun Marsh Preservation Act was enacted in 1977 to incorporate the findings and policies contained in the plan into state law.

California Environmental Quality Act of 1970

Among many other actions of the California Environmental Quality Act (CEQA), it enables regional air pollution control districts to participate in the local land use planning decision-making process.

Best Practices Highlight 3.A: Hermosa Beach—Integrating Coastal Protection with Land Use Planning

In 2017, the City of Hermosa Beach updated and integrated two of the City's key planning documents - the general plan and the Local Coastal Program (LCP). Collectively referred to as PLAN Hermosa, the integrated plan sets a long-term vision and provides policy direction and guidance to residents, City staff, decision-makers, and the community on what investments the City makes in its infrastructure, how it preserves its small-town character and historic buildings, and where changes are needed to grow its economy and create local jobs.

Within PLAN Hermosa, goals and measurable actions have been established that will help achieve the City's long-term vision as a community that values a small beach town character, vibrant economy, and healthy environment and lifestyles.

Within the City's integrated plan, the safety element was updated to identify hazards and specifically those exacerbated by climate change. In addition, social vulnerability, physical vulnerability, and infrastructure vulnerability were assessed and conclusions used to set priorities for addressing adaptation needs.

3.10 CALIFORNIA STATE STRATEGY 5: INCORPORATE CLIMATE CHANGE INTO LOCAL, TRIBAL, REGIONAL, AND STATEWIDE HAZARDS PROFILES, RISK ASSESSMENTS, AND MITIGATION PLANS

California has recognized the variety of ways in which climate change may affect the state. As a result, action to address climate change is being integrated into nearly every aspect of state operations. The SHMP's provision of hazard mitigation guidance and Cal OES coordination efforts support integration of projected climate change impacts when developing hazard mitigation measures. This integration makes these measures more compatible with other state, local, and tribal aims.

In 2009, Cal-Adapt,[26] a publicly accessible web portal with downscaled climate change projections, was released, and has resulted in a tool that provides information critical to the integration of climate change impacts into state and local plans. Subsequent to the release of Cal-Adapt, Cal OES developed the Adaptation Planning Guide to aid communities in using the Cal-Adapt information to support local decision-making.[27] The integration of climate change considerations into hazards mitigation is further bolstered by the recent passage of SB 379 (2015).

The Safeguarding California Plan: 2018 Update - California's Climate Adaptation Strategy communicates current and needed actions that state government should take to build climate change resiliency, with the ultimate goal of ensuring that people, communities, and natural systems are able to withstand the impacts of climate disruption. To this end, the document presents recommended adaptation strategies.

Some state agencies actively participating in climate change initiatives include the California Natural Resources Agency, the California Department of Water Resources (DWR), the California Coastal Commission (CCC), the Ocean Protection Council (OPC), CAL FIRE, the Governor's Office of Planning and Research (OPR), the State Lands Commission (SLC), the California Department of Public Health (CDPH), the Bay Conservation and Development Commission (BCDC), the California State Lands Commission (SCC), the State Water Resources Control Board (SWRCB), and many others. Regional agencies, such as the San Francisco Bay Regional Quality Control Board, and local jurisdictions are also addressing climate change mitigation. For more information about efforts to address climate change, see *Section 4.3*.

For example, in 2017, the SWRCB adopted a resolution addressing its comprehensive response to climate change. The 2017 resolution builds on the SWRCB's 2007 resolution setting forth initial actions to respond to climate change and requires a proactive approach to climate change in all SWRCB actions, with the intent to embed climate change consideration into all programs and activities. For more information about the SWRCB resolution, visit:

[26] California Energy Commission. Cal-Adapt. 2017. Retrieved on 5/30/2017 from www.cal-adapt.org.
[27] California Natural Resources Agency and California Emergency Management Agency. California Adaptation Planning Guide. 2012. Sacramento: author.

https://www.waterboards.ca.gov/water_issues/programs/climate/.

The Regional Water Quality Control Boards are also implementing legislative mandates to strengthen climate change resilience, including the Sustainable Groundwater Management Act, which will bring depleted groundwater basins into balance to provide a buffer against future droughts.

Two important senate bills establish the framework for incorporating climate change adaptation into local and regional hazard mitigation plans and general plan safety elements. SB 379 (2015) says that "Upon the next revision of a local hazard mitigation plan, adopted in accordance with the federal Disaster Mitigation Act of 2000 (Public Law 106-390), on or after January 1, 2017, or, if a local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022, the safety element shall be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to the city or county."

SB 246 (2015) establishes the Integrated Climate Adaptation and Resiliency Program (ICARP) to coordinate regional and local efforts with state climate adaptation strategies. For more information about other adaptation legislation and initiatives, see *Section 4.3.6*.

3.11 CALIFORNIA STATE STRATEGY 6: ENHANCE COLLABORATION ON THE DEVELOPMENT AND SHARING OF DATA SYSTEMS AND GIS MODELING

California Geoportal

With advances in GIS modeling and computer technology, many new websites offering interactive hazard mapping tools have emerged. The most comprehensive example of this is the California Department of Technology's Geoportal, which provides easy and convenient ways to search, discover, and use geospatial data resources. A primary goal of the California Geoportal is to improve access to California's geographic data portfolio and expand the creative use of those data resources.

The California Geoportal strives to increase information transparency and is committed to creating an open environment for accessing important government-derived geographic data. The benefits derived from the California Geoportal will encourage information sharing and promote efficiency and effectiveness in providing individuals and organizations with timely and accurate geographic information for better and more informed decision-making.

The Geoportal is organized into five topical sections: public safety, natural resources, education, health, and government. The public safety section includes many of the hazard maps necessary for developing LHMPs, including Alquist-Priolo Special Studies Zones, Fire Threat and Wildland Fire Maps, and Tsunami Maps.

Of special note is the inclusion of the Cal OES developed "MyPlan" which is included under the heading Natural Hazards in the Public Safety section. Also of great importance is the addition of Cal-Adapt in the Natural Resources section of the portal.

For additional details, go to: http://portal.gis.ca.gov/geoportal/catalog/content/about.page.

California's Open Data Portal

California also shares government data through the state's open data portal, which provides data sets from various state agencies including the California Air Resources Board, California Public Utilities Commission, California Department of Water Resources, Office of Environmental Health Assessment, and many others. To view available data sets, visit: https://data.ca.gov/.

Examples of State GIS and Other Hazard Data Tools

Cal-Adapt

Cal-Adapt is developed by the Geospatial Innovation Facility at University of California, Berkeley with funding and advisory oversight from the California Energy Commission. It is designed to provide access to the wealth of data and information that has been, and continues to be, produced by the State of California's scientific and research community. The data available on this site offer a view of how climate change might affect California at the local level. The site includes interactive visualization tools and maps related to climate change topics, including average temperatures, extreme heat, sea-level rise, snowpack, wildfire, and cooling and heating degree-days. Information on drought and streamflow projections is under development at this time.

CalEnviroScreen

CalEnviroScreen was developed by the Office of Environmental Health Hazard Assessment (OEHHA), on behalf of the California Environmental Protection Agency (CalEPA) to identify disadvantaged communities as required by SB 525 in 2017. It is a screening methodology that can be used to help identify California communities that are disproportionately burdened by multiple sources of pollution.

California Healthy Places Index

The California Healthy Places Index (HPI) is an interactive data and mapping tool that provides a detailed snapshot of the social determinants of health across California, mapped down to the Census tract level. HPI provides comparison rankings of Census tracts statewide and an accompanying policy action guide. HPI can thus be a useful tool in targeting areas with high levels of social and economic disadvantage for funding, policy, and planning interventions.

Seismic Maps

The California Geological Survey website provides the ability to download GIS maps pertinent to the Alquist-Priolo Earthquake Fault Zoning Map Act and the Seismic Hazards Mapping Act, as well as landslide susceptibility and tsunami inundation maps that can be used to develop LHMPs, and to meet real estate hazard disclosure requirements.

Sea-level Rise Viewers

The California State Lands Commission (SLC) website offers access to two sea-level rise viewers (as well as other sea-level rise mapping tools). In addition to the state viewer provided to assist SLC staff, the SLC website also links to and is supported by the Sea-level Rise interactive viewer developed by the National Oceanic and Atmospheric Administration (NOAA). NOAA's web mapping tool visualizes community-level impacts from coastal flooding or sea-level rise (up to 6 feet above average high tides). Photo simulations of how future flooding might affect local landmarks are also provided, as are data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence. The U.S. Geological Survey (USGS) CoSMoS tool is also publicly available, is linked through Cal-Adapt, and has been heavily used by local jurisdictions in their vulnerability assessment work.

Awareness Floodplain Map

DWR provides an interactive "Awareness Floodplain Map" tool to identify all pertinent flood hazard areas for areas that are not mapped under the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) and to provide the community and residents with an additional tool for understanding potential flood hazards not mapped as a regulated floodplain. The awareness maps identify the 100-year flood hazard areas using approximate assessment procedures. These floodplains are shown simply as flood-prone areas without specific depths and other flood hazard data. Awareness Floodplain Maps will be added as they become available.

CAL FIRE Map Viewers

CAL FIRE has created a web-based map viewer to allow Californians to participate in understanding and identifying the areas most affected by tree mortality as a threat to life and property. This viewer shows areas of tree mortality mapped from 2012 through 2016 as well as examples of assets important to life and property, such as roads, water supply infrastructure, and communications facilities. Where the tree mortality intersects with an asset, the area will be categorized as high priority. CAL FIRE also maintains the State Responsibility Area (SRA) GIS mapping layer and a data viewer to assist landowners in determining if their property may fall within an SRA. SRA boundaries are those adopted by the Board of Forestry and Fire Protection in January 2011, updated to reflect changes as of July 1, 2016. They are the official boundaries recognized by the Board of Forestry and Fire Protection to define the areas where CAL FIRE has financial responsibility for fire suppression and prevention.

General Plan Guidelines Online Data Mapping Tool

The General Plan Guidelines Data Mapping Tool (GPMT) is a useful tool to help communities identify existing resources, including natural resources, roads, buildings, and demographics, and develop open space inventories accordingly. The GPMT pulls data from multiple state and federal sources into one comprehensive site and allows supplemental data layers from local jurisdictions. The GPMT allows mapping of known resources, assets, and needs of the community and can be used in conjunction with Cal-Adapt to further support local jurisdictions' climate change analysis.

Climate Heat Adaptation Tool

The California Natural Resources Agency is sponsoring development of the Climate Heat Adaptation Tool (CHAT) as part of its Fourth Climate Assessment Portfolio. CHAT is a decision-support tool for city, county, and state practitioners involved in public health and local planning efforts to better prepare for extreme heat in the future. This online, interactive tool will support the inclusion of extreme heat and its impact on human health into long-term policy and planning decisions in California. CHAT will be launched in 2018.

MyPlan and MyHazards

The purpose of MyPlan is to improve the quality of hazards and risk assessment by local communities in preparing Local Hazard Mitigation Plans (LHMPs), general plan safety elements, and Local Coastal Programs (LCPs). MyPlan complements the *MyHazards* mapping tool, which was established to provide homeowners, property owners, and residents with natural hazards data in response to simple queries involving a location or address. Data accessible in MyHazards on a more localized, neighborhood scale address hazards such as flood, earthquake, fire, tsunami, and liquefaction zones. Mitigation strategies are also displayed based on applicability to that particular hazard. Users are provided links that explain how to complete mitigation actions.

Progress Summary 3.G: MyPlan and GIS TAWC

Progress as of 2018: Launched in the fall of 2010, the MyPlan Internet Mapping Tool (IMT) continues to provide Geographic Information Systems (GIS) web-based mapping to specialized local users such as planning, building, public works, and administrative professionals at the city, county, special district, and tribal organization levels, as well as consultants who, under contract with local jurisdictions, are tasked with evaluating and mitigating natural hazards. The California Governor's Office of Emergency Services (Cal OES) convened a meeting with the California Natural Resources Agency (CNRA) and California Department of Technology (CDT) to discuss the planned update for MyPlan. During this collaborative session, CDT agreed to take on the technical update of MyPlan to better streamline with other tools and applications that are native to Cal OES. CDT is well positioned to handle inter-agency coordination for this project.

In 2016, Cal OES in collaboration with CDT launched an enhanced version MyPlan. As part of the 2016 launch, modifications and adjustments were made to meet broader and current needs, including the addition of data layers that are valuable to planners of all types. The updates also included user interface updates, technology updates, and an ability to use the website via mobile devices. This required developers to recreate the application to meet the most current standards and have the flexibility to build upon it further in the future.

In 2018, Cal OES began considering switching the MyPlan platform to potentially allow access to hazard mapping information on handheld devices. If this project goes forward, it will be guided by the Geographic Information Systems Technical Advisory Working Committee (GIS TAWC) and occur during implementation of the 2018 SHMP.

3.12 CALIFORNIA STATE STRATEGY 7: SUPPORT AND COORDINATE MONITORING OF PROGRESS ON STATE GOALS AND OBJECTIVES

The SHMT is a key source of information on hazard mitigation project and progress. Collaborative efforts often inform SHMT members of hazard mitigation projects that may be related to mitigation actions they are currently undertaking. SHMT meetings provide a venue for the sharing hazard mitigation progress with other team members and featuring mitigation "success stories."

Strategic targets established for hazard mitigation can include quantified objectives (such as expressing the numbers of vulnerable buildings to be identified and/or retrofitted by type of structure), other measurable outcomes reached, or a certain time deadline. Common factors are 1) determination of reasonable targets, 2) establishment of means by which progress can be measured, and 3) dates by which action must be completed.

Sometimes targets are broadly stated. For example, a state-initiated performance target setting was SB 547 (1986), which required California cities and counties in high seismicity regions (previously referred to as Seismic Zone 4) of the Uniform Building Code then in force to identify all "potentially hazardous" buildings (in this case, unreinforced masonry or unreinforced masonry structures) within their boundaries by January 1, 1990.

An example given in the 2010 SHMP of strategic target setting included seismic retrofit targets established by Health and Safety Code Section 130050 et seq., expressed in terms of time as follows:

- By 2013, replace or retrofit all acute care hospitals posing a significant risk to life in the event of earthquakes
- By 2030, replace or retrofit all acute care hospitals that will not be immediately occupiable and reasonably capable of providing emergency services after earthquakes

While they do not include numbers, these targets state conditions by which progress can be measured and determined. Other examples in California law include time targets, numerical targets, and certain programmatic requirements.

An example of a target reflecting programmatic requirements as well as a numerical target and deadline date is SB 32 (2016), which amends the statewide goal to reduce greenhouse gas emissions 40 percent below 1990 levels by 2030, and requires the California Air Resources Board (CARB) to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emissions reductions.

An example of a mitigation planning target was established under the Sustainable Groundwater Management Act of 2014, which directed DWR to identify groundwater basins and sub-basins in conditions of critical overdraft, and required all basins designated as high or medium priority and critically overdrafted to be managed under a groundwater sustainability plan or coordinated groundwater sustainability plan by January 31, 2020. All other high and medium priority basins must be managed under a groundwater sustainability plan by January 31, 2022.

It should be noted that setting hazard mitigation performance targets is a highly complex and expensive undertaking that implies the existence or development of capacity to measure progress against a given target.

3.13 CALIFORNIA STATE STRATEGY 8: ESTABLISH A MITIGATION REGISTRY FOR COMMUNICATING PROGRESS

During preparation of previous SHMPs, the SHMT discussed the desirability of establishing, with state and local agencies and the private sector, a registry of mitigation projects featuring a statewide database publicizing local

experiences in mitigating various types of hazards, especially the primary hazards of earthquakes, floods, and wildfires. Such a database would represent valuable information on mitigation efforts and enhance hazard mitigation strategies undertaken by state and local governments, businesses, and community organizations.

In 2017, the SHMP mitigation report form was updated and made available on the Cal OES Hazard Mitigation web page. Cal OES continues to encourage SHMT members and others to use this form to report mitigation progress. The form was used as a method for tracking mitigation progress for the 2018 SHMP update.

At the local level, tracking progress is an essential aspect of the LHMP evaluation and implementation process. Jurisdictions should develop a mitigation action monitoring system that fits the needs of their community in tracking progress over time toward completing planned actions. The plan must identify how, when, and by whom the plan will be monitored.

An existing system available to jurisdictions, the state, and FEMA for tracking the status of the identified hazard mitigation actions is the FEMA Mitigation Action Tracker.

FEMA developed the Mitigation Action Tracker to support the collection and tracking of local hazard mitigation actions. The Mitigation Action Tracker serves as a valuable tool to capture and organize mitigation actions at any stage, from proposed actions to funded projects. Registered users have the ability to add new actions, remove old actions, or update the status of an action as it changes over time. In addition, funding and collaboration opportunities to implement mitigation actions may be identified through the tracking process.

California encourages jurisdictions to use the FEMA Mitigation Action Tracker tool over the life of their approved LHMPs, to help support comprehensive tracking of jurisdictional mitigation progress and support statewide implementation efforts. To link directly to the Mitigation Action Tracker, visit: https://mat.msc.fema.gov/About.aspx.

3.14 CALIFORNIA STATE STRATEGY 9: EXPAND MITIGATION PROJECT LOSS AVOIDANCE TRACKING THROUGH THE STATE MITIGATION ASSESSMENT REVIEW TEAM (SMART) SYSTEM

During preparation of the 2007 SHMP, the concept of the State Mitigation Assessment Review Team (SMART), a post-disaster loss-avoidance tracking system, was first introduced. The purpose of SMART is to assess federally funded mitigation projects completed prior to a disaster after the event to establish a record of the effectiveness of the mitigation actions. SMART system objectives are to assess the outcome of previously funded mitigation projects in a disaster area by 1) ascertaining project performance at a given level of intensity of an event, and 2) identifying effectiveness of mitigation practices. A summary of the SMART system assessment steps is included in *Section 10.6*.

Progress Summary 3.H: SMART Post-Disaster Loss Avoidance Tracking

Progress as of 2018: In the fall of 2017 the California Governor's Office of Emergency Services (Cal OES) began a re-evaluation of the State Mitigation Assessment Review Team (SMART) system to determine how it could be restructured to be more effective. As a result of this evaluation, the decision was made to move operation of the SMART system to the Cal OES Hazard Mitigation Grant Program (HMGP) in the Response and Recovery Directorate. HMGP is in the process of developing updated standard operating procedures for the SMART system. The SMART system is discussed in more detail in *Section 10.6*.

3.15 STATE PRIORITIES

Mitigation actions are the response to priorities determined through federal and state mandates, plans (such as the California Earthquake Loss Reduction Plan, the Strategic Fire Plan, Managing the State's Flood Risk, and Safeguarding California), and special reports. A variety of state laws and programs guide not only state mitigation actions, but also those taken by local agencies, businesses, and private citizens. *Chapter 1: Introduction* summarizes state laws guiding mitigation action at all levels. Additional information is provided in *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

There are also mandates directing state agencies to protect state-owned property. The state protects critical facilities such as the State Water Project, university systems, park systems, highways, and bridges, and facilities owned or operated by the Department of General Services. *Chapters 6, 7, and 8* include mapped depictions of state-owned properties in relation to primary hazards (earthquakes, fires, and floods).

3.15.1 STATE PRIORITY DETERMINATION

Because of the probability and severity of multiple risks faced by the state, California is forced to continuously address multiple hazards, vulnerabilities, and risks described in depth in *Chapters 6 through 9*. Differences in diversity, geographic variation, and levels of risks and vulnerability make it difficult to assign priority to one type of hazard over another on a statewide basis.

California's disaster history since 1950 indicates that the primary hazards of earthquakes, floods, and wildfires require priority attention because they account for the largest losses and occur most often. All of the major plans for addressing these hazards are built on the premise that the state, while living with these hazards, shall reduce their impacts on people and property. For discussions of the implications of California's disaster history on setting priorities for specific mitigation actions, see *Chapters 4, and 6 through* 9.

All the major natural hazard plans (earthquake, flood, and fire) call for utilization of land use planning and better risk information as foundations for effective risk reduction actions. It should be noted that the ongoing issues of climate adaptation, environmental justice, and cyber security are now being integrated into, and influencing, mitigation priorities.

Setting Priorities Based on Mitigation Goals and Federal Mandates

Certain fundamental priorities are inherent in the first three goals of this SHMP. The fourth goal, to promote community resilience through integration of hazard mitigation with public policy and standard business practices, comprises the basic guiding principle for priority actions based on this SHMP.

Federal mandates constitute an important source of prioritization. Congressional legislation and presidential executive orders affect the entire federal system. For example, the allocation for the distribution of federal funding is based on federal requirements, and any state priorities must be addressed within those requirements.

Priorities reflected in pursuit of SHMP goals and objectives are consistent with requirements of Section 206.435(b)(2) of Title 44, Code of Federal Regulations, which mandates that states establish procedures and priorities for the selection of mitigation actions that, if not taken, will have a severe detrimental impact, such as:

- Potential loss of life
- Loss of essential services
- Damage to critical facilities
- Economic hardship on the community

Such federally mandated priorities provide guidance for the state in evaluation of proposed hazard mitigation grant projects (See *Appendix L*). California requires that all FEMA funded mitigation projects must support and be consistent with goals identified in this SHMP.

Setting Priorities Based on State Legislation and Executive Orders

Emerging priorities for action are reflected in new laws addressing specific hazard mitigation needs. Examples of these are identified in *Chapter 4*, and *Chapters 6 through 9*. After large disasters, post-disaster assessments often stimulate new recommendations for legislative and administrative action. These legislative and administrative assessments result in important new lines of mitigation policy for hazards such as earthquakes, floods, wildfires, and other disasters. Actions that are a result of state legislation or Governor's executive orders carry the highest priorities. Actions recommended or identified in agency strategic plans or reports demand a somewhat lesser priority.

Budget Adoption

The allocation of state resources is the responsibility of the Governor and legislature through the state budget process and reflects priorities in any given year. Budget shortfalls can interfere with long-term funding of many mitigation programs at the state or local level.

3.15.2 PRIORITIES USING FEDERAL HAZARD MITIGATION FUNDING

Cal OES is responsible for distributing federal mitigation funds from the Federal Emergency Management Agency (FEMA). The following are primary priorities for distributing FEMA funds:

- **Protecting lives and property at risk from imminent hazards created or exacerbated by disasters**. Mitigating risk in in high hazard areas of the state is a priority both pre- and post-disaster. Recovery efforts after a disaster have several sources of funding that can help in abating or mitigating hazards. The process for making Hazard Mitigation Grant Program (HMGP) funds available usually takes 180 to 300 days. A Hazard Mitigation Operational Strategy is developed and outlines how the California Governor's Office of Emergency Services (Cal OES) and the Federal Emergency Management Agency (FEMA) will operate in the Joint Field Office (JFO) to address the priorities established by the California State Hazard Mitigation Officer (SHMO), in response to a disaster declaration.

  Priority is given to funding projects that will mitigate imminent hazards, that are highly cost-effective, and that assist in critical efforts to help communities recover from disasters. The state also promotes and gives priority to those projects and activities that would not cause adverse environmental impacts, ensuring the state is in compliance with all relevant state and federal environmental and historical preservation laws. The state utilizes and promotes green infrastructure methods to support its overall mission of using natural infrastructure to manage stormwater and water supplies while delivering environmental, social, and economic benefits for communities. These priorities together all lead toward better protection of lives and property. Establishing these priorities provides guidance for local and tribal governments to build in flexibility for identifying critical mitigation needs that may arise from a disaster when there is no time to update a local and tribal plan. See *Chapter 10* for additional information regarding FEMA and additional funding priorities and opportunities.

- **Protecting vulnerable critical facilities and infrastructure**. Another important priority for federal funding is to help with protecting critical facilities and infrastructure. Though the state and many communities have ongoing capital improvement programs, there remains an almost overwhelming need to retrofit, replace, protect, or relocate facilities and infrastructure important to the state's communities that are at risk from hazards.

- **Maximizing project benefit-cost ratios.** A principal criterion for evaluating grants is the extent to which a project maximizes benefits and minimizes future disaster costs. In other words, the greater the cost-effectiveness of the project, the lower future disaster costs will be. As part of the Hazard Mitigation Assistance (HMA) grant subapplication review, the higher the project benefit cost ratio, the higher the subapplication is ranked, thus giving the project a higher priority to receive grant funding.

- **Reducing repetitive losses.** Mitigation areas with repetitive loss are high priorities for hazard mitigation funding and resiliency efforts. Repetitive losses are a drain on community, state, and national disaster management resources and are very cost-effective to mitigate. The current national and state priority is the reduction of repetitive flood losses because these translate into a loss to the National Flood Insurance Program (NFIP). California has numerous areas of repetitive flood loss. Through the Community Rating System, building codes, education and resiliency programs, California works to reduce these losses. Additionally, many areas of the state experience repetitive losses from other hazards which are also mitigated through education, and various funding opportunities. See *Section 7.1.4.1* and *Appendices J and K* for repetitive loss information.

- **Ensuring communities are eligible for federal programs by supporting local multi-hazard mitigation planning and encouraging all communities to prepare and adopt a Local Hazard Mitigation Plan**. FEMA provides states with hazard mitigation grant funding from three programs: the Hazard Mitigation Grant Program (HMGP) described under the Robert T. Stafford Act, the Pre-Disaster Mitigation Program described in the Disaster Mitigation Act of 2000, and the Flood Mitigation Assistance Program, as part of the National Flood Insurance Reform Act (NFIRA) of 1994. These programs require approved projects to be consistent with locally and state-developed plans and comprise a cost-effective long-term mitigation program. Also, each program allows some funding to be available for hazard mitigation planning efforts.

  Encouraging communities to develop and implement LHMPs is a high priority for California. Such plans are necessary to ensure that local communities are made aware of the hazards and vulnerabilities within their jurisdictions, to develop strategies to reduce those vulnerabilities, and to receive certain federal financial assistance for hazard mitigation. See *Chapter 5* for more information about the LHMP program in California.

- **Addressing climate impacts.** For HMA funding, the state is working with FEMA to set priorities for projects that address climate impacts or adaptation efforts. This effort includes the Climate Resilient Mitigation Activities (CRMAs) identified by FEMA as eligible for HMA funding.

- **Protecting vulnerable populations.** The HMA grant subapplication process gives priority to funding of mitigation projects in disadvantaged communities. Disadvantaged communities within California are identified by CalEPA's CalEnviroScreen tool.

Integrating Federal, State, and Local Priorities

Following a disaster, a Cal OES appointed representative, working with the State Hazard Mitigation Officer and appropriate committees and task forces, develops a mitigation strategy that identifies areas and types of hazard mitigation activities proposed as priorities. This identification is guided by both the established framework of statewide mitigation priorities and the federal priorities described above. It also takes into account the nature of the disaster. Specific post-disaster prioritization is determined as part of initial program guidance to potential applicants. Information to be considered in establishing priority categories may include the evaluation of natural hazards in the disaster area, state-of-the-art knowledge, and practices relative to hazard reduction, existing state mandates or legislation, existing state or local programs, and long-term mitigation goals and objectives at the state, local, tribal, and community level.

Each disaster has particular characteristics that influence the specific mitigation priority determination. For example, earthquake hazards differ from those that affect much of the rest of the nation. Flood risk management in California is a shared responsibility among local, state, and federal agencies. Four of the nation's 15 largest cities are in California (Los Angeles, San Diego, San Jose, and San Francisco), and all are at risk for some type of flooding. Integrated Water Management (IWM) is, along with land use planning and increasing agency collaboration, one of the top priorities for addressing the states flood approach.[28] Wildfire has a different set of considerations. When an area has been burned, one major factor of the hazard in the immediate area–fuel load–has been reduced. The immediate mitigation concerns are then to avoid further damage from mudslides and flooding (especially in steeply

[28] California's Flood Future: Recommendations for Managing the State's Flood Risk. November 2013

sloped areas). The long-term concern is to reduce hazards and/or vulnerabilities to fire in areas that have not burned and contain heavy fuel loads.

Additionally, Cal OES has modified its grant subapplicant scoring and rating form to recognize and provide additional scoring to local jurisdictions that have adopted their LHMPs as part of their general plan safety elements. For more information on grant subapplication review and determination of project priorities, see *Chapter 10*.

3.16 STATE MITIGATION CAPABILITIES

The State of California has a history of successfully implementing hazard mitigation through a process of legislation, program development, and project implementation. This history demonstrates the state's capability to implement state-level hazard mitigation programs that are effective and, in many ways, state of the art. Some examples of state capability to reduce risk and increase resilience include the following:

Earthquake Hazard

- California Earthquake Authority's Brace+Bolt program pilot, launched in 2013, successfully provided seismic retrofit grant funding to homeowners and is being expanded to more areas of Northern and Southern California with $6 million of grant funding available in 2017.

Flood Hazard

- The 2017 Central Valley Flood Protection Plan (CVFPP), updated in August 2017, incorporates the latest information and science to improve flood risk management throughout California's Central Valley. The CVFPP emphasizes the importance of investing in long-term, multi-benefit actions to improve flood risk management while improving ecosystem functions, modernizing operations and maintenance practices, and strengthening institutional support for flood management. It identifies the need to invest $17 billion to $21 billion in the Central Valley flood system over the next 30 years.

Sea-level Rise Hazard

- The State of California Sea-Level Rise Guidance Document, initially released in 2010 and first updated in 2013, has provided guidance to state agencies for incorporating sea-level rise projections into planning, design, permitting, construction, investment, and other decisions. The Sea-Level Rise Guidance 2018 Update reflects recent advances in ice loss science and updates and expands projections of sea-level rise. The 2018 Guidance update can assist cities and counties as they comply with SB 379 (2015), which requires local planning efforts to address climate change, as well as assist state agencies in preparing for and adapting to climate change, as directed by Executive Order B-30-15.

Wildfire Hazard

- As part of the Tree Mortality Task Force's High Hazard Zone Tree Removal effort, the California Department of Transportation (Caltrans) is identifying and removing dead and dying hazardous trees along highways that could affect the safety of the traveling public.
- The 2017-18 Local Assistance for Tree Mortality (LATM) Grant Program gives a one-time appropriation of $6 million in grants to local agencies in the 10 high priority counties participating in the Tree Mortality Task Force for the purposes of identifying, removing, and disposing of dead and dying trees that pose a threat to public health and safety.
- The Office of the State Fire Marshal's Code Development and Analysis Division reviews all of California's regulations relating to fire and life safety for relevancy, necessity, conflict, duplication, and/or overlap. The division also prepares the California State Fire Marshal's fire and life safety regulations and building standards for review and adoption by the California Building Standards Commission.

Energy Shortage Hazard

- In 2015, the Energy Commission adopted the Existing Buildings Energy Efficiency Action Plan to help meet the Governor's goal to double the efficiency savings of existing buildings by 2030 and adopted the first update in December 2016. Further updates are expected every three years. SB 350 (2015), the Clean Energy and Pollution Reduction Act, requires the Energy Commission to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a doubling of energy efficiency savings from buildings and retail end uses by 2030.

Other Mitigation-Related Efforts

- AB 2800 (2017) requires state agencies to take into account current and future impacts of climate change in all stages of planning, designing, building, operating, maintaining, and investing in state infrastructure. The bill required that a Climate-Safe Infrastructure Working Group be established from 2017 to 2020 to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering. In early September 2018, the Climate-Safe Infrastructure Working Group launched "Paying It Forward: The Path Toward Climate-Safe Infrastructure in California", a 160-page report addressing the problem of climate change impacts on aging or poorly maintained infrastructure. Key sections of the report present the problem, a vision, and elements of a framework to action to ensure resilient and sustainable infrastructure in the future.

3.16.1 LEGAL FOUNDATIONS OF STATE CAPABILITY

Chapter 1: Introduction, Section 1.4, provides a general summary of the laws, policies, and institutions underlying the state's capability in implementing hazard mitigation. Together they establish the underlying framework for the state's policies related to hazard mitigation and disaster management and form the core of the state's capabilities. To more fully understand the legal foundations of the state's capability, it is useful to examine federal and State of California laws and programs described in further detail in *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

3.16.2 TYPES OF STATE CAPABILITY

The state's efforts at implementing hazard management can be viewed as being effective at three levels: state legislation, state-level implementation, and local level implementation of state priorities.

State Legislation

State legislation related to hazard mitigation is, for the most part, hazard-specific. While much legislation has been the result of disaster events in which specific vulnerabilities were highlighted, there is also a sustained approach to legislation with a focus on planning and emerging hazards.

Recent examples of these laws include the following:

- SB 1278 and AB 1965 revised the definition of urban level of flood protection and modified the dates and timeframes for general plan amendments (July 2, 2015) and zoning ordinance updates (July 2, 2016).
- SB 32, signed by Governor Brown on September 8, 2016, put into law a statewide goal to reduce greenhouse gas emissions 40 percent below 1990 levels by 2030.
- The Sustainable Groundwater Management Act of 2014 (AB 1739, SB 1168, and SB 1316) commits California to local management of groundwater supplies with the goal of achieving sustainable management of groundwater basins through development and implementation of groundwater sustainability plans (GSPs) by local agencies within 20 years.

Much of the state legislation addressing hazard mitigation has resulted from recommendations by special commissions formed following a disaster. The legislative aspect of California's approach to hazard mitigation is responsive, focused, and effective.

Additional information on over 30 laws forming a foundation for emergency management and hazard mitigation in California may be found in *Annex 1, Section 1.10*. A variety of additional laws and programs responding to mitigation needs for specific hazards (earthquake, wildfires, and floods) are documented in *Appendices G, H, and* I.

State-Level Implementation of Priorities

The state has expended tens of billions of dollars on seismic, fire, and flood hazard mitigation. Some of these efforts include the Dam Safety Act of 2006, the Alquist-Priolo Earthquake Fault Zone Mapping Act, the Unreinforced Masonry Building Law, the Essential Services Building Seismic Safety Act, the Seismic Hazards Mapping Act, statutes forming the California Earthquake Authority, the State Water Project, the Caltrans Seismic Retrofit Program, residential seismic retrofit programs, mapping of Fire Hazard Severity Zones, the State Water Plan, the Central Valley Flood Protection Plan, and the Sustainable Groundwater Management Act.

The state has certain direct oversight authority over specific forms of hazard mitigation involving land use. For example, the California Coastal Commission (CCC) administers the California Coastal Act, which provides for long-term protection of California's 1,100 miles of coastline. Along with the San Francisco Bay Conservation and Development Commission (BCDC) and the State Coastal Conservancy, the CCC administers the California Coastal Management Program.

Unique in the U.S., the California Coastal Act, administered by the CCC and local jurisdictions or entities with certified Local Coastal Programs (LCPs), Port Master Plans, Long-Range Development Plans, or Public Works Plans, provides for the protection and enhancement of California's coast and ocean for present and future generations. It does so through careful planning and regulation of environmentally sustainable development, rigorous use of science, strong public participation, education, and effective intergovernmental coordination. In the San Francisco Bay Area, the Bay Conservation and Development Commission (BCDC), created by the McAteer-Petris Act, supports implementation of state coastal priorities.

Section 30253 of the California Coastal Act requires that new development minimize risks to life and property in areas of high geologic, flood, and wildfire hazard. Development must assure stability and structural integrity, and not create or contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or require construction of protective devices that substantially alters natural landforms along bluffs or cliffs.

Additionally, Section 2697 of the Seismic Hazard Mapping Act requires that cities and counties condition approval of subdivision plans and the issuance of building permits on approved seismic hazard investigations and plans to mitigate identified hazards. This requirement induces sustainable mitigation in that it affects all future construction within designated zones. Section 2699 requires cities and counties to take into account seismic hazards zones when preparing the safety elements of general plans (and other elements that must be consistent with the safety element according to state law), and when adopting and revising land use planning and permitting ordinances.

To improve understanding of natural hazards and the performance of hazard mitigation practices, state agencies and many of the state's universities are researching the behavior of natural events and developing improved methods for research. There is also considerable research devoted to improving disaster-resistant building materials and practices. The California Energy Commission, the California Air Resources Board, and the Strategic Growth Council all fund university level research addressing specific hazard topics. This research is critical to improving building standards and practices.

Local-Level Implementation of State Priorities

State efforts to implement hazard mitigation at both the state and local level are complicated. State laws that strengthen building codes and standards and their enforcement have been effective in that California arguably appears to have experienced substantially less damage than had such regulations not been adopted. This especially seems to be the case for California's three primary hazards: earthquakes, flood, and wildfire. Local governments may adopt amendments enhancing minimum requirements of the California Building Code.

California law also stipulates mandatory local hazard mitigation requirements, such as Senate Bill 379 requirements that local jurisdictions include climate adaptation strategies in the general plan safety element. SB 1000 requires local jurisdictions to include upon the next update of their general plan, either a new environmental justice element or environmental justice goals, objectives, and policies integrated into the other required general plan elements.

The state encourages local governments to voluntarily initiate hazard mitigation efforts. An example of local-level implementation can be seen in the recent approval by Bay Area residents of Measure AA which applies a parcel tax to raise funds to address potential flooding and sea-level rise impacts resulting from climate change.

Another example of local implementation efforts supporting the SHMP goal of protecting property is the creation of numerous geological hazard abatement districts (GHADs), local voter-approved districts that are primarily established to fund mitigation of geologic hazards.

A major area of opportunity exists to realize benefits of locally initiated and implemented hazard mitigation strategies and actions integrated with jurisdictional planning. This is why one of the state's hazard mitigation priorities is reflected in Goal 4 (promote integrated hazard mitigation policy), Objective 4: "Improve the quality and effectiveness of regional, local, and tribal hazard mitigation plans through effective training and guidance that strengthens linkages between these plans, local general plan elements, local coastal plans, other local plan initiatives, related land use controls, and the SHMP."

3.17 COMPREHENSIVE MULTI-AGENCY MITIGATION ACTION PROGRAM

As can be seen from the preceding progress statements in this chapter, California uses a multi-agency approach, capturing the energy and resources of multiple state and local agencies as well as tribal governments and the private sector to make advances in natural hazard mitigation and disaster loss reduction.

State agencies are tasked by statute and executive orders to provide mitigation programs related to specific hazards. Mitigation actions stemming from these separate authorizations are woven together into a comprehensive multi-agency mitigation action program, as described below.

Interagency integration is a key strategy used by the state to strengthen capabilities in order to further mitigation efforts. This is accomplished through coordination of multiple state agencies, along with organizations that have focused missions.

Examples of mitigation efforts using integration include:

- *Cyber Threat Prevention and Response*. The California Cybersecurity Task Force consists of an inter-agency team headed by Cal OES which coordinates efforts of the California Department of Technology, Cal OES, the California Military Department, and the California Highway Patrol with those efforts grouped into two sectors, external facing and internal-facing. For more information about the Task Force, see *Section 9.3.2*.
- *Well Stimulation and Hydraulic Fracturing Regulation and Oversight*. As a result of SB 4 (2013), the following five state agencies are now are involved in coordinated oversight and regulation of well stimulation and hydraulic fracturing activities: Division of Oil, Gas, and Geothermal Resources (DOGGR), Office of Environmental Health Assessment, Department of Toxic Substance Control (DTSC), State Water Resources Control Board (SWRCB), and California Air Resources Board (CARB).

3.17.1 MULTIPLE FUNDING SOURCES

As discussed in *Chapters 6 through 10*, billions of dollars of state, local/tribal, and private funds are committed to hazard mitigation efforts in amounts far exceeding those administered by FEMA. This multi-agency approach is coordinated and cross-cutting, yet decentralized. Operating through separate agency programs, the state's comprehensive mitigation program is fiscally supported by a variety of financial sources, including general funds, bonds, fees, and federal grants, as described more fully in *Annex 2: Public Sector Funding Sources*.

Thus, no single agency directs or has authority over all hazard mitigation actions and resources. Instead, because of California's size and complexity, the model is that of a distributed system of coordinated and often complementary mitigation actions. Within that, each agency seeks to avoid conflict or redundancies of its mitigation programs with those of other agencies, regardless of the funding source. For example, as a result of the 2012 to 2016 statewide

drought, more than $300 million has been authorized for grant projects administered by multiple state agencies designed for water conservation, flood risk, watershed protection, ecosystem restoration, and groundwater management. Another example is the Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP), which has invested more than $700 million for projects designed to help California reach its greenhouse gas emission goals, improve air quality, reduce dependence on petroleum, and increase energy efficiency, which will ensure energy supplies can meet future energy demand.

3.17.2 COORDINATION OF MITIGATION ACTIONS

In this multi-agency context, coordination of mitigation planning and action priorities is undertaken through a variety of means, including cross-referencing of common mitigation objectives in separate agency plans as well as a variety of joint inter-agency coordination mechanisms, both formal and informal. Within each agency, coordination is exercised at both the management and field levels.

The Role of the SHMT

The SHMT has played an instrumental role in coordinating participating agencies at the management level in the preparation of this SHMP. In addition to supporting preparation of the 2018 SHMP, SHMT members play critically important roles in coordinating implementation of actions identified in the 2013 SHMP, including monitoring mitigation progress within their agencies. Coordination is focused at the statewide level in a wide variety of action areas specified by a broad range of programmatic legislation and executive orders.

Coordination Example: Tree Mortality Task Force

An example of a coordinated multi-agency mitigation effort by the state is the Tree Mortality Task Force comprised of over 300 state and federal agencies, local governments, utilities, and various stakeholders that coordinate emergency protective actions and monitor ongoing conditions to address the vast tree mortality resulting from four years of unprecedented drought and the resulting bark beetle infestations across large regions of the state.

Coordination Challenges

Previously, the organization of tribal mitigation plan reviews was not closely coordinated with Local Hazard Mitigation Plan (LHMP) reviews. Since 2016, Cal OES LHMP technical assistance and training staff have been working more closely with FEMA Region IX staff to gain access to tribal mitigation plans in review by FEMA. As access to these tribal mitigation plans becomes available, Cal OES staff continue to work with FEMA Region IX staff to strengthen the state's approach to support integration of state, local and tribal mitigation actions.

For an overview of the many new, ongoing, and completed mitigation actions within the state, see *Appendix C: Multi-Agency Mitigation Action Matrix*.

CHAPTER 4 – PROFILING CALIFORNIA'S SETTING

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About Chapter 4

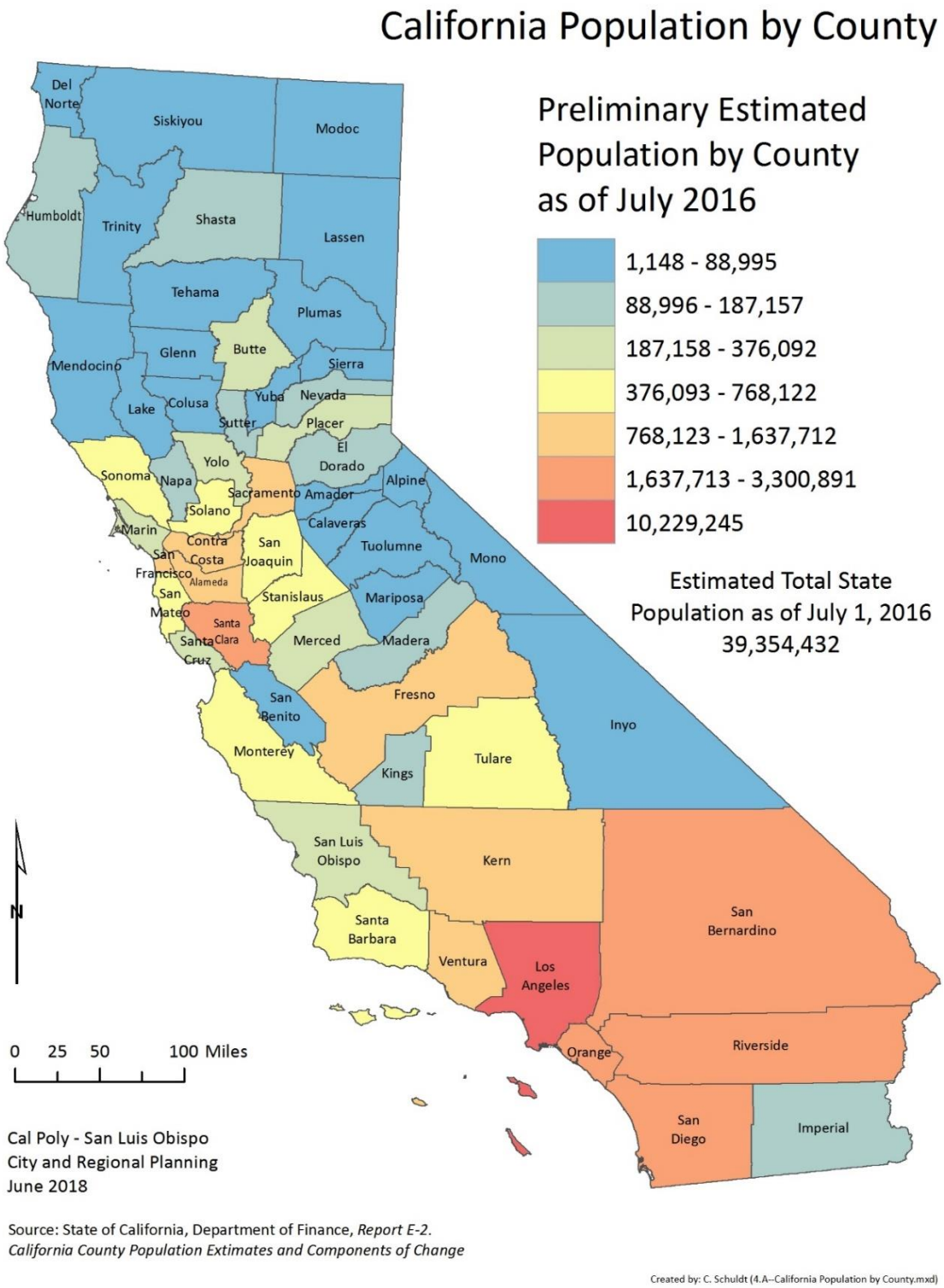
This chapter describes California's setting and key elements influencing the scale and complexity of the state's mitigation challenge. As a state, California is unique in its physical, economic, and demographic diversity. This diversity is a strength of the state, but also a challenge when assessing and mitigating risk. In attempting to mitigate natural and human-caused hazards across the state, it is crucial for state agencies, local and regional jurisdictions, and other stakeholders to understand and acknowledge the state's complexities when creating and implementing mitigation goals, strategies, and actions. This chapter summarizes key elements influencing the scale and complexity of California's mitigation challenge. For a risk assessment of California's hazards, see *Chapters 6 through 9*. Included in this chapter are discussions that address the following questions:

- What assets are at risk?
- Who is at risk?
- Where and what were the consequences from prior disasters?
- What does climate change mean for future risk from disasters?

4.1 STATE ASSETS AT RISK

California is an extraordinarily large, diverse, and complex state. With 12.1 percent of the U.S. population, it is culturally, ethnically, economically, ecologically, and politically diverse. Human, economic, and natural assets worthy of protection from natural and human-caused disasters include the state's people, economy, infrastructure, and environment. If it were a separate nation, California would have the fifth largest economy in the world. A catastrophic disaster here could adversely affect the national and world economies. This confluence of demographic, economic, and environmental characteristics makes mitigating hazards in California both challenging and critically important.

Map 4.A: California Population by County



Map 4.A shows population by county in seven classifications, as of July 2016. Counties with populations of 1 million to 3.5 million inhabitants, shown in darker brown, are concentrated in the San Francisco Bay, Sacramento, and Southern California areas. Los Angeles County, shown in red, is in a class of its own with 10,229,245 people.[29]

[29] http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/

4.1.1 POPULATION, ECONOMY, AND INFRASTRUCTURE

Population

California is the most populous state in the U.S., with a January 1, 2017 population of 39,523,513. California leads the nation in population, employment, manufacturing, and agricultural output. Its 58 counties, and 482 incorporated cities and towns, vary widely in land area, population, and growth. For example, in 2016, the most populous county, Los Angeles, had 10,229,245 residents; while the smallest county, Alpine, had 1,148 people. Los Angeles, the largest county in U.S. in terms of population, also leads the state in permits issued for residential growth; in 2016, the county issued 20,339 such permits, a number estimated to be 59 percent higher than the county with the next largest number of residential permits, which is Orange County.

Table 4.A identifies California's top 10 counties in total population. Together, these counties represent 28,413,848 people, or an estimated 73 percent of the state's population in 2016. Of this total, 21,220,167 people, or over half the state's total population, live in the five southernmost counties (Los Angeles, San Diego, Orange, Riverside, and San Bernardino). Within these counties from 2012 to2016, the overall trend is gradual population increase over the four-year period with projections by the California Department of Finance for the year 2025 showing steady growth.

Table 4.A: Population Change, 2012-2016, in 10 Largest Counties by Population

2016 Rank	County	2016 Population	2012 Population	Percent Change, 2012 to 2016	California Department of Finance Projection 2025
1	Los Angeles	10,229,245	9,988,287	+2.4%	10,701,051
2	San Diego	3,300,891	3,174,446	+4.0%	3,482,977
3	Orange	3,181,371	3,084,036	+3.2%	3,305,644
4	Riverside	2,360,727	2,253,317	+4.8%	2,662,235
5	San Bernardino	2,147,933	2,077,560	+3.4%	2,366,662
6	Santa Clara	1,930,215	1,840,218	+4.9%	2,059,786
7	Alameda	1,637,712	1,554,446	+5.4%	1,763,028
8	Sacramento	1,506,677	1,445,230	+4.3%	1,639,613
9	Contra Costa	1,129,894	1,075,665	+5.0%	1,224,372
10	Fresno	989,183	950,634	+4.1%	1,130,406
	TOTAL	**28,413,848**	**27,443,839**	**+3.5%**	**30,335,774**

Source: http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/ http://www.dof.ca.gov/Forecasting/Demographics/projections/ (Table P-1 and P-2)

Table 4.B lists the 10 least populated counties in California. Seven of the 10 least populated counties are located in the eastern portion of the state; two are northern inland, and one is located on the north coast. Together, these counties represent 151,600 people or an estimated 0.39 percent of the total population of California. It should be noted that these counties include a significant amount of public land holdings, as depicted in Map 4.F later in this chapter. Unlike the state's most populous counties, these least populous counties generally saw population decreases over the 2012-2016 period. The exceptions were Inyo and Colusa Counties.

Table 4.B: Population Change, 2012-2016, in 10 Smallest Counties by Population

2016 Rank	County	2016 Population	2012 Population	Percent Change 2012 to 2016	California Department of Finance Projection 2025
58	Alpine	1,148	1,166	-2%	1,329
57	Sierra	3,140	3,206	-2%	3,091
56	Modoc	9,469	9,634	-2%	9,866
55	Trinity	13,482	13,704	-2%	14,510
54	Mono	13,785	14,122	-2%	15,750
53	Mariposa	18,055	18,223	-1%	19,375
52	Inyo	18,649	18,569	+1%	20,004
51	Plumas	19,494	19,883	-2%	20,520
50	Colusa	22,408	21,781	+3%	25,821
49	Del Norte	27,040	27,996	-3%	29,735
	TOTAL	**151,600**	**146,670**	**+2%**	**160,001**

Source: http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/

Diversity, Mobility, and Age

California's current population is among the most diverse in the nation. Demographic characteristics tell an important story about the significance of migration to the state. California is one of four states (also including New Mexico, Texas, and Hawaii) where no single ethnic group represents a majority of the population. The historical influx of immigrants highlights the importance of public outreach on disaster mitigation in an accessible, culturally and linguistically appropriate manner. Other demographic factors related to mitigation planning in California are the high mobility of the population,[30] age characteristics,[31] large Native-American populations, and individuals with access and functional needs.

California's population is continuing to become more diverse. The 2015 American Community Survey reported the racial and ethnic composition of California as 38.7 percent White (not Hispanic), 38.4 percent Hispanic, 13.5 percent Asian, 5.6 percent Black, 0.4 percent American Indian, and 3.4 percent Other. Continued population diversification presents a challenge for outreach and implementation of the state's hazard mitigation strategies. Government agencies at all levels find it necessary to address related challenges, such as language, communications, trust of government, adherence to regulations, and extent of participation in mitigation-related community stakeholder groups.

In addition to being diverse, California's population is mobile. Statistics from the California Bureau of Real Estate indicate that the average homeowner in California relocates every seven years. Forty-five percent of California residents live in rental units, and it is anticipated that these residents, as renters, will move more frequently than homeowners. The mobility of the population poses a challenge to continuously educating residents about the hazards and risks associated with their communities. According to the 2015 American Community Survey, California has an estimated 20,695,882 residents in owner-occupied housing units and an estimated 16,908,728 in renter-occupied housing units.[32]

California faces an aging workforce, like the rest of the nation, together with loss of skilled workers due to retirement. The California Department of Finance projects that in 2020 the state will have a population of 6,052,716 persons over 65 years of age. This estimate represents a substantially aging population who are more vulnerable to disasters. Residents over age 65 present a challenge for mitigation by adding to the total number of people in age groups more vulnerable and/or less able to respond to disasters. California also has a substantial population of residents over 75 years of age. In 2010, more than 1.5 million people 75 years and older lived in the 16 counties

[30] The average homeowner moves every seven years, and renters move more often, making educational outreach for mitigation difficult.
[31] The population of California is, on average, slightly younger than the rest of the nation.
[32] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_B25008&prodType=table

with 50,000 people or more. Additionally, according to the American Community Survey, there are an estimated 1,117,647 households with residents over the age 65 living alone, which illustrates increased vulnerability in the state. The California Department of Finance reports that in 2010 approximately seven percent of the state was comprised of children younger than five years old. This proportion is expected to remain constant through 2020.

Native Americans

California is home to more Native Americans than any other state in the country. Of the 566 federally recognized tribal governments in the United States, 109 have land or offices in California and there are 78 entities petitioning for recognition from the state of California.[33]

The U.S. Census Bureau's 2015 American Community Survey reported an estimated population of 287,028 Native Americans in California. The top five counties for Native American population were Los Angeles (59,340), Riverside (21,535), San Diego (21,237), San Bernardino (17,846), and Orange (12,476). According to the 2010 U.S. Census, California's Native American population represents an estimated 14 percent of the Native American population of the United States.[34]

The California Government Code (Sections 65352.3 to 65352.4) requires local governments to conduct meaningful consultation with California Native American tribes before a city or county government adopts or amends its general plan. The purpose of the consultation is to protect cultural places on lands affected by the proposed general plan. For more information, see the California Native American Heritage Commission website at: http://nahc.ca.gov/codes/.

The State of California recognizes the right of Native American tribes to self-govern and exercise inherent sovereign powers over their members and territory. On September 19, 2011, Governor Jerry Brown issued Executive Order B-10-11, which states that "it is the policy of the administration that every state agency and department subject to executive control is to encourage communication and consultation with California Native American tribes." The State is working with Native American tribes (federally and non-federally recognized) on a government-to-government basis to address issues concerning Native American tribal self-government and tribal trust resources.[35]

Persons with Access and Functional Needs

No two disasters are ever the same, yet virtually all disproportionately affect individuals with access and functional needs.

People with access and functional needs are individuals who have:

- Developmental, intellectual, or physical disabilities
- Chronic conditions or injuries
- Limited or no English proficiency speaking

People with access and functional needs may also be:

- Older adults, children, or pregnant
- Living in institutional settings
- Low-income, homeless, and/or transportation disadvantaged
- From diverse cultures

A study titled "The Impact of Wildfires on People with Disabilities," published by the State Independent Living Council (SILC), noted that individuals with disabilities were especially hard hit by the Southern California fires of 2003. It pointed out that many individuals with disabilities need assistance with evacuation or may be unable to see approaching danger or hear announcements to evacuate. The report identified the following areas that are

[33] http://www.courts.ca.gov/3066.htm
[34] https://www.census.gov/prod/cen2010/briefs/c2010br-10.pdf
[35] www.caloes.ca.gov/cal-oes-divisions/tribal-coordination

particularly key for individuals with disabilities: preparation, notification, evacuation, sheltering and interim services, and recovery. For more information see: https://www.calsilc.ca.gov/.

According to the U.S. Census Bureau's 2015 American Community Survey, an estimated 3,947,390 people in California have some form of disability. Table 4.C lists the top 10 counties that have the most households containing members with a disability. Among these counties, the percentage of households with disabilities ranges from a low of 16 percent of total households (in Santa Clara County) to a high of 22 percent of total households (in Sacramento County). According to the 2015 American Community Survey, 16.4 percent of Native Americans in the United States —and the same percentage in California—have a disability.

Table 4.C: 10 California Counties with Largest Number of Households with Disabled Residents, 2015

County	2012 Total Households in County	2015 Total Households in County	2012 Households with Members with a Disability	2015 Households with Members with a Disability	2012-2015 Change in Households with a Disability
Los Angeles	3,444,644	3,504,348	639,057	663,967	+4%
San Diego	1,169,225	1,194,494	198,829	215,370	+8%
Orange	1,052,535	1,081,042	164,911	179,945	+8%
Riverside	805,050	826,825	164,463	175,701	+6%
San Bernardino	700,200	711,715	143,463	145,923	+2%
Santa Clara	636,293	660,622	98,580	105,826	+7%
Alameda	583,618	595,871	93,854	110,826	+15%
Sacramento	556,314	563,670	119,858	124,165	+3%
Contra Costa	401,397	408,783	76,291	89,514	+15%
Fresno	318 ,451	318,451	73,171	85,163	+14%
TOTAL	**9,667,727**	**9,865,821**	**1,772,477**	**1,896,400**	**+7%**

Source: PUMS DATA, 2017, Association of Bay Area Governments

Based on the data in Table 4.C, the top 10 counties in terms of population also contain 71 percent of households in the state and 68 percent of all households in the state with a disabled member. Additionally, these counties also represent 73 percent of state's population in 2016.

An estimated 5.1 percent of the non-institutional population age 16 and over has an "independent living difficulty," and approximately 28 percent of individuals with a disability live alone. One in four people between the ages of 65 and 74 will experience disability in their lifetime, with the rate increasing to one out of two for people 75 years and older.

Communities in states throughout the country, including California, wrestle with the complexity of integrating access and functional needs considerations during critical incidents. To assist with this effort and to improve the ability for individuals with access and functional needs to maintain independence, health, and safety during disasters, the Governor created the Office for Access and Functional Needs (OAFN) within the California Governor's Office of Emergency Services (Cal OES) in 2008. The purpose of OAFN is to identify the needs of individuals with access and functional needs before, during, and after a disaster and to integrate needs and resources into all aspects of emergency management systems. OAFN uses a whole community approach by offering training and guidance to emergency managers and planners, disability advocates, and other service providers responsible for planning for, responding to and helping communities recover from disasters. For more information about OAFN, visit the OAFN web page at: http://www.caloes.ca.gov/Cal-OES-Divisions/Access-Functional-Needs.

In addition, the California Department of Social Services (CDSS) initiated a planning effort by putting together a stakeholder group that included local, state, and federal government organizations, as well as various community-based organizations and private non-profit organizations, to determine how individuals with access and functional needs could be better supported in general population shelters.

The result of the stakeholder group process was the creation of the Functional Assessment Service Team (FAST) program. The purpose of the FAST program is to provide trained staff in general population shelters to conduct functional assessments of shelter residents. The assessments will evaluate the immediate needs that people with disabilities and others with access and functional needs may have when evacuated to emergency/disaster shelters. Once the needs have been assessed, the FAST member will initiate the appropriate resource request for the shelter resident. FAST members will be deployed to shelters when the resource is requested by the shelter manager and the members will remain in the shelters until it is determined that they are no longer needed. The CDSS administers the FAST program and works with counties and cities to develop their FAST programs and incorporate the program into their local mass care and shelter plans. The CDSS also collaborates with the counties to bring the FAST program training to their communities.

For more information about the FAST program, visit the following link on the CDSS website: http://www.cdss.ca.gov/inforesources/Mass-Care-and-Shelter/FAST.

Economy

As a result of its large population, productive industry, and large agricultural sector, California has the largest economy of any state in the nation. World Bank estimates from 2017 rank California as the fifth largest economy in the world. California's economy represents 13.7 percent of the U.S. gross domestic product. It is a highly diversified economy with jobs and businesses in many different industries.

As of February 2017, California had the largest labor market in the U.S. with an estimated 16 million non-farm jobs and 18 million total employed persons.[36] California's largest industries include trade, transportation, and utilities (3.00 million jobs); professional and business services (2.55 million jobs) and government (2.52 million jobs). California is strong in the manufacturing of electronic equipment, computers and related chips and software, machinery, transportation equipment, and metal products. It continues to be a major center for motion picture, television, film, and related entertainment industries. Tourism is another important source of income.

The state is the nation's largest producer of agricultural products. The Central Valley, covers about 20,000 square miles and, contains 75 percent of California's irrigated land. Using less than 1 percent of U.S. farmland, the Central Valley supplies 8 percent of U.S. agricultural output (by value) and produces 25 percent of the nation's food, including 40 percent of the nation's fruits, nuts, and other table foods.[37] With an unemployment rate of 4.9 percent as of October 2017,[38] the state contains two million people who may be vulnerable to economic distress.

Infrastructure

California has an extensive infrastructure system. The state contains more than 1,250 dams under state jurisdiction, and 11 seaports that handle over half of the shipping freight in the United States. Additionally, California has over 170,000 miles of roads, 50,000 miles of highways, over 12,000 bridges, and 246 public use airports, including Los Angeles International Airport, which is the world's seventh busiest.[39] The state contains over 115,000 miles of oil and natural gas pipelines, 20 refineries and over 100 oil and natural gas terminal facilities, and more than a dozen of the U.S.'s largest oil fields.

California has over 7,400 public drinking water systems serving safe, clean, wholesome potable water reliably and adequately to the citizenry of California. The California State Water Resources Control Board is mandated to regulate and oversee this critical infrastructure. The drinking water infrastructure has a direct effect upon the communities' health.

[36] www.bls.gov/eag/eag.ca.htm
[37] https://ca.water.usgs.gov/projects/central-valley/about-central-valley.html
[38] http://www.ncsl.org/research/labor-and-employment/state-unemployment-update.aspx
[39] http://www.caloes.ca.gov/cal-oes-divisions/law-enforcement/critical-infrastructure-protection

California has the largest public education system in the world, including 23 campuses of the California State University (CSU) system, 10 campuses of the University of California (UC) system, and 109 community colleges within 72 districts, in addition to many K-12 public and private schools. The State of California owns more than 20,000 buildings and leases space at more than 2,298 sites.

Critical infrastructure is essential to the state's ability to provide assistance to its people for their everyday lives. Critical infrastructure such as transportation routes, utilities, government facilities, schools, and hospitals also provides the state with the capacity to respond to disasters. California's resiliency (the ability to withstand, respond to, and recover from a disaster) strongly depends on its capacity to quickly restore the functioning of critical infrastructure and facilities after disasters.

Estimated Animal Population

There are approximately 19 million domestic animals in California, and countless millions of wild animals beyond that. About one out of every three households in California owns a dog or cat.[40] The state is estimated to contain:

- Nearly 6.7 million dogs
- Over 7.1 million cats
- Approximately 500,000 horses
- Approximately 5.5 million cattle
- About 711,000 sheep and goats

For more information on pet planning and preparedness, visit:
http://www.caloes.ca.gov/for-individuals-families/california-animal-response-emergency-system.

4.1.2 GROWTH PATTERNS AND TRENDS

Recent Growth Trends

From 2012 to 2016, California's population grew by an estimated 1,214,394 people, or 3.2 percent.[41] Table 4.D shows the top 10 counties in population growth from 2012 to 2016. Highest growth took place in the five most heavily populated Southern California counties. Growth in the top 10 counties totaled 970,009 people, representing an estimated 70 percent of the state's growth.

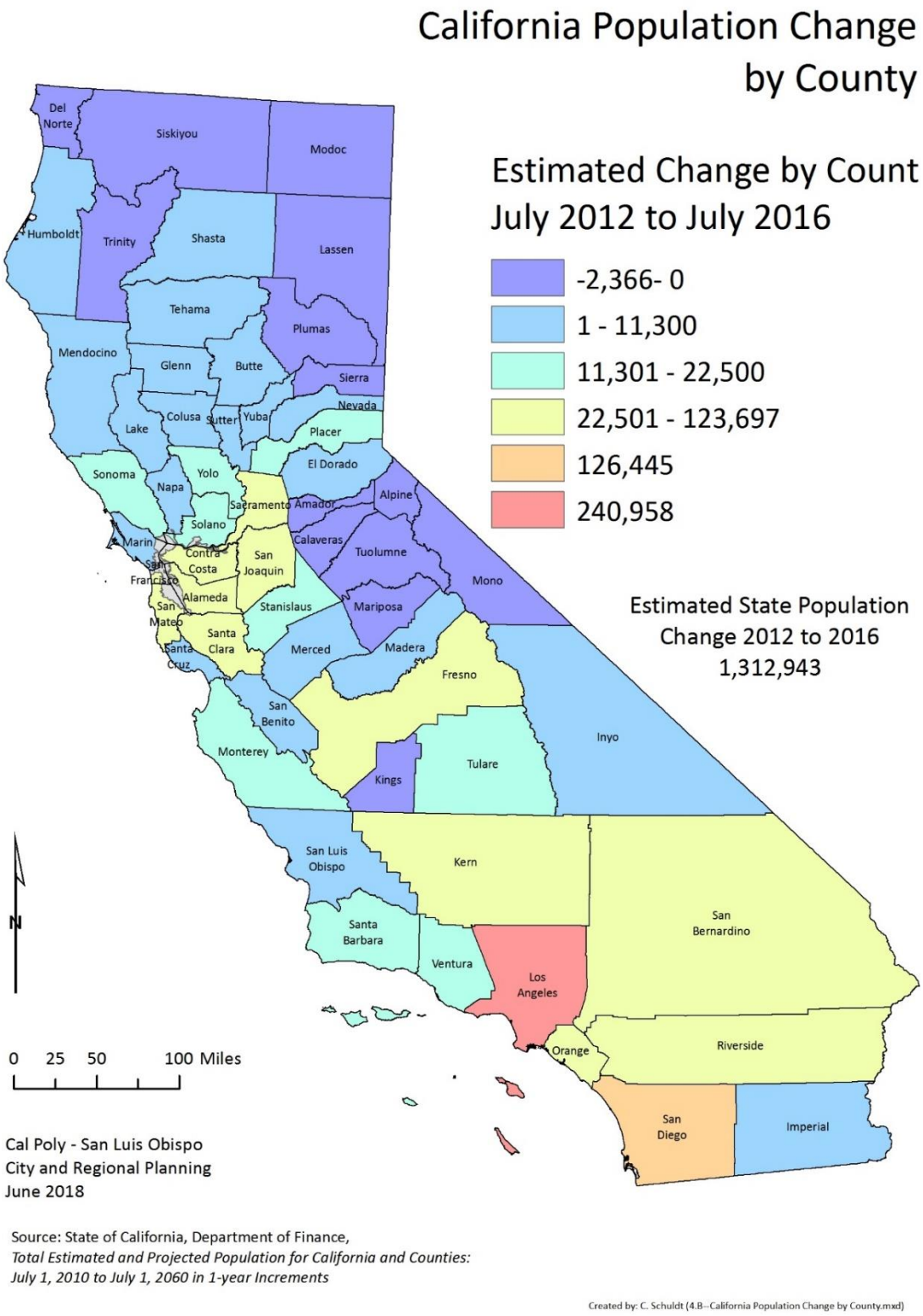
Table 4.D: Top 10 Counties in Population Growth, 2012-2016

County	2012-2016 Rank	2000-2012 Rank	Population Change, 2012 to 2016
Los Angeles	1	2	240,958
San Diego	2	4	126,445
Riverside	3	1	107,410
Orange	4	5	97,335
Santa Clara	5	9	89,997
Alameda	6	--	83,266
San Bernardino	7	3	70,373
Sacramento	8	6	61,447
Contra Costa	9	--	54,229
Fresno	10	8	38,549
TOTAL			**970,009**

Source: http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/ http://www.dof.ca.gov/Forecasting/Demographics/projections/ (Table P-1 and P-2)

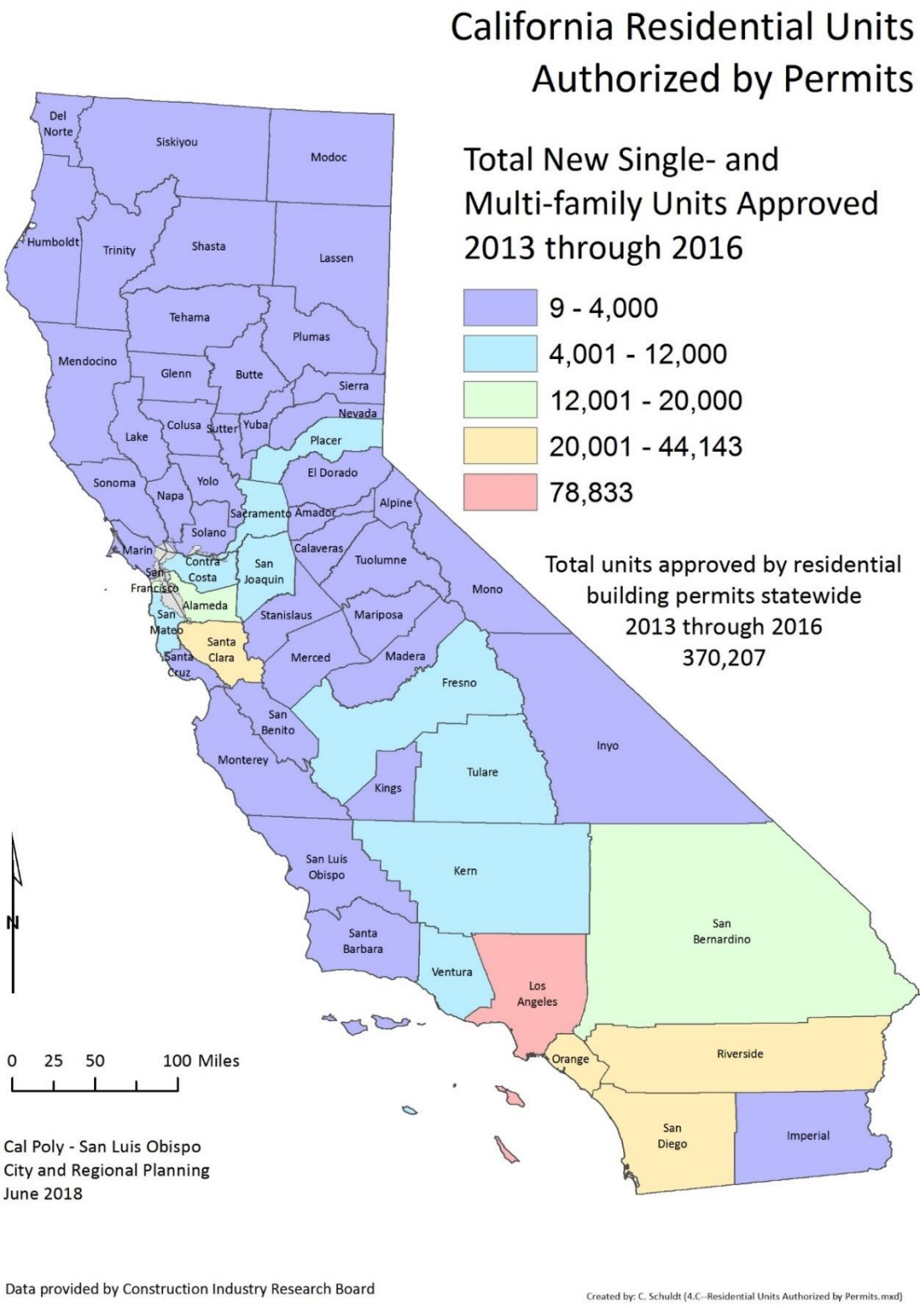
[40] https://cal-cares.com/
[41] http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/

Map 4.B: California Population Change by County



Map 4.B shows that population growth from 2012 to 2016 has been concentrated largely in Southern California, San Francisco Bay, Sacramento area, and Central Valley counties.

Map 4.C: California Residential Units Authorized by Permits



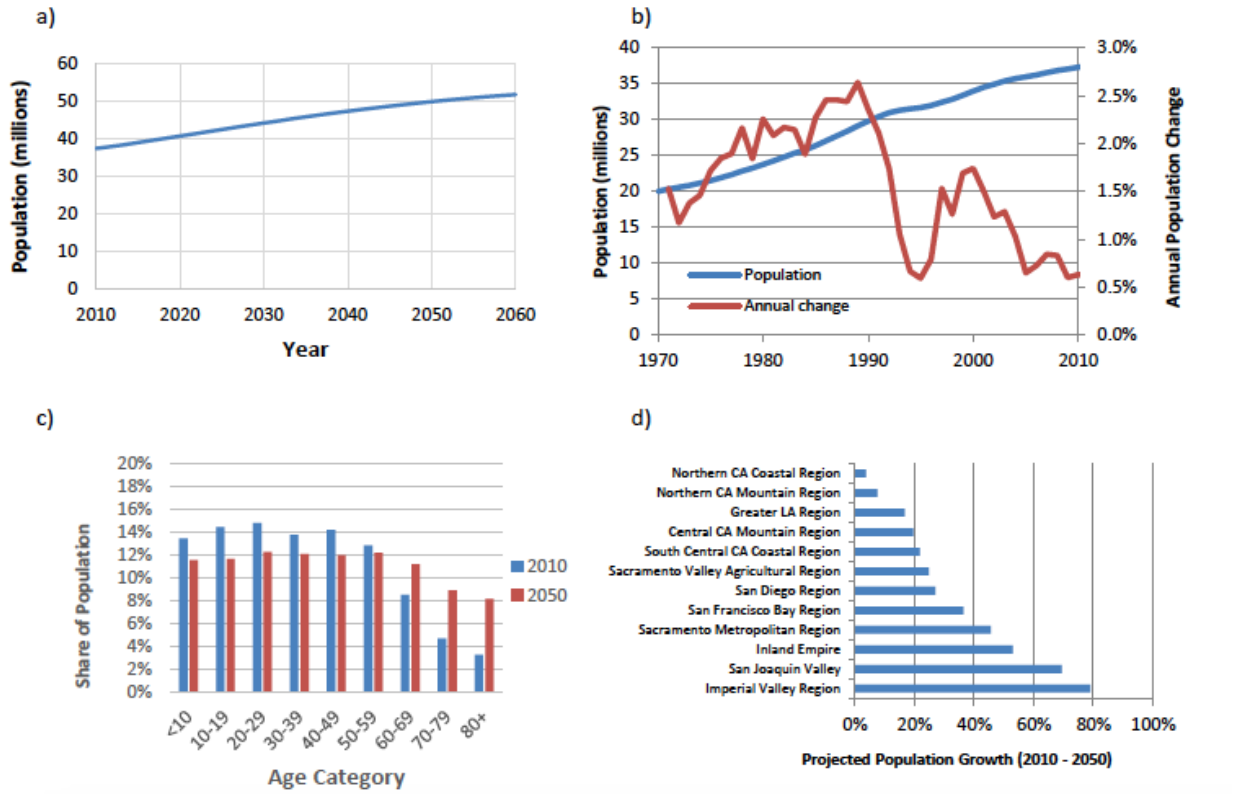
Map 4.C shows the ranges of additional dwelling units authorized by building permits. Most of the approved new units are in Southern California, the Bay Area, and the Sacramento area. Building codes and other state and local mitigation efforts assist in minimizing losses that this new development experiences from future disasters. With

climate change, however, increased severity of storms and prolonged droughts will increase vulnerability of this new development to flooding and wildfires.

Projected Growth Trends

By 2050, the population is expected to reach 50,365,074, roughly 12 million more people than presently live in California. As this growth occurs, California's age demographics are also projected to shift, with a greater percentage of the population 60 years of age or older.

Figure 4.A: California Population Projections

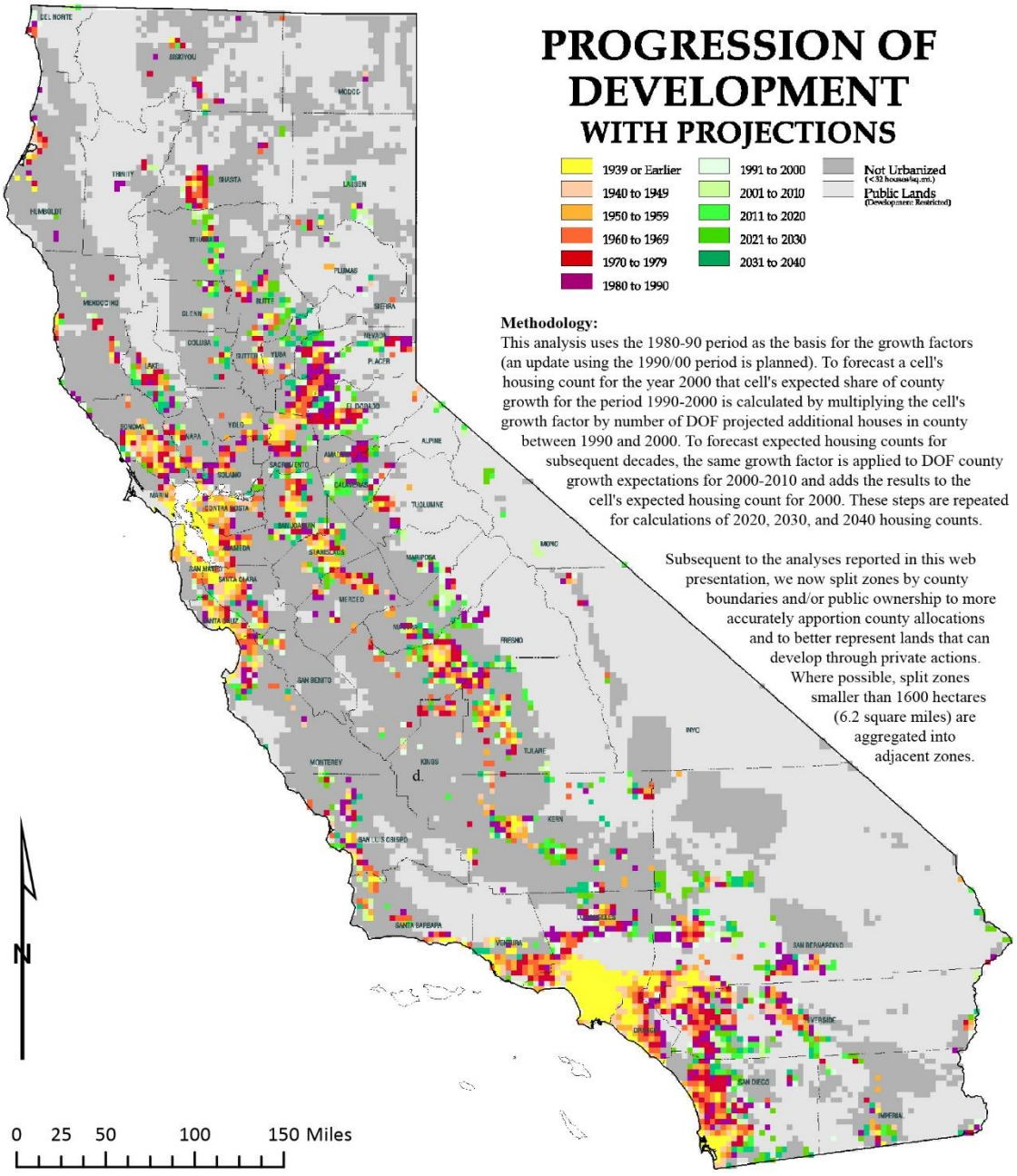


Source: A Strategy for California@50 Million, The Governor's Environmental Goals, and Policy Report, November 2015, http://opr.ca.gov/planning/environmental-goals/

Growth projections shown in Figure 4.A indicate a spatial shift from coastal development (mainly in Los Angeles, Orange, and San Diego Counties) to development inland, mainly in the Central Valley, the Imperial Valley, and the Inland Empire, located east of Los Angeles County. These are warmer and drier areas of the state, with available land for expansion. In order to address this growth, Governor Brown, in his inaugural address, set forth five pillars to support the long-term reduction of climate pollution, protect public health, and steward the state's natural resources to support resilience and other environmental benefits.[42] One of these five pillars is stewarding natural resources, including forests, working lands, and wetlands, to ensure that they store carbon, are resilient, and enhance other environmental benefits. This pillar establishes a basis for a "co-benefit approach" in which state investments may serve more than one purpose.

[42] The other pillars are:
1. Increasing the share of renewable energy in the state's energy mix to at least 50 percent by 2030;
2. Reducing petroleum use by up to 50 percent by 2030;
3. Increasing the energy efficiency of existing buildings by 50 percent by 2030;
4. Reducing emissions of short-lived climate pollutants.
Source: Supporting California's Climate Change Goals (November 2015) State of California Office of Planning and Research

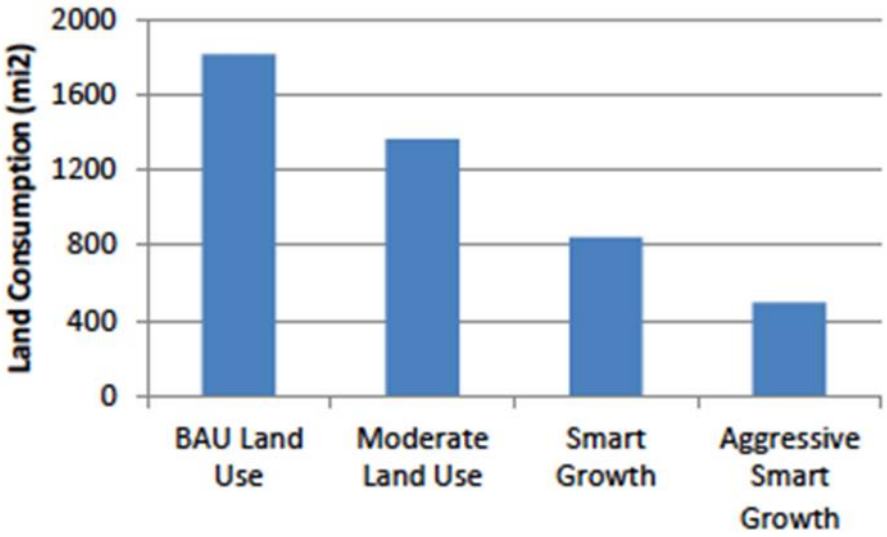
Map 4.D: California's Projection of Development Based on Historical Factors



For the purposes of projecting location of development in the next two decades, Map 4.D indicates a continued inland expansion, mostly occurring in the inland areas of the southern portion of the state and the Central Valley. Land use strategies promoted by the state and coordinated with local governments could affect the rate and location of development.

A major land use strategy to address residential and commercial growth is to pursue "aggressive smart growth." In Figure 4.B, where BAU means "Business As Usual", the amount of land required to accommodate growth is shown using four scenarios. As discussed in the Governor's 2015 Environmental Goals and Policy Report, close to 75 percent less land can be developed under aggressive smart growth policies compared to continuing traditional development patterns. Aggressive smart growth is the scenario yielding less environmental impact and a denser urban pattern (supported by transit services).

Figure 4.B: California Growth Scenarios



Source: State of California: A Strategy for California@50 Million, The Governor's Environmental Goals, and Policy Report. November 2015. Available online at: http://opr.ca.gov/planning/environmental-goals/

In support of "smarter growth" the California Strategic Growth Council has invested over $150 million to support sustainable community planning and urban greening.[43] The Strategic Growth Council is now investing over $100 million annually to support project implementation in the Affordable Housing and Sustainable Community Program, which is being funded with proceeds from Greenhouse Gas Reduction Fund. These efforts are examples of the "co-benefit approach" in action; saving more land supports environmental actions and will lead to a more compact overall urban pattern in the next 30 years.

Implications of Growth on Risk

Growth patterns have a direct bearing on the impacts of hazards, risk, and vulnerability. *Chapter 6* describes rapid growth in Southern California counties, including Los Angeles, Orange, Riverside, and San Bernardino, that has intensified high earthquake hazard exposure of large, vulnerable populations. The San Francisco Bay region constitutes nine counties (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma), and contains roughly 19 percent of California's population, making this region's earthquake and hazard vulnerability high. As noted in *Chapter 7*, Central Valley counties are highly vulnerable to flood hazards and, as noted in *Chapter 8*, the foothill and mountainous counties have high vulnerability to wildfire hazards. Inland counties are replacing coastal counties as the leading growth areas.

[43] The Council is comprised of agency secretaries from the California Business Consumer Services and Housing Agency (BCSH), California Health and Human Services (CHHS), California Environmental Protection Agency (CalEPA), California State Transportation Agency (CalSTA), the California Department of Food and Agriculture (CDFA) and the California Natural Resources Agency (CNRA); the director of the Governor's Office of Planning and Research (OPR); and three public members - one each appointed by the Governor, Senate Committee on Rules, and Speaker of the Assembly. Its mission is to coordinate the activities of State agencies and partners with stakeholders to promote sustainability, economic prosperity, and quality of life for all Californians.

Table 4.E compares residential permits by county for 2013 and 2016, demonstrating percentage of growth in the top 15 counties listed. As seen in the table, the top three counties in terms of residential growth remained the same in ranking between 2013 and 2016, while there were slight adjustments in the ranking of other counties. Overall, Southern California and the San Francisco Bay Area counties saw the most residential growth in the state.

Table 4.E: Residential Permits by County, 2013 and 2016

County	Permits Issued 2013	2013 Rank	County	Permits Issued 2016	2016 Rank
Los Angeles	16,895	1	Los Angeles	20,339	1
Orange	10,453	2	Orange	12,157	2
San Diego	8,382	3	San Diego	10,100	3
Santa Clara	7,868	4	Riverside	6,506	4
Riverside	6,220	5	Santa Clara	5,367	5
San Francisco	5,277	6	Alameda	5,277	6
Alameda	3,362	7	San Francisco	4,207	7
San Bernardino	3,313	8	San Bernardino	3,765	8
Fresno	3,083	9	Sacramento	3,285	9
Kern	2,472	10	Contra Costa	2,896	10
Contra Costa	1,955	11	Fresno	2,881	11
Sacramento	1,909	12	Placer	2,418	12
Placer	1,476	13	San Joaquin	2,300	13
San Mateo	1,190	14	Kern	2,247	14
San Joaquin	1,136	15	San Mateo	1,754	15
Total	*74,991*		*Total*	*85,499*	
Percent of State	*88%*		*Percent of State*	*85%*	
California Total	**85,472**			**100,658**	

Source: CIRB (Construction Industry Research Board)

Most growth illustrated by residential permit issuance in California has taken place largely in three clusters: the Southern California region, the San Francisco Bay area, and the Sacramento-Delta region. The top 15 counties in these regions, with permit issuance rates at over 1,000 per year, represented approximately 88 percent of growth in the state and accounted for significant physical growth in the state.

This information, when compared with Map 4.G (State and Federal Declared Disasters) later in this chapter, indicates that a substantial amount of growth has occurred in areas that have a significant disaster history. Specifically, in Los Angeles, San Bernardino, and Riverside Counties, there are high rates of disaster declarations alongside physical growth and urban development. This trend illustrates increased disaster risks for populations in these counties.

While earthquake risk in California is a concern, the California Residential Mitigation Program, California Earthquake Authority's Brace + Bolt Program, and State Building Standards have increased physical and community resiliency to earthquake damage in these growth areas and across the state. Hazards of greater concern based on growth areas are flooding (particularly coastal flooding) and wildfire risk, with increased frequency of risks due to a changing climate. California will work to implement mitigation and adaptation strategies in the areas that have seen increased development between 2012 and 2016.

An important objective of future land use planning is to include the consideration of the effects of climate change on fire risk and other aspects of public safety. In anticipation of continued population growth in the state's wildland-urban interface areas and uncertainties related to climate change, public safety impacts from more frequent, intense wildfires will be addressed through strategic planning at both the local level (where building permits are issued) and the regional scale. An example of new local co-benefit action is the "Build Forward" effort in the City of Los Angeles, the aim of which is to encourage buildings of all types to integrate advancements and innovations in design,

engineering, and construction, and to take full advantage of the buildings' ability to improve the environment. Through this effort, buildings become part of the solution to achieve a safer city.

Additionally, the policies the California Department of Housing and Community Development (HCD) creates are in response to California's current housing challenges. Those challenges include:

- *Not enough housing being built*: During the last ten years, housing production averaged fewer than 80,000 new homes each year, and ongoing production continues to fall far below the projected need of 180,000 additional homes annually.
- *Increased inequality and lack of opportunities*: Lack of supply and rising costs are compounding growing inequality and limiting advancement opportunities for younger Californians. Without intervention, much of the new housing growth is expected to be focused in areas where fewer jobs are available to the families that live there.
- *Too much of people's incomes going toward rent*: The majority of Californian renters—more than 3 million households—pay more than 30 percent of their income toward rent, and nearly one-third—more than 1.5 million households—pay more than 50 percent of their income toward rent.
- *Fewer people becoming homeowners*: Overall homeownership rates are at their lowest since the 1940s.
- *Disproportionate number of Californians experiencing homelessness*: California is home to 12 percent of the nation's population, but a disproportionate 22 percent of the nation's homeless population.
- *Many people facing multiple, seemingly insurmountable barriers—beyond just cost—in trying to find an affordable place to live*: For California's vulnerable populations, discrimination and inadequate accommodations for people with disabilities are worsening housing cost and affordability challenges.

While the state's housing challenges appear overwhelming, California's housing crisis is a solvable issue. With focus and continued support, California can begin to reverse the course. Housing affordability and homelessness have far-reaching impacts that affect other important issues facing Californians, including health, education, transportation, economic well-being, and climate change. Land-use policies and planning are more than just tools to increase housing affordability. These processes also drive the type and location of housing, which can translate into the ability for families to live in neighborhoods of opportunity, where children can attend higher-performing schools, where there is a greater availability of jobs that afford entry to the middle-class, and where people have convenient access to transit and services.

As California works to ensure equity and reduce greenhouse gases, the focus has turned to more compact development that reduces sprawl (and many of its negative environmental and health consequences); however, targeting development to specific areas can put pressure on limited land and result in higher costs for a variety of reasons (infrastructure limitations, demand for limited land, etc.). The true costs of sprawl are much higher when taking into account health impacts, environmental damage, and lost productivity, but these costs are often "hidden" from housing prices.

4.1.3 NATURAL ENVIRONMENT

Geography

California has the third largest land area among the nation's 50 states, with roughly 163,695 square miles. Its location and physical configuration make it vulnerable to many different hazards. For example, the state has over 1,100 miles of coastline, and is home to several major coastal cities—including San Francisco, Los Angeles, and San Diego—that are prone to flooding, tsunamis, and rising sea-levels. Associated with much of the coastline are the northern and central coastal mountain ranges, which have rugged terrain.

A key inland feature is the Central Valley, a fertile valley bounded by the coastal mountain ranges to the west, the Sierra Nevada to the east, the Cascade Range to the north, and the Tehachapi Mountains to the south. It contains 11 percent of the state's land mass, and has 18 counties (ten in the northern Sacramento Valley and eight in the southern San Joaquin Valley). Mountain-fed rivers irrigate the Central Valley. With dredging, a number of these

rivers have become sufficiently large and deep that several inland cities, most notably Stockton, are harbor communities that can dock ocean-going vessels.

The Sierra Nevada range runs much of the length of California's eastern border. Located in the Sierra Nevada are Mount Whitney, the highest peak in the continental U.S. at 14,494 feet[44]; Yosemite National Park; and Lake Tahoe. To the east of the Sierra are the Owens Valley and Mono Lake, which are environmentally significant as habitat essential to birds. The south portion of the state has the Transverse Ranges, one of the few east-west trending ranges in the country; the Mojave Desert; and Death Valley, which contains the lowest point in North America (282 feet below sea-level) and has the hottest recorded temperature in the U.S. (134 degrees, on July 10, 1913).

Geology and Seismicity

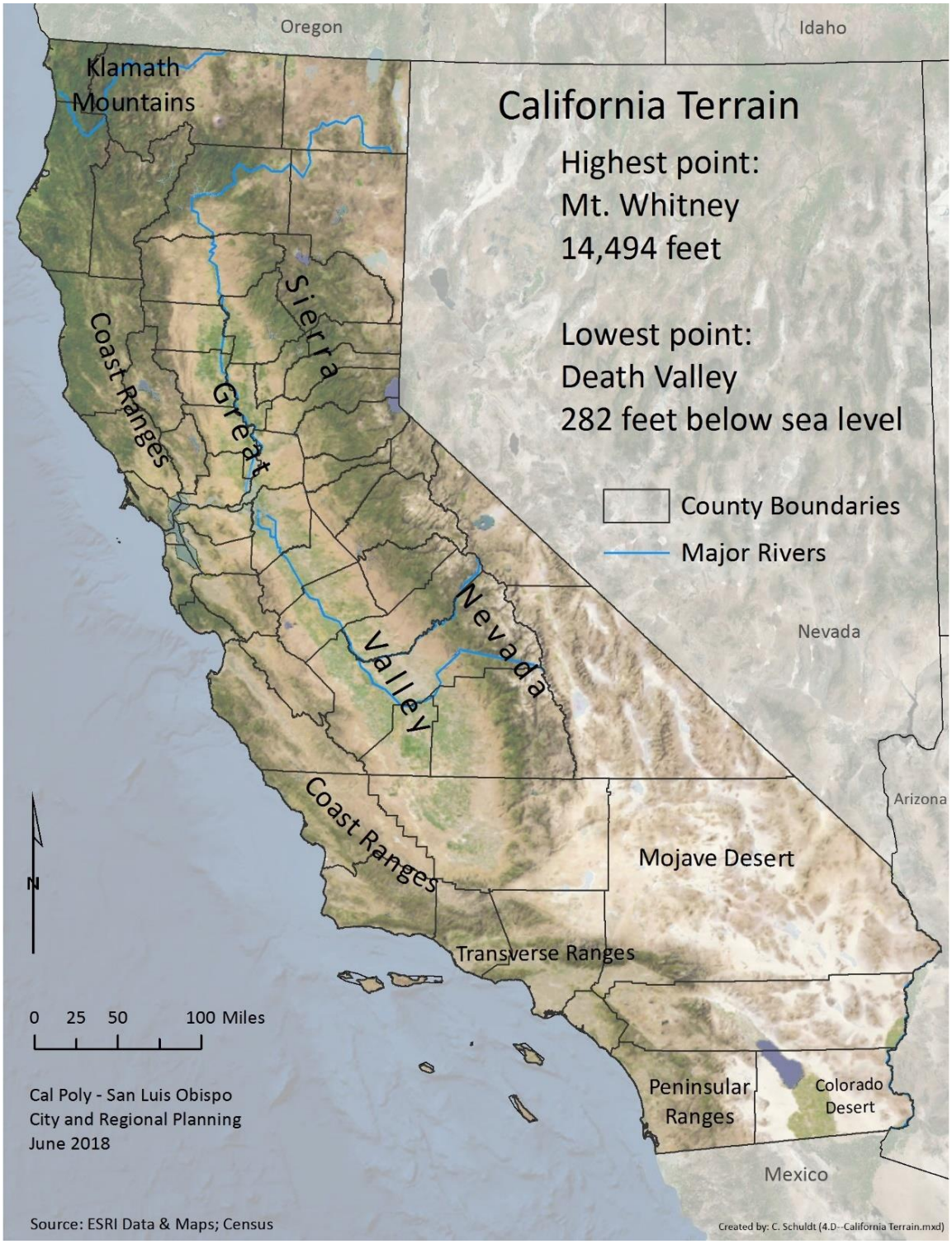
California has extensive seismic activity. While Alaska experiences the greatest number of large earthquakes, most located in remote and uninhabited areas, California experiences the most *damaging* earthquakes[45] because of its greater population and extensive infrastructure. According to the Federal Emergency Management Agency (FEMA) 2017 Estimated Annualized Earthquake Losses for the United States, 61 percent ($3.7 billion) of the country's overall expected annualized losses are concentrated in California alone, consistent with the state's population and building inventory exposed to earthquake hazard.[46] Earthquakes have claimed the lives of more than 3,000 Californians in the past two centuries.

Not only is California more seismically active than all other states except Alaska and Oklahoma, but it also has more than two-thirds of the nation's earthquake risk, according to the California Earthquake Authority. Alaska registers the most earthquakes in a given year, with California placing second until 2014, when a sudden increase in seismicity in Oklahoma pushed it well past California as the second most active in terms of magnitude 3.0 or greater earthquakes. In 2014, there were 585 magnitude 3.0 or greater earthquakes in Oklahoma and about 200 in California. As of April 2015, Oklahoma was still well ahead of California with 260 events compared to California's 29 events.[47]

California sits at the juncture of two major tectonic plates, the North America Plate and the Pacific Plate. The San Andreas Fault generally parallels the coast in a southeasterly direction, coming ashore near Eureka, passing west of San Francisco and east of Los Angeles into Mexico.

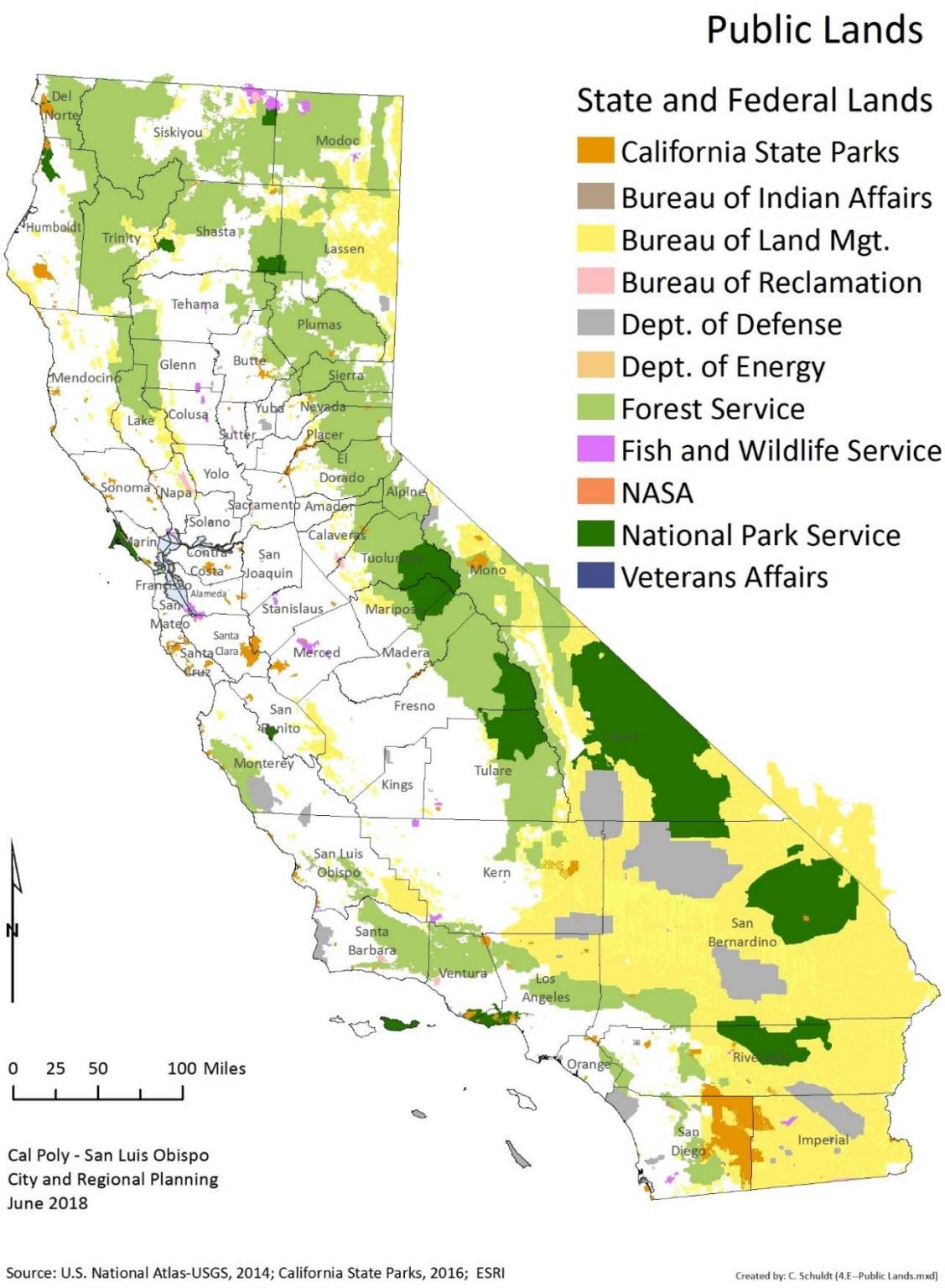
[44] https://www.nps.gov/seki/planyourvisit/whitney.htm
[45] FEMA Earthquake Fast Facts. https://www.fema.gov/earthquake
[46] Hazus Estimated Annualized Earthquake Losses for the United States: FEMA P-336, April 2017. https://www.fema.gov/media-library-data/1497362829336-7831a863fd9c5490379b28409d541efe/FEMAP-366_2017.pdf
[47] https://earthquake.usgs.gov/learn/topics/megaqk_facts_fantasy.php

Map 4.E: California Terrain



Map 4.E shows the general topography of California, including 1,100 miles of coastline from Oregon to Mexico. The Central Valley, labeled as "Great Valley" on the map, is a major topographic feature; the valley collects major river run-off from the Sierra Nevada Range and channels it though the Delta to San Francisco Bay and out to the Pacific Ocean.

Map 4.F: California Public Lands



Map 4.F shows that most state and federal public land holdings are in mountainous regions of the state. Hazards originating on these public lands can affect nearby communities and infrastructure within the area.

The San Andreas Fault is not the only significant fault/plate boundary in California. The seismicity north of the Cape Mendocino is controlled by faults associated with the Cascadia Subduction Zone, a large fault system offshore that separates the Juan de Fuca Plate to the west and the North American Plate to the east. This area is the most seismically active portion of the state.

Watersheds and Terrain

The Sacramento and San Joaquin Rivers and their tributaries, which drain the Central Valley, form California's principal river systems. On average, the state receives about 200 million acre-feet of water per year in the form of rain and snow. In reality, the average rarely occurs, as California has the most variable weather conditions in the nation and climate change may increase the variability.[48]

The Sacramento River, the longest river in the state, flows south for 377 miles to its junction with the San Joaquin River. The Sacramento and San Joaquin Rivers unite to form a large inland delta that drains into Suisun Bay, the eastern arm of San Francisco Bay. Development vulnerable to flooding continues to occur in floodplains associated with this extensive network of rivers.

Coastline

California has 1,100 miles of general coastline encompassing beaches, rocky cliffs, harbors, and estuaries, as well as coastal communities that range from metropolitan cities to rural towns.[49] California's ocean and coast are among its most valuable assets, including diverse and highly productive ecosystems with abundant wildlife, the state's marine fisheries, and many recreational opportunities.

Public Lands

Map 4.F shows California's major public land areas. The largest category is U.S. Forest Service land, which covers over 22 million acres (as of 2014). Other major public holdings include those of the Bureau of Land Management and National Park Service. Collectively, federally owned land in California totals 45,864,800 acres, while state-owned land totals 100,206,720 acres. Forest and rangelands in and near these public holdings are subject to wildfire risk, which is increasing due to climate change.

Ecosystems

According to the California Climate Adaptation Strategy, California is one of the most biologically diverse regions of the world, with the most unique plant and animal species and greatest number of endangered species among all 50 states. Its wide biodiversity stems from its varied climate and assorted landscapes. Ecological communities include coastal ranges, coastal dunes, wetlands, kelp forests, rivers, lakes, streams, deserts, grasslands, chaparral, and inland, forested mountains among others. The vast number of endemic species here, combined with high level of threats to their persistence, makes California one of 25 biodiversity "hotspots" on earth.[50]

[48] California Water Action Plan 2016 Update
[49] http://www.opc.ca.gov/2010/11/the-california-shoreline-mapping-project/
[50] Stein, Bruce A., Lynn S. Kutner, and Jonathan S. Adams (eds., 2000). Precious Heritage: The Status of Biodiversity in the United States. Oxford, UK: Oxford University Press.

4.2 CALIFORNIA'S DISASTER HISTORY

Federal regulations require each state to undertake a risk assessment of the hazards and vulnerabilities that affect it in order to provide a factual basis for developing a hazard mitigation strategy.

The following analysis of California's disaster history provides a foundation for the risk assessment found in *Chapters 6 through 9*. Together those chapters identify emerging hazard, vulnerability, and risk issues, linking them to mitigation strategies and actions.

For a more detailed account of the state's disaster history from 1950 to present, see *Appendix E, California Disaster History*.

4.2.1 STATEWIDE DISASTER LOSS FINDINGS

Over the past six decades, disasters and corresponding losses have grown rapidly as has California's population. Table 4.F shows overall increases in state emergency proclamations and federal disaster declarations from 1950 through 2017.

The table also shows casualties and Cal OES-administered disaster costs by decade. These casualties and costs peaked in the 1990s due to the 1994 Northridge Earthquake. Figures for deaths and injuries are partial for the periods 2000-2009 and 2010-2017, and are based on best available data.

Table 4.F: Disasters and Losses by Time Phase, 1950 – 2017

Year	State Emergency Proclamations [a]	Federal Disaster Declarations [a]	Deaths [b,d]	Injuries [b]	Cal OES-Administered Costs [b, c]
1950 – 1959	8	3	100	227	$332,283,000
1960 – 1969	32	12	99	1,224	$706,931,196
1970 – 1979	60	18	96	2,226	$4,197,670,330
1980 – 1989	60	23	128	5,243	$3,342,205,537
1990 – 1999	48	19	224	15,592	$9,245,038,369
2000 – 2009	63	101	59	885	$1,845,112,390
2010 – 2017	52	91	92	27	$1,120,667,471
Total	**323**	**267**	**798**	**25,424**	**$20,789,908,293**

Source: California Governor's Office of Emergency Services (Cal OES) database

[a] Through 2017.

[b] Information from 2000-2017 remains preliminary based on Incident Command System (ICS) Reporting and Cal OES After Action Reviews

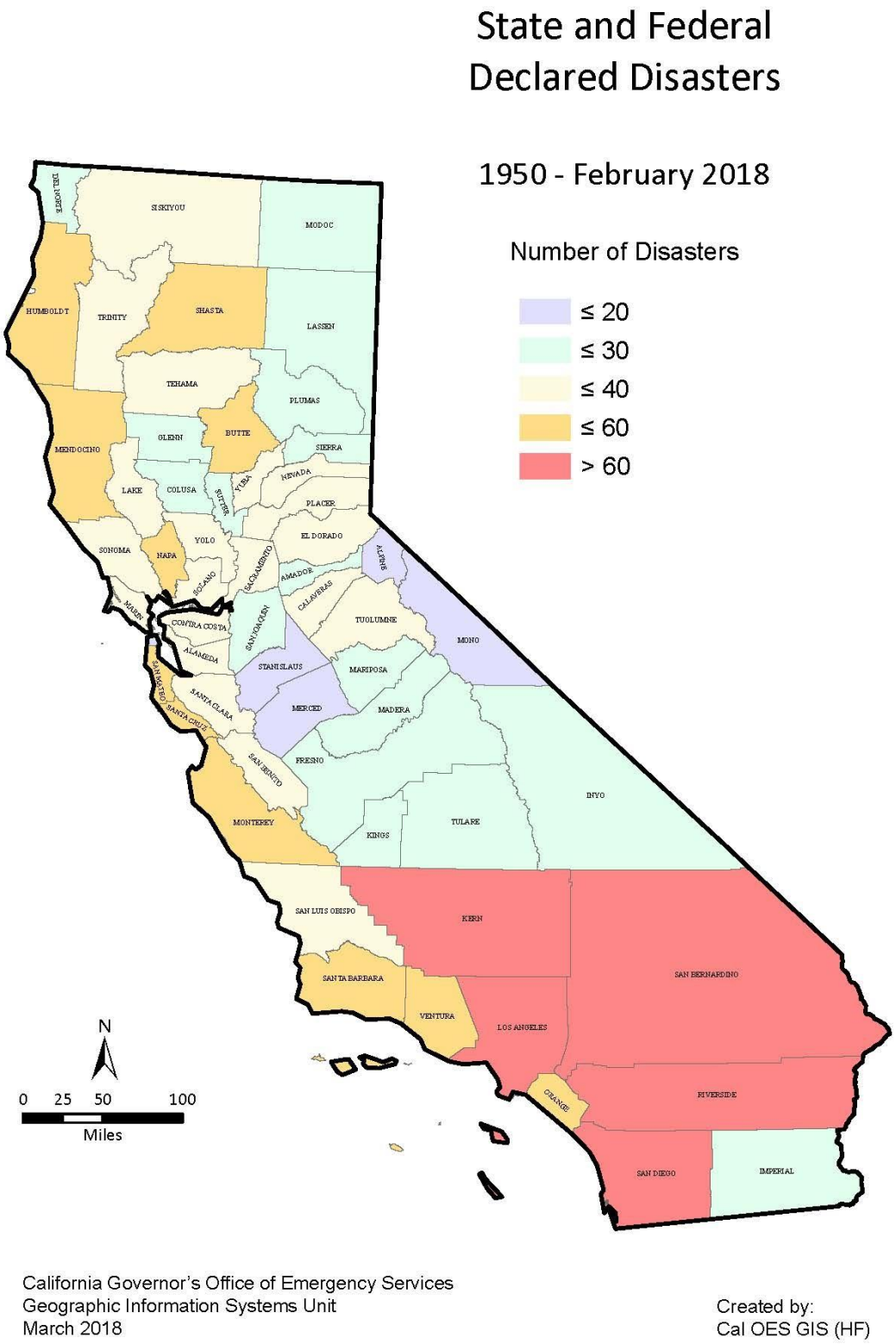
[c] Figures in this column show only certain post-disaster recovery costs, such as Individual and Public Assistance grants, which together reflect only a portion of total disaster costs. Disaster costs reflect actual estimates at the time of incidents not adjusted for inflation through normal means such as applying the Consumer Price Index to get equivalent values.

[d] Information from the California Department of Forestry and Fire Protection (CAL FIRE): http://cdfdata.fire.ca.gov/incidents/incidents_statsevents

As discussed in *Chapter 3*, California's leading mitigation goal is to significantly reduce life loss and injuries. Table 4.G provides an overall perspective on life loss and injury in relation to population growth for the period from 1950 to 2017.

California's population more than tripled from 1950 to 2017, while numbers of deaths resulting from disasters remained within a relatively narrow range. Injuries have varied more widely. Over 11,000 injuries during the 1990s were due to the Northridge Earthquake.

Map 4.G: State and Federal Declared Disasters, 1950-February 2018



Map 4.G shows the pattern of California disasters since 1950. The largest numbers have occurred in Southern California in the state's most heavily populated counties.

Table 4.G: Population and Disaster Deaths and Injuries by Time Phase, 1950 – 2017

Year	State Population Beginning of Decade	Deaths	Injuries
1950 – 1959	10,586,000	100	227
1960 – 1969	15,717,000	99	1,224
1970 – 1979	19,953,000	96	2,226
1980 – 1989	23,668,000	128	5,243
1990 – 1999	29,760,000	224	15,592
2000 – 2009	33,872,000	59	885
2010 – 2017	37,253,956	92[a]	27

Source: California Governor's Office of Emergency Services (Cal OES) database. At the time of this writing, information for "Deaths," and "Injuries," from 2000-2017 remains preliminary based on Incident Command System (ICS) Reporting and After Action Reviews; population from Counting California, UC Libraries

[a] Information from the California Department of Forestry and Fire Protection (CAL FIRE): http://cdfdata.fire.ca.gov/incidents/incidents_statsevents

Table 4.H: Declared or Proclaimed Disaster Incidents, Casualties, and Cost by Type, 1950 – 2017

Disaster Type Per Federal Emergency Management Agency (FEMA)	Declared/ Proclaimed Emergencies Through 2017*	State Emergency Proclamations Though 2017	Federal Disaster Declarations Though 2017	Deaths Through 2017**	Cal OES-Administered Costs Though 2017**
Fire	287	96	191	209[a]	$3,363,404,368
Flood	168	118	50	302	$4,723,407,152
Earthquake	35	22	13	193	$8,144,903,796
Agricultural	18	17	0	0	$389,895,974
Freeze	9	8	4	0	$1,017,890,620
Landslide	9	8	1	24	$126,172,037
Civil Unrest	6	6	1	85	$167,722,732
Drought	9	9	0	0	$2,722,036,634
Hazardous Material	5	3	0	0	0
Wind	3	3	0	0	$82,100
Tsunami	3	3	2	13	$49,617,379
Invasive Species	1	1	0	0	0
Storms	13	9	1	0	$74,115,181
Tornado	1	1	0	0	0
Other	5	5	1	0	$10,660,320
Total	***572***	***309***	***264***	***826***	***$20,789,908,293***

Source: California Governor's Office of Emergency Services (Cal OES) database

**Any event not included in the state proclamation or federal declaration column may be included as a local emergency proclamation.*

***Death and injury estimates from 2003-2017 based on Incident Command System Reports and After Action Reviews. Administered Costs include obligated, but unspent expenditures in the case the incident remains open for Individual and Public Assistance grants. Any additional death information was provided by Cal OES Law Enforcement Branch*

[a] Information from the California Department of Forestry and Fire Protection (CAL FIRE): http://cdfdata.fire.ca.gov/incidents/incidents_statsevents

Table 4.H identifies disaster incidents, casualties, and Cal OES costs by type. This table does not take into account the cost of losses to natural or green infrastructure. Cal OES revised the database from which these summary tables were drawn during the preparation of the 2013 State Hazard Mitigation Plan (SHMP) in an effort to continuously improve disaster history data. At the time of this writing, "Deaths," and "Injuries" information for 2000-2012 remains preliminary based on Incident Command System (ICS) Reporting and After Action Reviews. These figures will be updated when data are available. For a detailed account of the data in the preceding tables, see *Appendix E: California Disaster History*.

Need for Accurate Disaster Loss Data

The preceding disaster summary tables reflect the challenge of providing an accurate analysis of California's true long-term patterns of losses by disaster. Disaster loss databases vary widely in how data are compiled, how loss topics are defined, how data are updated, and what is included. Because no single source provides all needed data, data from such databases need to be used carefully. To compile these tables, data are pulled from various sources, as such best efforts are made to maintain consistency of the data.

It is important to recognize that monetary loss data are limited to costs of federal grant programs administered by Cal OES, such as Individual and Household Assistance, Public Assistance, and Flood Mitigation Assistance grants, and thus are inadequate to reflect the true magnitude of losses experienced in these events. It is clear from this data management challenge that there is a need for a nationwide natural hazard loss database that would provide a comprehensive clearinghouse for disaster loss information by hazard type.[51]

4.2.2 PRIMARY SOURCES OF DISASTER LOSSES

Table 4.H, which shows the pattern of emergencies, disasters, and associated losses by hazard types since 1950, when coupled with seismic knowledge, suggests the following findings:

1. Earthquakes occur less frequently than the other primary hazards causing disasters but account for the greatest combined losses (deaths, injuries, and damage costs).
2. Floods are the second most frequent disaster source and account for the second highest combined losses.
3. Wildfires are the most frequent source of declared disasters and account for the third highest combined losses.
4. Earthquake costs exceeded wildfire costs by four times, using limited measures identified in these tables.
5. Although floods have resulted in a greater number of total deaths during this period, earthquakes have accounted for the highest number of combined deaths and injuries.
6. Earthquakes represent by far the greatest long-term catastrophic disaster threat.

From this analysis, it is clear that three hazards—earthquakes, fires, and floods—are predominant among the sources of disaster since 1950. Therefore, they are referred to in this risk assessment as "primary hazards." Such findings also reflect the basis for past preparation of hazard-specific statewide mitigation plans for each primary hazard, and direct attention to primary hazards risk assessments and mitigation measures identified in *Chapters 6 through 8*.

Earthquake hazard mitigation is particularly relevant to SHMP Goal 1 (Significantly reduce life loss and injuries) and SHMP Goal 2 (Minimize damage to structures and property), set forth in *Chapter 3*. In light of both the social and economic disruption caused by moderate-sized earthquakes, together with the significant potential for catastrophic disasters posed by earthquakes far greater in magnitude than those experienced since 1950, heightened attention is needed to mitigation strategies relating to this particular hazard.

4.2.3 CATASTROPHIC VULNERABILITIES

Overview

The widespread impact of a catastrophe makes it one of the most important topics in emergency management today. Characteristics of the precipitating event will severely aggravate the response strategy and further tax the capabilities and resources available to the area. Lifesaving support from outside the area will be required, and time is of the essence. The event will likely have long-term impacts within the incident area as well as on the state, and to a lesser extent the nation.

[51] Gall, Melanie, Kevin A. Borden, and Susan L. Cutter. "When Do Losses Count? Six Fallacies of Natural Hazard Loss Data." 2009. American Meteorological Society 90(6). 2009. 799.

Catastrophic events can either be fast-moving, such as an earthquake events or in some areas hurricanes, or slow-moving, such as progressive drought events that unfold and deepen over a number of years. A fast-moving catastrophic incident is defined by a sudden event, which results in tens of thousands of casualties and tens of thousands of evacuees; response capabilities and resources of the state and local jurisdictions will be overwhelmed. In the past, California has been faced largely with fast-moving events such as earthquakes and fires. However, slow-moving droughts and climate-related conditions such as sea-level rise are now thought to have the potential to develop into catastrophic-level events in California.

Recent geologic studies suggest that a megaquake could rupture the San Andreas Fault which runs through major urban areas in Los Angeles, Riverside, and San Bernardino Counties. An earthquake of magnitude 8.0 or greater in densely populated areas of Southern California would result in catastrophic destruction.

The 7.8 magnitude Shakeout2 Full Scenario, updated in 2015 with the "Ardentsentry2015 Scenario" depicted in Map 4.H, was developed by the U.S. Geological Survey (USGS) and California Geological Survey (CGS) for catastrophic event planning purposes. This scenario shows that the greatest intensity shaking would occur under densely populated areas of Southern California. Analysis of the Shakeout scenario by USGS and CGS concluded that while mitigation investments in bridges and the electrical grid will allow for a quicker restoration of some functions, there is significant vulnerability in the water conveyance system where pipes and other components cross or are located close to the San Andreas Fault. Major damage to the water system could leave the most affected areas without running water for six months.[52]

A catastrophic earthquake along the San Andreas Fault System will affect water utilities, causing failed pipelines, interrupted sources of supply, damaged facilities (e.g., water treatment plants) and ultimately loss of service. Many cities have performed earthquake seismic and supply redundancy upgrades, but up to 25 percent of households could experience intermittent water supply (or no water, 90 days post-earthquake).

Earthquake effects on the power grid can include damage to transmission lines, both – underground (which are challenging to repair) and above ground, as well as distribution stations (creating the potential for rotating outages). Timely restoration of an affected power grid is determined by several variables, but access to the affected site(s) is seen as one of the most urgent response concerns. Power restoration estimates for some major cities along the San Andreas Fault System are 25 percent within 48 hours, 95 percent within one week, and 100 percent within one month.

Another example of catastrophic vulnerability is the increase in intensity, magnitude, and frequency of fires in California. In the last five years, the state has endured four of the largest wildfires and eight of the most destructive wildfires in the state's history.[53] These events occurred at the same time that other states and countries also experienced disastrous fires, seriously stretching thin and exhausting California's robust fire and rescue mutual aid system. The state's vulnerability to additional catastrophic fire disaster events has substantially increased as a result of state's recent five-year drought (2012-2017) along with associated water shortages (the years 2012-2015 had driest four-year statewide precipitation totals on record [54]), and significant tree mortality (including the die-off of 129 million trees between 2010 and 2017[55]). Additional information regarding wildfire, drought, and tree mortality hazards can be found in *Chapters 8 and 9*.

Need for Mitigation Focus on Potential Catastrophic Events

Since much of the state's population growth in the past 67 years has been in counties with high hazard exposure, these figures ongoing mitigation investments have clearly helped limit what might otherwise have been higher loss totals from more common, small, and moderate-sized disasters. It is important to recognize, however, that during this period there have been no catastrophic events like the 1906 San Francisco Earthquake. Catastrophic events are

[52] The ShakeOut Scenario, USGS Open File Report 2008-1150, Version 1.0, 2008
[53] http://cdfdata.fire.ca.gov/incidents/incidents_statsevents
[54] https://www.water.ca.gov/LegacyFiles/waterconditions/docs/a3065_Drought_8page_v9_FINALsm.pdf
[55] USFS Tree Mortality Team/CAL FIRE News Release, December 12, 2017; https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd566303.pdf

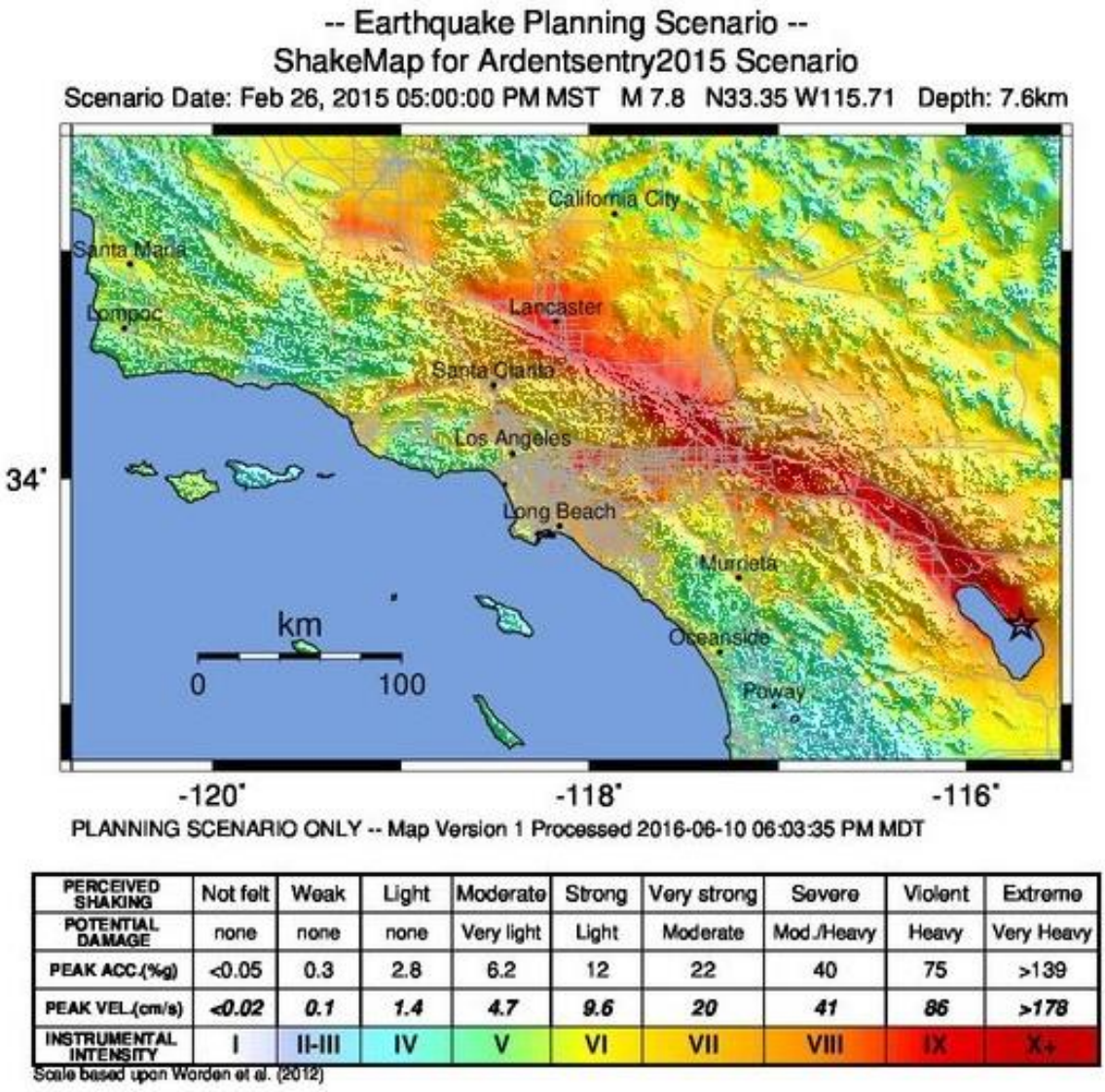
expected on longer time cycles than the many more "routine" disasters reported above. Thus, a major focus of mitigation efforts should be on the question of how to reduce losses from future catastrophic events.

Cal OES' Catastrophic Planning Division facilitates planning efforts to address and coordinate response to potential catastrophic events through development of joint local, state, and federal catastrophic event response plans including the following:

- Bay Area Earthquake Plan
- Southern California Catastrophic Earthquake Response Plan
- Cascadia Subduction Zone – Earthquake and Tsunami Response Plan
- Northern California Catastrophic Flood Response Plan

These catastrophic planning efforts help to prepare the state to respond to various catastrophic events, but only prevention and mitigation efforts and activities will help the state become more resilient to and recover faster from disasters.

Map 4.H: USGS ShakeMap for Ardentsentry2015 Scenario 7.8 Magnitude Earthquake



Source: U.S. Geologic Survey Earthquake Hazards Program

4.3 RISK FACTOR: CLIMATE CHANGE

An increasingly important factor affecting all four disaster management functions is climate change caused by increases in greenhouse gas (GHG) concentrations. Climate change reflects new uncertainties and factors shaping and conditioning hazard mitigation planning. It is addressed in this chapter as a factor intensifying impacts of many natural hazards described in *Chapters 6 through 9*.

California is already experiencing the impacts of climate change including prolonged drought, increased coastal flooding and erosion, and tree mortality.[56,57] The state has also seen increased average temperatures, more extreme heat days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year. In addition to changes in average temperatures, sea-level, and precipitation patterns, the intensity of extreme weather events is also changing. Extreme weather events and resulting hazards, such as heat waves, wildfires, droughts, and floods, are already being experienced.[58]

Climate change not only results in progressive change such as shifting seasonal weather patterns, but also affects the frequency and severity of hazard events. For example, in 2015 there were 1,800 more wildfires than average.[59] Wildfire events are becoming less predictable and more catastrophic; they are occurring in months not previously considered as typical fire season months, and with larger conflagration size and more resulting damage.

This section summarizes the way climate change influences hazard events and describes the manner in which it is addressed in the SHMP.

In order to address these changes, the State of California has developed a variety of laws, policies, and programs to both mitigate (or reduce) the emission of greenhouse gases into the atmosphere and adapt to the changes that will take place. (For further discussion on these laws, policies, and programs, see *Sections 4.3.5* and *4.3.*6.)

In the following sections, climate change and projected outcomes related to hazard probability are described, relevant state laws and policies are explained, preliminary strategies for addressing climate change are outlined, and principles for incorporating climate change into state, local, and regional hazard mitigation planning are identified.

4.3.1 WHAT IS CLIMATE CHANGE?

Climate change refers to changes in conditions that result from increased atmospheric greenhouse gas (GHG) concentrations. Monthly mean GHG levels now exceed 400 parts per million (ppm) for the first time in recorded history.[60] This GHG increase is linked to an increase in average global temperature. These global temperature and GHG increases are resulting in a series of changes to the global climate: shifts in seasonal temperature patterns; altered precipitation timing, amount, and location; sea-level rise; ocean acidification due to increased carbon dioxide (CO_2) absorption; and altered wind and storm event frequency, severity, and location. These climate change outcomes interact, and their potential consequences are the result not only of the shifts in global climate but the variety of characteristics that define biophysical systems and human development.

GHGs stay in the atmosphere for varying periods of time, from just over a decade to hundreds—and even thousands—of years.[61] In recent decades, communities all over the world have begun to curb GHG emissions. Despite these efforts, communities are experiencing the outcomes of emissions that occurred many decades in the past. In 2015, global CO_2 emissions from fossil fuel combustion and other industrial processes were estimated 36

[56] California Natural Resources Agency. Draft Report Safeguarding California Plan: 2017 Update. 2017. Sacramento: author, p. 183
[57] California Natural Resources Agency & California Emergency Management Agency. (2012). California Adaptation Planning Guide. 2012. Sacramento: author.
[58] Ibid
[59] CAL FIRE. Incident Information. 2016. Retrieved on June 2, 2017 from http://cdfdata.fire.ca.gov/incidents/incidents_stats?year=2015
[60] NOAA Earth System Research Laboratory. Trends in Atmospheric Carbon Dioxide, 2017. Retrieved on May 15, 2017 from https://www.esrl.noaa.gov/gmd/ccgg/trends/full.html.
[61] Environmental Protection Agency. Climate Change Indicators. 2017. Retrieved on May 15, 2017 from https://www.epa.gov/climate-indicators/greenhouse-gases.

billion metric tons, accounting for about 68 percent of all GHG emissions.[62] Together, past and present emissions result in climate change impacts that are increasingly apparent. The future progression of climate change is dependent on current and future levels of global GHG emissions. Planning and adaptation to address climate change impacts require flexibility to incorporate new science, projected trajectories of global GHG emissions, and changing conditions in communities.

4.3.2 PROJECTED IMPACTS

Climate change alters the frequency, severity, and location of many hazard events and should be accounted for in hazards planning. The potential impacts and associated risks of climate change have been detailed in several state reports including the 2009 California Climate Adaptation Strategy, updated as Safeguarding California Plan: 2018 Update, and the 2012 California Adaptation Planning Guide built on the findings of California's Climate Change Assessments. The following discussion summarizes some of this material.

In the SHMP, potential climate change outcomes are included in the risk assessments for those specific hazards resulting from, or exacerbated by, climate change. Specific hazard risk assessments are discussed in *Chapters 6 through 9*.

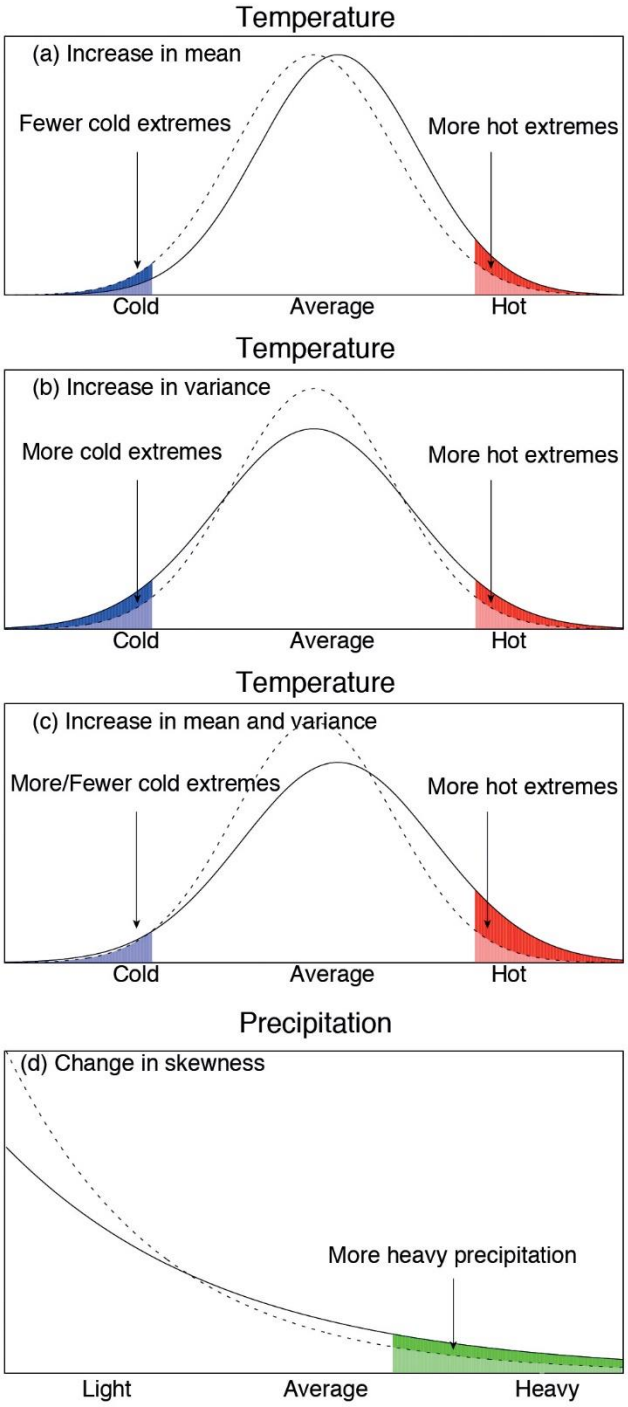
Relation to Hazard Probability

Climate change exacerbates hazards already experienced in California and also introduces new hazards. In addition to increasing global average temperature, climate change results in an increase in variance of climate patterns, as shown in Figure 4.C.[63]

The increase in variance means that extreme events—disasters—may exhibit changes in severity, frequency, and location. For example, the increased variance in climate patterns will result in more frequent incidence of severe events, such as extreme rainfall, wind, wildfire, extreme heat, and extended drought.

The increased variance therefore creates challenges for hazards planning, which previously used historic recurrence rates to predict future events, and now must incorporate changes to frequency, severity, and location due to climate change influences.

Figure 4.C: Climate Change Impacts on Temperature Patterns.



[62] United Nations Environment Programme, The Emissions Gap Report 2016, November 2016. 61 pages. p. 3. Retrieved on October 9, 2017 from http://wedocs.unep.org/bitstream/handle/20.500.11822/10016/emission_gap_report_2016.pdf

[63] Intergovernmental Panel on Climate Change (IPCC) 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

For example, the state is projecting more frequent and higher-temperature heat waves. These increased heat events will require local jurisdictions to use additional resources, not previously allocated, to minimize impacts on vulnerable populations.

It can seem counterintuitive to, for example, plan for increased floods when total rainfall is projected to decrease. However, this is exactly the type of planning needed due to the increasing variance in climate patterns. For this reason, climate change must be incorporated into the assessment of hazards risk. As explained below, however, including climate change in hazards management requires a shift from traditional risk assessment to new methods of evaluating the impacts of climate change on hazard events.

Estimating Risk for Hazards Affected by Climate Change

Risk assessment for hazards is built on the frequency of past events and the assumption that historic occurrence rates are generally a good predictor of future event probability. With the onset of climate change, history has become an inadequate predictor of future occurrence. As a result, planning now must be based on potential (or modeled) scenarios that account for shifts in historic conditions due to anticipated climate change.

Hazards caused or exacerbated by climate change are beginning to be assessed based on scenarios defined by global GHG emissions projections that assume either moderate, global-scale efforts to reduce GHG emissions or the continued growth in emissions through the end of 2100. These two scenarios suggest bounds within which climate change-influenced hazards planning should be framed.

Cal-Adapt, the tool made available by the state to enable exploration of local climate risks, allows California communities to view climate impacts under various global GHG scenarios. The best case, a moderate scenario, used by Cal-Adapt (RCP 4.5)[64], representing substantial international cooperation to limit warming with emissions peaking in 2040 and declining after, offers projections that allow communities to identify unavoidable outcomes (regardless of GHG emissions reduction). The worst-case "Business As Usual" scenario (RCP 8.5)[65] is congruent with continued growth of emissions, a failure of international cooperation to limit climate change, and extreme climate impacts. These two scenarios are consistent with the Governor's Office of Planning and Research (OPR)'s adaptation guidance and represent the range of potential futures for which communities must prepare.

In cases where the worst-case scenario results in outcomes disruptive to critical functions that are permanent or likely to last for protracted periods of time, communities may choose to take mitigative action even if the likelihood of an event occurring is small. California's Adaptation Planning Guide, the Safeguarding California Plan: 2018 Update, and the OPR's "Planning and Investing for a Resilient California" are important resources to help communities assess which potential climate change impacts require adaptation measures, determine where additional studies may be necessary, and define the phasing of these measures through time. The "profiling the hazard" section of the risk assessment template includes climate change considerations in the discussion of each hazard potentially affected by climate change (see *Chapter 1: Introduction, Section 1.2.3* for an overview of the 2018 SHMP risk assessment template).

4.3.3 CALIFORNIA'S CLIMATE CHANGE ASSESSMENT PROGRAM

Overview

California produces periodic scientific assessments on the potential impacts of climate change in California and reports potential adaptation responses. Required by Executive Order S-03-05, these assessments influence legislation and inform policy makers.

The First Climate Change Assessment, released in 2006, looked at the potential impacts of climate change on key state resources such as the water supply, public health, agriculture, coastal areas, forestry, and electricity production

[64] www.cal-adapt.org
[65] www.cal-adapt.org

and demand. The assessment influenced the passage of Assembly Bill 32, the California Global Warming Solutions Act of 2006.

The Second Climate Change Assessment, released in 2009, attempted to provide initial estimates of the economic impacts of climate change. It concluded that adaptation —as a complementary approach to mitigation—could substantially reduce economic impacts of loss and damage from a changing climate. Findings from the Second Assessment were instrumental in preparing California's 2009 statewide adaptation strategy.

The Third Climate Change Assessment, released in 2012, was shaped by the request for more information on vulnerability and adaptation options discussed in the 2009 California Adaptation Strategy. It made significant progress in projecting climate change impacts, but also in better understanding the interactions of those potential impacts with on-the-ground exposure, sensitivity, and response capacity of natural and human systems.

California's Fourth Climate Change Assessment

The *Fourth Climate Change Assessment* is part of California's comprehensive strategy to take action based on cutting-edge climate research. California's 2015 Climate Change Research Plan articulates near-term climate change research needs to ensure that the state stays on track to meet its climate goals. The *Fourth Climate Change Assessment*, released in August 2018, is the first inter-agency effort to implement a substantial portion of the Climate Change Research Plan.[66] *The Fourth Climate Change Assessment* endeavors to provide improved vulnerability assessments based on better understandings of projected extremes, as well as to provide scientific results that can support action. The Assessment program continues to support development of policy-relevant data and studies, and generated data and other information to be integrated into Cal-Adapt, as resources allow. The state will continue to pursue additional opportunities to make climate data accessible and available through Cal-Adapt and other tools.

Overview of Reports

The Fourth Climate Change Assessment is comprised of a series of statewide, regional, and technical reports as well as some external contributions.

Statewide reports, included in the assessment for the first time, cover critical topics for the entire state. In addition to a statewide summary report which provides an overview of the findings and context for the entire Fourth Assessment, three statewide reports were prepared on the following topics:

- Climate Justice
- Tribal and Indigenous Communities within California
- California's Ocean and Coast

To address local and regional information needs, the Fourth Assessment includes nine regional reports. These summary reports were included for the first time as part of the State's assessment process in part because the vast majority of adaptation planning and implementation will happen at local and regional scales. Each of these reports provides a summary of relevant climate impacts and adaptation solutions for a region of the state.

The regional reports which include climate science, impacts, and adaptation information by region are:

- Central Coast—covers Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties
- Inlands Deserts—covers Imperial, eastern parts of San Bernardino, and Riverside Counties
- Los Angeles—covers Ventura, Los Angeles, Orange, and western parts of San Bernardino and Riverside Counties
- North Coast—covers Lake, Mendocino, Humboldt, Trinity, Siskiyou and Del Norte Counties
- Sacramento Valley—covers Sacramento, Yolo, Sutter, Yuba, Colusa, Glenn, Butte, Tehama, Shasta, and the eastern half of Solano and wester part of Pacer Counties
- San Diego—covers San Diego County

[66] http://www.climatechange.ca.gov/climate_action_team/reports/CAT_research_plan_2015.pdf

- San Francisco Bay Area—covers San Francisco, Marin, Contra Costa, Alameda, the western half of Solano, Santa Clara, San Mateo, Sonoma, and Napa Counties
- San Joaquin Valley—covers San Joaquin, Stanislaus, Merced, Kings, and the western parts of Madera, Fresno, Tulare, and Kern Counties
- Sierra Nevada—covers Modoc, Lassen, Plumas, Sierra, Nevada, Placer, El Dorado, Amador, Calaveras, Alpine, Mono, Tuolumne, Mariposa, Inyo, and the eastern parts of Madera, Fresno, Tulare, and Kern Counties

The foundation of California's Fourth Climate Change Assessment are scientific research studies projecting climate change impacts and exploring what those impacts mean for various sectors. A total of 44 reports and 7 external contributions cover the following nine sectors:

- Projections, Data, and Tools—9 documents
- Energy—11 documents
- Water—10 documents
- Oceans and Coasts—5 documents
- Forests and Wildfire—3 documents
- Agriculture—3 documents
- Biodiversity—2 documents
- Public Health—5 documents
- Governance—3 documents

Project Summary: Assessing Vulnerability and Improving Resilience of Critical Emergency Management Infrastructure in a Changing Climate

Climate Change and Emergency Management in California is part of California's *Fourth Climate Change Assessment*: Non-Energy Research Program (Project 6A, state funded at $375,000). It has two components: a Critical Facilities Vulnerability Assessment (CFVAC) system accounting for climate change, and active transportation as a critical lifeline service for resilient communities. The first component, Assessing Vulnerability and Improving Resilience of Critical Emergency Management Infrastructure in a Changing Climate, is a decision support system. The CFVAC identifies, evaluates, assesses, and estimates potential dollar loss of state-owned or -operated critical facilities and lifelines necessary for post-disaster and recovery operations in areas subject to climate change. CFVAC then prioritizes projects in relation to their relative importance to the continuity of state government and recovery operations following a natural disaster, with emphasis on disadvantaged communities. This component will be used to assist emergency management, critical infrastructure risk assessment, and hazard mitigation planning efforts. The second component develops selection criteria for an active transportation program that prioritizes climate change adaptation.

The Assessing Vulnerability and Improving Resilience of Critical Emergency Management Infrastructure in a Changing Climate project includes the interactive "California Emergency Response Infrastructure Climate Vulnerability Tool" (CERI-Climate) that combines a database of California critical emergency response infrastructure with projected flood and wildfire hazard footprints to examine exposure and associated impacts on infrastructure from exposed climate-related hazards. Outputs include maps and tables describing facility exposures, flood, and fire risks, property damage estimates from flooding, and estimates of operational disruption. The analyses examine a range of conditions spanning different emissions scenarios, climate models, hazard severity, and other factors in 20-year intervals through the year 2100. The tool also provides the ability to examine results for particular facility types, for specific counties, and for facilities located in disadvantaged communities. Cal OES uses the tool to conduct its own analysis and data visualization, and can potentially add new data as the state's assets change. The CERI-Climate tool will be available for public use at the end of 2018.

For more information on California's Climate Assessments, see the Natural Resources Agency webpage: http://climatechange.ca.gov/climate_action_team/reports/climate_assessments.html.

4.3.4 CLIMATE CHANGE AND THE 2018 SHMP

Climate change should be considered a standard and integral part of preparing for and mitigating hazard events. Many of the hazards already regularly experienced by the state are likely to be changed in intensity and frequency as a result of climate change. The State of California continues to pass legislation and has taken a series of actions with the aim of improving preparation for climate change, in both climate change mitigation and adaptation actions.

The state defines climate change mitigation and climate change adaptation as follows:

> *Climate Change Mitigation*: A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.[67]
>
> *Climate Change Adaptation*: Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities.

The SHMP seeks not only to meet Federal Emergency Management Agency (FEMA) expectations, but also provide a framework for integration with other state actions such as climate change related efforts. The SHMP, as the state's hazard mitigation guidance document, strives to highlight much of the great climate mitigation and adaptation work the state has accomplished in the last five years while not duplicating the efforts of the state's climate adaptation strategy document, Safeguarding California. With the passage of Senate Bill (SB) 246 (2015) and SB 379 (2015), and regular updates of Safeguarding California (all described later in this section), hazard mitigation is explicitly integrated into state climate change adaptation efforts. The individual hazard assessments in *Chapters 6 through 9* include additional detailed discussion on the influence of climate change.

For hazards potentially caused or exacerbated by climate change, the potential impacts of climate change are discussed in the "Profiling the Hazard" section of each affected hazard risk assessment, as explained in *Chapter 1: Introduction, Section 1.2*.

4.3.5 CLIMATE CHANGE MITIGATION EFFORTS

California has been a leader in adopting initiatives to address climate change through the reduction of GHG emissions and taking innovative actions to respond to risks associated with climate change. Although climate change is a global issue, actions taken by California can have far-reaching effects by encouraging other states, the federal government, and other countries to act. Though California ranked 20th in 2012 on the list of the world's largest emitters of energy-related greenhouse gases,[68] many important pieces of legislation have been passed and actions have been taken to improve that ranking for the state. The following summarizes major climate mitigation and adaptation initiatives and progress of the state.

California Legislative History

The initial push for GHG reduction was set in motion in 2005 by Executive Order S-03-05, which established climate change emission reduction targets for the state. The goal at that time was to reduce emission levels to 80 percent below 1990 levels by 2050. To achieve those goals, the California Global Warming Solutions Act of 2006 (Assembly Bill [AB] 32) was passed to establish a comprehensive implementation program, which included setting a GHG emissions cap for 2020, adopting regulations, and creating mandatory reporting rules for significant sources of GHG.

In 2008, the California Air Resources Board (CARB), the lead agency for implementing AB 32, developed a Scoping Plan outlining the state's strategy to achieve the 2020 GHG emissions reduction goals. The Scoping Plan outlined a set of actions designed to reduce overall GHG emissions in California to 1990 levels by 2020 and proposed a comprehensive set of actions designed to reduce overall GHG emissions in California, improve the environment, reduce dependence on oil, diversify energy sources, save energy, create new jobs, and enhance public health. The

[67] California Natural Resources Agency. Safeguarding California: Reducing Climate Risk. 2014. Sacramento: author. 344 p.
[68] Next 10, California Green Innovation Index: International Edition. 2015. 95 pages. p. 15. Retrieved on October 9, 2017 from http://www.next10.org/sites/next10.org/files/2015-Green-Innovation-Index.pdf

Scoping Plan presented GHG emission reduction strategies that combine regulatory approaches, voluntary measures, fees, policies, and programs.

By enacting SB 97 in 2007, California's lawmakers expressly recognized the need to analyze GHG emissions as a part of the California Environmental Quality Act (CEQA) process. SB 97 required the Governor's Office of Planning and Research (OPR) to develop, and the Natural Resources Agency to adopt, amendments to the CEQA Guidelines addressing the analysis and mitigation of GHG emissions.

Enacted in October 2008, SB 375 further built on AB 32 by connecting the reduction of GHG emissions from cars and light trucks to regional and local land use and transportation planning. SB 375 also required the CARB to establish GHG emission reduction targets for each region (as opposed to individual cities or households), and required each region's metropolitan planning organization (MPO) to create a Sustainable Communities Strategy (SCS) as part of the Regional Transportation Plan (RTP) that will meet the target for the region.

In September 2008, the Governor signed SB 732 creating the Strategic Growth Council (SGC). The SGC, a cabinet-level committee, was given authority to distribute Proposition 84 funds available for planning grants and incentives to encourage the development of regional and local land use plans designed to promote water conservation, reduce automobile use and fuel consumption, encourage greater infill and compact development, protect natural resources and agricultural lands, and increase adaptability to climate change. All projects and plans must be consistent with the state's planning priorities and reduce GHG emissions on a permanent basis consistent with AB 32 and any applicable regional plan. The planning grant criteria Priority Considerations award extra points for addressing climate change impacts on human and natural areas and adaptation planning to address these issues.

Mitigation Efforts Since 2013

There are many climate mitigation efforts that occurred throughout California since 2013. Below are a few major examples. For more information on California's integrated plan for addressing climate change and climate mitigation legislation visit: http://www.climatechange.ca.gov/.

Greenhouse Gas Emission Reduction

On September 8, 2016, the Governor signed SB 32, putting into law an amended statewide goal to reduce GHG emissions 40 percent below 1990 levels by 2030, and to adopt rules and regulations in an open public process to achieve the maximum, technologically feasible, and cost-effective greenhouse gas emissions reductions. The CARB is the designated lead agency assigned to implement the provisions of the bill. The Climate Action Team (CAT), made up of relevant state agencies, is charged with helping direct state efforts on the reduction of GHG emissions and engaging state agencies. For specific information regarding each agency's climate change mitigation efforts, visit their individual websites. A few examples of current programs are listed below.

In January 2017, the CARB released an update to the 2008 Scoping Plan, building on key programs that include the Cap-and-Trade Regulation, the Low Carbon Fuel Standard, and programs for much cleaner cars, trucks, and freight movement; use of cleaner renewable energy; and reduction of methane emissions from agricultural and other wastes by using the wastes to produce energy. It also comprehensively addresses for the first time the GHG emissions from natural and working lands of California, including the agriculture and forestry sectors. The updated Scoping Plan also highlights an updated strategy: achieving the state's 2030 GHG target and a 40 percent emissions reduction below 1990 levels. The 2017 update also builds on the state's success to date, proposing to strengthen major programs that have already been deemed successful for further integrating efforts to reduce both GHGs and air pollution.

In July 2017, AB 398 was signed by the Governor to extend and improve the state's world-leading cap-and-trade program to ensure that California continues to meet its ambitious climate change goals. This legislation extends the program by 10 years until 2030, and makes the following improvements based on years of operation, analysis, and input:

- Ensures that carbon pollution will decrease as the program's emissions cap declines

- Cuts the use of out-of-state carbon offsets and brings those environmental benefits back to California
- Designates the CARB as the statewide regulatory body responsible for ensuring that California meets its statewide carbon pollution reduction targets, while retaining local air districts' responsibility and authority to curb toxic air contaminants and criteria pollutants from local sources that severely affect public health
- Decreases free carbon allowances over 40 percent by 2030
- Set priorities for cap-and-trade spending to ensure that funds go where they are needed most, including reducing diesel emissions in the most affected communities

Extending California's cap-and-trade program ensures that billions of dollars in auction proceeds continue flowing to communities across California. To date, these investments have preserved and restored tens of thousands of acres of open space, helped plant thousands of new trees, funded 30,000 energy efficiency improvements in homes, expanded affordable housing, boosted public transit, helped more than 100,000 Californians purchase ZEVs, and supported many other programs.

The Budget Act of 2017, Senate Bill 109, allocates $11 million from the greenhouse gas reduction fund through the Strategic Growth Council for research to address reduction of GHG emissions with an emphasis on serving disadvantaged and vulnerable communities. Additional, the Budget Act of 2017 allocates funding to other state agencies for climate change programs such as urban greening and healthy forest and fire prevention.

In September 2018, Governor Brown issued Executive Order B-55-18 in a significant step for California toward achieving carbon neutrality. The executive order establishes a new statewide goal to achieve net carbon neutrality as soon as possible, but no later than 2045, and to maintain net negative emissions thereafter. The executive order tasks the California Air Resources Board (CARB) with developing an implementation framework and working with other state agencies to achieve this goal. CARB is also responsible for developing an accounting system to track progress toward this goal.

Zero-Emission Vehicles and Infrastructure

Transportation accounted for about 37 percent of California's GHG emissions in 2014. Transforming California's transportation system away from gasoline to zero-emission vehicles (ZEV) and near zero-emission vehicles is a fundamental part of the state's efforts to meet its climate goals. The Governor established the foundation to support 1.5 million ZEV by 2025 and published a ZEV action plan to achieve this goal. The Energy Commission provides funding for plug-in electric vehicle charging and hydrogen refueling stations, and guidance on plug-in electric and hydrogen vehicle infrastructure deployment. For additional information about this program, see the Energy Commission website at: http://www.energy.ca.gov/.

Alternative Energy Sources

In 2002 Senate Bill 1078 established California's Renewables Portfolio Standard (RPS). In a series of subsequent legislation and Executive Order S-14-08, the RPS targets were accelerated. The Energy Commission and the California Public Utilities Commission work collaboratively to implement the RPS.[69]

Reduced GHG emissions from the electricity sector are largely attributable to increases in renewable energy and decreases in coal-fired generation. Installed capacity of renewable energy in California has more than tripled from 6,800 megawatts (MW) in 2001 to 26,300 MW (including small self-generation such as rooftop solar) as of October 31, 2016. Meanwhile, coal-fired electricity served about 11 percent of California's electricity demand in 2000 but has steadily declined, serving less than 6 percent by the end of 2015; the percentage is expected to decline to zero by the middle of the next decade. Criteria pollutant emissions from the electricity sector (emissions that cause smog and harm human health) are modest, contributing just 2 percent of total emissions in 2000, and were cut by more than half by 2015.

[69] http://www.energy.ca.gov/portfolio/

Senate Bill 100, passed in September 2018, further advances the state's RPS to 50 percent by 2025, and 60 percent by 2030. It also sets a goal for California to implement a zero-carbon electricity grid by 2045.

Under2MOU

The Under2 Coalition, the collective of governments who have signed or endorsed the Under2 MOU, a Subnational Global Climate Leadership Memorandum of Understanding (MOU), was formed in 2015 by the states of California and Baden-Württemberg, Germany to galvanize bold climate action from like-minded city, state and regional governments around the globe. Coalition members pledge to limit GHG emissions to 2 tons per capita or 80 to 95 percent below 1990 levels by 2050.

U.S. Climate Alliance

In response to the federal government's decision to withdraw the United States from the Paris Agreement on climate change, Governors Andrew Cuomo, Jay Inslee, and Jerry Brown created the United States Climate Alliance. This bi-partisan coalition of states is committed to the goal of reducing GHG emissions consistent with the goals of the Paris Agreement. Smart, coordinated state action can ensure that the United States continues to contribute to the global effort to address climate change.

General Plan Guidelines

California communities need to respond to climate change both through policies that promote adaptation and resilience and by significantly reducing GHG emissions. The 2017 General Plan Guidelines chapter on climate change summarizes how a general plan or climate action plan can be consistent with CEQA Guidelines Section 15183.5 (b) (entitled Plans for the Reduction of Greenhouse Gas Emissions). The 2017 General Plan Guidelines note that California is unique in requiring that an environmental impact report, using CEQA procedures, be prepared as a final document for updating and adopting a city or county general plan. A GHG emissions reduction plan can be either a stand-alone climate action plan or part of the general plan. The CEQA Guidelines recognize either approach. Regardless of approach, local governments should inventory and mitigate GHG emissions "within a defined geographical area"—typically the city or unincorporated county over which they have land use authority. Under CEQA, lead agencies should analyze the GHG emissions of proposed projects, and should reach a conclusion regarding the significance of those emissions. Chapter 8 of the 2017 General Plan Guidelines provides resources and information on the CEQA Guidelines that local jurisdictions can use as guidance for GHG inventory, planning, and reduction implementation efforts.

Climate Action Portal Map

The California Air Resources Board (CARB) developed the Climate Action Portal Map (CAP-Map), an interactive web resource that is intended to help local governments learn more about other climate action plans and climate change policies being implemented across California. The resource was launched December 2017 on the www.CoolCalifornia.org local government portal. The CAP-Map aggregates the climate action planning efforts of California jurisdictions, and provides a searchable database of climate action strategies. OPR and CARB hosted webinars in late 2017, providing demonstrations of the tool's features and CAP-Map's relationship to other state efforts such as the 2017 General Plan Guidelines. For more information about CAP-Map visit the local government portal: http://www.coolcalifornia.org/local-government.

4.3.6 CLIMATE CHANGE ADAPTATION INITIATIVES

To respond to the threat of climate change, the state has enacted executive orders, legislation, regulations, and programs that address the impacts of climate change on the state by promoting adaptation efforts at state, regional, and local levels. This section summarizes the state's most significant adaptation efforts.

4.3.6.1 EXECUTIVE ORDERS AND PROCLAMATIONS SINCE 2013

Governor's Executive Order B-30-15

In addition to issuing new interim statewide targets and further addressing greenhouse gas emission reduction, Governor's Executive Order B-30-15 (EO B-30-15), issued in April 2015, also addresses the need for climate adaptation, and directs the state government to:

- Update the Safeguarding California Plan (the state's climate adaptation strategy) on a three-year time schedule to identify how climate change will affect California infrastructure and industry and what actions the state can take to reduce the risks posed by climate change. As part of this effort, the plan outlines primary risks to residents, property, communities, and natural systems that should be used as the basis for identifying priority actions needed for risk reduction.
- Identify climate change vulnerabilities by sector, including at a minimum the water, energy, transportation, public health, agriculture, emergency services, forestry, biodiversity and habitat, and ocean and coastal resources sectors, and identify a lead agency to lead the adaptation efforts for each sector.
- Develop Implementation Action Plans by sector outlining the actions that will be taken as identified in Safeguarding California.
- Factor climate change into state agencies' planning and investment decisions, considering action to protect the state's most vulnerable populations and prioritizing natural infrastructure solutions.
- Incorporate current and future climate change impacts into the state's Five-Year Infrastructure Plan.
- Continue a rigorous climate change research program for understanding of impacts of climate change to inform adaptation efforts.
- Establish a Technical Advisory Group (TAG) to support agencies in incorporation of climate change into planning and investment decisions (See *Section 4.3.6.3* for more information on the TAG).

For the text of Governor's Executive Order B-30-15, see the executive order press release on the Governor's website: https://www.gov.ca.gov/news.php?id=18938.

Tree Mortality Emergency Proclamation

In October 2015, Governor Brown issued an Emergency Proclamation that supplemented his January 17, 2014 proclamation of a State of Emergency, addressed tree mortality, and established the Tree Mortality Task Force (TMTF). For specific information about tree mortality hazard and mitigation, see *Chapter 9, Section 9.1.11*.

Governor's Executive Order B-42-17

This executive order, issued in September 2017, continues the 2015 Tree Mortality Emergency Proclamation with modifications to better facilitate dead/dying tree removal across the state. Tree mortality hazard is discussed in *Section 9.1.11*.

Governor's Executive Order B-52-18

Governor Brown issued an executive order on May 10, 2018 to combat dangerous tree mortality, increase the ability of forests to capture carbon, and systematically improve forest management. The issuance of Executive Order B-52-18 coincides with the release of the California Forest Carbon Plan: Managing our Forest Landscapes in a Changing Climate, prepared jointly by the California Department of Forestry and Fire Protection (CAL FIRE), California Environmental Protection Agency (CalEPA), and California Natural Resources Agency (CNRA).

Key elements of Executive Order B-52-18 include:

- Doubling the land actively managed through vegetation thinning, controlled fires and reforestation from 250,000 acres to 500,000 acres.
- Launching new training and certification programs to help promote forest health through prescribed burning.
- Boosting education and outreach to landowners on the most effective ways to reduce vegetation and other forest-fire fuel sources on private lands.
- Streamlining permitting for landowner-initiated projects that improve forest health and reduce forest-fire fuels on their properties.
- Supporting the innovative use of forest products by the building industry.
- Expanding grants, training, and other incentives to improve watersheds.

Executive Order B-52-18 will improve the health of the state's forests and help mitigate the threat and impacts of deadly and destructive wildfires, which hinder the state's progress toward its climate goals.

Other Climate-Related Executive Orders and Proclamations

The Governor has issued several executive orders and emergency proclamations addressing drought conditions. These are discussed in *Section 9.1.5*.

4.3.6.2 ADAPTATION LEGISLATION SINCE 2013

The following is a list of climate change adaptation legislation passed since 2013. While legislation specifically addressing climate change mitigation has also been passed in this time frame, it is not included in this list as the focus of this section is specifically on climate change adaptation.

Assembly Bill 1471 (August 2014)

The Water Quality, Supply, and Infrastructure Improvement Act of 2014, among other things, funds for projects which help water infrastructure systems adapt to climate change (including but not limited to sea-level rise).

Assembly Bill 2516 (September 2014)

Requires the California Natural Resources Agency, in collaboration with the Ocean Protection Council (OPC), to conduct biannual surveys of sea-level rise planning information to catalog California's efforts to prepare for rising seas.

Senate Bill 379 (October 2015)

Senate Bill 379 (2015) establishes a framework for incorporating climate change adaptation into local and regional hazard mitigation plans and general plan safety elements.

Senate Bill 246 (October 2015)

Senate Bill 246 (2015) establishes the Integrated Climate Adaptation and Resiliency Program (ICARP) to "coordinate regional and local efforts with State climate adaptation strategies", including, at a minimum:

- Developing tools and guidance
- Promoting and coordinating State agency support for local and regional efforts
- Informing State-led programs to better reflect the goals, efforts, and challenges faced by local and regional agencies
- Coordinate with Cal OES on updates to the California Adaptation Planning Guide
- Create a Technical Advisory Council and Clearinghouse to support the goals of ICARP

The bill requires Cal OES to work with stakeholders to review and update (as necessary) the California Climate Adaptation Planning Guide within one year of an update to Safeguarding California. The bill also requires coordination with the Climate Action Team, Strategic Growth Council, Cal OES, the California Natural Resources

Agency (CNRA), the California Department of Public Health (CDPH), and other agencies to inform state-led adaptation programs.

Assembly Bill 1482 (October 2015)

AB 1482 requires regular updating of the State's climate adaptation strategy Safeguarding California by January 2017 and every three years after. The bill requires the CRNA to report to the Legislature annually on the actions being taken to implement Safeguarding California. Additionally, the bill expands the role of the Strategic Growth Council (SGC) to include consistency with Safeguarding California in its review of the State activities and funding activities. The bill also requires that at a minimum the SGC include consistency with Safeguarding California in its review of the 5-year infrastructure plan.

Senate Bill 2800 (September 2016)

Requires State agencies to take into account current and future impacts of climate change in all stages of planning, designing, building, operating, maintaining, and investing in State infrastructure. Senate Bill 2800 requires a Climate-Safe Infrastructure Working Group be established from 2017 to 2020 to examine how to integrate scientific data concerning projected climate change impacts into State infrastructure engineering.

Senate Bill 1000 (September 2016)

This bill requires that an environmental justice element be included in a jurisdiction's general plan or that goals, objectives, and policies addressing environmental justice be integrated into the other elements of the general plan. Senate Bill 1000 (2016) also builds on the requirement to address climate change in the Safety Element of the General Plan.

Senate Bill 1383 (September 2016)

Addressing Short-lived Climate Pollutants on September 19, 2016 the Governor signed Senate Bill 1383, which directed the CARB to adopt the Short-Climate Pollutant Reduction Strategy. The Strategy requires an immediate reduction of specific pollutants (black carbon, methane, and fluorinated gasses) by 2030. Short-lived climate pollutants are estimated to be responsible for about 40 percent of net climate forcing (a net gain of energy resulting in warming). Action to reduce these "super pollutants" will provide immediate benefits and help mitigate the impacts of climate change. While reducing CO_2 emissions limits climate change over the long-term, reducing emissions of short-lived climate pollutants will effectively slow the rate of climate change in the near-tem. The Short-Lived Climate Pollutant Reduction Strategy, provides specific direction for reductions from dairy and livestock operations and from landfills by diverting organic materials, and requires actions to support in-State production and use of renewable natural gas.

Senate Bill 1 (2017)

The Road Repair and Accountability Act of 2017 is a ten-year transportation funding bill provide source of funds to maintain and integrate the State's multi-modal transportation system. As a result of this transportation funding, $20 million in climate change adaptation planning grants has been allocated to local and regional agencies for adaptation planning. Seven million dollars are available for the Fiscal Year 2017-2018 grant cycle, seven million dollars will be available in 2018-2019, and six million dollars in 2019-2020. This funding will advance adaptation planning on the state transportation system. Applicants who have adaptation planning efforts underway as well as those who have not yet started adaptation work are encouraged to apply. For more information visit Caltrans Transportation Planning Grant Program webpage: http://www.dot.ca.gov/hq/tpp/grants.html.

4.3.6.3 AGENCY AND STAKEHOLDER COORDINATION AND INTEGRATION

Climate Action Team and Climate Action Initiative (Established 2005)

Overview

The Climate Action Team (CAT) was created by Governor's Executive Order S-03-05 in 2005 and is an important venue for cross-agency collaboration on climate activities. The CAT's objective is to coordinate statewide efforts to implement both GHG reduction and climate adaptation efforts. The CAT members are state agency secretaries and the heads of agencies, boards, and departments, led by the Secretary of the California Environmental Protection Agency (Cal/EPA). CAT members are mandated by Executive Order S-03-05 to provide biannual reports to the Governor and State Legislature regarding the status of the impacts on the state from global warming and the mitigation and adaptation plans underway to combat those impacts.

Within the CAT are the following topic-specific working groups, or sub-CATs:

- Agriculture (http://www.climatechange.ca.gov/climate_action_team/agriculture.html)
- Biodiversity (http://www.climatechange.ca.gov/climate_action_team/biodiversity.html)
- Coastal and Ocean Climate Adaptation Team (http://www.opc.ca.gov/2010/07/coastal-and-ocean-climate-action-team-co-cat/)
- Interagency Forestry Working Group (http://www.climatechange.ca.gov/climate_action_team/forestry.html)
- Intergovernmental Working Group (http://www.climatechange.ca.gov/climate_action_team/partnerships.html)
- Land Use and Infrastructure Working Group (http://www.climatechange.ca.gov/climate_action_team/land_use.html)
- Public Health Working Group (http://www.climatechange.ca.gov/climate_action_team/health.html)
- Research Working Group (http://www.climatechange.ca.gov/climate_action_team/research.html)
- State Government (http://www.climatechange.ca.gov/climate_action_team/state.html)
- Water Energy Working Group (http://www.climatechange.ca.gov/climate_action_team/water.html)

Each of the 10 CAT working groups listed above has a separate purpose, set of activities and deliverables, and roster of participating agencies.

Safeguarding California Climate Action Team (SafeCAT) (Established 2017)

The Safeguarding California CAT was established as a new Climate Action Team in 2017 to provide a venue for cross-sector collaboration and information sharing on development of the Safeguarding California plan, Executive Order B-30-15 TAG guidance implementation, and engagement with local and regional agencies. Co-led by the Office of Planning and Research (OPR) and California Natural Resources Agency (CNRA), this sub-CAT meets quarterly to provide updates on adaptation-related guidance documents, report updates, programs, and other matters, and provides a venue to discuss other collaborative efforts involving all agency members.

The SafeCAT, together with the Integrated Climate Adaptation and Resiliency Program and its associated Technical Advisory Council, provide a suite of agency bodies and resources to foster information sharing and engagement with local and regional governments working to address the impacts of climate change. Cal OES participates in the SafeCAT meetings as well as sits on the aforementioned Technical Advisory Council for the Integrated Climate Adaptation and Resiliency Program. For more information about the Safeguarding California Climate Action Team, visit: http://resources.ca.gov/climate/safeguarding/.

Strategic Growth Council (Established 2008)

In September 2008, the Governor signed SB 732 creating the Strategic Growth Council (SGC). The SGC is a cabinet-level committee that is tasked with coordinating the activities of state agencies to:

- Improve air and water quality
- Protect natural resource and agriculture lands
- Increase the availability of affordable housing
- Promote public health and equity
- Improve transportation
- Encourage greater infill and compact development
- Strengthen the economy
- Promote water conservation
- Revitalize community and urban centers
- Assist state and local entities in the planning of sustainable communities and meeting AB 32 goals
- Advance the priorities developed in Safeguarding California, the state's climate adaptation strategy

SB 732 (2008) gives the council authority to distribute Proposition 84 funds available for planning grants and incentives to encourage the development of regional and local land use plans designed to promote water conservation, reduce automobile use and fuel consumption, encourage greater infill and compact development, protect natural resources and agricultural lands, and increase adaptability to climate change. All projects and plans must be consistent with the state's planning priorities and reduce greenhouse gas emissions on a permanent basis consistent with AB 32 and any applicable regional plan. The planning grant criteria Priority Considerations award extra points for addressing climate change impacts on human and natural areas and adaptation planning to address these issues.

AB 1482 (October 2015) expanded the role of the Strategic Growth Council (SGC) to include review of the Five-Year Infrastructure Plan and other state program activities for consistency with state climate goals, including adaptation and resilience.

Department of Water Resources Climate Change Technical Advisory Group (Established 2009)

In support of the California Water Plan Update 2009, the California Department of Water Resources (DWR) assembled an external advisory group to provide technical support and feedback for climate change issues. Known as the Climate Change Technical Advisory Group (CCTAG), the nominally 28-member expert panel advised DWR on the scientific aspects of climate change, its impacts on water resources, the use and creation of planning approaches and analytical tools, and the development of adaptation responses for California's water sector. CCTAG panel experts from state, local, research, and education sector backgrounds will work with DWR on incorporating climate change into water resources planning and management, with a particular focus on climate adaptation and extreme events.

For more information about the CCTAG, visit: https://www.water.ca.gov/Programs/All-Programs/Climate-Change-Program.

California Fire Service Task Force on Climate Impacts (Established 2015)

Responding to Executive Order B-30-15, the California Fire Service Task Force on Climate Impacts builds on the work of the Governor's Blue Ribbon Fire Commission that was established following the 2003 wildfires. In continuing to expand the State of California's wildfire preparedness, capability, and resilience efforts, the California Fire Service Task Force on Climate Impacts will review and develop policy and operational recommendations associated with the effect of future conditions on California fire service to be used by fire service providers, emergency responders, and emergency managers at all levels of government.

Membership on the task force includes local, state, federal, and professional organizations representing fire services, emergency management, and state climate policy. The Cal OES director acts as the task force chair and Cal OES organizes and conducts all meetings. Information produced by the task force is also shared with the Governor of California. More information about the task force can be found on the Cal OES website at the following link: http://www.caloes.ca.gov/FireRescueSite/Pages/Fire-Service-Task-Force-on-Climate-Impacts.aspx.

Executive Order B-30-15 Technical Advisory Group and Sub-TAGs (Established 2015-2016)

This Technical Advisory Group was convened by OPR in response to Governor's Executive Order B-30-15, with the purpose of providing guidance for agencies to incorporate and integrate climate change into all planning and investment decisions. The Technical Advisory Group (TAG) included members from nearly every state agency, local and regional governments, non-governmental and community-based organizations, and the private sector. The TAG met from April 2016 through January 2017, and various sub-TAG working groups were also created to support the implementation efforts of the directives in Executive Order B-30-15. These groups included:

- Built Infrastructure Sub-TAG
- Climate Scenarios Sub-TAG
- Green and Natural Infrastructure Sub-TAG
- Local, Regional, and State Collaboration Sub-TAG
- Metrics and Tracking Progress Sub-TAG
- Vulnerable Populations and Community Development

The sub-TAGs met separately from the main TAG group and discussed specific topics that were outlined by the TAG as needing to be addressed based on Executive Order B-30-15. The efforts of the TAG and sub-TAGs led to the development of a guidance document called "Planning and Investing for a Resilient California: A Guidebook for State Agencies." This guidebook provides a step-by-step process for state agencies to analyze climate risk and apply the resulting information to decision-making, and also provides direction on integrating climate benefits into infrastructure investment. To download the guidebook, visit: http://opr.ca.gov/planning/icarp/resilient-ca.html.

Coastal and Ocean Resources Working Group for the Climate Action Team (CO-CAT) (Established 2016)

The Coastal and Ocean Resources Working Group for the Climate Action Team (CO-CAT) is a working group comprised of senior level staff from state agencies with ocean and coastal resource management responsibilities. CO-CAT's task is to ensure the state's ability to adapt to climate change impacts on ocean and coastal resources, including implementing the ocean and coastal resources chapter of the 2014 Safeguarding California Plan and the 2009 California Climate Adaptation Strategy. For more information about CO-CAT, visit: http://www.opc.ca.gov/2010/07/coastal-and-ocean-climate-action-team-co-cat/.

Integrated Climate Adaptation and Resiliency Program (ICARP) Technical Advisory Council (Established 2016)

The Integrated Climate Adaptation and Resiliency Program (ICARP) Technical Advisory Council (TAC) was created with the approval of Senate Bill (SB) 246 (2015). SB 246 requires that an advisory council be established to support coordination efforts among state, regional, and local agency efforts to adapt to the impacts of climate change by:

- Developing tools and guidance
- Promoting and coordinating state agency support for local and regional efforts
- Informing state-led programs, including state planning processes, grant programs, and guideline development, to better reflect the goals, efforts, and challenges faced by local and regional entities pursuing adaptation, preparedness, and resilience

The TAC also works together to facilitate development of strategies that increase California's resilience to climate change, advance equity and environmental justice, and benefit both greenhouse gas (GHG) emissions reduction and adaptation efforts.

In accordance with SB 246, the TAC should have expertise in climate change and areas that include, but need not be limited to, the following:

- Public health
- Environmental quality
- Environmental justice
- Agriculture

- Transportation and housing
- Energy
- Natural resources and water
- Planning
- Recycling and waste management
- Local or regional government
- Tribal issues
- Emergency services and public safety

For more information about ICARP and the TAC, visit: http://opr.ca.gov/planning/icarp/.

Climate-Safe Infrastructure Working Group (Established 2017)

Assembly Bill (AB) 2800 (2017) required that a Climate-Safe Infrastructure Working Group be established from 2017 to 2020 to examine how to integrate scientific data concerning projected climate change impacts into state infrastructure engineering.

As of early September 2018, the working group had completed six meetings to date and used the input from those meetings to produce "Paying It Forward: The Path Toward Climate-Safe Infrastructure in California", a 160-page report addressing the problem of climate change impacts on aging or poorly maintained infrastructure in response to AB 2800. Key sections of the report present: 1) the problem, 2) a vision, and 3) elements of a framework to action to ensure resilient and sustainable infrastructure in the future. The report is intended to provide a path toward realizing climate-safe infrastructure in California and provides 9 specific recommendations for the state to follow to achieve stronger climate-safe infrastructure practices.

4.3.6.4 STATE CLIMATE ADAPTATION PLANNING

In addition to being a leader in greenhouse gas emissions reduction, California has also led efforts to prepare for and respond to climate change impacts. These actions are referred to as adaptation.

The people of California face escalating threats related to climate change, including extreme storm events, more frequent and severe wildfires, disruptions to water and energy delivery systems, disruptions to transportation systems, more frequent and severe heat waves and associated air quality issues, environmental degradation such as tree mortality, and the potential loss of species and habitats due to various climate related stressors. These climate impacts threaten not only public health and safety, but also billions of dollars of property and the economic livelihood of California. Adjustments in natural or human systems can help reduce the potential harm from climate changes that is occurring or expected.

California Climate Adaptation Strategy and Safeguarding California 2018

Pursuant to Executive Order S-13-08, a multi-sectoral 2009 California Climate Adaptation Strategy (2009 CAS) was developed.[70] The 2009 CAS was based on best available science at the time and included recommendations to inform state decision-makers in developing policies to prepare for climate impacts, reduce exposure and vulnerability, and build more resilient California communities. A First Year Progress Report was issued in 2010.[71]

Given the diversity of potential outcomes, most assessments and policy responses break climate change impacts into sectors. California has a regularly updated Climate Change Adaptation Strategy, first published in 2009 and updated in 2013, as a coordinated effort between the California Natural Resources Agency and other state agencies.

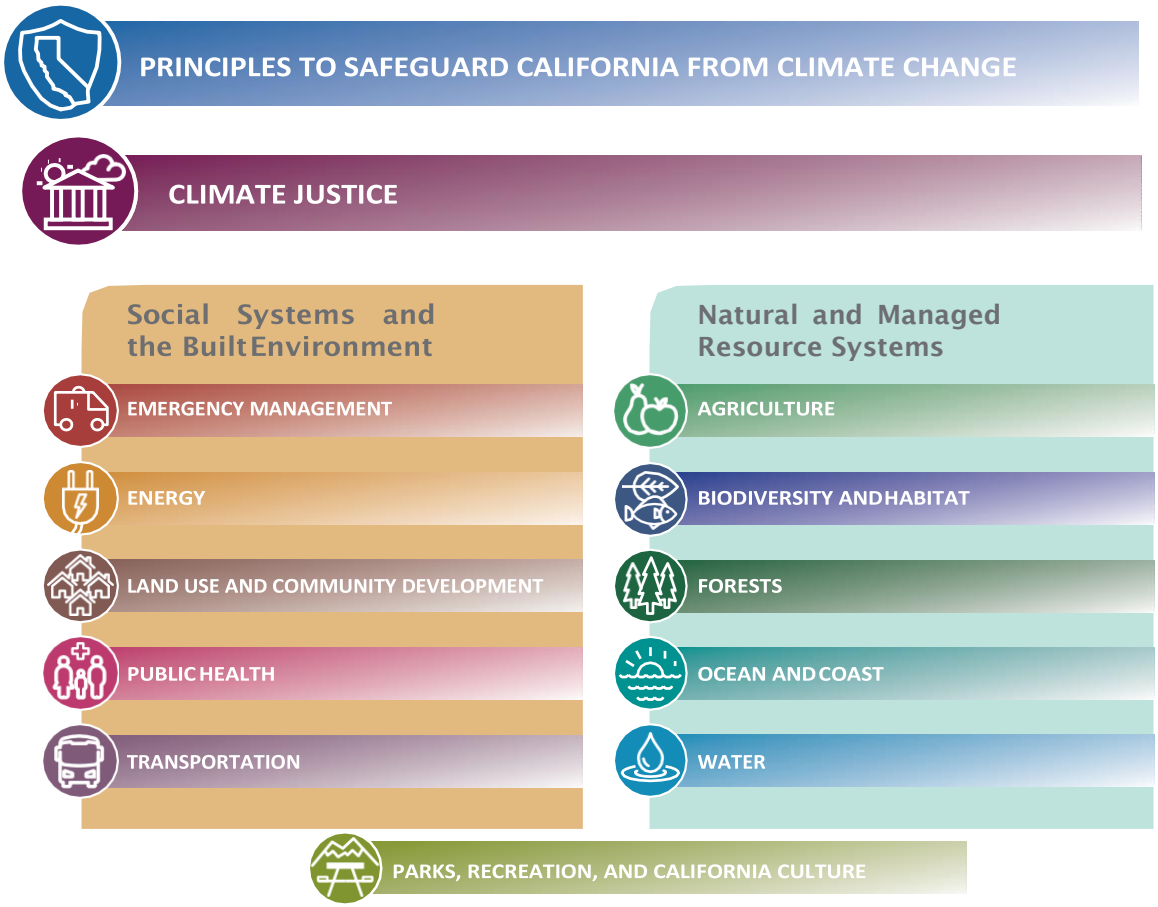
In order to augment previously identified strategies, and in light of advances in climate science and risk management options, the California Natural Resources Agency, in coordination with other state agencies and partners, developed an update to the California Climate Adaptation Strategy, 2014 Safeguarding California. The 2014 update included

[70] http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf
[71] http://www.energy.ca.gov/2010publications/CNRA-1000-2010-010/CNRA-1000-2010-010.PDF

two additional sector chapters not previously included in the 2009 CAS (an energy chapter and an emergency management chapter) and communicates current and needed actions state government should take to build climate change resiliency. The primary objective of *Safeguarding California Plan: 2018 Update – California's Climate Adaptation Strategy*, as with the prior 2009 and 2014 drafts, is to communicate current and needed actions state government should take to build climate change resiliency, with the ultimate goal of ensuring that people, communities, and natural systems are able to withstand the impacts of climate disruption. To this end, the document presents recommended adaptation strategies.

In the 2018 update to the Safeguarding California Plan, strategies are organized into 10 sectors, with five for social systems and the built environment and five for natural and managed resource systems and an additional sector, new to the 2018 update, for Parks, Recreation, and California Culture.[72] The Parks, Recreation, and California Culture sector is categorized under both systems, as it deals with social systems, the built environment, and natural resources. Climate justice recommendations, also new to the 2018 update, are included in all policy sectors. Figure 4.D is a graphical representation of the framework of the Safeguarding California Plan: 2018 Update. For more information on the 2018 update, visit: http://resources.ca.gov/climate/safeguarding/.

Figure 4.D: 2018 Safeguarding California Climate Change Impact Sector Breakdown



Source: Safeguarding California Plan: 2018 Update

[72] California Natural Resources Agency. Draft Report Safeguarding California Plan: 2017 Update. 2017. Sacramento: author, 183 p., p. 4.

Integrated Climate Adaptation and Resiliency Program (ICARP) and the State Adaptation Clearinghouse

The Integrated Climate Adaptation and Resiliency Program (ICARP), discussed in *Section 4.3.6.3*, Agency and Stakeholder Coordination and Integration, is responsible for coordinating and maintaining the State Adaptation Clearinghouse (Public Resources Code 71360).

The ICARP has two components:

- The Technical Advisory Council (TAC): An entity that brings together local government, practitioners, scientists, and community leaders to help coordinate activities that better prepare California for the impacts of a changing climate. (TAC members bring expertise in the intersection of climate change and the sector-based areas outlined in SB 246 [2015], Public Resources Code 71358(b)).

- The State Adaptation Clearinghouse: A centralized source of information and resources to assist decision-makers at the state, regional, and local levels when planning for and implementing climate adaptation projects to promote resiliency across California. This allows local and regional governments access to climate data, which is a direct cost and staff benefit to these governments.

The Adaptation Clearinghouse aims to support a community of practice across the state through knowledge exchange between communities and businesses and across levels of government. The Adaptation Clearinghouse provides a clearinghouse and a searchable database of adaptation and resilience resources that have been organized by climate impact, topic, and region. The Clearinghouse also provides an important platform where Californians can find and share case studies and stories about how and why their communities, businesses, and organizations are responding to climate change impacts.

The types of resources included in the Clearinghouse include, but are not limited to:

- Assessments, plans, and strategies
- Communication and educational materials
- Planning and/or policy guidance
- Data, tools, and research
- Case studies, projects, or examples

Visit OPR's website for more information on the ICARP and State Adaptation Clearinghouse: http://opr.ca.gov/clearinghouse/adaptation/.

General Plan Guidelines and the Governor's Office of Planning and Research Guidance on Climate Adaptation

Climate change has also been recognized by the Governor's Office of Planning and Research (OPR) as a factor to be considered in preparation of local general plans. The 2017 State of California General Plan Guidelines prepared by OPR further address the need for climate adaptation with the inclusion of new chapters on healthy communities, equitable and resilient communities, economic development, and climate change.

The General Plan Guidelines include two general plan preparation directives, the first of which is preparation of seven required general plan elements. The second directive requires the inclusion of content on climate change and environmental justice within the general plan. This information can be included in a stand-alone general plan element or can be weaved into other general plan elements. Each jurisdiction determines which form is most appropriate to local needs.

Chapter 8 of the 2017 General Plan Guidelines reemphasizes the climate adaptation discussion presented in the safety element content in General Plan Guidelines Chapter 4 and reminds jurisdictions that while the safety element may be "home" to adaptation discussions in the general plan, "climate change adaptation should be integrated throughout the elements of a general plan to create internal consistency and support holistic consideration of this

important issue."[73] General Plan Guidelines Chapter 8 also provides a listing of resources and climate change policy recommendations for use by local jurisdictions.

Local agencies are encouraged by California law to adopt Local Hazard Mitigation Plans (LHMPs) as part of their general plan safety elements.[74] The LHMP must be consistent with the goals and objectives of both the local general plan and the SHMP. As such, the general plan and LHMP provide a local vehicle for implementation of the SHMP, including provisions dealing with climate change.

OPR provides tools and guidance for use by local governments in address climate change including:

- Technical advisories and regulatory guidelines
- Coordination of state online resources that local governments can use to understand how climate change might affect their jurisdiction and how to reduce greenhouse gas (GHG) emissions
- Ongoing creation and support of a technical assistance and best practices learning network for local governments
- "Climate Changers," an innovative video initiative to share hot lessons and cool solutions. A full video library can be found on OPR's YouTube page at the following link: https://www.youtube.com/user/OPRClimateChange.

Guidance publications are available on OPR's web page: http://opr.ca.gov/.

OPR also provides technical advice on issues affecting land use planning including some advisory publications on climate change, adaptation, and action planning. These advisories, for use by local jurisdictions and public agencies, support integration of climate adaptation and action with general plans and other regulations. OPR's technical advisories are available at the following link: http://opr.ca.gov/ceqa/technical-advisories.html.

OPR has many ongoing partnerships and programs that help to produce case studies of replicable best practices, some of which are highlighted in the Best Practice Pilot Program (BP3). BP3 includes a collection of climate adaptation and resiliency action best practices in the process of being adopted and implemented at the local and regional levels around California. The intent of BP3 is to develop a comprehensive library of case studies for local and regional partners to use in their planning and policies, while informing state policy and providing training, tools, and networking opportunities for stakeholders. OPR is continually collecting a variety of case studies that are updated on an ongoing basis. For information about BP3 and other efforts, visit: http://opr.ca.gov/planning/land-use/case-studies/.

For further discussion of the 2017 General Plan Guidelines related to hazard mitigation integration and social justice and vulnerability, see *Sections 2.3.3* and *4.4.6*.

Cal-Adapt

In 2011, California launched Cal-Adapt, a web-based tool that allows users to see how climate is projected to change in local areas in California. Cal-Adapt has been designed to provide access to the wealth of data and information produced by the State's scientific and research community. Cal-Adapt affords the opportunity for jurisdictions and individuals to participate in community and knowledge-sharing activities.

Cal-Adapt's development is a key recommendation of the 2009 California Climate Adaptation Strategy:

> *"The California Energy Commission will develop the Cal-Adapt Web site that will synthesize existing California climate change scenarios and climate impact research and to encourage its use in a way that is beneficial for local decision-makers."* – Page 9, 2009 California Climate Adaptation Strategy

The Cal-Adapt tool was originally developed by UC Berkeley's Geospatial Innovation Facility (GIF) with funding and advisory oversight by the California Energy Commission (CEC)'s Public Interest Energy Research program. Since then, CEC has continued to support Cal-Adapt, and GIF released Cal-Adapt version 2.0 in August 2017, which includes new,

[73] State of California 2017 General Plan Guidelines, Governor's Office of Planning and Research, 2017, p232.
[74] AB 2140 provides financial incentives for local agencies to adopt LHMPs as part of the safety elements of their general plans.

higher-resolution climate projections; more powerful visualizations; improved access to data and a new public Applications Programming Interface (API); and connections with supporting resources.

The tool helps translate climate research from the scientific community into a format that is usable for local planning purposes through a combination of locally relevant information, visualization tools, and access to primary data. With continued funding support, Cal-Adapt can be maintained and enhanced so that it continues to serve as a central resource for those working on preparing for climate risks in California.

One feature of Cal-Adapt is a series of interactive maps and charts that can be used to obtain climate change impact statistics based on what climate change modeling predicts for specific locations within California. Maps and charts displaying temperature change, extreme heat, snowpack, precipitation, sea-level rise, and wildfire risk can be used to project future risk from climate change. Cal-Adapt also allows the user to evaluate different scenarios, such as GHG emissions scenarios, inundation scenarios, and seasonal weather pattern scenarios.

All data presented on Cal-Adapt are available for download and users can use the API to integrate climate projections for California into their own tools and workflows. For more information on Cal-Adapt, visit: http://cal-adapt.org/.

California Adaptation Planning Guide

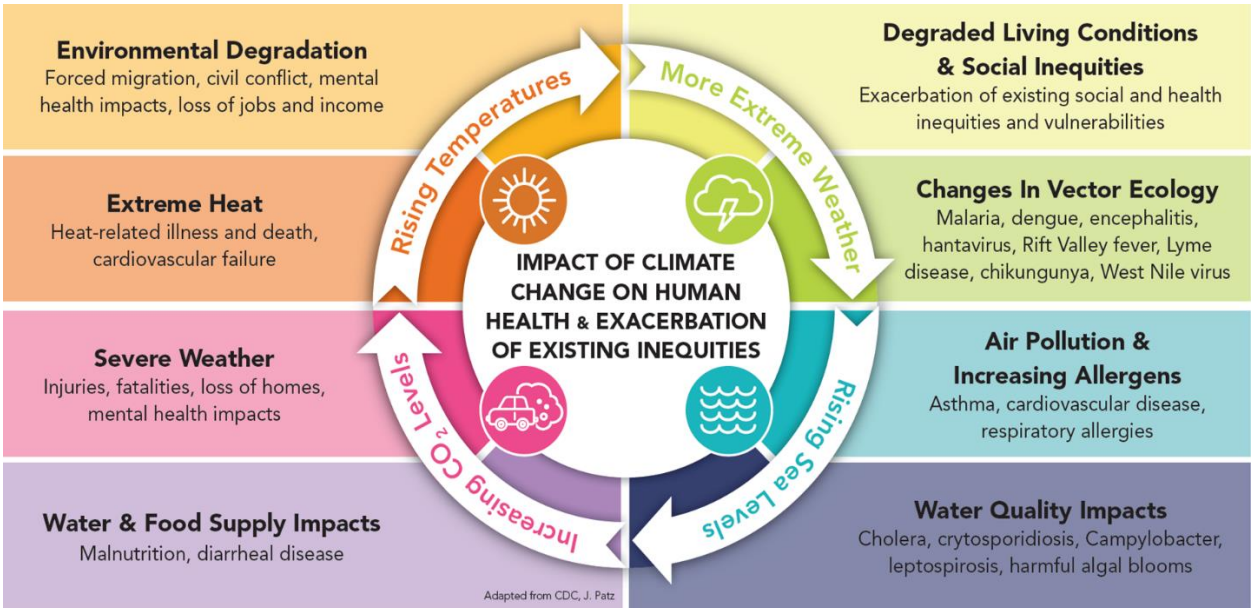
In 2012, the state released the California Adaptation Planning Guide (APG), a set of four complementary documents that provide guidance to support communities in addressing the unavoidable consequences of climate change. The APG provides a step-by-step guide for local and regional governments to assess relevant climate impacts in their area and develop local climate action plans. The APG is discussed in more detail in *Section 4.3.6.5*.

Climate Change and Health Equity Program

The Climate Change and Health Equity Program (CCHEP) promotes health as part of local "climate action planning" and regional sustainable community planning efforts under laws like SB 375 (2008), the Sustainable Communities and Climate Protection Act. CCHEP embeds health and equity in California climate change planning, and embeds climate change and equity in public health planning. CCHEP works with local, state, and national partners to assure that climate change mitigation and adaptation activities have beneficial effects on health while not exacerbating already existing unfair and preventable differences in health status of some groups (health inequities). CCHEP implements California's climate change laws and executive orders, adding health equity considerations to the process, and works to reduce vulnerability to climate impacts by improving living conditions with and for people facing inequities.

Climate change-related health impacts can include an increased number of cases of heat-related illness and death, more air pollution-related exacerbations of cardiovascular and respiratory diseases, increased injury and loss of life due to severe storms and flooding, increased occurrences of vector-borne and water-borne diseases, and stress and mental trauma from loss of livelihoods, property loss, and displacement. Figure 4.E provides a graphical representation of how climate change might affect human health and how these impacts exacerbate inequities.

Figure 4.E: Impact of Climate Change on Human Health and Exacerbation of Existing Inequities



Source: https://www.cdph.ca.gov/Programs/OHE/Pages/CCHEP.aspx

CDPH has a unique role in identifying and assessing GHG reduction strategies that improve the health of Californians or that may have unintentional harms. Many of the key strategies for reducing GHGs are some of the same strategies used by public health departments to improve community health and health equity. There are a number of co-benefit areas that can be actively linked within and across climate mitigation and healthy community efforts. These efforts can help achieve healthier communities in the short term, while also addressing longer-term climate risks. Cal OES' Office of Access and Functional Needs and CDPH work together to better understand the impact of climate change on access and functional needs populations and collaboratively plan for these considerations.

For more information about the CCHEP, visit: https://www.cdph.ca.gov/Programs/OHE/Pages/CCHEP.aspx#.

CalBRACE: California Building Resilience Against Climate Effects Project

The goals of the California Building Resilience Against Climate Effects (CalBRACE) project are to enhance CDPH's capability to plan for and reduce health risks associated with climate change. The program provides resources and technical assistance for the state and local public health departments to build climate adaptation capacity and enhance resilience at the local and regional levels.

Efforts are underway to identify and understand how climate change is affecting public health and to enhance preparedness and resilience to the specific threats and changes posed by climate change at the state and local level. Climate change threatens public health now and will continue to affect California's way of life. Some changes—including increased temperatures, drought, extreme storms, wildfires, rising sea-levels, ocean acidification, and decreased air quality—are already apparent in California.

The CalBRACE project focuses primarily on preparing for three of the major climate impacts facing our state: increasing temperature/extreme heat, wildfire, and sea-level rise (including flooding). In order to improve our understanding of the health implications of climate change, it is important to start with short and long-range climate projections. Then, climate change can be incorporated into a variety of public health planning and response activities.

The federal Centers for Disease Control and Prevention (CDC) has developed a five-step BRACE framework that enables health departments to incorporate the best available climate projections and epidemiology analysis into a traditional preparedness planning process. This approach supports the development and implementation of a unified climate and health adaptation strategy for a jurisdiction, while allowing flexibility for local and regional conditions and needs. The steps are not necessarily linear and can be addressed in a sequence that best aligns with local priorities, opportunities, and resources. Key principles for the framework include adaptive management, evidence-based public health practice, and stakeholder engagement.

For more information about CalBRACE, visit the CalBRACE program website: https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx.

As part of CDPH's CalBRACE project, Climate Change and Health Profile Reports are published to help counties in California to prepare for the health impacts related to climate change through adaptation planning. The reports present projections for county and regional climate impacts, climate-related health risks, and local populations that could be vulnerable to climate effects. The report information is based on available science compiled from previously published, state-sponsored research and plans.

To download Climate Change and Health Profile Reports by county, visit CDPH's Climate Change and Health Profile Reports page: https://www.cdph.ca.gov/Programs/OHE/Pages/ClimateHealthProfileReports.aspx#.

California Environmental Health Tracking Program

The California Environmental Health Tracking Program (CEHTP) works to improve public health with science-based information on the trends and distributions of diseases and environmental threats, as well as the often complex relationships between them. To date, over 50 statewide programs routinely use CEHTP's web-based services to visualize and link environmental hazard and health data across time and geography, and to explore possible associations between the environment and health outcomes.

CEHTP collaborates with diverse stakeholders including community organizations, local health departments, researchers, and journalists who use the CEHTP website as an essential tool for surveillance, research, program planning, and reporting. Additionally, CEHTP expertise has informed cutting-edge public health projects such as mapping community vulnerability to climate change, evaluating autism-pesticide associations, and conducting statewide mapping of breast cancer at the sub-county level. Visit the CEHTP website at http://cehtp.org/page/main.

4.3.6.5 LOCAL AND REGIONAL CLIMATE ADAPTATION PLANNING

It is now clear that the scientific community generally expects natural disasters to intensify due to climate change in the coming decades. Emergency managers, planning agencies, private companies, and communities especially affected by climate change will be challenged to adapt their planning to take into account an increase in the type, extent, and intensity of natural hazards.

Disasters expected to be more widely experienced in the future include avalanches, coastal erosion, flooding, sea-level rise, extreme heat, drought, landslides, severe weather and storms, and wildland fires. Particular interest and priority should be given to those climate change impacts having the potential to escalate to catastrophic levels.

Senate Bill 379 (2015)

SB 379 requires all cities and counties to include climate adaptation and resiliency strategies in the safety elements of their general plans upon the next revision of their Local Hazard Mitigation Plan on or after January 1, 2017, or, if the local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022. These are additional requirements beyond those related to seismic and geologic factors. The intent of the legislation is to ensure that cities, counties, and other local jurisdictions integrate adaptation into their general planning process.

SB 379 requires the update to: include a set of goals, policies, and objectives based on a vulnerability assessment; identify the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts; and provide implementation measures, which include the conservation and utilization of natural infrastructure that may be used in adaptation projects.

Jurisdictions can meet the requirements of SB 379 by including the relevant information into their Local Hazard Mitigation Plan (LHMP) and adopting the LHMP into the safety element of their general plan. Cal OES and OPR are working with other stakeholders to coordinate the implementation of this bill and support the alignment of general plans and LHMPs through guidance provided in the 2017 General Plan Guidelines. Other state adaptation resources such as the California Adaptation Planning Guide, and sector specific guidance, discussed in more detail below, are also available for use by local jurisdictions to support their climate adaptation efforts.

General Plan Guidelines – Adaptation Guidance for SB 379 (2015) Implementation

The recent introduction of climate risk to the discussion of the safety element, adds a focus on longer-term preparation and adaptation by each community to address a changing climate. Senate Bill 379 (2015) establishes a state-mandated climate adaptation requirement and further strengthens the safety element's hazard mitigation content by requiring that climate adaptation and resiliency strategies applicable to the jurisdiction be addressed its next required general plan element update.

The 2017 General Plan Guidelines provide a description of the requirements and timing of updates for climate change adaptation that must be addressed in the safety element and note that, while the safety element is the "statutory 'home'"[75] for the climate change adaptation discussion, this issue should be addressed throughout a jurisdiction's general plan. The 2017 General Plan Guidelines note the importance of consideration of the end year of a jurisdiction's general plan and the changes to future conditions and environmental change that may occur through that time frame to guide long-range policy. To support jurisdictions in addressing climate change, OPR has included a full chapter on climate change that offers additional guidance on how a jurisdiction might link its general plan to a climate action plan or adaption plan.

The 2017 General Plan Guidelines notes that numerous tools are now available to support the climate change analysis outlined by the APG steps and that OPR's Integrated Climate Adaptation Resiliency Program (ICARP) webpage includes case studies which can be helpful to a jurisdiction's adaptation analysis and planning efforts. ICARP staff are also available to provide support to jurisdictions to choose appropriate resources. The General Plan Guidelines also encourage jurisdictions to consider working with regional collaboratives, such as collaboratives working through the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), to identify opportunities to partner on analysis or implementation efforts.

To further support local jurisdictions' climate change analysis, OPR has launched the General Plan Guidelines Data Mapping Tool, which can be used in conjunction with outputs from Cal-Adapt (see *Section 4.3.6.4* for more information on Cal-Adapt). This mapping tool is a free resource that draws from data sets from multiple sources to allow users to incorporate local, regional, and statewide data in their general plans. For access to the mapping tool, visit: http://opr.ca.gov/planning/general-plan/data-mapping-tool.html.

See Chapters 4 and 8 of the 2017 General Plan Guidelines, which can be downloaded from the OPR website: http://opr.ca.gov/.

California's Adaptation Planning Guide: Steps in Climate Adaptation Strategy Development

The APG was developed cooperatively by the California Natural Resources Agency and California Emergency Management Agency (now Cal OES), with support from California Polytechnic State University San Luis Obispo, and with funding through the Federal Emergency Management Agency (FEMA) and the California Energy Commission (CEC).

[75] Governor's Office of Planning and Research. State of California 2017 General Plan Guidelines. 2017. pp152.

The APG consists of the following four documents:

- *APG: Planning for Adaptive Communities* – This document presents the basis for climate change adaptation planning and introduces a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development. All communities should start with this document.
- *APG: Defining Local and Regional Impacts* – This supplemental document provides a more in-depth understanding of how climate change can affect a community. Seven "impact sectors" are included to support communities conducting a climate vulnerability assessment.
- *APG: Understanding Regional Characteristics* – The impact of climate change varies across the state. This supplemental document identifies climate impact regions, including their environmental and socioeconomic characteristics.
- *APG: Identifying Adaptation Strategies* – This supplemental document explores potential adaptation strategies that communities can use to meet adaptation needs. Adaptation strategies are categorized into the same impact sectors used in the APG: Defining Local and Regional Impacts document.

In accordance with SB 246, the APG is required to be reviewed and updated within one year of Safeguarding California updates. The state is in the process of reviewing the APG with other stakeholders and the final updated products are anticipated to be available to the public in the summer of 2019.

The state developed the APG as a step-by-step guide for local and regional governments to assess relevant climate impacts in their area and develop local climate action plans. The APG serves as a foundational resource for climate adaptation planning in California. Ongoing implementation of Senate Bill 379 relies heavily on the APG to assist local governments with general plan updates.

The process of developing climate change adaptation strategies can vary from a short, initial qualitative process to a much more detailed, lengthy, comprehensive approach. Regardless of where a community falls in this spectrum, the basic steps are the same, as follows:

Vulnerability Assessment

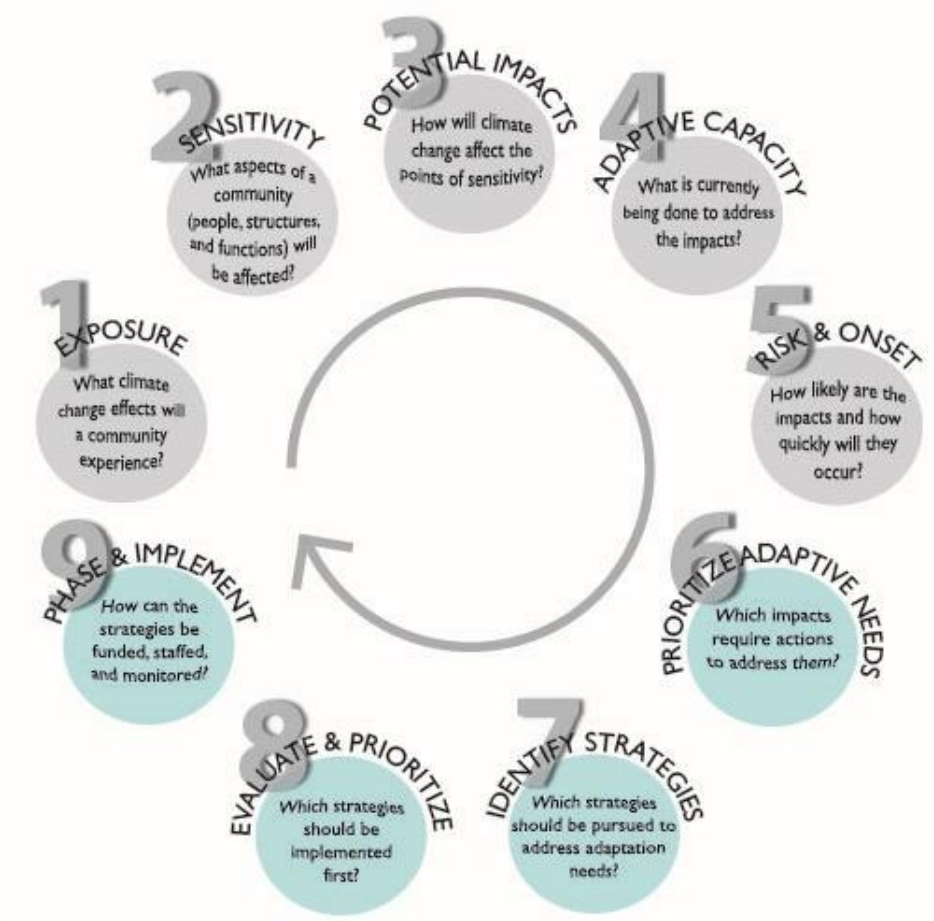
1. Exposure: Identify the climate change effects a community will experience
2. Sensitivity: Identify the key community structures, functions, and populations that are potentially susceptible to each climate change exposure
3. Potential Impacts: Analyze how the climate change exposure will affect the community structures, functions, and populations (impacts)
4. Adaptive Capacity: Evaluate the community's current ability to address the projected impacts
5. Risk and Onset: Adjust the impact assessment to account for uncertainty, timing, and adaptive capacity

Adaptation Strategy Development

6. Prioritize Adaptive Needs: Based on the vulnerability assessment, set priorities for adaptation needs
7. Identify Strategies: Identify strategies to address the highest priority adaptation needs
8. Evaluate and Prioritize: Evaluate and rank strategies based on the projected onset of the impact, projected cost, co-benefits, and other feasibility factors
9. Phase and Implement: Develop an implementation plan that includes phasing of strategies and a monitoring system to assess effectiveness

In Figure 4.F, the gray steps indicate vulnerability assessment efforts (Steps 1-5) and the blue steps indicate adaptation strategy development efforts (Steps 6-9).

Figure 4.F: The Nine Steps in Adaptation Strategy Development



Source: California APG: Defining Local and Regional Impacts

A key to execution of *Step 1: Identifying Community Exposure* is using available online climate change resources such as Cal-Adapt or other available regional data. Since projected changes to the climate vary based on location, each community must determine what primary climate change impacts, and in some cases associated secondary impacts, may be experienced in their locale. Cal-Adapt serves as good starting point for California communities to determine local and regional climate exposure.

Cal-Adapt's website includes the next generation of downscaled climate data for temperature, precipitation, and snowpack. Cal-Adapt is discussed in more detail in *Section 4.3.6.4*. For more information on Cal-Adapt visit: http://cal-adapt.org/. Communities seeking to understand their vulnerability to climate change and develop strategies to address the issue should refer to the APG: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/california-climate-adaptation.

Progress Summary 4.A: California Adaptation Planning Guide (APG) Updates

Progress as of 2018: Released in 2012, the California Adaptation Planning Guide (APG), was developed by the state to provide guidance and support to communities in addressing the unavoidable consequences of climate change. The APG introduces the basis for climate change adaptation planning and details a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development.

In October 2015, Senate Bill 246 was passed, requiring the California Governor's Office of Emergency Services (Cal OES) to review and update (as necessary) the California Adaptation Planning Guide (APG) within one year of an update to Safeguarding California. Updates to Safeguarding California were completed in early 2018. As of early 2018, the APG is in the process of being reviewed and updated by Cal OES and other stakeholders and is anticipated to be available to the public sometime in 2019.

State Adaptation Progress and Resources for Jurisdictions

In addition to the APG, other guidance documents from state agencies are intended to assist local governments in planning for climate change. While the 2018 Safeguarding California Plan provides a comprehensive picture of California's continued needs with respect to preparing for climate impacts and sector specific strategies, more in-depth, sector-specific guidance, policies, and actions are also being developed and/or updated. State progress to date includes, but is not limited to, the documents and other resources listed in Table 4.I.

Progress Summary 4.B: Additional Local Climate Adaptation Guidance Sources

Progress as of 2018: California state agencies continue to prepare additional guidance documents to assist local governments in planning and preparing for climate change. These documents assist local planners and managers in assessing risk, identifying at risk-assets and populations, and developing climate adaptation policies and strategies. Table 4.I lists many of the adaptation guidance documents and efforts by state agencies.

Table 4.I: Climate Adaptation Sector Specific Guidance

Lead Agency	Guidance Document	Resource Website
AGRICULTURE SECTOR		
California Department of Food and Agriculture	2012 California Department of Food and Agriculture launch of the Climate Change Consortium to help specialty crop growers prepare for climate impacts	https://www.cdfa.ca.gov/oefi/climate/climate_change_consortium.html
California Energy Commission	2009 Potential for Adaptation to Climate Change in an Agricultural Landscape in the Central Valley of California	http://www.energy.ca.gov/2009publications/CEC-500-2009-044/CEC-500-2009-044-F.PDF
BIODIVERSITY SECTOR		
Department of Fish and Wildlife	Habitat Connectivity Planning for Fish and Wildlife Program and the 2010 California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California	https://www.wildlife.ca.gov/Conservation/Planning/Connectivity https://www.wildlife.ca.gov/Conservation/Planning/Connectivity/CEHC
Department of Fish and Wildlife	2011 Vision for Confronting Climate Change in California: Unity-Integration-Action; Climate Science Program	https://www.wildlife.ca.gov/Conservation/Climate-Science
COAST & OCEANS SECTOR		
State Coastal Conservancy	Climate Ready Program supporting planning, project implementation, and multi-agency coordination to advance actions that will increase the resilience of coastal communities and ecosystems	http://scc.ca.gov/climate-change/

Lead Agency	Guidance Document	Resource Website
Ocean Protection Council	Rising Seas in California: An Update on Sea-Level Rise Science	http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf
Ocean Protection Council	State of California Sea-Level Rise Guidance Document 2018 Update	http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/
California Coastal Commission	2015 Sea-level Rise Policy Guidance – Interpretive Guidelines for Addressing Sea-level Rise in Local Coastal Programs and Coastal Development Permits *(2018 update pending)*	https://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf
San Francisco Bay Conservation and Development Commission	Adapting to Rising Tides Program	http://www.adaptingtorisingtides.org/
California Coastal Commission (CCC)	Local Coastal Programs Activity	https://www.coastal.ca.gov/lcps.html
National Oceanic and Atmospheric Administration (NOAA)	Coastal Plan Alignment Compass	https://resilientca.org/topics/plan-alignment/
ELECTRICITY & NATURAL GAS SECTOR		
California Energy Commission	2013 Integrated Energy Policy Report that includes policy recommendations on vulnerability of the California energy system to extreme weather events and climate change	http://www.energy.ca.gov/2013_energypolicy/index.html
California Energy Commission	Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks from Climate Change in California	http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf
California Public Utilities Commission	2016 Climate Adaptation in the Electric Sector: Vulnerability Assessments and Resiliency Plans	http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Divisions/Policy_and_Planning/PPD_Work/PPD_Work_Products_(2014_forward)/PPD%20-%20Climate%20Adaptation%20Plans.pdf
FORESTRY SECTOR		
California Department of Forestry and Fire Protection (CAL FIRE)	2012 relaunch of the CAL FIRE wildfire preparedness website with added features and steps to assist homeowners in preparing for wildfires	www.ReadyForWildfire.org
CAL FIRE	Tree Mortality Task Force, that mainly documents Task Force work but, also provides information on grants for tree mortality efforts	http://www.fire.ca.gov/treetaskforce/
LAND USE SECTOR		
Climate Change Land Use & Infrastructure (CCLU)	Climate Change, Land Use, and Infrastructure Web Portal (The CCLU working group is a multi-agency subcommittee to the Climate Action Team)	http://www.climatechange.ca.gov/action/cclu/
PUBLIC HEALTH SECTOR		
Department of Public Health	California Environmental Health Tracking Program, climate change topic area	http://cehtp.org/page/climate_change

Lead Agency	Guidance Document	Resource Website
Public Health Alliance of Southern California	California Healthy Places Index interactive data and mapping tool providing snapshots of the social determinants of health across the state	http://healthyplacesindex.org/
Office of Environmental Health Hazard Assessment (OEHHA)	2018 Office of Environmental Health and Hazard Assessment Indicators of Climate Change in California	https://oehha.ca.gov/climate-change/document/indicators-climate-change-california
Department of Public Health	California Building Resilience Against Climate Effects (CalBRACE) Climate Change and Health Profile report (one for each county)	https://www.cdph.ca.gov/Programs/OHE/Pages/ClimateHealthProfileReports.aspx#
Natural Resources Agency	California Heat Adaptation Tool (CHAT) (developed by Four Twenty Seven)	www.cal-heat.org http://427mt.com/cal-heat/
Department of Public Health	2013 Preparing California for Extreme Heat: Guidance and Recommendations	http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf
Department of Public Health	2012 Climate Action for Health: Integrating Public Health into Climate Action Planning	https://www.cdph.ca.gov/Programs/OHE/Pages/CCHEP.aspx
OEHHA	2010 Indicators of Climate Change in California: Environmental Justice Impacts	https://oehha.ca.gov/media/downloads/risk-assessment/document/climatechangeej123110.pdf
STATE GOVERNMENT OPERATIONS		
Department of Fish and Wildlife	2012-2013 launch of the Climate College to promote climate literacy by providing open lectures on the fundamentals of climate science and providing tools and resources necessary to empower participants to better incorporate climate change into their professional responsibilities	http://www.dfg.ca.gov/Climate_and_Energy/Climate_Change/Climate_College/
TRANSPORTATION		
Department of Transportation (Caltrans)	Climate Change Vulnerability Assessments: 2017 District 4 Technical Report	http://www.dot.ca.gov/transplanning/ocp/vulnerability-assessment.html
Caltrans	2014 District 1 Climate Change Pilot Study	http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/projects_and_studies.shtml
Caltrans	2013 California Department of Transportation release of "Addressing Climate Change Adaptation in Regional Transportation Plans - A Guide for California MPOs and RTPAs"	http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/assessment.shtml
Caltrans	2012 Cool Pavements Bill (Assembly Bill 296) regarding materials that can be used to reduce extreme heat in urban areas	http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0251-0300/ab_296_bill_20120927_chaptered.pdf
Caltrans	2011 California Department of Transportation Guidance for Incorporating Sea-level Rise for Use in the Planning and Development of Project Initiation Documents	http://www.dot.ca.gov/ser/downloads/sealevel/guide_incorp_slr.pdf

Lead Agency	Guidance Document	Resource Website
WATER		
Department of Water Resources NOAA California Ocean Science Trust	October 2016 Relating Future Coastal Conditions to Existing FEMA Flood Hazard Maps: Technical Methods Manual	http://www.oceansciencetrust.org/wp-content/uploads/2016/12/Technical-Methods-Manual_FINAL_2016_12_02_clean.pdf
Department of Water Resources	2011 Climate Change Handbook for Regional Water Planning developed cooperatively by Department of Water Resources, the U.S. Environmental Protection Agency, Resources Legacy Fund and the U.S. Army Corps of Engineers	https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Integrated-Regional-Water-Management/Files/Climate_Change_Handbook_Regional_Water_Planning.pdf
State Water Resources Control Board (SWRCB)	SWRCB Comprehensive Response to Climate Change (Resolution No. 2017-0012), which builds on previous work and requires a proactive approach to climate change in all board actions with the intent to embed climate change consideration into all programs and activities	https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2017/rs2017_0012.pdf

Progress on preparing for climate impacts in California is not limited to state efforts. As noted in the 2009 CAS, the federal government, tribes, local and regional governments, businesses, non-governmental organizations, and Californians all play an important role in preparing for climate impacts. The 2014 CAS Update (Safeguarding California) describes some of the successes of non-state entities and individuals, as well as a number of collaborative efforts.

Continued cooperation and innovative solutions will be important in ensuring resilient California communities. Significant local adaptation efforts are underway around the state to address various impacts of climate change.

Progress Summary 4.C: Creation of a Coastal Plan Alignment Compass: A Planning Tool for Coastal Communities

New as of 2018: During 2017 and 2018, the California Governor's Office of Planning and Research (OPR), California Coastal Commission (CCC), the Ocean Protection Council (OPC), Cal OES, and other state agencies collaborated with National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and FEMA in an informal working group to develop a coastal plan alignment tool for local jurisdictions. This tool supports efforts by local jurisdictions to align local coastal programs with local hazard mitigation plans, as well as general plans and adaptation plans.

Guidance in the Compass explains common elements between various plans and how these elements can be can be aligned across planning documents to further support adaptation and mitigation efforts, and assists local governments to begin to coordinate plans.

For more information about the compass, visit: https://resilientca.org/topics/plan-alignment/.

Best Practices Highlight 4.A: Santa Cruz County Plan for Climate Action and Adaptation

In 2017, the Santa Cruz County Board of Supervisors approved a county Climate Action Strategy that incorporated adaptation efforts. In addition to addressing greenhouse gas emissions through emission reduction targets and strategies, the Strategy also identified the vulnerabilities to climate change that the county is expected to face by 2100, but acknowledges that uncertainly is a condition that must be accepted and dealt with through the decision-making process. Based on these identified vulnerabilities, the Strategy provides a risk assessment of the effects of climate change, followed by goals and strategies to assist in reducing significant impacts from climate change. A key element of the Strategy is its structure, which emphasizes partnership between public and private county stakeholders to achieve the Strategy's eight adaptation goals.

Other Climate Change Adaptation Resources

California Energy Commission California Climate Change Center Report Series

In 2012, the California Energy Commission's California Climate Change Center commissioned the preparation of case studies evaluating regional climate adaptation efforts. These studies resulted in white papers that in part, identified adaptation barriers encountered by the jurisdictions evaluated and define lessons from these adaptation efforts to help inform future research priorities and policies.

Case studies can be downloaded at the following links:
http://www.energy.ca.gov/2012publications/CEC-500-2012-034/CEC-500-2012-034.pdf
http://www.energy.ca.gov/2012publications/CEC-500-2012-038/CEC-500-2012-038.pdf
http://www.energy.ca.gov/2012publications/CEC-500-2012-027/CEC-500-2012-027.pdf

National Disaster Resilience Competition Award: A Model of Large-Scale Co-Benefit Climate Adaptation

California will receive more than $70 million in federal funding for an innovative disaster recovery and resilience program in Tuolumne County following the devastating 2013 Rim Fire. The funding, part of the U.S. Department of Housing and Urban Development's National Disaster Resilience Competition, will be used to help restore forest and watershed health, support local economic development and increase disaster resilience in the rural mountain areas affected by the fire.

The funding will be used to pilot Tuolumne County's Community and Watershed Resilience Program, which will provide co-benefits of supporting forest and watershed health and economic development, develop a community resilience center, and create a long-term economically and environmentally sustainable program that can be replicated throughout the state. For more information about the program, visit: http://www.tuolumnecounty.ca.gov/951/National-Disaster-Resilience-Competition.

4.4 ENVIRONMENTAL JUSTICE, EQUITY, AND HAZARD MITIGATION IN CALIFORNIA

The United States Environmental Protection Agency (EPA) defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." The EPA notes that within the goal of environmental justice all persons would be afforded "the same degree of protection from environmental and health hazards."[76]

Since President Clinton's signing of Executive Order 12898 on Environmental Justice in 1994, the environmental justice movement has gained greater mainstream awareness. The 1994 executive order mandated that federal agencies address disproportionate pollution experienced by minority communities.

In California, environmental justice is defined in Government Code as the "fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (Government Code Section 65040.12(e)).

Environmental justice principles are an important part of the California Environmental Protection Agency (CalEPA) goal to restore, protect, and improve the environment, and to ensure the health of people, the environment, and the economy.

According to the State of California 2017 General Plan Guidelines (GPG) the environmental justice field has expanded significantly and now overlaps with equity and healthy community issues, as evidenced by the 2016 environmental justice legislation, Senate Bill 1000. As such, Chapter 5 of the 2017 GPG specifically addresses "Equitable and Resilient Communities" and also "Healthy Communities."

Inequities are systemic differences that disadvantage an individual or group in favor of another. Equity is the full and equal access to opportunities, power, and resources so that all people achieve their full potential and thrive.[77,78]

4.4.1 SOCIAL VULNERABILITY

According to the Centers for Disease Control and Prevention (CDC), a number of factors, including poverty, lack of access to transportation, and crowded housing may weaken a community's ability to prevent human suffering and financial loss in the event of disaster. These factors are known as social vulnerability.[79]

Social vulnerability varies across communities and also across households within communities. Variations in social vulnerability can increase or decrease the effect of hazard exposure. Three impact conditions—social vulnerability, structural vulnerability, and hazard exposure—can largely determine the effects of a disaster.

The resilience of a community when confronted by external stresses on human health—stresses such as natural or human-caused disasters, or disease outbreaks—is influenced by its level of social vulnerability. Reducing social vulnerability can increase a community's resilience and decrease both human suffering and economic loss.

In Executive Order B-30-15 Governor Brown declared that "climate change will disproportionately affect the state's most vulnerable citizens," and thus "State agencies' planning and investment shall…protect the state's most vulnerable populations." The state is developing guidance to help agencies identify vulnerable populations to help reduce their vulnerability to disaster impacts by providing increased resources, training, services, jobs, access to meaningful participation in decision-making, or other benefits that increase equity. Promoting equity can be thought of as consideration of how and why some communities face more disaster impacts and therefore deserve more investment and services.

[76] https://www.epa.gov/environmentaljustice
[77] King County, Washington. King County Equity and Social Justice Strategic Plan, 2016-2020. 2016. Available at http://your.kingcounty.gov/dnrp/library/dnrp-directors-office/equity-social-justice/201609-ESJ-SP-INT-ToC-Strat-VAL.pdf
[78] King County Equity and Social Justice Ordinance (16948)
[79] https://stacks.cdc.gov/view/cdc/27762/Share

Climate change and its effects threaten the health and well-being of California's diverse population of nearly 38 million people. Climate change affects human health and well-being through environmental changes including more extreme heat and other severe weather events, a decline in air quality, more frequent wildfires, increases in allergens, and altered environmental conditions that foster the spread of communicable and other diseases. Climate change also threatens the basic life support systems on which humans depend—water, food, shelter, clean air, and security. The resulting human health impacts include increases in the risk of asthma, allergies, and other respiratory ailments; cardiovascular disease; vector-borne diseases; mental illness; cognitive impairment; civil conflicts and migrations; malnutrition; injuries; and heat-related illness and death.[80,81] These challenges amplify risks among the state's most vulnerable populations, making climate change a threat multiplier.

While all Californians are affected by climate change, different groups are affected in unique and overlapping ways. The people most vulnerable to the impacts of climate change are largely the same communities that already experience health inequities, or systemic differences in health status that are preventable and therefore considered unfair. Consequently, climate change has the potential to exacerbate a wide array of pre-existing inequities and conditions of vulnerability for many already-disadvantaged people. Those most vulnerable to climate change impacts are low-income people, some communities of color, people with disabilities, people with existing health conditions such as chronic diseases and mental illness, young children, older adults, people experiencing homelessness, outdoor workers including farmworkers, immigrants and refugees, people who are linguistically isolated, indigenous people and tribal nations, individuals who are or have been incarcerated, lesbian, gay, bisexual, transgender, queer, and questioning (LGBTQQ) communities and people who are physically or socially isolated.[82,83,84]

These populations are more vulnerable to climate change impacts for a number of distinct or overlapping reasons. First and foremost, due to existing inequities, institutionalized racism, or exclusion, people in these groups often have lower socio-economic status, with its attendant lack of resources and economic and political power. Vulnerable populations often also experience higher rates of health and living conditions that may be affected by extreme weather impacts, such as asthma or cardiovascular disease, poor housing quality, living in high-poverty neighborhoods or areas with high risk of harm from sea-level rise, extreme heat, drought, wildfire, or poor air quality associated with climate change. Vulnerable populations often have less adaptive capacity to manage extreme weather events and adapt to a changing climate. In many cases, people in these groups are not inherently vulnerable to these impacts. Rather, their vulnerability is created by social, economic, and other systems that inequitably distribute power and resources.

Other populations that have been shown to be at higher risk of harm from climate change impacts include people who are uninsured or underinsured or lack access to health care, lack access to transportation; are pregnant; live in areas with poor air quality; live on upper floors of tall buildings; live in areas with lots of impervious surfaces and little tree cover and lack life-supporting resources such as adequate housing, ways to cool living space, food security, and medications; or are tenants or renters.

In addition, people often are affected by multiple forms of vulnerability at once. For example, an individual may experience racism, have a low income, and live in substandard housing without tree cover and surrounded by impervious surfaces, and thus may experience higher risk of heat illness, respiratory illness, and cardiovascular disease. State agencies can provide resources to improve living conditions and reduce multiple forms of vulnerability at once through strategic investments and involvement of vulnerable populations in policy decisions. The capacity for climate resilience is significantly driven by living conditions and the forces that shape them including income, education, housing, transportation, environmental quality, and access to services.

[80] https://www.epa.gov/environmentaljustice
[81] King County Equity and Social Justice Ordinance (16948).
[82] California Health and Safety Code Section 131019.5
[83] California Natural Resources Agency. Safeguarding California: Reducing Climate Risk. 2014.
[84] Shonkoff SB, Morello-Frosch R, Pastor M, Sadd J. The climate gap: environmental health and equity implications of climate change and mitigation policies in California – a review of the literature. Climate Change. 2011;109(1):485-503.

Vulnerable communities have historically experienced lack of investment and opportunities, leading to degraded living conditions and limited influence over decisions that affect their lives. Therefore, achieving a fair distribution of power and access to resources will require *extra* (not equal) investment and *additional* opportunities in and for these communities. Efforts to achieve this broad-based fairness, and ultimately well-being, involve striving for equity.

Decisions, plans, and investments by state and local agencies can help residents least able to cope with damage to their homes, communities, and physical and mental health. This can be achieved by making services and resources for vulnerable populations a top priority, so that their quality of life is not worsened due to disasters, but rather their living standard is improved through hazard mitigation-related investments, and reliable avenues for meaningful participation in decision-making.

In the 2018 SHMP, the CDC definition forms the basis for a California-specific social vulnerability approach as explained in *Section 4.4.4* of this chapter.

In California, the highest concentrations of socially vulnerable communities occur in the highly populated San Francisco Bay, Los Angeles-San Bernardino, and San Diego areas, as well as in rural and urban areas of the Central Valley. Smaller concentrations of socially vulnerable communities can be found in other rural areas including the foothills and north coast.

4.4.2 HEALTH EQUITY

Environmental injustice and social vulnerability are two contributing factors to health inequities, or preventable and systemic differences in health status among groups. Working to achieve health equity involves eliminating systemic and preventable differences in health status among groups that are strongly associated with social disadvantage and unequal access to resources and opportunity. The state of health equity is full and equal access for all people to opportunities that enable them to lead healthy lives, with a focus on improving conditions for those who have had fewer opportunities.

4.4.3 HAZARD EVENTS AND DISPROPORTIONATE IMPACTS ON ENVIRONMENTAL JUSTICE COMMUNITIES AND SOCIALLY VULNERABLE POPULATIONS

Today the concept of environmental justice is applied beyond environmental pollution to identify communities with disproportionate exposure to and lack of capacity to address or respond to natural hazards (such as floods or hurricanes) and climate change. Environmental justice communities are disproportionately:

- More vulnerable to disasters and illness
- More vulnerable to extreme heat
- More likely to be in areas with higher rates of air pollution
- More likely to be at risk from energy and food price shocks
- More economically vulnerable to disaster[85]

The conditions in which people live, learn, work, and play affect individual and community vulnerability to disasters. These vulnerabilities are further deepened by climate change, which exacerbates existing health threats and creates new public health challenges. Disadvantaged, vulnerable, and environmental justice communities have thus far and will likely bear a disproportionate burden of climate change impacts.

For example, temperatures in most urban areas are significantly higher than in less urbanized areas because pavement and building materials absorb sunlight and heat. This is known as the urban heat island effect. The most intense effects are often in neighborhoods where impervious paved surfaces predominate, and trees, vegetation, and parks are less common. These features are not evenly or fairly distributed. Nationally, African-Americans were

[85] https://www.epa.gov/sites/production/files/2015-10/documents/post_2_-_environmental_justice_climate_change.pdf

52 percent more likely, Asians 32percent more likely, and Hispanics 21 percent more likely than Whites to live in areas where impervious surfaces covered more than half the ground, and more than half the population lacked tree canopy.[86] Populations of color are less likely to have air conditioning, more likely to have one or more chronic conditions, and less likely to own cars to escape from climate-related events such as extreme heat, floods, or wildfires.[87,88,89]

This vulnerability to extreme heat is further compounded for low-income communities, which are less likely to have access to heat adaptive features. Communities facing inequities, which have the fewest resources to adapt, feel the impacts of climate change first and are hit the hardest. As climate impacts become more pronounced across the state, climate adaptation efforts focused on communities most vulnerable to potential increased burdens from the effects of climate change, such as air emissions and extreme heat days, will be increasingly important.

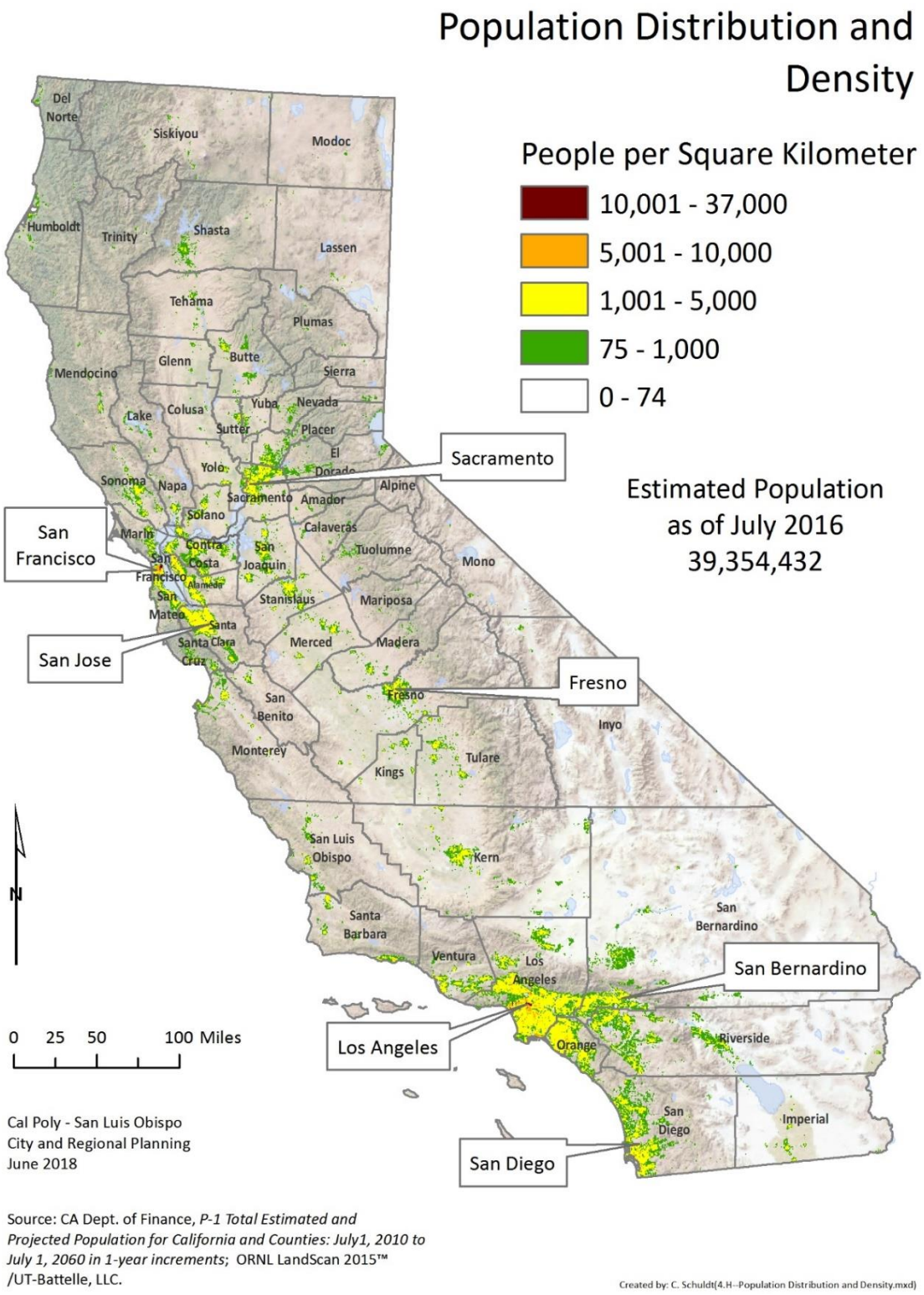
While it is broadly recognized that environmental justice communities experience a disproportionate amount of chronic exposures and risks, as discussed above, it is important to note vulnerabilities to acute exposures resulting from hazardous material releases due to earthquakes, floods, or other natural or human-induced disasters. For example, a study in Houston, Texas found that linguistically isolated households tend to reside in areas with greater exposure to severe incidents that may require public evacuation, yet such households are likely to face evacuation problems should an incident occur.[90]

In addition to linguistic isolation, evacuation challenges in disadvantaged communities may include lacking a car or other transportation, inability to access information, or not having outside support. This is an important consideration for any neighborhood with facilities that store or use hazardous substances, where infrastructure damage due to a natural disaster could result in a chemical release.

See Maps 4.I and 4.J for an overview of areas of the state with higher population densities and areas of highest concentrations of social vulnerability based on based on the index detailed in *Appendix N*.

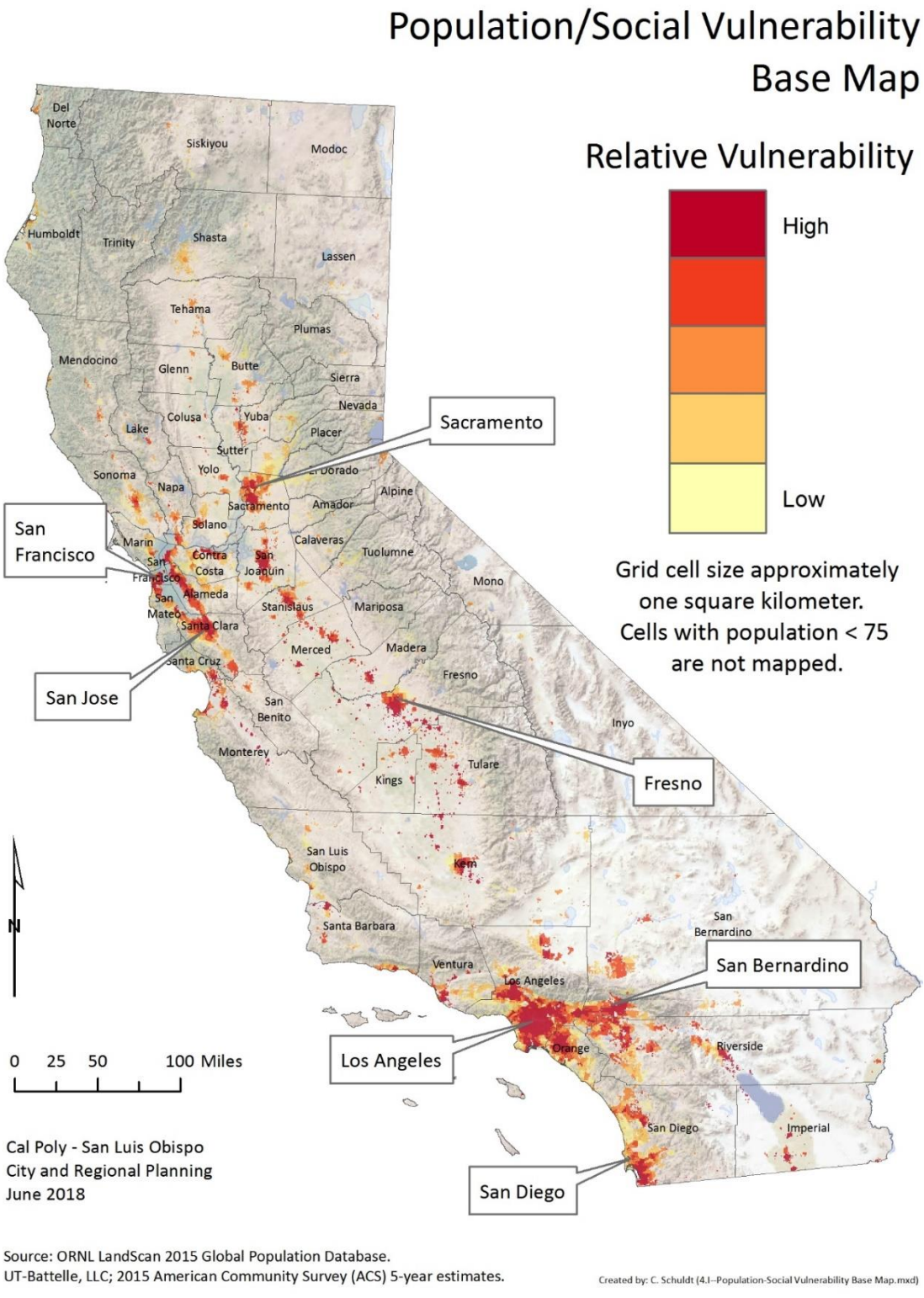
[86] Jesdale BM, Morello-Frosch R, Cushing L. The racial/ethnic distribution of heat risk-related land cover in relation to residential segregation. Environ Health Perspect. 2013 Jul;121(7) 811-817.
[87] Shonkoff SB, Morello-Frosch R, Pastor M, Sadd J. The climate gap: environmental health and equity implications of climate change and mitigation policies in California – a review of the literature. Climate Change. 2011;109(1):485-503.
[88] English P, Richardson M, Morello-Frosch R, Pastor M, Sadd J, King G, Jesdale W and Jerrett M. Racial and income disparities in relation to a proposed climate change vulnerability screening method for California. 2013. International Journal of Climate Change: Impacts & Responses, 4(2).
[89] Gronlund CJ. Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review. Current Epidemiology Reports. 2014. 1(3) 165-173.
[90] Chakraborty, et al. Comparing Disproportionate Exposure to Acute and Chronic Pollution Risks: A Case Study in Houston, Texas. 2014. Risk Analysis, Vol. 34, No. 11.

Map 4.I: Population Distribution and Density



Map 4.I differentiates areas of 75 to 1,000 people per square kilometer, which are more rural and suburban, from those with 1,000 people or more per square kilometer, which are more urban. Most urban residents live in the Southern California, San Francisco, and Sacramento regions.

Map 4.J: Population/Social Vulnerability Base Map



Map 4.J shows that the highest concentrations of combined population density and social vulnerability (based on the index described in *Appendix N*) are in Southern California, the San Francisco Bay Area, and the Central Valley area.

4.4.4 STATEWIDE GIS ANALYSIS OF VULNERABILITY TO HAZARDS

California's Geographic Information Systems (GIS) resources include a suite of web-accessible mapping tools available to communities, stakeholders, and the public that provide distributed information about hazards and vulnerable populations. Examples of these tools include:

- General Plan Guidelines Online Mapping tool
- MyPlan
- MyHazards
- Cal-Adapt
- CalEnviroScreen
- California Environmental Health Tracking Program
- California Healthy Places Index
- Seismic Hazard Zone Maps and Alquist-Priolo Earthquake Fault Zone Maps
- Awareness Floodplain Map
- Fire and Resource Assessment Program (FRAP) Maps
- Sea-level Rise Viewer
- Tree Mortality Viewer

For a list of examples of California's GIS resources and other hazard data tools, see *Section 3.11* in *Chapter 3: California's Mitigation Framework: Goals, Objectives, Strategies, and Priorities*, which outlines the state strategy to "Enhance collaboration on the development and sharing of data systems and GIS modeling." Further GIS mapping tools may be found on the gallery page of the state's Geoportal website, which is provided as a data portfolio of California GIS mapping tools: http://portal.gis.ca.gov/geoportal/catalog/gallery/gallery.page.

Updating GIS Risk Assessment Modeling and Maps for the 2018 SHMP

To determine appropriate hazard mitigation strategies and actions, California has used GIS analysis to undertake a risk and vulnerability assessment of socially vulnerable populations for the state's primary hazards—earthquakes, floods and wildfires—and has also the applied the social vulnerability model data to the secondary hazard of extreme heat. GIS is helpful for analyzing spatial relationships between natural hazards and populations that live within areas affected by natural hazards.

In the 2018 SHMP, the population/social vulnerability maps from the 2013 and 2010 SHMPs are revised using updated hazard and population data and a redeveloped GIS model, previously based on a model developed for the 2010 SHMP to analyze vulnerability of California's population to disasters. Four maps were created through the GIS model: a population/social vulnerability base map and three hazard maps, for earthquakes, floods, and wildfires. Population/social vulnerability data were combined with each GIS hazard dataset to show vulnerability for that hazard as it varies throughout the state.

Although the 1-kilometer grid cell size used in the vulnerability maps is appropriate for generalized statewide analysis, it is generally not useful for interpretation of hazards, risk, and vulnerability at the community level. Users are cautioned that, although they may use the portable document file (PDF) version of the 2018 SHMP to zoom in on these maps to a closer scale, more detailed information useful for hazard mitigation planning by communities may not necessarily be revealed.

ArcGIS ModelBuilder is a tool for designing and implementing geoprocessing of GIS layer data. It allows creation of a series of steps to manipulate GIS data that can be run repeatedly to test and refine the outcome. Because the 2018 SHMP risk analysis was created in ModelBuilder, as new base datasets become available, the model can be rerun and the vulnerability maps updated.

As part of the 2018 SHMP, the population indicator variables used to model social vulnerability within the state were reviewed and updated by a State Hazard Mitigation Team (SHMT) Social Vulnerability Working Group, a subset of the Geographic Information Systems Technical Advisory Working Committee (GIS TAWC), over a series of conference call meetings and follow-up email communications.

Through this series of communications, the Working Group developed an updated set of population indicator variables to model social vulnerability. The selected indicator variables were grouped in three sub-indices: differential access to resources and information, cultural or linguistic isolation, and access and functional needs. Table 4.J lists each variable and its indicator and the sub-index grouping.

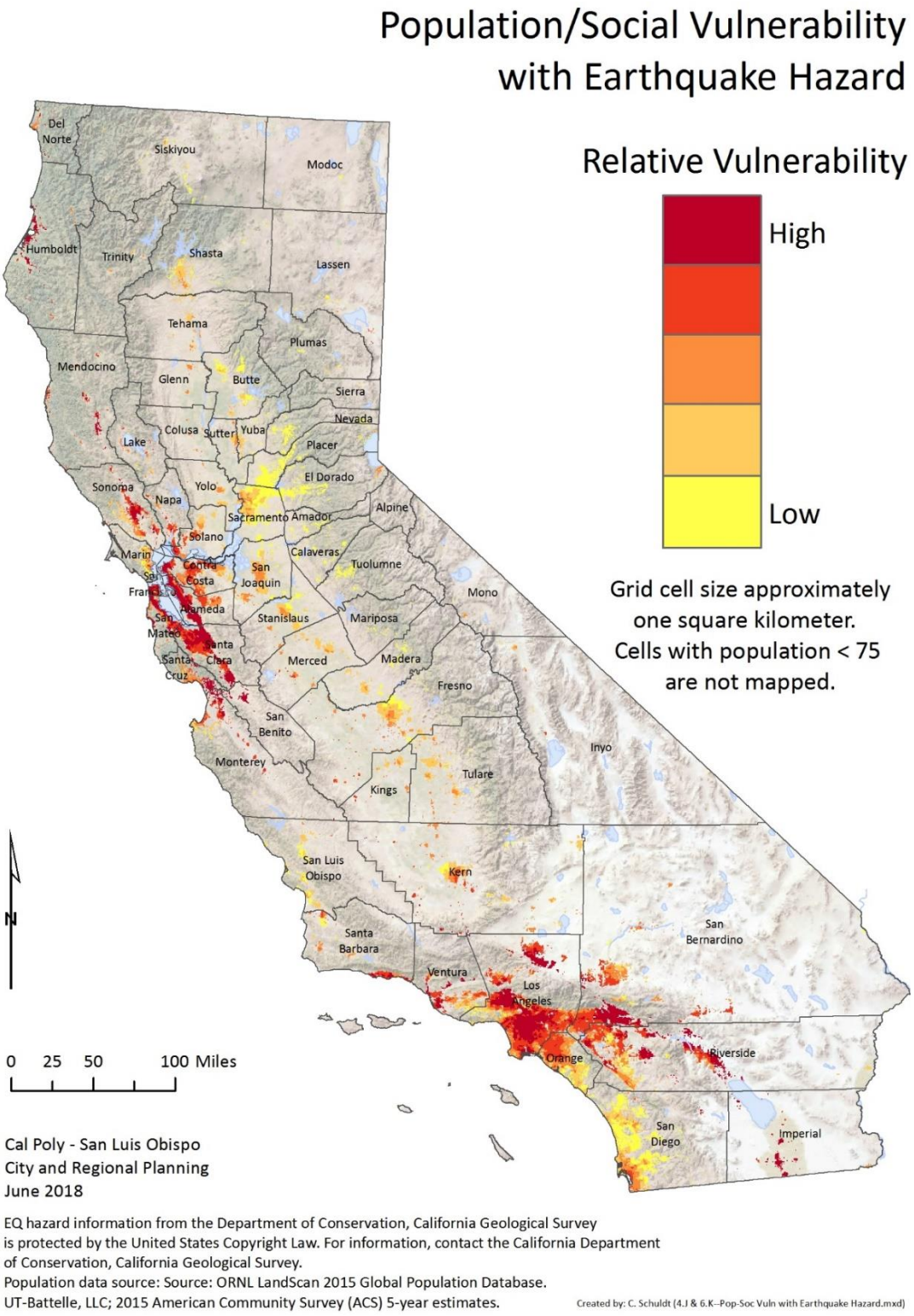
Table 4.J: Social Vulnerability Index Conceptual Model and Associated Variables

Sub-Index	Indicator	Variable
Differential Access to Resources and Information	Poverty/ Income	Annual housing costs to income ratio
	Education	Percent of the population 25 or older without a high school diploma or equivalent
	Housing Tenure	Percent renter occupied housing units
	Gender	Percent female population
	Food Access	Modified Retail Food Environment Index (mRFEI)
Cultural or Linguistic Isolation	Linguistic Isolation	Percent of population 5 or older who speak English less than very well
	Minority Status	Percent non-White or Hispanic population
Access and Functional Needs	Disability	Percent of population with a disability
	Long-Term Care Facility Residents	Beds in licensed long-term care facilities per person
	Age	Percent of population 65 or older, or younger than 5
	Vehicle Access	Percent of households with no available vehicles

The input variables for each indicator were processed and weighted within each sub-index and each overall sub-index was further weighted. The model was then run with varying combinations of the reasonable alternatives for each set of indicators to produce the social vulnerability intermediate output that was then combined with the hazard layer to generate the model metrics.

This model is the basis for the social vulnerability maps shown on the following pages of this section. For more information about the SHMP GIS vulnerability modeling methodology, see *Appendix N*.

Map 4.K: Population/Social Vulnerability with Earthquake Hazard

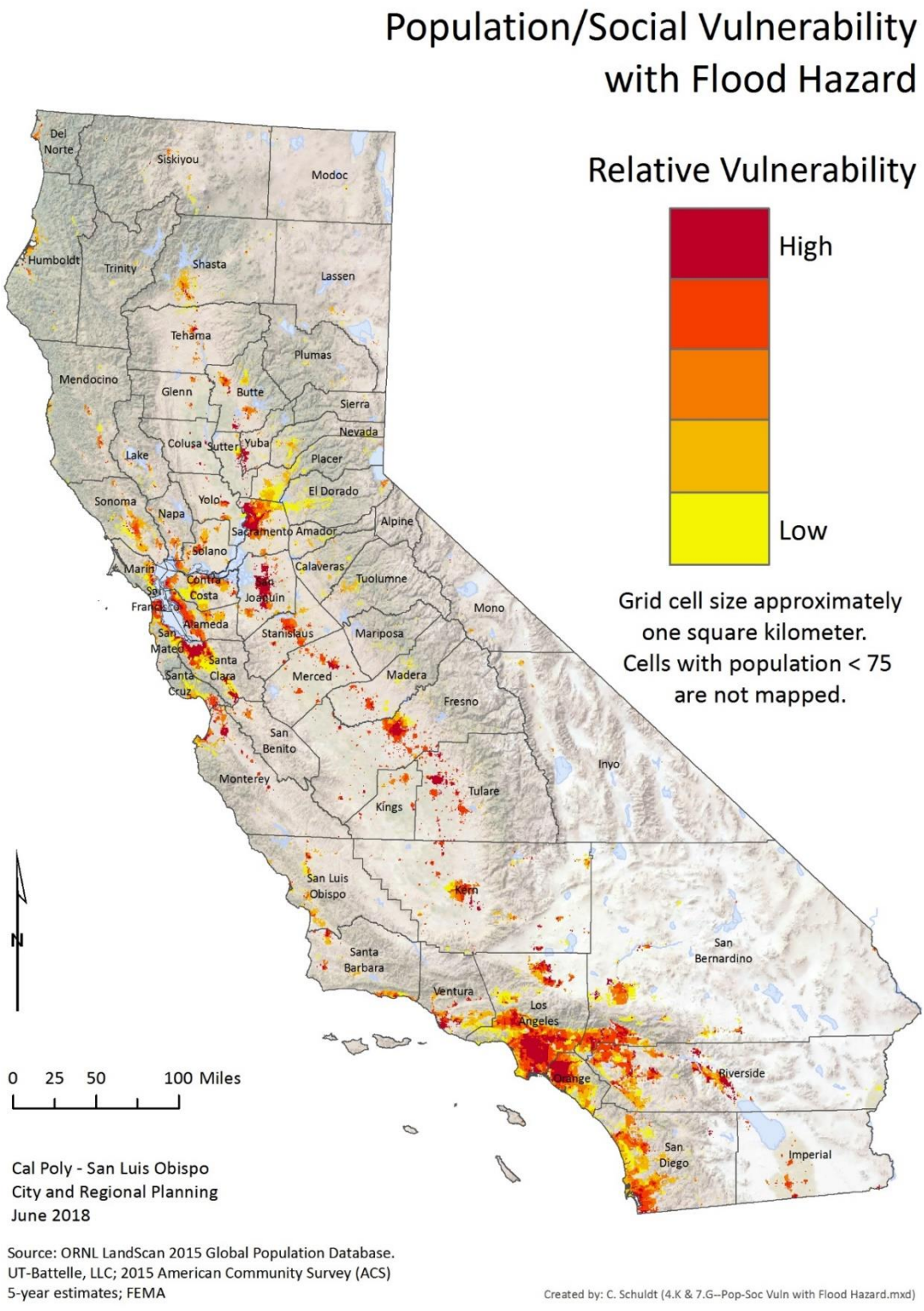


EQ hazard information from the Department of Conservation, California Geological Survey is protected by the United States Copyright Law. For information, contact the California Department of Conservation, California Geological Survey.
Population data source: Source: ORNL LandScan 2015 Global Population Database. UT-Battelle, LLC; 2015 American Community Survey (ACS) 5-year estimates.

Created by: C. Schuldt (4.J & 6.K--Pop-Soc Vuln with Earthquake Hazard.mxd)

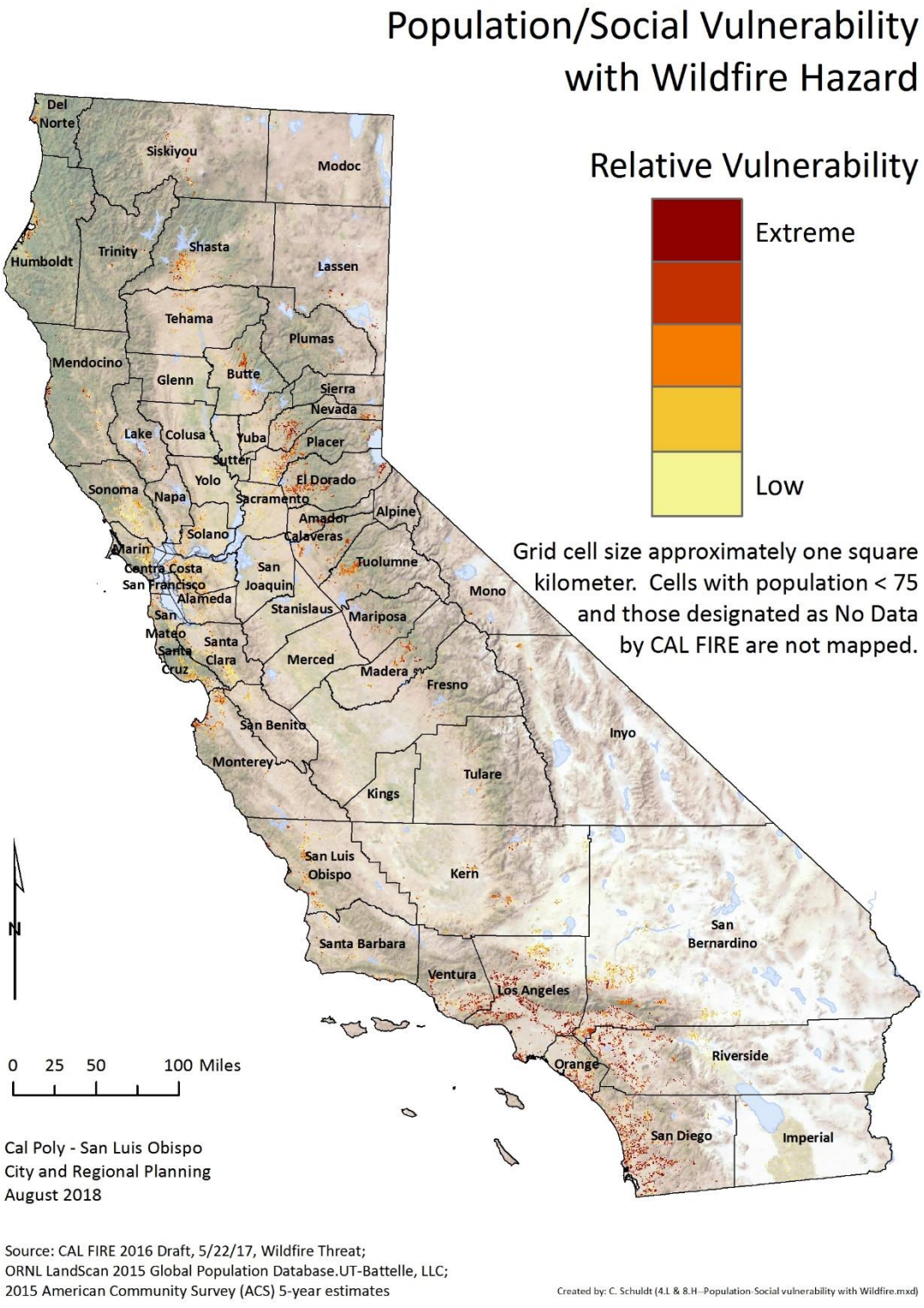
Map 4.K shows population/social vulnerability (based on the index described in *Appendix N*) in areas at high risk of earthquake hazards. Greatest concentrations are in Southern California and the San Francisco Bay Area.

Map 4.L: Population/Social Vulnerability with Flood Hazard



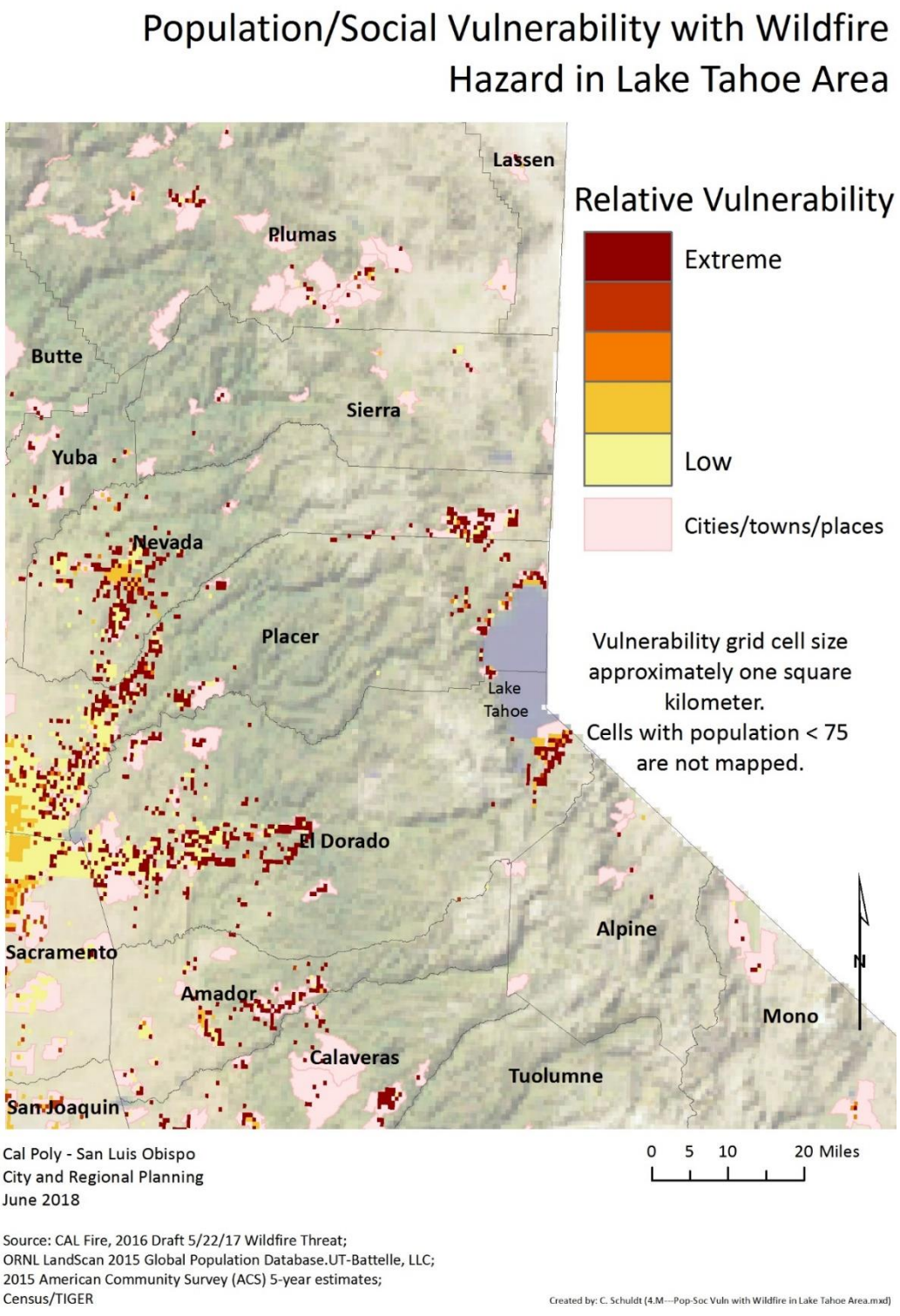
Map 4.L shows high concentrations of population/social vulnerability (based on the index described in *Appendix N*) in areas at high risk of flood hazards with low-lying areas spread across the state. Most heavily affected counties are in the San Francisco Bay Area, the Central Valley area, and Southern California.

Map 4.M: Population/Social Vulnerability with Wildfire Hazard



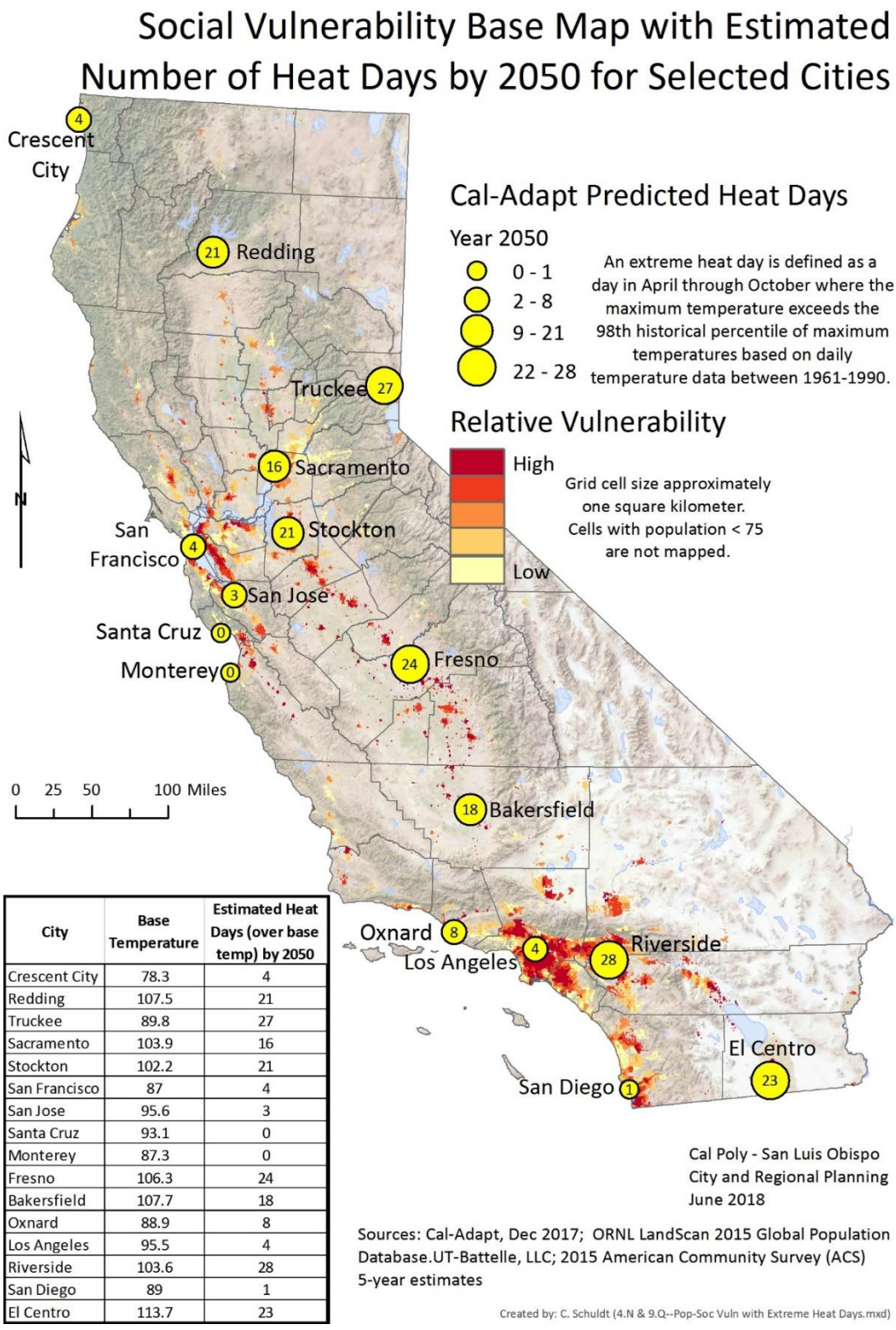
Map 4.M shows moderate to high concentrations of population/social vulnerability (based on the index described in *Appendix N*) in areas at high risk of wildfire hazards. Most heavily affected areas are in the hilly and mountainous portions of the San Francisco Bay Area, Southern California, and the Sierra Nevada.

Map 4.N: Population/Social Vulnerability with Wildfire Hazard, showing Northeastern California at Closer Scale



Map 4.N shows a close-up of a northwestern portion of the state taken from Map 4.M. illustrating that, at a county level, many smaller communities have extreme vulnerability to wildfire hazards. It should be noted that the Lake Tahoe map area is used only as an example ; other lesser populated areas in the state could also be used in such a map to illustrate the presence of smaller communities with vulnerable populations across the state.

Map 4.O: Population/Social Vulnerability with Extreme Heat Days for Selected Cities



City	Base Temperature	Estimated Heat Days (over base temp) by 2050
Crescent City	78.3	4
Redding	107.5	21
Truckee	89.8	27
Sacramento	103.9	16
Stockton	102.2	21
San Francisco	87	4
San Jose	95.6	3
Santa Cruz	93.1	0
Monterey	87.3	0
Fresno	106.3	24
Bakersfield	107.7	18
Oxnard	88.9	8
Los Angeles	95.5	4
Riverside	103.6	28
San Diego	89	1
El Centro	113.7	23

Map 4.O shows moderate to high concentrations of population/social vulnerability (based on the index described in *Appendix N*) in selected cities at risk of increased extreme heat days.

For a detailed discussion of GIS modeling used to initially create the population/social vulnerability and related maps, see *Appendix N: GIS Risk Exposure Methodology*.

Earthquake Vulnerability

As noted in earlier in this chapter, while earthquakes occur less frequently than the other primary hazard events, they have accounted for the greatest combined losses (deaths, injuries, and damage costs) in disasters since 1950 and have the greatest catastrophic disaster potential.

The earthquake hazard base map began with statewide vector (areas) data supplied by the California Geological Survey showing differing levels of expected relative intensity of ground shaking in California from anticipated future earthquakes.[91]

The relationship of social vulnerability to earthquakes is shown by the intensity of the color in the Population/Social Vulnerability with Earthquake Hazard Map (Map 4.K). For example, while earthquake-shaking hazards are lower in the Central Valley than other parts of the state, relative vulnerability shown in Map 4.K is high through portions of the Central Valley due to higher density of socially vulnerable populations.

Flood Vulnerability

Flooding in California is widespread and the second most frequent disaster source. Since 1950, floods have accounted for the second highest combined losses and the largest number of deaths.

As with earthquake hazards, the relationship of social vulnerability to flood is shown by the intensity of the color in the Population/Social Vulnerability with Flood Hazard Map (Map 4.L). The patterns shown in the map reflect the greater frequency of flooding, combined with greater social vulnerability in portions of the Central Valley region.

Wildfire Vulnerability

Wildfires are the most frequent source of declared disasters and account for the third highest combined losses. The Population/Social Vulnerability with Wildfire Hazard Map (Map 4.M) uses data from the 2017 Wildfire Threat GIS map created by the California Department of Forestry and Fire Protection (CAL FIRE)'s Fire and Resource Assessment Program (FRAP). Its original data take into account fuel loads and fire history, among other factors, to create five threat classes: extreme, very high, high, moderate, and low or no threat.

Wildfire vulnerability in California is found chiefly in wildland-urban interface (WUI) communities, located largely on the periphery of suburban areas in Southern California, coastal mountains, and heavily wooded areas of the Sierra Nevada. Some areas burn frequently, particularly the hills surrounding Los Angeles; the eastern parts of the San Francisco Bay Area, San Diego, and Big Sur; and more isolated areas of the Coast Ranges and Sierra Nevada.

WUI areas tend to be less heavily populated than other parts of urban California. Therefore, the vulnerability patterns shown in a statewide map such as Map 4.M tend to be understated when viewed at a statewide scale. Densely populated urban areas will appear at higher relative vulnerability due to the larger concentrations of socially vulnerable communities in these areas. However, less populated areas have socially vulnerable populations that can be at high risk of wildfire hazard.

Map 4.N, a close-up of a portion of Map 4.M, is included as an example to illustrate how vulnerability may be identified at county level. When the state is looked at on a county-by-county basis, the vulnerability in less populated counties is more readily depicted, as example Map 4.N shows in a zoomed-in view of the counties between Sacramento and Lake Tahoe. Individuals can use the MyPlan or MyHazards internet mapping tools to develop fire risk assessments for their specific communities or at a county level.

[91] 1.0 second spectral acceleration with 2-percent probability of exceedance in 50 years.

Extreme Heat Vulnerability

Effects of climate change are already occurring due to increasing temperature. As the climate changes in California, one of the more serious threats to the public health of Californians will stem primarily from the higher frequency of extreme conditions, principally more frequent, more intense, and longer heat waves. Temperature records continue to be broken with increasing temperatures on record.[92]

Temperatures in urban areas can exacerbate already warm conditions due to materials such as asphalt absorbing heat and then releasing it, causing urban heat islands. Increased exposure to heat puts children, the elderly, and people with pre-existing health conditions at more serious risk of heat stroke and heat-related complications. For many urban areas with moderate to high socially vulnerable populations, Cal-Adapt climate models show a notable rise in the number extreme heat days per year, as shown in Map 4.O.

Extreme heat days are calculated by Cal-Adapt as the 98th percentile of historical maximum temperatures for an area between April 1 and October 31, based on observed daily temperature data from 1961 to 1990. In Map 4.O, extreme heat day data were sourced from Cal-Adapt 2.0 using scenario RCP 8.5 and HadGem2-ES modeled data for 2006-2099. For more information about this extreme heat days data, visit the Cal-Adapt website: http://cal-adapt.org/tools/extreme-heat/.

MyPlan Internet Mapping Tool

In the 2010 SHMP, three primary hazards and various secondary hazards were evaluated for their potential impacts across California using Geographic Information Systems (GIS) software. Part of that effort included analyzing California's population density in relation to social vulnerability and creating a GIS dataset that visually displayed that vulnerability at a scale of approximately 1 square kilometer for each square kilometer of the state. That dataset was then combined with hazard location data for wildfire, flood, and earthquake to identify areas most at risk.

Cal OES's MyPlan Internet Mapping Tool (IMT) website (http://myplan.caloes.ca.gov/) was launched in the fall of 2011 through collaborative efforts of the then-California Emergency Management Agency (Cal EMA), the California Natural Resources Agency, the GIS TAWC, and other state agency partners.

Since its release, MyPlan has been available for creation of community-scale GIS hazard maps. It is aimed primarily at local planners and other professionals working for local communities. MyPlan now offers many data layers that can be turned on and off as needed to create community-scale hazard maps. The intent is to provide support for preparation of Local Hazard Mitigation Plans (LHMPs), general plan safety elements (all elements of a general plan, whether mandatory or optional, must be consistent with one another), and Local Coastal Programs (LCPs).

The MyPlan website provides a simple-to-use interface for viewing the hazard and base data layers and creating user-specific maps. The GIS TAWC continues to provide updated GIS hazard datasets and to develop suggestions for improving MyPlan. The basic design of the website is also available to other states and agencies for use in their own specific applications of GIS web mapping.

A future layer that has been identified to be added to MyPlan is a dam inundation area layer based on the new map requirements that were enacted with Senate Bill 92. It is expected that the first layer will be integrated with MyPlan by the fall of 2018.

[92] National Oceanic and Atmospheric Administration (2015). Global Climate Report - Annual 2015. Retrieved from https://www.ncdc.noaa.gov/sotc/global/201513

4.4.5 PLANNING, POLICY, AND ACTION IMPLICATIONS

The following GIS multi-hazard risk exposure findings contain implications for priority setting with respect to hazard mitigation strategies.

- When comparing population growth from 2000-2012 identified in *Chapter 4* with risk exposure of socially vulnerable populations to various hazards, a substantial overlap is found among heavily populated areas, growth areas, and high risk exposure.

- Historically, mitigation priority setting has been done largely on an ad hoc basis in response to specific outcomes of particular disasters, including losses, damage locations, and scales.

- The preceding multi-hazard risk analysis, together with historical analysis of declared disasters in California since 1950, reveals that earthquakes, floods, and wildfire hazards are pervasive, primary determinants of disaster losses.

When these findings are compared with the findings on population and construction growth presented elsewhere in *Chapter 4*, additional implications are found.

4.4.6 CALIFORNIA'S ACTIONS TO ADDRESS SOCIAL VULNERABILITY AND EQUITY NEEDS

While California's communities themselves have potential capacity and resources that can be leveraged when devising and implementing adaptation strategies to address community-specific social vulnerability issues, the state has several emerging programs to support these efforts.

Legislation

Senate Bill 244 (2011)

Senate Bill (SB) 244, passed in 2011, specifically recognized that many disadvantaged unincorporated communities lacked adequate investment in infrastructure such as sidewalks, safe drinking water, and adequate waste processing. This lack of adequate investment threatens both health and safety of residents and creates inequity in terms of access to quality services. SB 244 (2011) requires general plan land use elements to include analysis of the presence of island, fringe, or legacy unincorporated communities to identify these areas of risk and update general plan policies to improve conditions. This legislation was subsequently amended by Senate Bill 1090 (2012).

Senate Bill 88 (2015)

This bill authorized the State Water Resources Control Board to order consolidation with a receiving water system where a public water system, or a state small water system within a disadvantaged community, consistently fails to provide an adequate supply of safe drinking water. This bill also authorized the State Water Resources Control Board to order the extension of service to an area that does not have access to an adequate supply of safe drinking water.

Assembly Bill 1071 (2015)

This bill requires each board, department, and office within CalEPA to establish a policy on supplemental environmental projects that benefits environmental justice communities.

Senate Bill 350 (2015)

SB 350 requires state agencies to evaluate the barriers faced by low-income customers, including those living in disadvantaged communities in gaining access to clean energy technologies and provide recommendations for how to address these barriers. Furthermore, to ensure that the full economic and societal benefits of California's clean energy transition are realized, the Energy Commission must also evaluate the barriers to contracting opportunities for local small businesses located in disadvantaged communities, along with potential solutions.

Assembly Bill 1550 (2016)

This bill modifies SB 535 (2012) regarding the Greenhouse Gas Reduction Fund (GGRF) for disadvantaged communities. The bill requires a minimum of 25 percent of GGRF funding to be allocated to projects located within and benefiting individuals living in disadvantaged communities and allocates additional funding to benefit low-income households. As of Fiscal Year 2017-2018, the California Air Resources Board (CARB) and administering agencies are in the process of implementing AB 1550 and the CARB is in the process of updating its Funding Guidelines for Agencies that Administer California Climate Investments to incorporate the legislative requirements of AB 1550.

Assembly Bill 1613 (2016) and Companion Bill, Senate Bill 859 (2016)

These bills allocate $900 million from the GGRF (proceeds from California's cap-and-trade program to limit greenhouse gas emissions) to support programs that benefit disadvantaged communities, advance clean transportation, protect the natural environment, and cut short-lived climate pollutant emissions.

Assembly Bill 2722 (2016)

This bill establishes the Transformative Climate Communities program to be administered by the Strategic Growth Council. The bill would require the council to award grants to programs that advance development and implementation of multiple climate and clean energy efforts in a community-wide approach, such as by providing for affordable housing near transit, energy efficiency, clean transportation, and other local economic, environmental, and health benefits to disadvantaged communities.

Senate Bill 1000 (2016): Land Use: General Plans: Safety and Environmental Justice

This bill requires that a jurisdiction's general plan either include an environmental justice element or integrate goals, objectives, and policies addressing environmental justice into other elements of the general plan.

As part of this requirement, jurisdictions must:

- Identify objectives and policies to reduce the unique or compounded health risks in disadvantaged communities, including:
  - Reducing pollution exposure, including improving air quality
  - Promoting public facilities
  - Promoting food access
  - Promoting safe and sanitary homes
  - Promoting physical activity
- Identify objectives and policies to promote civil engagement in the public decision-making process
- Identify objectives and policies that prioritize improvements and programs that address the needs of disadvantaged communities.

There is a strong linkage between a jurisdiction's environmental justice actions and a community's climate change adaptation efforts. The requirements of SB 1000 (2016) are cross-linked with new requirements that climate change adaptation be addressed in safety elements. As part of climate change adaptation updates to their safety elements, jurisdictions will assess community vulnerability.

General Plan Guidelines

The Governor's Office of Planning and Research (OPR) is responsible for preparation and updates of the General Plan Guidelines. The General Plan Guidelines includes resources, data, tools, and model policies to help cities and counties update their general plans.

As required by AB 1553 (2001), the General Plan Guidelines have provided guidance on environmental justice considerations for local jurisdictions since 2003. As noted above, legislation adopted in 2016, Senate Bill 1000, now requires both cities and counties that have disadvantaged communities to incorporate environmental justice policies

into their general plans, either in a separate environmental justice element or by integrating related goals, policies, and objectives throughout the other elements. The 2017 General Plan Guidelines update provides detailed guidance for an environmental justice element within the "Required Elements" chapter (Chapter 4).

The environmental justice element section within Chapter 4 of the 2017 General Plan Guidelines includes an evaluation of the required timeline to address environmental justice under Senate Bill 1000, linkage to other elements, required contents, and a completeness checklist that describes each requirement of the statute. The detailed description of each statutory requirement includes considerations of the requirement, OPR-recommended data for element analysis, best practice examples of jurisdiction projects or programs that address environmental justice, and sample policies.

OPR notes that "the General Plan Guidelines [GPG] contains the statutory requirements for SB 1000 (2016), but since the legislation passed after the public comment concluded for the GPG, the Governor's Office of Planning and Research will be soliciting more focused feedback with related state and local agencies as well as local jurisdictions and partners to learn more about the process to do these new updates, discuss data use, promising policies, and case examples to share with other jurisdictions across California. This new guidance will be made available on the OPR website." An update to the General Plan Guidelines to further address SB 1000 is planned for late 2018.

Further guidance and information related to environmental justice is also offered in the 2017 General Plan Guidelines chapters on "Equitable and Resilient Communities" and "Healthy Communities." These chapters include definitions of terms in reference to equity, examples, strategies for incorporating social equity and health considerations into planning, and recommended policies. Many of these strategies and planning opportunities align with existing planning practice and state legislation addressing climate change and resiliency, which also correlate closely with issues addressed in the circulation, housing, and open space elements. The General Plan Guidelines nots the linkages between climate change and increased risks to public health, especially to vulnerable populations, and the necessity of land use planning and policy to benefit the most vulnerable segments of the community. For a comprehensive listing of addition health-related data resources, see Chapter 8 of the 2017 General Plan Guidelines.

OPR has also created technical advisories related to environmental justice and disadvantaged communities, such as the SB 244 (2011) Technical Advisory. Information about OPR's technical advisories can be found on the OPR website.

2018 Safeguarding California Plan: Climate Justice

While climate justice is addressed throughout the Safeguarding California Plan: 2018 Update, the plan also includes a specific chapter dedicated to climate justice. The 2018 Safeguarding California Plan defines climate justice as "ensuring that the people and communities who are least culpable in the warming of the planet, and most vulnerable to the impacts of climate change, do not suffer disproportionately as a result of historical injustice and disinvestment." The draft 2018 Safeguarding California Plan identifies five climate justice goals for Safeguarding California and highlights next steps that state agencies are taking to realize the state's vision of an equitable and resilient California.

To download the *Safeguarding California Plan: 2018 Update*, visit: http://resources.ca.gov/climate/safeguarding/.

OPR Defining Vulnerable Communities Guide

As part of the efforts undertaken by the Integrated Climate Adaptation and Resiliency Program (ICARP), established by Senate Bill 246, the ICARP Technical Advisory Council determined that is was necessary to define the term "vulnerable communities". Through a series of working groups a definition was adopted in April 2018. With input from the ICARP Technical Advisory Council, the Governor's Office of Planning and Research (OPR) developed a resource guide to assist local planners in defining vulnerable communities in the climate adaptation planning context. The guide is available on OPR's website.

To download the guide, visit: http://opr.ca.gov/planning/icarp/vulnerable-communities.html.

CalEPA Environmental Justice Program

California was one of the first states in the nation to codify environmental justice in statute. Beyond the fair treatment called for in code, leaders in the environmental justice movement work to include individuals disproportionately affected by pollution in decision-making processes. The aim is to lift the unfair burden of pollution from those most vulnerable to its effects.

The CalEPA Environmental Justice Task Force operates under CalEPA's Enforcement Program. It coordinates the compliance and enforcement work of CalEPA's boards, departments, and office in areas of California that are burdened by multiple sources of pollution and are disproportionately vulnerable to its effects. The Environmental Justice Task Force develops new initiatives in communities where increased compliance has the potential to have the greatest impact.

Initiative: Los Angeles

In 2015-2016, the Task Force conducted an initiative focused on the Los Angeles communities of Boyle Heights and Pacoima. Both communities are among the top five percent of disadvantaged communities in California, according to CalEnviroScreen. For an overview of this pilot initiative, download the report at: https://calepa.ca.gov/wp-content/uploads/sites/62/2017/02/LAReport.pdf.

Initiative: Fresno

In 2013-2014, the Task Force selected a portion of the city of Fresno and its surrounding unincorporated area for its first initiative, with the goal of increasing compliance with environmental laws in this area. For an overview of this pilot initiative, download the report at: https://calepa.ca.gov/wp-content/uploads/sites/62/2016/10/Enforcement-Publications-2015yr-FresnoReport.pdf.

OEHHA Environmental Justice Program and CalEnviroScreen 3.0

The Office Environmental Health Hazard Assessment (OEHHA) Environmental Justice program assists CalEPA in its environmental justice efforts. OEHHA developed and maintains the CalEnviroScreen mapping tool as a screening methodology that can be used to help identify California communities that are disproportionately burdened by multiple sources of pollution.

CalEnviroScreen 3.0 uses environmental, health, and socioeconomic information to produce scores for every census tract in the state. The scores are mapped so that different communities can be compared. An area with a high score is one that experiences a much higher pollution burden than areas with low scores. CalEnviroScreen ranks communities based on data that are available from state and federal government sources.

For more information about CalEnviroScreen, see the program website: https://oehha.ca.gov/calenviroscreen.

California Healthy Places Index

The California Healthy Places Index (HPI) is an interactive data and mapping tool developed by the Public Health Alliance of Southern California that provides a detailed snapshot of the social and environmental conditions that contribute to health, at the census tract level. The HPI includes maps and indicators, including the Climate Change and Health Vulnerability Indicators for California created by the California Department of Public Health.

This tool will enable users to assess an area's health risks due to wildfire, heat, drought, sea-level rise, or air quality, while simultaneously assessing social vulnerabilities or adaptive capacities, such as living in poverty; having a disability; lacking access to transportation, air conditioning, or tree canopy; and much more. Jurisdictions can use the tool to identify actionable policies that would improve health in their communities, and that would increase resilience to climate change impacts.

For access to the Healthy Places Index, visit http://healthyplacesindex.org.

California Department of Public Health Products and Programs

California Environmental Health Tracking Program

The California Environmental Health Tracking Program (CEHTP) is a program of the Public Health Institute, in partnership with the California Department of Public Health. CEHTP is primarily funded by the Centers for Disease Control (CDC) National Environmental Public Health Tracking Program. CEHTP works to make environmental health data and information publicly available through the development of a web-based data query system, state-of-the-art data displays, and innovative web tools and services. CEHTP aims to make these data and information accessible and useful to a variety of stakeholders including communities, governments, academia, and private partners. Strategic Directions 2017-2020 include:

- Track environmental and public health data for California
- Enhance data and information on the portal
- Develop policy-relevant products
- Participate in community-engaged research
- Facilitate use of water boundary and quality data
- Support environmental justice communities and identify health inequities

Office of Health Equity's Climate Change and Health Equity Program and the CalBRACE Project

The Office of Health Equity (OHE) was established, as authorized by Section 131019.5 of the California Health and Safety Code, to promote equitable social, economic, and environmental conditions to achieve optimal health, mental health, and well-being for all. The Climate Change and Health Equity Program (CCHEP) is located within the Office of Health Equity. CCHEP embeds health and equity in California climate change policy and planning, and embeds climate change and equity in public health policy and planning.

California Building Resilience Against Climate Effects (CalBRACE) is a project of the CCHEP. CalBRACE project goals are to enhance the California Department of Public Health's capability to plan for and reduce health risks associated with climate change. As part of the CalBRACE project, Climate Change and Health Profile Reports have been published to help counties in California to prepare for the health impacts related to climate change through adaptation planning. These reports are tools to address vulnerability to climate change from a public health and health equity perspective for every county in California.

For more information about CCEHP and the CalBRACE project, see *Section 4.3.6.4* or visit: https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx.

Climate Change & Health Vulnerability Indicators for California

CCHVIz is the interactive data visualization platform for the Climate Change & Health Vulnerability Indicators for California (CCHVIs). It is produced by the California Department of Public Health Office of Health Equity. The CalBRACE Project produced Climate Change and Health Vulnerability Indicators to help stakeholders better understand the people and places that are more susceptible to adverse health impacts associated with climate change. They are a suite of 21 indicators (18 available here) of climate exposure, population sensitivity, and adaptive capacity to the impacts of climate change. These indicators are being used by local and state programs to plan to meet the needs of the communities most at risk of harm from climate change.

For more information about CCHVIz visit: https://discovery.cdph.ca.gov/ohe/CCHVIz/.

Best Practices Highlight 4.B: "OutsideIn" Program

PILOT PROJECT

OutsideIn SLO: We Take Health and Climate Change Personally was a pilot program led by a partnership between the San Luis Obispo County Public Health Department and the California Department of Public Health (CDPH). The purpose of the pilot program was to increase awareness of the health effects of climate change in San Luis Obispo County (SLO), as part of CDPH's effort to increase state and local capacity to prevent and prepare for those effects.

Existing Efforts

San Luis Obispo County emerged as a state leader on climate change through its early efforts to develop climate action plans and reduce greenhouse gas (GHG) emissions. The San Luis Obispo County Public Health Department brings a public health perspective into these planning processes.

Interagency Collaboration and Community Partnerships

In January 2014, the CDPH proposed the partnership to the San Luis Obispo County Public Health Department. Soon after the project was approved, the San Luis Obispo County Public Health Department invited community partners to participate and help advise the project. Organizations and individuals involved in the pilot project include but are not limited to the following: the Planning and Building Department; the Environmental Health Director; Woman, Infants, and Children (WIC) staff; the Air Pollution Control District; the San Luis Obispo Council of Governments; the Sierra Club; local private planning firms; several local non-profits; and faculty of Cal Polytechnic State University San Luis Obispo.

Progress

Through formal presentations, social media, radio, local news, and other media, the program reached thousands of people, including 1,100 WIC families (about 5,000 people). Formal presentations alone reached over 700 people, including 130 public health staff. As San Luis Obispo County is an agricultural community, farmers and farmworkers were also important stakeholders. The CDPH and OutsideIn SLO collaborated with the local university to secure a Resilient Food Systems Conference that included a keynote presentation by the California Department of Food and Agriculture Secretary Karen Ross.

Lessons Learned

- *Framing the message:* The message was well received by most people, regardless of political affiliation; however, it is still important to understand the audience and provide a narrative that is most relevant to them.
- *Grassroots organizing:* Education campaigns need to take a community organizing approach to develop strong personal relationships with community members. Involving community and local partners early in the campaign planning creates a shared mission to promote climate and health awareness and activities.
- *Interagency collaboration:* Local public health departments need to have both internal and external relationships to effectively address emerging issues like climate change.
- *Utilizing existing resources:* With limited funding, climate and health activities can leverage existing resources and enhance existing public health programs.

For more information about OutsideIn SLO, visit: http://www.healslo.com/outsidein-slo/.

EXPANDING THE PROGRAM ACROSS THE STATE

In 2017, the Kings County Public Health Department and the Capital Region Climate Readiness Collaborative (CRC) developed OutsideIn campaigns tailored to increase awareness of the health impacts of climate change and actions people can take to be prepared, improve health, and build community resilience. CRCs campaign can be viewed at http://climatereadiness.info/outsidein-capital-region/. A recorded webinar on OutsideIn and other campaigns can be found at the Communicating Climate Change as a Public Health Issue webinar series, at: http://www.healslo.com/webinar/.

Linkage to SHMP Goals and Objectives

The OutsideIn program accomplishes implementation of State Hazard Mitigation Plan (SHMP) Objective 2 of Goal 1 which is to "ensure that hazard mitigation measures and allocation of mitigation funds are protective of the state's low-income, underserved, linguistically isolated, minority, access and functional needs, and other highly vulnerable populations so that hazards do not have a disproportionately negative impact on those populations, and improve coordination with those populations to ensure that hazard, risks, and preparedness options are well understood."

Source: Kathleen Karle, San Luis Obispo County Public Health Department and the California Public Health Department, Office of Health Equity's Climate Change and Health Equity Program.

State of California's Sea-Level Rise Guidance and Social Equity

The Ocean Protection Council's 2018 update to the State's Sea-level Rise Guidance includes recommendations for preferred sea-level rise planning and adaptation approaches. The first recommendation in the 2018 Guidance is: *Adaptation planning and strategies should prioritize social equity, environmental justice and the needs of vulnerable communities*. The Guidance discussion on this recommendation emphasizes that engaging communities early in the planning process helps to ensure accurate vulnerability assessments and development of adaptation strategies that adequately address needs and priorities.

The Guidance recommends the following steps be included in incorporating social equity and environmental justice into sea-level rise planning and adaptation strategies:

- Address environmental contamination risks for coastal communities adjacent to industry or toxic sites
- Preserve access to and along the beach
- Prevent displacement by ensuring that investments in coastal resilience protect local jobs and housing costs
- Address economic impacts on agriculture
- Address emergency services and response to natural disasters
- Evaluate the social and economic implications of various adaptation strategies

For more information about this and other recommendations, download the Guidance: http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.

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CHAPTER 5 – CALIFORNIA LOCAL HAZARD MITIGATION PLANNING

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About Chapter 5

As part of the 2018 State Hazard Mitigation Plan (SHMP) reorganization process, this chapter was created to bring back together various discussions of local hazard mitigation planning that were spread across different chapters of the 2010 and 2013 SHMPs.

The intent of this reorganized chapter is to explain California's role in implementing the Federal Emergency Management Agency (FEMA)'s Local Hazard Mitigation Plan (LHMP) program and provide an analysis of LHMPs in the state approved by FEMA since 2013. Further, the chapter reorganization seeks to provide a more convenient and comprehensive collection of guidance, resources, and tools supporting local hazard mitigation planning for use by local jurisdictions. Any updates made to this Chapter and/or the contents of this Chapter after 2018 will be placed on the Cal OES Hazard Mitigation Planning website.

5.1 CALIFORNIA'S ROLE IN IMPLEMENTING FEMA'S LHMP PROGRAM

44 Code of Federal Regulations (CFR) Part 201, Section 201.6 establishes the mitigation planning requirements for states, local governments, special districts, and tribal organizations. For LHMPs, Section 201.6 essentially states that local jurisdictions must demonstrate that proposed mitigation actions are based on a sound planning process that accounts for the inherent risk and capabilities of the individual communities.

FEMA's Hazard Mitigation Planning webpage provides a comprehensive overview of FEMA's hazard mitigation program, including federal resources for local planning. For access to the resources website, visit: https://www.fema.gov/hazard-mitigation-planning-resources.

Through the California Governor's Office of Emergency Services (Cal OES), and in partnership with FEMA, the state has implemented a program to promote and support local hazard mitigation planning and local participation in state hazard mitigation planning. Principal among its own local hazard mitigation responsibilities is Cal OES's coordination of the planning requirements of the Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA), and Pre-Disaster Mitigation (PDM) grant programs to promote multi-hazard mitigation planning by local governments. State resources supporting local hazard mitigation planning are provided at the end of this chapter.

5.1.1 CAL OES LHMP TECHNICAL ASSISTANCE AND TRAINING PROGRAM

The goal of the LHMP Technical Assistance and Training Program is for all local jurisdictions (including special districts and tribal governments) in California to have FEMA-approved and local jurisdiction-adopted LHMPs that provide each community with a path toward increased resiliency. Eligible jurisdictions must have an approved plan to be considered for funding through mitigation programs authorized under the Stafford Act.

Program Objectives

The objectives of the LHMP Technical Assistance and Training Program are to:

- Integrate hazard mitigation activities into all pertinent local government programs
- Maximize the use of hazard mitigation resources, grants, and funds to reduce the impact of future disasters at the local level
- Maintain collaborative and cooperative relationships with local emergency managers, land use planners, and the scientific and technical communities involved in hazard mitigation
- Provide technical assistance guidance and training to local governments to improve hazard risk assessments, mitigation project identification and analysis, and the development of LHMPs
- Improve communications with stakeholders, legislators, and special interest groups involved in hazard mitigation
- Continue to enhance Cal OES Regional and Operational Area capability and coordination
- Develop a statewide program of support for hazard identification and analysis and a risk-based approach to project identification, prioritization, and support for local governments
- Maintain transparent and continuous communication with FEMA Hazard Mitigation Planning program staff and stakeholders

Program Staff Resources

Beginning in 2018, Cal OES Hazard Mitigation Planning staff assigned to LHMP reviews, technical assistance, and training, in addition to other duties, include three permanent staff. Additionally, Hazard Mitigation Planning has two limited-term staff who are assigned to review LHMPs.

Program Components

The state is committed to supporting a robust hazard mitigation program. Cal OES administers FEMA's Hazard Mitigation Assistance program by providing support to local jurisdictions through training workshops, consultation and LHMP review, jurisdiction-specific technical assistance, and maintenance of an LHMP resource web page. All of the program components together are intended to result in a successful LHMP submittal by jurisdictions. Program components include the following:

Formal LHMP Training Offered by Cal OES Hazard Mitigation Planning Staff

- FEMA-approved training classes delivered in partnership with the California Specialized Training Institute (CSTI) and FEMA (G318: *Local Mitigation Planning Workshop*, G393: *Disaster Mitigation*)

- LHMP/grant meetings and workshops for local jurisdictions: jurisdiction-specific, held upon request from jurisdictions (i.e., kick-off meetings)
- LHMP workshops for other professional associations, groups, or agencies
- Presentations at public meetings and panel discussion participation

LHMP Review and Informal Technical Assistance Offered by Cal OES Hazard Mitigation Planning Staff

- LHMP/Grant meetings and phone calls with local jurisdiction staff, professional associations and agency staff
- Informational emails with local jurisdiction staff, professional associations and agency staff
- Letters and emails on plan status to jurisdictions from Cal OES
- Other personal communications

Cal OES Hazard Mitigation Planning staff also works with Cal OES grants staff to provide some high-level grant information to local jurisdictions. Detailed grant subapplication training is offered directly from Cal OES grants staff.

Best Practices Highlight 5.A: Hazard Mitigation Strategy for the 2017 Severe Winter Storms (DR-4301)

Aligning local mitigation actions with California's hazard mitigation strategies is an ongoing process requiring continued diligence and attention. In the case of the severe storms that occurred in the winter of 2017 (FEMA-4301-DR-CA), state and federal agencies combined efforts to develop a Joint Hazard Mitigation Branch office. This joint branch team worked together to develop a strategy to enhance and expand hazard mitigation technical assistance to local jurisdictions.

The strategy organized the team into four principal groups and defined actions to be taken by each group to support local capabilities, as follows:

- *Hazard Mitigation Grants and Planning:* This group partners with Public Assistance (PA) and determine immediate needs projects that would be first priority for Hazard Mitigation Grant Program (HMGP) funding received under this disaster. The group will work together to solicit immediate needs projects during applicant briefings and will conduct outreach in declared counties to determine if any additional prior local hazard mitigation project requests could be funded. The group will provide prioritized technical assistance and training outreach efforts to counties that declared under DR-4301, focusing on the counties without approved Local Hazard Mitigation Plans (LHMPs) or LHMPs that expired in 2017.
- *Hazards Performance and Analysis:* This group executes an "advanced losses avoided" analysis to conduct a comprehensive study of the mitigation effectiveness of projects within declared counties, as well as an analysis of the compounding effects of economic and climatologic changes over time. This effort is intended to support the declared counties with conducting mitigation project performance assessments.
- *Flood Management and Insurance:* This group serves as a point of coordination and resource on local floodplain management regulations and enforcement and all hazards insurance, promotes community participation in the National Flood Insurance Program (NFIP), and ensures compliance with NFIP regulations in disaster recovery.
- *Community Education and Outreach:* Efforts by this group will be coordinated between the Federal Emergency Management Agency (FEMA) and California Governor's Office of Emergency Services (Cal OES) External Affairs, as needed.

Tribal Outreach

On September 19, 2011, Governor Edmund G. Brown Jr. issued Executive Order B-10-11, which directs, among other activities, state agencies and departments to implement effective government-to-government consultation with California Federally Recognized Tribes. When state agencies and departments are developing policies, laws, or regulations that could affect the tribes, they are encouraged to communicate and collaborate with the tribes in this process. In July 2012, the California Governor's Office of Emergency Services (Cal OES) established the Office of Tribal Coordination (Tribal Office). The Tribal Office is responsible for the coordination of Cal OES activities necessary to fulfill the intent of this Executive Order.

Cal OES Hazard Mitigation Planning works with the Cal OES Tribal Office, FEMA's tribal coordinator, and the FEMA tribal mitigation plan liaison to provide guidance on tribal government's mitigation planning questions and feedback on plan preparation and review efforts.

As a result of the Joint Field Office established after the 2017 Severe Winter Storms, three tribal consultation summit-workshops were held to strengthen communication and facilitate information sharing about mitigation programs. Governor Brown's tribal advisor, the Cal OES Tribal Office, Cal OES Hazard Mitigation Planning staff, Cal OES Hazard Mitigation Assistance (HMA) grants staff, FEMA Hazard Mitigation Planning staff, FEMA HMA staff, FEMA's tribal coordinator, and the FEMA tribal mitigation plan liaison participated in these summit-workshops and discussed hazard mitigation grants, updated FEMA LHMP guidance, and Cal OES's updated tribal policy consultation policy.

For tribal mitigation plans submitted to Cal OES from tribal governments, or LHMPs that include a tribal component, Cal OES will forward the tribal mitigation plan, or the tribal component, to FEMA Region IX staff for review. Any remaining non-tribal components of the submitted LHMP will be reviewed by Cal OES.

For additional information, please see the 2017 FEMA Tribal Mitigation Plan Review Guide at: https://www.fema.gov/media-library-data/1512757722502-00b8f917b23ece763161c14b04d7eae8/Tribal_Mitigation_Plan_Review_Guide_Dec5_2017_508.pdf.

Local Mitigation Planning Assistance from Other State Agencies

While Cal OES is the primary agency providing technical assistance and training to local jurisdictions for LHMP development, many other state agencies offer mitigation planning assistance. For more information, see the resources section at the end of this chapter.

State agencies also work with local governments to enhance local hazard mitigation efforts. The following are examples of assistance offered by other state agencies:

- Governor's Office of Planning and Research (OPR) is providing technical assistance supporting local hazard mitigation planning through the 2017 General Plan Guidelines update, including:
  - Integration of local hazard mitigation planning and linkage to the 2018 SHMP. (See further discussion in *Sections 2.4.4, 4.3.6.4, and 4.4.5*.)
  - Review of Senate Bill 379 (2015) requirements for inclusion of climate adaptation and resiliency strategies in local planning and required integration of climate adaptation and resilience into general plan safety elements. (See further discussion in *Section 4.3.6.2*.)
  - Review of Senate Bill 1000 (2015) requirements for inclusion of environmental justice components in local planning strategies and into the general plan. (See further discussion in *Section 4.3.6.2*.)
- The California Department of Forestry and Fire Protection (CAL FIRE) Land Use Planning Division works closely with local governments to develop of fire hazard planning and mitigation policies that affect State Responsibility Areas (SRAs) and cities with lands designated as Very High Fire Hazard Severity Zones (VHFHSZs) in Local Responsibility Areas (LRAs) for fire protection, and to meet the fire hazard planning requirements of Senate Bills 1241 (2012) and 379 (2015).
- The California Department of Water Resources (DWR) works with FEMA and local governments in administration of the NFIP. The California Silver Jackets program (co-led by DWR) offers Watershed University presentations and flood risk outreach to local emergency managers and decision-makers.

Recent Program Successes

Recent successes include the following:

- In 2017, Cal OES Hazard Mitigation LHMP reviewers, with guidance from FEMA, developed and began using a planning report document that tracks the status of LHMP reviews and LHMP technical assistance calls, emails, and other contacts.
- Since September 2017, Cal OES has co-facilitated six G318 Local Mitigation Planning courses statewide.
- Starting February 1, 2018, Cal OES and FEMA implemented a shared goal of a 45-day review timeline for completing first review of incoming LHMPs.
- Between May 2017 and March 2018, LHMP coverage increased to 71.9 percent.

5.1.2 THE LHMP SUBMITTAL AND REVIEW PROCESS

Overview

Cal OES Hazard Mitigation Planning staff administers the LHMP program for the state. Cal OES supports and assists local jurisdictions in the development of new and updated LHMPs. It provides local jurisdictions with information on integrating hazard identification, risk assessment, risk management, and mitigation actions into a comprehensive approach to hazard mitigation.

In addition to providing technical assistance, training, and outreach to local jurisdictions, Cal OES reviews all LHMPs in accordance with FEMA's Local Mitigation Plan Review Guide, FEMA's Local Mitigation Handbook, FEMA's Mitigation Ideas Book, and the Region IX Local Mitigation Plan Review Tool. Additionally, Cal OES staff strive to review each plan and work with jurisdictions to ensure compliance and consistency with the following SHMP components:

- Plan goals, objectives, and strategy
- Hazard risk assessments

Listed below are the submittal review and approval steps that are followed by jurisdictions, Cal OES LHMP reviewers, and FEMA Region IX. All jurisdictions must submit their plans to Cal OES for both initial review and subsequent forwarding to FEMA for final review and approval. For discussion on tribal mitigation plans, see *Section 5.1.1*.

Jurisdiction LHMP Submittal Steps

1. The jurisdiction finalizes its LHMP and uses the final LHMP to complete the Region IX Local Mitigation Plan Review Tool. (Note: the FEMA Region IX Review Tool is a detailed version of the 2011 FEMA Local Mitigation Plan Review Guide tool but does not add any additional requirements.)

   It is imperative that the first page of the review tool is filled out completely by the jurisdiction, *this includes adding correct jurisdiction contact information for the staff position that will be responsible for LHMP communications throughout the review process with both Cal OES and FEMA*.

   If a consultant has been used for preparation of the LHMP, a jurisdiction contact, rather than a consultant contact, must still be provided on page one of the review tool. A jurisdiction must provide written confirmation if it wishes for a consultant to communicate with Cal OES and FEMA on its behalf.

   The Region IX Local Mitigation Plan Review Tool and related resources can be downloaded from the Cal OES website at: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program.

2. The jurisdiction is requested to submit:
   - One (1) hard copy of the latest final draft of the LHMP document ready for Cal OES review

- An electronic version of the LHMP document *on a CD or USB drive*
- An electronic copy of the Region IX Local Mitigation Plan Review Tool in a Word document file (or other editable format) with the "Location In Plan" field completed for each element, *on a CD or USB drive*

Submittals should be sent to the following address:

Cal OES Mitigation Planning Division
3650 Schriever Avenue
Mather, CA 95655

State LHMP Receipt Steps:

1. Upon receipt of the hard copy submittal by Cal OES, the submittal package is date-stamped and assigned to a Cal OES LHMP reviewer to assess whether all documentation has been received. The submittal is logged into the Cal OES mitigation planning database.
2. The Cal OES LHMP reviewer assesses the application submittal package to confirm that all required items have been submitted and determines if it is complete. As part of the initial assessment process by Cal OES, the LHMP reviewer will confirm that page one of the Region IX Local Mitigation Plan Review Tool is complete and correct. If any items are missing, the reviewer will contact the jurisdiction via email to request missing information.

   If the initial submittal is incomplete, the 45-day review period will begin upon receipt of all required documentation from the jurisdiction and determination of application completeness by the LHMP reviewer.

3. If the submittal package is determined to be complete upon initial submittal, the Cal OES LHMP reviewer issues an acknowledgement of receipt email to the jurisdiction stating that a complete submittal package has been received and will be reviewed within 45 days, where possible.

State LHMP Review and Guidance Steps:

1. Within 45 days of receipt of a complete LHMP submittal package, the assigned Cal OES LHMP reviewer conducts a review of the LHMP. If the review cannot be completed by Cal OES within 45 days, the LHMP reviewer will send an email to the jurisdiction with notification of the delay and indicating a new estimated review completion date.

   The review uses the Region IX Local Mitigation Plan Review Tool to determine if each required element and sub-element is "met "or "not met." The reviewer will add a description of required revisions in the tool, as applicable, for any elements or sub-elements that are determined to be "not met", as well as the regulatory citation and the location of information in the FEMA Guidance Publications that will assist the jurisdiction in successfully completing the required element.

2. If the Cal OES reviewer finds that any elements have not been met, review comments and suggestions for improvement are provided in the Review Tool and returned to the jurisdiction

3. If any elements are not met, the jurisdiction is then responsible for making the required revisions and re-submitting to Cal OES for re-review within one year. *If a revised LHMP is not submitted within one year of receiving the required revision, the jurisdiction may be asked to start its LHMP planning process over again because the original information may be outdated.*

4. Once the Cal OES reviewer agrees that the jurisdiction's LHMP has met all required elements, Cal OES formally submits the latest draft of the LHMP (one hard copy and one electronic copy on CD or USB drive) to FEMA Region IX for review along with a formal transmittal letter and a completed copy of the Region IX Local Mitigation Plan Review Tool.

FEMA Review and Approval Steps Following State Review:

1. The FEMA LHMP reviewer issues an acknowledgment of receipt letter to the jurisdiction, and copies the Cal OES Mitigation Planning Team, providing confirmation that the LHMP has been received and will be reviewed within 45 days, where possible.
2. FEMA conducts review and completes the Region IX Local Mitigation Plan Review Tool.
3. If FEMA determines that revisions are required, requested revisions will be added to the Region IX Review Tool, emailed directly to the jurisdiction, and copied to the Cal OES Mitigation Planning Team, with instructions to complete revisions as soon as possible.
4. Once the jurisdiction completes the requested revisions, and FEMA accepts the revisions, FEMA will notify the jurisdiction through a formal letter via email, and copied to the Cal OES Mitigation Planning Team, that the LHMP is "approved pending adoption" (APA).
5. For APA designations, the jurisdiction is then responsible for formally adopting its plan within one year of the APA and notifying FEMA and Cal OES when adoption is completed. FEMA requires that the adoption documents be sent directly to the FEMA reviewer, but jurisdictions are encouraged to send adoption documentation to both Cal OES and FEMA. (A scanned copy can be sent via email.)
6. Upon final approval, FEMA will issue a formal approval letter and a final Region IX Local Mitigation Plan Review Tool. The approval letter will include an expiration date five years from the date of the final approval letter.

How to Find Out the Status of an LHMP Review

To find out the status of an LHMP, send an email either to the assigned Cal OES LHMP reviewer or to the Cal OES Hazard Mitigation Planning Division general email box at: mitigationplanning@caloes.ca.gov.

For status of plan reviews by FEMA, contact the assigned FEMA plan reviewer.

5.1.3 LHMP MAINTENANCE: IMPLEMENTATION AND EVALUATION

Following formal approval of their LHMPs by FEMA (and adoption by the jurisdiction), jurisdictions have five years to implement the components of their LHMP.

As described in Task 7 of FEMA's Local Mitigation Planning Handbook, the LHMP "is a living plan document that guides action over time". 44 CFR 201.6(c)(4)(i) requires LHMPs to describe how the local jurisdiction will monitor and evaluate the progress of the LHMP's implementation. The plan maintenance process of monitoring and evaluating implementation will also inform future LHMP updates. The plan maintenance description should specify the title of the individual or name of the department/agency responsible for leading each mitigation action identified in the LHMP.

Key aspects of the LHMP maintenance process by the jurisdiction should include:

- Reviewing the LHMP routinely to determine if any changes have occurred since plan approval
- Updating the LHMP risk assessment as needed, following a disaster event
- Reassessing LHMP goals for continued alignment with the jurisdiction's priorities following changes to disaster history
- Assessing the effectiveness of the LHMP at achieving its stated purpose and goal
- Reviewing and updating the status of mitigation actions in the LHMP

For example, if a disaster occurs, if new hazard information becomes available, or if new legislation is passed, jurisdictions should review their LHMP hazard risk assessments to ensure that hazards are accurately profiled and related vulnerability assessments are current.

The LHMP should discuss how the community will continue public participation in the plan maintenance process. Because an LHMP is the best potential tool for educating the public about local hazards, ongoing outreach is a key to ensuring successful implementation.

Funding Local Hazard Mitigation Plans and Projects

The regulation checklist in the 2011 FEMA Local Mitigation Plan Review Guide (Element C5) requires that potential funding sources for identified mitigation actions be included by local jurisdictions in their LHMPs.

A primary source of funding for local hazard mitigation planning activities and hazard mitigation projects is FEMA's Hazard Mitigation Assistance (HMA) program. Within the HMA program, both pre-disaster and post-disaster funding is made available. Pre-disaster funding through the Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) programs are made available through annual congressional appropriation. Post-disaster, Hazard Mitigation Grant Program (HMGP) funding is made available statewide.

Both the PDM/FMA and HMGP programs have specific criteria for funding of hazard mitigation planning activities and projects. For PDM/FMA and HMGP grants, a portion of overall funding is specifically available for hazard mitigation planning activities. Development of an LHMP or Geographic Information Systems (GIS) hazard mapping are examples of eligible hazard mitigation planning activities. From 2013 through early 2017, 65 PDM and HMGP planning grant subapplications were approved as eligible to fund LHMP preparation. More information about PDM and HGMP grant funding from 2013-2016 is included in *Section 10.3*.

For an overview of HMA grants and a detailed description of the Cal OES Hazard Mitigation Assistance Grant Programs, including the grant Notice of Interest (NOI) and subapplication submittal process, see *Sections 10.4 and 10.5*.

Tracking Progress

At the local level, tracking progress is an essential aspect of the LHMP evaluation and implementation process. Jurisdictions should develop a mitigation action monitoring system that fits the needs of their communities in tracking progress over time toward completing planned actions. The LHMP must identify how, when, and by whom the plan will be monitored.

An existing system available to jurisdictions, the state, and FEMA for tracking the status of the identified hazard mitigation actions is the FEMA Mitigation Action Tracker. FEMA developed the Mitigation Action Tracker to support in the collection and tracking of local hazard mitigation actions. The Mitigation Action Tracker serves as a valuable tool to capture and organize mitigation actions at any stage from proposed actions to funded projects. Registered users have the ability to add new actions, remove old actions, or update the status of an action as it changes over time. In addition, funding and collaboration opportunities to implement mitigation actions may be identified through the tracking process.

California encourages jurisdictions to use the FEMA Mitigation Action Tracker tool, over the life of their approved LHMPs, to help support comprehensive tracking of jurisdictional mitigation progress and support statewide implementation efforts.

To link directly to the Mitigation Action Tracker visit: https://mat.msc.fema.gov/About.aspx.

5.1.4 WAY FORWARD FOR THE CAL OES LHMP PROGRAM

Areas for LHMP Program Improvement

Annually Cal OES staff evaluates the Cal OES LHMP program, with input FEMA staff and local stakeholders, and identifies program strengths, as well as areas where improvement may be needed.

In 2017, Cal OES staff identified program areas to be improved. These program areas—which are overlapping and cross-cutting, and thus all equally important—are as follows:

- *Review team staffing*: Responses to the large disasters in 2015, 2016, and 2017 have affected staff availability and ability to conduct LHMP reviews. To address this, Cal OES hired limited-term LHMP review staff to help bring workloads current. Additionally, Cal OES is assessing cross-training opportunities between grants and planning staff to allow continued efficient reviews to occur when large influxes of LHMPs are submitted.
- *Tracking informal technical training and assistance*: Cal OES has realized that informal technical training and assistance efforts have not been consistently and fully documented. This lack of complete documentation inhibits effective reporting of progress of communication between Cal OES LHMP reviewers and local jurisdictions. To address this, Cal OES staff have worked with FEMA to develop a new weekly plan status report and tracking spreadsheet to better track informal efforts (phone calls, emails, and other personal communications).
- *Increasing transparency and communication with local jurisdictions and FEMA*: Prior to 2017, Cal OES was inconsistent in maintaining communication with local jurisdictions during the review process. To better facilitate timely and consistent communications, Cal OES has developed template notification emails that will be used to notify jurisdictions of review timelines and Cal OES LHMP reviewer contact information. Additionally, Cal OES will be updating the weekly planning report to communicate current review status of LHMPs to FEMA.
- *Strengthening integration of hazard mitigation planning staff with HMA grant programs staff*: An ongoing challenge for Cal OES has been maintaining clear and detailed communication about jurisdiction LHMP status and proposed and ongoing grant funded local mitigation projects. This challenge has been further exacerbated by the separation of the grant programs division and hazard mitigation planning division between Cal OES' two directorates. To address this challenge, hazard mitigation staff is fostering information sharing opportunities and strengthening intra- and inter-program communication.
- *Addressing gaps in consistency of LHMP reviews:* During 2017, discussions between FEMA and Cal OES identified gaps in consistency of review between the two agencies. To address this, monthly progress meetings between Cal OES and FEMA were established, beginning in December 2017, to cross-train FEMA and state reviewers to strengthen consistency of reviews. In addition, periodic joint LHMP reviews between FEMA and Cal OES plan reviewers will be scheduled to ensure consistency of reviews and allow for ongoing training of all plan reviewers.
- *Strengthening linkages between SHMP and LHMPs*: Prior to 2017, plan reviews found weak linkages between LHMPs and the SHMP. Beginning in 2017, Cal OES has increased SHMP socialization efforts with jurisdictions through training and outreach efforts to improve linkages and alignment of goals and strategies. Cal OES Hazard Mitigation Planning staff are working to develop a tool that links the required elements of an LHMP to resources within SHMP sections.
- *Strengthening linkages between LHMPs and local planning*: In an effort to meet the general plan safety element requirements for cities and counties outlined in Assembly Bill 2140, Senate Bill 1241, Senate Bill 379, and Senate Bill 1000, as of May 2018, Cal OES is developing sample resolution language that incorporates not only the formal adoption of the LHMP by a jurisdiction's governing board, but also the adoption of the LHMP into the safety element according to the requirements outlined in the above-noted legislation. This sample resolution language will be posted on the Cal OES Mitigation Planning website. To bridge the gap between LHMPs and other planning resources, Cal OES continues to work with other agencies to identify resources that can help streamline local planning processes with mitigation planning.

While FEMA does not require local jurisdictions to prepare an LHMP, Cal OES does encourage all jurisdictions within the state to maintain an adopted and FEMA-approved LHMP, in order to be eligible for both pre- and post-disaster Hazard Mitigation Assistance (HMA) funding. All of the items listed as areas for program improvement above support Cal OES's collective strategy to increase LHMP population coverage and grant eligibility of jurisdictions throughout the state.

The goal of these improvement efforts is to create new procedures and transparency that will provide more effective support for local jurisdiction capability, so that their planning efforts are successful and align more closely with SHMP goals and strategies.

5.2 ANALYSIS OF CALIFORNIA LHMPS

Cal OES works with Cal Polytechnic University San Luis Obispo to undertake a review of approved and adopted LHMPs for each update of the SHMP. LHMPs are required as a precondition for federal hazard mitigation grant eligibility. Federal law and guidelines require description of the relationship between LHMPs and the SHMP. The purpose of LHMP reviews by Cal OES is to foster partnerships, promote more resilient communities, and reduce the costs associated with disaster response and recovery by promoting hazard mitigation activities consistent with SHMP goals and objectives.

Map 5.A shows the LHMP approval or review status for each California county, as of June 1, 2018. Due to the 2017 disasters, an extensive number of mitigation planning subapplications were submitted and obtained post-disaster funding to develop new or updated approvable LHMPs. These post-disaster LHMPs were submitted in addition to other LHMPs already due to expire and be updated.

Cal OES, FEMA Region IX, and local and tribal jurisdictions coordinated efforts to address the influx of LHMPs submitted and needing approval between the fall of 2017 and the spring of 2018. As a result of these efforts, the number of successful approved and/or approved pending adoption LHMPs helped to significantly increase the state's planning coverage from 42.7 percent in July 2017 to 73.8 percent as of June 1, 2018.

Following Map 5.A, *Section 5.2.1* summarizes changes in LHMP coverage across the state from May 2013 to May 2017 to February 2018. The analysis of LHMPs starting in *Section 5.2.2* discusses the trends in development of FEMA-approved LHMPs between May 2013 and May 2017. The 2017 LHMP analysis for the 2018 SHMP is based on a review of the contents of all approved and adopted LHMPs in California as of May 2017. The May 2017 data should be interpreted as lower estimates, since not all California communities have LHMPs and some LHMPs did not contain sufficient data in order to be added to the analysis. The findings do present a good snapshot of the activities of California cities and counties in identifying and mitigating local hazards. Additional analysis efforts of approved LHMPs are ongoing.

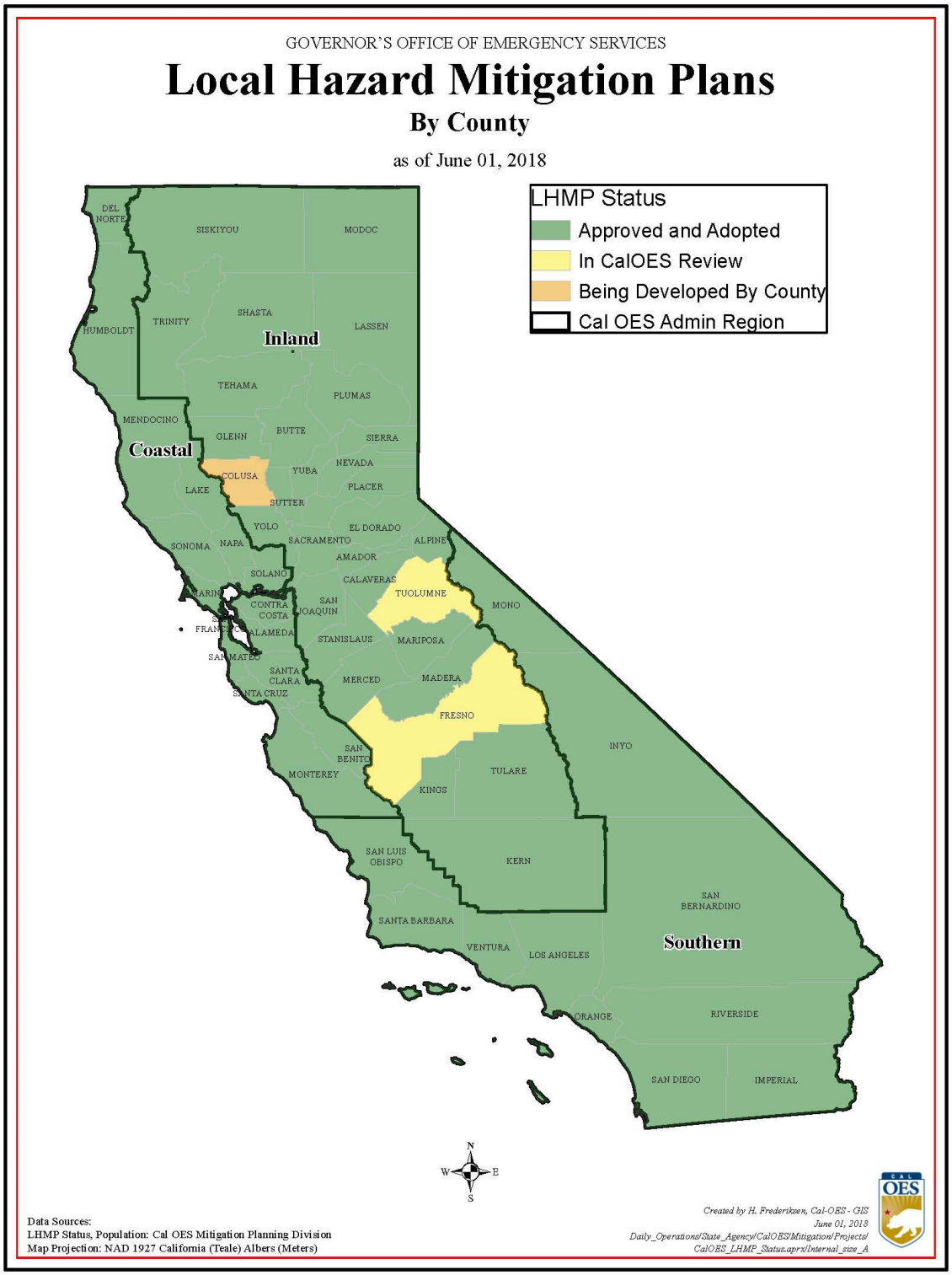
5.2.1 LHMP PREPARATION TRENDS

Communities that prepare LHMPs depend on a variety of methods, data, and digital tools. Nearly all LHMPs cited FEMA guidance documents (97 percent) and most cited Cal OES guidance documents (61 percent). Digital tools such as GIS (89 percent) and Hazards United States (HAZUS) (64 percent) were also an important for conducting hazards analysis. Notably, California's innovative Cal-Adapt tool for assessing the impacts of climate change was cited in over 13 percent of LHMPs.

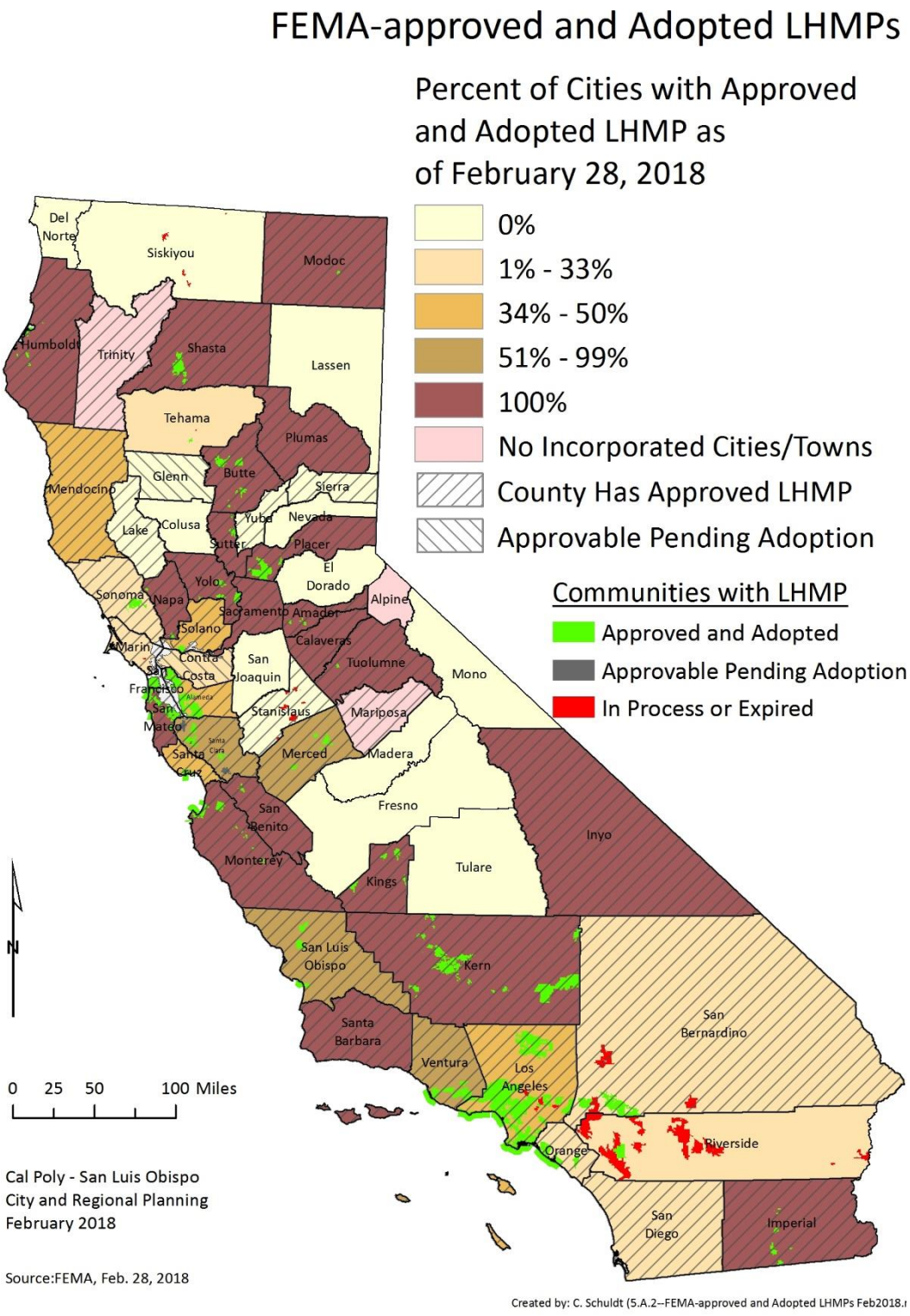
About one-fifth of LHMPs demonstrated direct links and references to the SHMP, especially use of the risk assessment chapters. Over 50 percent of communities included a social vulnerability assessment in their LHMPs, representing a notable increase from past practices. Additionally, the most cited changing social characteristic over the next 5 to 10 years, by a large margin is the "increasing percentage of 65+ population" (90 percent).

Table 5.A summarizes the status of LHMPs as of February 28, 2018. For comparison, the LHMP status summary from the 2013 SHMP is included in Table 5.B.

Map 5.A: Status of County LHMPs as of June 1, 2018



Map 5.B: FEMA-Approved City and County LHMPs as of February 28, 2018



Map 5.B shows the pattern of cities and counties with FEMA-approved, locally adopted LHMPs.

Progress Summary 5.A: Jurisdictions with Approved and Adopted LHMPs as of May 2017

Progress as of 2018: As of May 2017, 197 cities, 39 counties, and 215 special districts had Federal Emergency Management Agency (FEMA)-approved, locally adopted and FEMA-approved Local Hazard Mitigation Plans (LHMPs) (either single- or multi-jurisdiction plans), for a total of 451 jurisdictions with adopted and approved LHMPs. This is an increase from the number of jurisdictions with approved LHMPs as shown in the 2013 SHMP (see Table 5.B).

Since May 2017, an additional 6 multi-jurisdiction and 18 single-jurisdiction LHMPs have been approved. According to FEMA, another 20 LHMPs covering a total of 99 jurisdictions are approved pending adoption, as of February 28, 2018. (See Table 5.A)

Table 5.A: LHMP Status as of February 28, 2018

Jurisdiction Type	Number of California Jurisdictions	Number and Percent of Total Jurisdictions with Approved LHMPs	Population Covered (Percent of State Total)
City	482[93]	216 (44%)	16,963,779
County (Unincorporated)	58	42 (72%)	4,951,106
Special District/Other	4,711[94]	244 (5%)	(not available)
TOTAL		**502**	**21,814,885 (67%)†**

† Based on Federal Emergency Management Agency (FEMA) Mitigation Planning Portal population values

Table 5.B: LHMP Status as of May 2013

Jurisdiction Type	Number of California Jurisdictions	Number and Percent of Total Jurisdictions with Approved LHMPs	Population Covered (Percent of State Total)†
City	482	194 (40%)	17,106,211
County (Unincorporated)	58	32 (55%)	4,699,884
Special District/Other	4,400	148 (3%)	(not available)
TOTAL		**374**	**21,806,095 (57%)**

† Based on 2013 Department of Finance population estimates (state population total = 37,966,000)

The analysis of approved and adopted LHMPs as of May 2017 showed that close to 35 percent were prepared by emergency services departments within the jurisdiction. The next largest category of LHMP preparers was consultants working on behalf of the jurisdiction.

5.2.2 LHMP IDENTIFIED HAZARDS AND RISKS

Identified Hazards

Table 5.C shows the percentage of communities that identified specific hazards (using a standardized list) in their LHMPs and their ranking of those hazards based on approved LHMPs as of May 2017. These data confirm the state perspective that the "big three" hazards for California are earthquakes, floods, and wildfires.

Drought and severe weather and storms are also identified as significant hazards. In addition to these hazards, most communities identified landslide and other earth movements and dam failure as community hazards.

[93] California League of Cities, http://www.cacities.org/Resources/Learn-About-Cities
[94] State Controllers' Office, https://www.sco.ca.gov/ard_locarep_districts.html

Although only 9 percent of communities identified climate change as a hazard in their LHMPs, 40 percent identified climate change as a factor that exacerbated other hazards, especially drought, extreme heat, and wildfire. In addition, 27 percent of communities cited a local climate action plan in their LHMPs.

Table 5.C: Hazards Identified in LHMPs as of May 2017

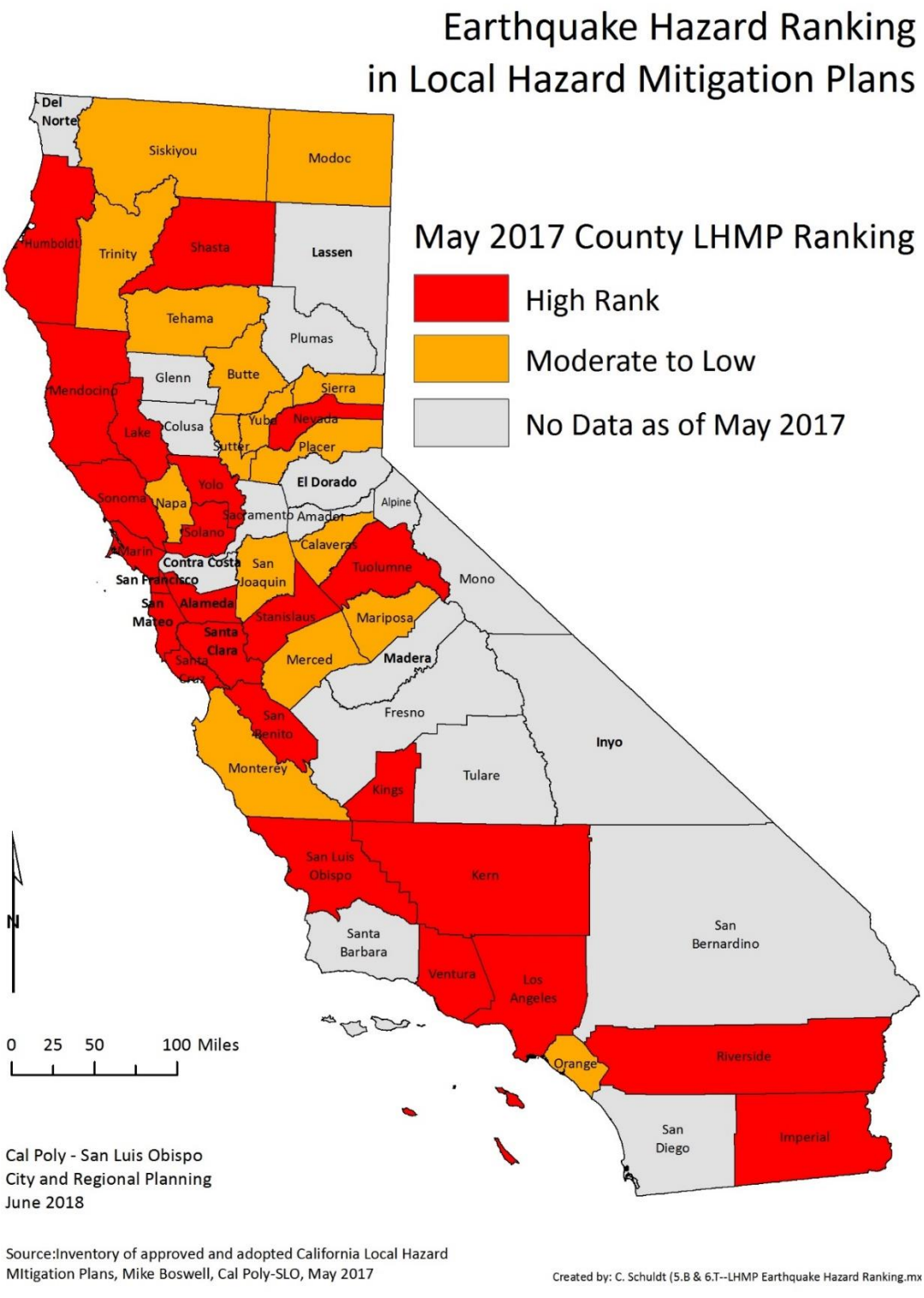
Hazard	Percent of LHMPs Identifying as a Community Hazard	Percent of LHMPs Identifying as "High Ranking, Significant, or Important"
Air Pollution	3%	1%
Agricultural/Silvicultural Pests & Disease	27%	11%
Avalanche	7%	0%
Climate change	9%	5%
Coastal Erosion	9%	2%
Coastal Storm & Flooding	18%	5%
Dam Failure	71%	16%
Drought	68%	30%
Earthquake	97%	73%
Energy Shortage	19%	7%
Epidemic/Pandemic	18%	8%
Extreme Heat	32%	11%
Flood	95%	59%
Freeze	20%	5%
Hazardous Material Release	44%	15%
Hurricane	4%	0%
Landslide & Other Earth Movements	63%	16%
Levee Failure	14%	5%
Radiological Accident	5%	2%
Severe Weather & Storms	65%	35%
Terrorist Attack	21%	9%
Tsunami	29%	6%
Volcano	15%	1%
Wildfire	85%	53%
Other Human-Caused Hazard	21%	7%
Other Natural Hazard	26%	11%

Maps 5.C, 5.D, and 5.E show the relative rank of the three main hazards as derived from review of California approved LHMPs as of May 2017. Aggregation to the county level occurred by the same method used to determine the "top hazard" (explained above). The hazard ranking followed the following method:

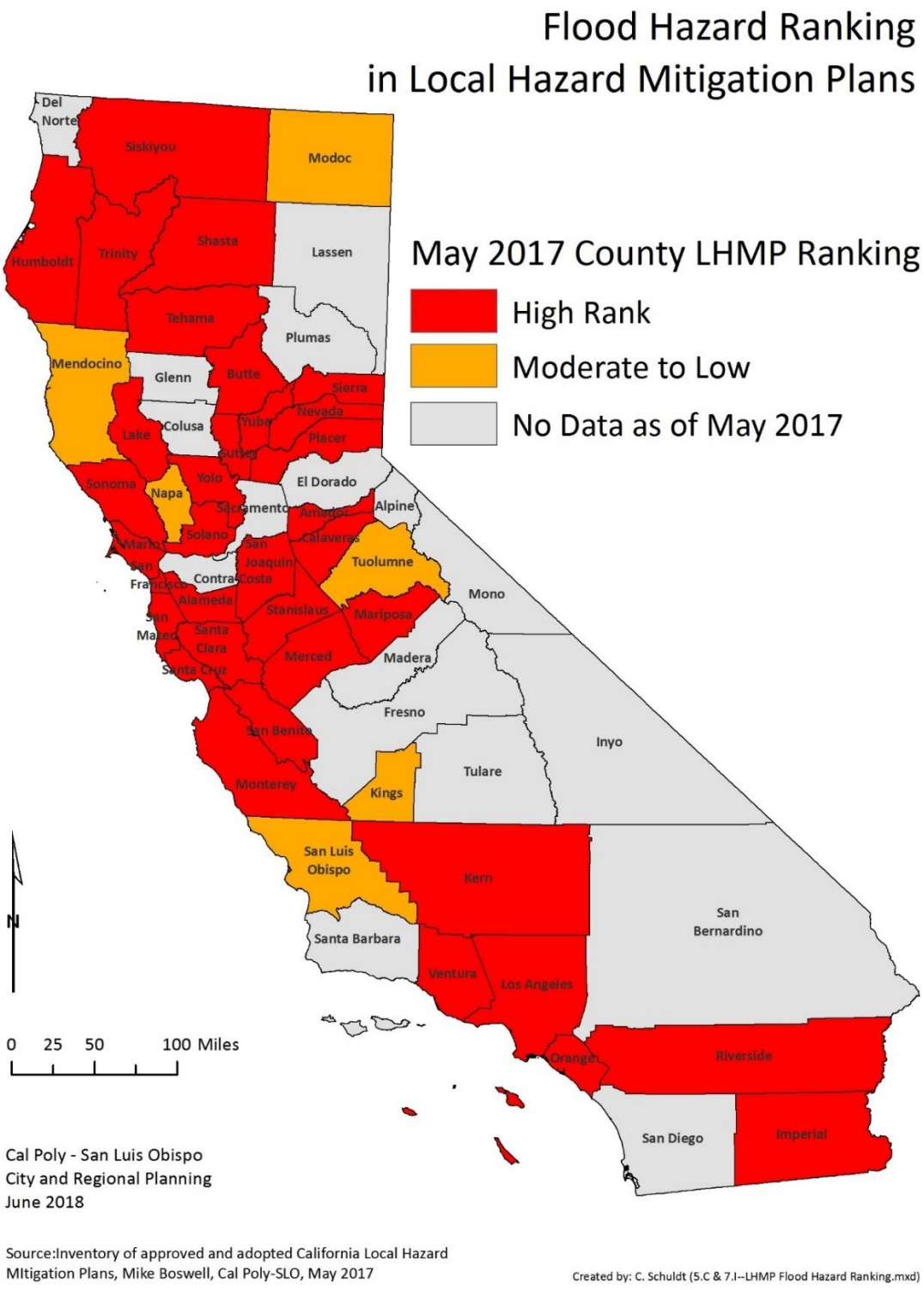
- High: Majority hazard based on designation as high/significant ranking or ranked in the Top 3
- Moderate to Low: Majority hazard based on designation as moderately/less significant ranking or ranking below the "Top 3" or the majority hazard based on designation as low/insignificant ranking or no ranking

The "Other Natural Hazard" category in Table 5.C is intended to capture any other natural hazards that local jurisdictions may have included in their LHMP, that are not included as a separate category in the table.

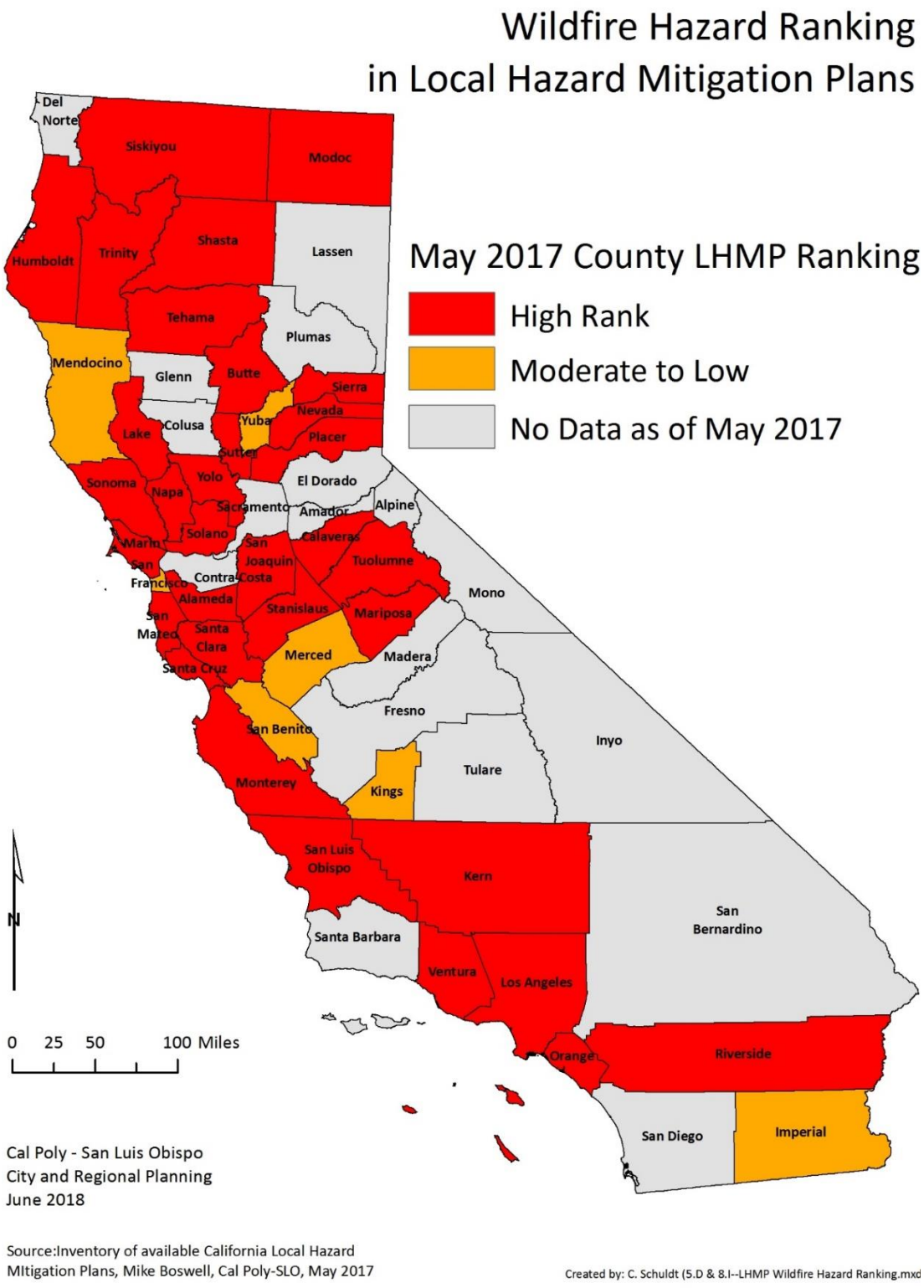
Map 5.C: Earthquake Hazard Ranking as of May 2017



Map 5.D: Flood Hazard Ranking as of May 2017



Map 5.E: Wildfire Hazard Ranking as of May 2017



Identified Risks

Many LHMPs identify the risks presented for structures, people, and critical facilities, and quantify the potential value of structures and property at risk. Tables 5.D through 5.G show these data for earthquake, flood, wildfire, and other hazards based on approved LHMPs as of May 2017. Not surprisingly, earthquakes generally put the most people and property at risk in California.

Table 5.D: Earthquake Risks Identified in LHMPs as of May 2017

Structures subject to earthquake risk	7,270,459
People subject to earthquake risk	3,401,541
Critical facilities subject to earthquake risk	9,238
Potential value of structures/property subject to earthquake risk	$230 billion

Table 5.E: Flood Risks Identified in LHMPs as of May 2017

Structures subject to 1% (100-year) flood risk	379,953
People subject to 1% (100-year) flood risk	871,070
Critical facilities subject to 1% (100-year) flood risk	6,434
Potential value of structures/property subject to 1% (100-year)flood risk	$44.4 billion

Table 5.F: Fire Risks Identified in LHMPs as of May 2017

Structures subject to wildfire risk	737,491
People subject to wildfire risk	2,072,358
Critical facilities subject to wildfire risk	11,650
Potential value of structures/property subject to wildfire risk	$192 billion

Table 5.G: All Other Hazards Risks Identified in LHMPs as of May 2017

Structures subject to risk from all other hazards	1,942,642
People subject to risk from all other hazards	4,182,930
Critical facilities subject to risk from all other hazards	14,160
Potential value of structures/property subject to risk from all other hazards	$135 billion

5.2.3 LHMP PLANNING AND MITIGATION TRENDS AND EFFECTIVENESS

Overview

Communities identified numerous mitigation measures in their LHMPs (based on approved LHMPs as of May 2017) as shown in Table 5.H. Standard mitigations such as public information and code revisions were the most included. Given that earthquakes, floods, and wildfires are the most cited hazards for communities, the LHMPs show consistency in that most identify flood control, structural retrofit, and vegetation management as important mitigation measures.

The analysis of approved and adopted LHMPs (as of May 2017) found that the top three identified sources of funding to implement mitigation measures are grants, general fund revenues, and special hazard related taxes or fees.

Table 5.H: Types of Mitigation Measures in California LHMPs as of May 2017

Mitigation Measure	Percent of LHMPs Identifying as Proposed Mitigation
Education/Information: public information programs on hazards	89%
Codes & Standards/Ordinance: adoption of codes, standards, or ordinances for hazard mitigation	75%
Flood Control: lessening the frequency or severity of flooding and decreasing predicted flood damage	74%
Structural Retrofit: earthquake/seismic retrofit programs that are structural	74%
Planning/Mapping: development of hazard mitigation plans and hazard mapping	61%
Vegetation Management: reduction or management of wildfire fuel loads	59%
Warning System: providing the public advance warning of an emergency	42%
Non-structural Retrofit: earthquake/seismic retrofit programs that are non-structural	36%
Elevation: elevation of flood-prone structures	35%
Equipment: equipment to support emergency management	35%
Technology Development: technological tools and solutions for hazard mitigation	35%
Relocation: voluntary physical relocation of an existing structure to an area outside of a hazard-prone area	33%
Hazardous Material: lessening the potential for or decreasing damage from hazardous material releases	26%
Acquisition: voluntary acquisition of existing flood-prone structures	24%
Erosion Control: reduction of risk to structures or infrastructure from erosion and landslides	23%
Fish Habitat Restoration-Flood Control: combined flood control and habitat restoration	3%

Review of approved LHMPs as of May 2017 found that over 70 percent of jurisdictions with approved LHMPs had used their general plan safety elements as a basic reference in preparation of the LHMP. This finding supports the importance of ensuring safety element's comprehensive assessment of hazards. The state has further strengthened the safety element by requiring its update on a five-year basis and mandating the inclusion of discussion on specific hazards including flood, fire, seismic, and climate change-influenced hazards.

In the sample of approved and adopted LHMPs as of May 2017, the single most noted challenge to the implementation of mitigation programs by jurisdictions was insufficient funding, followed by lack of technical expertise among staff.

LHMP Effectiveness – Best Practice Insights from Four LHMP Case Studies

Certain key components in LHMPs result in stronger and more effective plans. The following case studies highlight how some local jurisdictions used various key components to produce effective LHMPs for their communities. Table 5.I summaries key components used by the jurisdictions. *Please note that the components listed in Table 5.I are not the only components that can result in a successful LHMP*.

Contra Costa County LHMP

Contra Costa County's 2018 multi-jurisdiction LHMP includes the county, 14 municipalities, and 20 special districts. This LHMP, funded by a federal pre-disaster mitigation grant (PDM15-PL474), is being highlighted as a best practice example because it is strong in several areas.

The planning process included strong outreach for public participation. Allowing the public to participate in the planning process is essential because it educates people and motivates them to take personal accountability to protect themselves from hazards. It also helps to identify concerns, assets, hazard history, and other information essential to mitigation strategy development. The planning team used multiple media to reach out to as many citizens as possible, and used public input to develop the LHMP. The planning team created a special LHMP website to keep the public aware of plan development. On this website, the team posted a survey that helped influence the LHMP's goals, objectives, and mitigation strategies. The plan drafts were also available on the website with a point of contact so that the public could comment on the plan before it was submitted to Cal OES for review. Additionally, the public was invited to three public meetings where they could provide input and feedback. All public participation outreach was advertised through press releases and the county's LHMP website.

The county's LHMP provides a strong risk assessment, which is the cornerstone to developing a strong mitigation strategy. It includes a comprehensive assessment of hazards that affect the county, its municipalities, and its special districts. Along with the many hazards common throughout the state that specifically affect the county, the assessment discusses hazards that are becoming more prevalent and severe due to climate change such as drought, extreme heat, and sea-level rise. The LHMP also discusses secondary hazards that result from each of the primary hazards profiled, such as wildfire resulting from drought-induced tree mortality, earthquake-induced landslides, and higher flood risk due to runoff from wildfire-baked soils. It details worst-case scenarios for each hazard type and hazard-specific issues that helped guide the mitigation strategy. It also provides a comprehensive assessment of critical facilities and infrastructure for each hazard type including estimated costs of damage.

The LHMP has strong mitigation strategies for flood, fire, and earthquake hazards. The county and its participating municipalities and districts have a comprehensive list of actions for protecting the jurisdictions from the three most significant hazards as emphasized by the SHMP. Examples of mitigation actions include retrofits, relocations, and acquisitions of structures within hazard areas; creek restoration; infrastructure strengthening and improvements; linking the LHMP to other plans, ordinances, and programs that dictate land-use decisions; and public outreach activities. Most of these actions can also be performed to mitigate severe weather, sea-level rise, tsunami, landslide, and other hazards including some man-made hazards.

Santa Clara County LHMP

Santa Clara County's 2018 multi-jurisdiction LHMP includes the county, 14 municipalities, and the county fire district. This LHMP, funded by a federal pre-disaster mitigation grant (PDM15-PL517), is being highlighted as a best practice because it is strong in several areas.

The planning process included strong outreach for public participation. The planning team used multiple media to reach out to as many citizens as possible and used public input to develop the plan. The planning team created a survey and made it available on the county's website which helped influence the plan's goals, objectives, and mitigation strategies. Information booths were present at two farmer's markets where planning team members spoke with the public about the LHMP and invited them to take the survey, and provided them with information on individual exposure to hazards. Press releases invited the public to participate in numerous working group meetings.

Additionally, the public was provided an opportunity to comment on the LHMP plan before it was submitted to Cal OES for review. This comment period was advertised through a press release and the LHMP was posted on the county's website along with a point of contact.

The county's LHMP includes a strong risk assessment. It includes a comprehensive assessment of hazards that affect the county, its municipalities, and its special districts. Along with the many hazards common throughout the state that specifically affect the county, the assessment discusses hazards that are becoming more prevalent and severe due to climate change such as drought, extreme heat, and sea-level rise.

The LHMP also discusses secondary hazards that result from each of the primary hazards profiled. It details worst-case scenarios for each hazard type and hazard-specific issues which helped guide the mitigation strategy. It contains many high-quality maps and data from reputable sources such as the National Oceanic and Atmospheric Administration (NOAA), Environmental Systems Research Institute (ESRI), U.S. Geological Survey (USGS), California Department of Transportation (Caltrans), United States Department of Agriculture (USDA), and HAZUS to show critical facilities and infrastructure, population densities and exposure, and the location and extent of hazards. It provides a comprehensive assessment of critical facilities and infrastructure for each hazard type including estimated costs of damage, probability of damages to each facility or infrastructure, and recovery time. It discusses future trends of development including how development will be affected by each hazard type and how the county and stakeholders can handle future growth within the hazard areas.

The LHMP has a strong implementation strategy; it will be monitored and evaluated during a 12-month period and an annual progress report will be prepared. The planning team developed a progress report template, which is provided in the appendices. This annual report will be posted on the county web page, provided to local news media, and presented to the county and local governing bodies. Information from the LHMP will be integrated into a wide array of other planning mechanisms, including local general plans, capital improvement plans, emergency response plans, recovery plans, municipal codes, resiliency plans, and many others.

City of Laguna Beach LHMP

The City of Laguna Beach's 2018 LHMP, funded by a federal pre-disaster mitigation grant (PDM16-PL16), is being highlighted as a best practice example because it is strong in several areas.

The plan provides a thorough representation of how the LHMP and the City's general plan safety element are linked. The LHMP addresses California Government Code Section 65302 (g)(4), also known as Senate Bill (SB) 379. SB 379 requires that the safety element of a community's general plan address the hazards created or exacerbated by climate change. The City of Laguna Beach's LHMP includes an example of how climate change exacerbates each hazard identified by the Laguna Beach Planning Committee and the community.

In addition to the LHMP and general plan safety element link, the plan states that "the Laguna Beach LHMP is both a reference document and an action plan. It has information and resources to educate readers and decision makers about hazard events and related issues, and a comprehensive strategy that the City and community members can follow to improve resiliency in Laguna Beach."

The Laguna Beach Planning Committee conducted extensive public outreach by adopting a community engagement strategy that included: newsletter distribution, social media posts, press releases, website posts, public meetings, open house events, and radio engagements.

The LHMP also identifies resources that will help future city staff, the community, and local officials update the LHMP. The City of Laguna Beach's LHMP planning committee and stakeholders ultimately provided a well-organized road map for future hazard mitigation projects in their community.

Yolo County Multi-Jurisdictional LHMP

The 2018 Yolo County multi-jurisdictional LHMP is exemplary in the efforts made to engage and communicate with stakeholders during the planning process, including cities, reclamation districts, tribal governments, public, community leaders, and businesses. By engaging these groups from the beginning of the LHMP update, the County was able to forge local partnerships that assisted in the development of the plan, including a comprehensive look at the County's overall risk assessment.

With the 2017 release of the newly developed Flood Insurance Rate Maps for Yolo County and surrounding areas, this partnership between planners and emergency managers became even more important in the development of the LHMP as a vehicle to address countywide risk reduction, while integrating land use and hazard planning in all areas. The implementation phase of the LHMP includes the alignment of disaster risk reduction strategies with community objectives, and a plan to leverage available mitigation funding through the Hazard Mitigation Grant Program (HMGP), as well as Pre-Disaster Mitigation (PDM) funding and Flood Mitigation Assistance (FMA) funding. A tool kit was developed for use by all participants.

Table 5.I: Summary of Case Study Findings of Key LHMP Components

Key Local Hazard Mitigation Plan (LHMP) Component	Contra Costa County	Santa Clara County	City of Laguna Beach	Yolo County
Public participation/engagement	X	X	X	X
Use of multi-media approach	X	X		
Public participation to design plan		X		X
Strong risk assessment	X	X		X
In-depth assessment of critical infrastructure		X		
Use of worst-case scenarios		X		
Well-developed strategies for major hazard types	X	X	X	X
Clear implementation strategies		X	X	
Linked to general plan			X	X
Addresses climate change impacts and adaptation	X	X	X	

5.3 HAZARD MITIGATION PLANNING RESOURCE GUIDE FOR LOCAL JURISDICTIONS

The goal of this section is to provide information on resources that may assist California's local jurisdictions in developing and implementing their LHMP. Summaries of federal, state, and some regional resources that support both planning and hazards analyses are included as part of this guide. Topics also addressed include integration of local and state plans, an overview of local capabilities that contribute to local hazard mitigation planning efforts, and LHMP integration with other local planning processes.

5.3.1 INTEGRATION OF LOCAL AND STATE MITIGATION EFFORTS

Overview

Cal OES's LHMP program continues to evolve based on the current overall needs of LHMPs statewide, while also tracking ongoing updates to federal requirements. Cal OES continues to adjust the LHMP program to address the question of "How can Cal OES best support local jurisdictions' hazard mitigation planning efforts and integrate such efforts with state hazard mitigation actions?" The ongoing evolution of Cal OES's LHMP program includes utilization of new and emerging technologies for addressing and tracking hazards and gathering related data to successfully support local hazard mitigation planning.

The required LHMP elements related to hazard identification and vulnerability offer an opportunity for integration of state and local planning. The SHMP provides information on natural and technological hazards that are known to exist within the state, and the general location and vulnerability aspects of each hazard. Local jurisdictions can easily incorporate this general information into the hazard identification and vulnerability portion of their LHMP, and supplement with local knowledge and data, including use of the "My Plan" interactive mapping tool developed by Cal OES. (See *Section 5.3.2.3* for Hazard Information and Assessment Resources, below)

Using a consistent set of goals and objectives also reinforces the plan integration process. The 2018 SHMP contains an updated set of goals, objectives, and strategies that can easily be adopted or adapted by local jurisdictions to guide their LHMP development. In turn, when reviewing and evaluating LHMPs, state reviewers have the opportunity to ensure that local goals, objectives and strategies are consistent with those of the state, and local concerns are reflected in the overall state goals, objectives, and strategies.

The State of California has a broad array of hazard mitigation legislation, plans and programs that require, encourage, and/or support mitigation capabilities at the local level. These resource capabilities, including statewide codes and general plan requirements can be integrated into the capabilities section of LHMPs. This topic is discussed in greater detail in the following section.

Using the California SHMP and SHMT as Resources

A key topic of Cal OES's formal LHMP training efforts is walking jurisdictions through an overview of the SHMP and how it can be used as a resource for local hazard mitigation planning. Cal OES strongly encourages local jurisdictions beginning development of an LHMP to review the current approved SHMP and to participate in the State Hazard Mitigation Team (SHMT).

The SHMT is a group of key state agencies and other public and private sector stakeholders that promotes active participation in the SHMP update and implementation process to help integrate hazard mitigation with preparedness, response, and recovery efforts. The SHMT offers a unique resource to local jurisdiction hazard mitigation planning efforts through periodic meetings that facilitate hazard mitigation planning support and networking, information request opportunities, and presentations about current, as well as upcoming, state mitigation actions.

Benefits to participating in the SHMT include attending meetings and receiving messages where stakeholders can:

- Participate in discussion and review of state mitigation goals, objectives, and strategies

- Learn more about hazard risks around the state
- Hear about state actions supporting hazard mitigation and local hazard mitigation planning
- Learn more about updates to the SHMP
- Network with other jurisdictions and state agencies involved in hazard mitigation

Another benefit of local jurisdiction participation in the SHMT is the opportunity to provide input as part of the state hazard mitigation planning process. SHMT members also receive email updates on upcoming hazard mitigation grant opportunities, other hazard mitigation planning information, and climate adaptation information. Participation also allows members opportunities to contribute to strategic working groups addressing specific hazard mitigation topics.

5.3.2 LOCAL MITIGATION PLANNING RESOURCES

5.3.2.1 LHMP PREPARATION GUIDANCE

Previously Approved and Adopted LHMPs and the SHMP

Prior to beginning work on a new or updated LHMP, a jurisdiction should start by reviewing all of its previously approved and adopted LHMPs, along with any suggested revisions for future updates. As noted in *Section 5.3.1*, a local jurisdiction's initial local hazard mitigation planning efforts should also begin with an overview of California's current approved and adopted SHMP. The SHMP provides detailed discussion on the state's planning process and defines the state's hazard mitigation goals, objectives, strategies, and priorities. Local and regional jurisdictions should consider how their hazard mitigation goals, objectives, strategies, and priorities may align with the state's.

Following a complete review of all previously approved and adopted LHMPs and the current SHMP, jurisdictions can develop a preferred approach to their LHMP update. While all LHMP preparation efforts should refer to FEMA's mitigation planning guidance, there are many other recommended FEMA, state, and regional resources that jurisdictions are encouraged to use during their mitigation planning process.

FEMA Guidance

FEMA has developed many tools to support hazard mitigation planning by local and regional jurisdictions. While jurisdictions may follow any approach they choose, FEMA guidance provides a basic structure from which the hazard mitigation planning process may proceed. At a minimum, local and regional jurisdictions should refer to and follow the requirements of FEMA's Local Mitigation Planning Handbook the Local Mitigation Plan Review Guide during preparation.

The following FEMA resources provide an expected baseline for LHMP content. Regardless of how an LHMP is developed, it must meet the requirements of the elements defined in 44 CFR, Section 201.6, FEMA's Local Mitigation Plan Review Guide, and FEMA's Local Mitigation Handbook. However, jurisdictions are encouraged to customize their hazard mitigation planning process to their unique circumstances and go beyond the baseline requirements as necessary for their community's needs.

Local Mitigation Planning Handbook

The primary federal guidance tool for local jurisdictions to use in developing or updating LHMPs is the FEMA Local Mitigation Planning Handbook. FEMA updates this handbook every few years to ensure that guidance to jurisdictions is as current as possible. As of the preparation of this SHMP, the most recent Local Mitigation Planning Handbook was updated in 2013. The intent of the handbook is to assist local jurisdictions in meeting the requirements of 44 CFR 201.6 by offering tools, worksheets, and examples.

Local Mitigation Plan Review Guide

The Local Mitigation Plan Review Guide contains the FEMA Review Tool and instructions for meeting the requirements of each element. It acts as FEMA's official policy on and interpretation of local hazard mitigation planning requirements under 44 CFR 201.6. This guide is used by Cal OES and FEMA during formal review of each LHMP to ensure compliance. It is important to note that although FEMA Region IX has its own Review Tool, the elements and instructions for completing each section are the same as what is provided in both the Local Mitigation Plan Review Guide and in the Local Mitigation Planning Handbook. The FEMA Region IX Review Tool can be found on the Cal OES website at: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program.

Mitigation Ideas Guide

FEMA's Mitigation Ideas Guide is a resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters. The suggested mitigation actions are organized both by disaster type and by Local Planning and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, and Education and Awareness Programs topics. This publication can be used to assist in identifying mitigation actions to include in a jurisdiction's LHMP and to determine potential mitigation projects for funding under the HMA program.

Other FEMA Resources

FEMA's website offers access to many other valuable resources that support LHMP preparation and hazard risk and vulnerability assessment. Some additional recommended FEMA resources that support local hazard mitigation planning can be found in Table 5.J.

For a comprehensive listing of all FEMA resources, visit the FEMA website.

Summary of Local Mitigation Planning Guidance

While the state does not have final approving authority over LHMPs, it does play an integral role in providing available resources to jurisdictions to support local mitigation planning efforts to meet federal requirements. The state also helps local jurisdictions make important linkages to other California planning requirements, including general plan updates and climate change requirements.

A strong trend with LHMPs is the inclusion of climate change as both a separate hazard or as a condition that exacerbates hazards. Under Senate Bill (SB) 379, local jurisdictions are now required to address climate change in the safety elements of their general plan. Jurisdictions can meet the requirements of SB 379 by including climate change in their LHMPs and adopting their LHMP into the safety element of their general plans, which can also gain the post-disaster financial benefits of AB 2140. This effort encourages cross-linkages of various local planning efforts with hazard mitigation and provides an avenue to review existing plans; assess community vulnerability; create a comprehensive set of goals, policies, and objectives; define an implementation strategy; and implement identified mitigation measures.

The Governor's Office of Planning and Research (OPR) has compiled resources to assist local jurisdictions in determining climate-related assets, resources and populations that are sensitive to various climate change impacts. This information includes local, regional, and state data on the current status of climate change preparedness and past natural events and hazards; vulnerability maps showing areas that have repetitive loss and existing and planned development in at-risk areas; and information on the protection of public health, safety, and the environment. This information can be found on the OPR website under "General Plan Tools and Resources" at: http://opr.ca.gov/.

Table 5.J provides a listing of federal, state, and some regional resources that may be useful to jurisdictions for preparing LHMPs or other planning documents that address mitigation and climate adaptation and resiliency actions, such as general plan safety elements or local coastal plans. It should be noted that many exceptional resources now exist which aim to support local hazard mitigation and adaptation planning. While Table 5.J attempts to list many

of the key available resources (as of 2018), it is not an exhaustive list. Additionally, other resources may become available in the future that are not listed in Table 5.J, so it is recommended that the FEMA, Cal OES, OPR, and other agency websites are reviewed by local planning teams for additional resources during the hazard mitigation planning process.

Jurisdictions are encouraged to use these resources as applicable to their specific planning efforts. Resources listed in Table 5.J are grouped to correspond to the elements listed in FEMA's Local Mitigation Plan Review Guide (those resources which cross multiple elements from the review guide are listed in an initial "general" section at the beginning of the table).

Table 5.J: Resources Supporting Local Hazard Mitigation Planning

Agency	Guidance/Tool	Resource Website
GENERAL		
Previous Local Hazard Mitigation Plan (LHMP) Prepared by the Jurisdiction	Jurisdictions should review their current or previous LHMP at the beginning of the LHMP update process for background on previous goals and priorities, and to assess implementation of previous planned mitigation actions	***If a jurisdiction has a previously approved and adopted LHMP, it should be reviewed prior to starting the LHMP preparation or update process***
Federal Emergency Management Agency (FEMA)	Local Mitigation Planning Handbook	https://www.fema.gov/media-library/assets/documents/31598
FEMA	Local Mitigation Plan Review Guide	https://www.fema.gov/media-library/assets/documents/23194
FEMA	Tribal Mitigation Plan Review Guide	https://www.fema.gov/media-library/assets/documents/18355
FEMA	Mitigation Ideas	http://www.fema.gov/library/viewRecord.do?id=6938
FEMA	Independent Study 318: Mitigation Planning for Local and Tribal Communities	https://training.fema.gov/is/courseoverview.aspx?code=IS-318
FEMA	Integrating Disaster Data into Hazard Mitigation Planning: A State and Local Mitigation Planning How-to-Guide	https://www.fema.gov/media-library/assets/documents/103486
FEMA	FEMA Training Modules	G-318 Preparing and Reviewing Local Plans G-393 Mitigation for Emergency Managers https://www.fema.gov/hazard-mitigation-planning-training
Office of the Federal Register	Code of Federal Regulations (CFR), Title 44: Emergency Management and Assistance, Part 201 (44 CFR 201)	https://www.ecfr.gov/cgi-bin/text-idx?rgn=div5&node=44:1.0.1.4.53
California Native American Heritage Commission (NAHC)	NAHC website	http://nahc.ca.gov/codes/
California Governor's Office of Emergency Services (Cal OES)	California State Hazard Mitigation Plan	http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/state-hazard-mitigation-plan

Agency	Guidance/Tool	Resource Website
Cal OES	Local Hazard Mitigation Planning Program	http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program
Cal OES	Region IX LHMP Review Tool	http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/documents-publications-videos
Cal OES	State of California Emergency Plan and Emergency Support Functions	http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/state-of-california-emergency-plan-emergency-support-functions
OPR	Integrated Climate Adaptation and Resiliency Program (ICARP)	https://resilientca.org/
OPR	General Plan Guidelines (including Safety Element Completeness Checklist)	http://opr.ca.gov/planning/general-plan/guidelines.html
Beyond the Basics	A website designed to help guide the process of developing or updating an LHMP	http://mitigationguide.org/
American Planning Association (APA)/FEMA	Planning Information Exchange	https://www.planning.org/nationalcenters/hazards/planninginformationexchange/
ELEMENT A – PLANNING PROCESS/ELEMENT C – MITIGATION STRATEGY/ ELEMENT E – PLAN ADOPTION		
FEMA	Plan Integration: Linking Local Planning Efforts	https://www.fema.gov/media-library/assets/documents/108893
FEMA	Integrating Disaster Data into Hazard Mitigation Planning	https://www.fema.gov/media-library/assets/documents/103486
FEMA	Workshop: Planning for a Resilient Community	https://www.fema.gov/media-library/assets/documents/158758
FEMA	Training Module	IS-318 Mitigation Planning for Local and Tribal Communities https://training.fema.gov/is/courseoverview.aspx?code=is-318
FEMA	Training Module	IS-393 Introduction to Hazard Mitigation https://training.fema.gov/is/courseoverview.aspx?code=is-393.a
FEMA	Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning	https://www.fema.gov/ar/media-library/assets/documents/4317
NOAA	Local Plan Alignment Compass	https://resilientca.org/topics/plan-alignment/
Cal OES	Cal OES Hazard Mitigation Planning Website	http://www.caloes.ca.gov/for-individuals-families/hazard-mitigation-planning
National Institute of Standards and Technology (NIST), U.S. Department of Commerce	NIST Community Resilience Planning Guide	https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide
OPR	Community Engagement Best Practices	http://temp-opr.ca.gov/planning/icarp/resilient-ca.html
Local Government Commission/ARCCA	Adaptation Capability Advancement Toolkit (Adapt-CA)	http://arccacalifornia.org/adapt-ca/

Agency	Guidance/Tool	Resource Website
FEMA/Environmental Protection Agency (EPA)/OPR/ Association of Bay Area Governments (ABAG)	Vulnerability Assessment Toolkit: A Toolkit for Project Teams	http://www.centralcoastclimate.org/resources/
FEMA/EPA/OPR/ABAG	Framework for Building Regional Resilience in California: Workbook for Local and Regional Governments (Draft April 2018)	http://www.centralcoastclimate.org/resources/
California Natural Resources Agency (CNRA) Climate-Safe Infrastructure Working Group	Paying it Forward: A Path Toward Climate-Safe Infrastructure in California	http://resources.ca.gov/climate/climate-safe-infrastructure-working-group/
State of California Department of Finance	Population/ Demography Information	http://www.dof.ca.gov/Forecasting/Demographics/
California Animal Response Emergency system	Website for local animal emergency planners	www.cal-cares.com
APA	Hazard Mitigation: Integration Best Practices into Planning	https://www.planning.org/research/hazards/
APA	Policy Guide on Hazard Mitigation	https://www.planning.org/policy/guides/adopted/hazardmitigation.htm
APA	Planning for Post-Disaster Recovery: Next Generation (includes post-disaster model ordinance)	https://www.planning.org/research/postdisaster/
ELEMENT B – HAZARD IDENTIFICATION AND RISK ASSESSMENT		
See Hazard Specific Resources Table 5.K in Section 5.3.2.3		
ELEMENT D - PLAN REVIEW, EVALUATION, AND IMPLEMENTATION		
FEMA	2015 Hazard Mitigation Assistance Guidance *(note: check the FEMA website for updates to this document after 2018)*	https://www.fema.gov/media-library/assets/documents/103279
FEMA	Grants Visualization Tool	https://www.fema.gov/data-visualization
FEMA	Mitigating Flood and Drought Conditions Under Hazard Mitigation Assistance – various resources	https://www.fema.gov/media-library/assets/documents/110202
FEMA	Training Module	*IS-277 Benefit Cost Analysis Entry Level* http://www.training.fema.gov/is/courseoverview.aspx?code=IS-277
FEMA	Training Module	*Hazard Mitigation Assistance (HMA) Grant Programs IS-212.b Introduction to Unified HMA* http://www.training.fema.gov/is/courseoverview.aspx?code=IS-212.b
FEMA	Training Module	E-212 HMA: Developing Quality Application Elements https://training.fema.gov/emi.aspx

Agency	Guidance/Tool	Resource Website
FEMA	Training Module	E-213 HMA: Application Review and Evaluation https://training.fema.gov/emi.aspx
FEMA	Training Module	E-214 HMA: Project Implementation and Programmatic Closeout https://training.fema.gov/emi.aspx
FEMA	Training Module	E-276 Benefit-Cost Analysis Entry Level https://training.fema.gov/emi.aspx
Cal OES	Hazard Mitigation Grant Program web page	http://www.caloes.ca.gov/cal-oes-divisions/recovery/disaster-mitigation-technical-support/404-hazard-mitigation-grant-program
OPR	ICARP—Investing in Adaptation Topic	https://resilientca.org/topics/investing-in-adaptation/
ELEMENT F – ADDITIONAL STATE REQUIREMENTS		
California Environmental Justice Alliance	Senate Bill (SB) 1000 Toolkit: Planning for Healthy Communities	https://caleja.org/2017/09/sb-1000-toolkit-release/
Public Health Institute	Climate Change, Health, and Equity: A Guide for Local Health Departments	https://www.phi.org/resources/?resource=climate-change-health-and-equity-a-guide-for-local-health-departments
OPR	SB 1000: General Plan Guidelines: Chapter 4 (Environmental Justice Section) and Chapter 5	http://opr.ca.gov/planning/general-plan/guidelines.html
OPR	Defining Vulnerable Communities in the Context of Climate Adaptation	http://www.opr.ca.gov/planning/icarp/vulnerable-communities.html http://opr.ca.gov/planning/icarp/tac/
OPR	Resiliency Guidebook Equity Checklist	http://opr.ca.gov/planning/icarp/resilient-ca.html
OPR	Resiliency Guidebook Vulnerable Populations	http://opr.ca.gov/planning/icarp/resilient-ca.html
OPR	SB 379: General Plan Guidelines: Chapter 4	http://opr.ca.gov/planning/general-plan/guidelines.html
California Department of Forestry and Fire Protection (CAL FIRE)	SB 1241: Fire Prevention Program	http://calfire.ca.gov/fire_prevention/fire_prevention

5.3.2.2 KEY TO SUCCESS: LOCAL PLAN ALIGNMENT

For over a decade the State of California has moved to facilitate hazard mitigation at the local level by passing legislation that strengthens the linkage of mitigation and adaptation efforts with land use planning. This linkage is referred to as "plan alignment".

Within OPR's Integrated Climate Adaptation and Resiliency Program (ICARP) State Adaptation Clearinghouse, a topic area is included specifically addressing plan alignment. The Clearinghouse plan alignment topic page introduction notes that communities have many plans that help them manage their community's assets and resources. With deliberate coordination, many of these plans can be leveraged to supplement and enhance each other and help the community achieve its climate mitigation and adaptation goals. Aligning goals and actions across local hazard mitigation plans, adaptation plans, general plans, and other planning documents allows mitigation and adaptation efforts to be built into local jurisdictions' everyday planning.

The Coastal Plan Alignment Compass, released in 2018, was developed to assist local governments to coordinate local plans to ensure a cohesive planning approach that strengthens hazard mitigation and climate adaptation outcomes. Details about the Coastal Plan Alignment Compass are provided on the Clearinghouse plan alignment topic page as well as a listing of other resources supporting plan alignment and the incorporation of climate considerations into the planning process. For more information and details on how to receive the compass tool, visit: https://resilientca.org/topics/plan-alignment/.

5.3.2.3 HAZARD INFORMATION AND ASSESSMENT RESOURCES

A local jurisdiction's initial hazard assessment efforts can begin with a review of California's SHMP risk assessment chapters. The SHMP offers detailed information on actions being taken by state agencies to address hazards, including many planning and GIS resources that state agencies have created to assist local jurisdictions in strengthening their hazard mitigation efforts.

Federal Hazard Resources

FEMA, USGS, NOAA, and other federal agencies have developed many powerful tools that can be used to identify and assess hazards. These resources can be used independently or in coordination with state resources to assist local jurisdictions in identifying hazards that may affect their communities and to develop the basis for assessing the vulnerability of their communities. Many of these tools use GIS to determine physical extents of hazards or estimate potential impacts.

State Hazard Resources

California continues to develop many powerful tools to support risk and vulnerability assessment and hazard mitigation planning. These tools include guidance for climate adaptation, toolkits to guide local vulnerability assessments, and hazard mapping tools to identify many different hazards such as fault lines, air pollution, and tree mortality. These public resources allow users to quickly and easily begin to understand hazards in their community. The resources are designed to be "user friendly" and do not require specialized training to use. Jurisdictions are encouraged to review the resources available and spend time exploring those that they believe may assist their LHMP preparation efforts.

Summary of Hazard Information and Assessment Resources

Table 5.K provides a listing of some federal, state, and regional resources which may be useful to jurisdictions in their risk and vulnerability assessment efforts and hazard mitigation planning. Not all resources provided in this table will be applicable to all jurisdictions. While Table 5.K is fairly comprehensive, new resources continue to be developed and may not be included in this resource table which was finalized in August 2018. It is recommended that local planning teams review the FEMA, Cal OES, OPR, and other agency websites for additional resources during the hazard mitigation planning process.

While some resources are hazard specific, others address multiple hazards. This table groups resources in the following categories:

- Multiple hazard resources
- Earthquake and geologic hazard resources
- Flood hazard resources
- Fire hazard resources
- Climate change-related hazard resources (including subsections with a listing of some hazard-specific resources for sea-level rise, drought, and extreme heat)
- Sociotechnical/technological hazards resources

Table 5.K: Hazard Information, Assessment, and Mitigation Resources

Agency	Guidance/Tool	Resource Website
MULTIPLE HAZARDS		
Federal Emergency Management Agency (FEMA)	Hazus	https://www.fema.gov/hazus
FEMA	Risk Mapping, Assessment, and Planning Program (RiskMAP) Region IX	https://www.fema.gov/risk-map-region-ix
FEMA	Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards	http://www.fema.gov/library/viewRecord.do?id=6938
FEMA	How-To-Guide	FEMA 433 - Using Hazus-MH for Risk Assessment https://www.fema.gov/fema-433-using-hazus-mh-risk-assessment
FEMA	Training Modules	IS-922 Application of GIS for Emergency Management http://www.training.fema.gov/is/courseoverview.aspx?code=IS-922 *For modules below, see the FEMA Emergency Management Institute Website:* E-190 ArcGIS for Emergency Managers E-296 Application of Hazus-MH for Risk Assessment E-313 Basic Hazus-MH https://training.fema.gov/emicourses/emicatalog.aspx?cid=E313&ctype=R
California Governor's Office of Emergency Services (Cal OE)S	MyPlan	http://myplan.calema.ca.gov/
Cal OES	MyHazards	http://myhazards.caloes.ca.gov/
EARTHQUAKE AND GEOLOGIC HAZARDS		
Southern California Earthquake Center (SCEC)	Third Uniform California Earthquake Rupture Forecast (UCERF3)	https://www.scec.org/ucerf
California Geological Society (CGS)	Alquist-Priolo Earthquake Fault Zoning Maps	http://www.conservation.ca.gov/CGS/rghm/ap/
CGS	Seismic Zonation Maps	http://www.conservation.ca.gov/cgs/shp
CGS	California Earthquake Hazard Zone Application (EQZapp)	http://www.conservation.ca.gov/cgs/Pages/SH_EQZ_App.aspx
CGS	CGS Information Warehouse (PDF maps and reports and GIS data)	https://maps.conservation.ca.gov/cgs/EQZApp/app/

Agency	Guidance/Tool	Resource Website
CGS	Geologic Hazards Data Viewer	https://maps.conservation.ca.gov/geologichazards/#dataviewer
CGS	Geologic Hazards Data List	https://maps.conservation.ca.gov/geologichazards/#datalist
Cal OES/ U.S. Geological Society (USGS)	Shake Alert	https://www.shakealert.org/
Cal OES/California Earthquake Authority (CEA)/FEMA/ USGS/SCEC	ShakeOut	https://www.shakeout.org/california/
California Seismic Safety Commission (CSSC)	Earthquake Loss Reduction Plan	http://ssc.ca.gov/legislation/mitigation.html
USGS/ Science Application for Risk Reduction (SAFRR)	HayWired Scenario	https://www.usgs.gov/natural-hazards/science-application-risk-reduction/science/haywired-scenario?qt-science_center_objects=0#qt-science_center_objects
CAL FIRE	Watershed Emergency Response Team (WERT) Report *(see discussion in Section 6.2.4)*	Search CAL FIRE's website to see if any WERT assessments have been conducted for fires within the jurisdiction
FLOOD HAZARDS		
FEMA	National Flood Insurance Program (NFIP)	https://www.fema.gov/national-flood-insurance-program
FEMA	Community Rating System (CRS) User Manual	https://www.fema.gov/media-library/assets/documents/8768
FEMA	Using National Flood Hazard Layer Web Map Service (WMS)	https://hazards.fema.gov/femaportal/wps/portal/NFHLWMSkmzdownload
FEMA	NFIP Technical Bulletins	https://www.fema.gov/media-library/collections/4#
FEMA	Flood Risk Products: Using Flood Risk Products in Hazard Mitigation Plans	https://www.fema.gov/media-library-data/1533059807625-e1a0d07e4326e2ec4f027ce41befe922/Using_FRPs_in_HMPs_Guide_508_07-31-18.pdf and https://www.fema.gov/risk-map-flood-risk-products
FEMA	Resources for American Society of Civil Engineers (ASCE) 24 Hazard Mitigation Assistance (HMA) Flood Retrofitting	https://www.fema.gov/media-library/assets/documents/93594
FEMA P-312	Homeowners Guide to Retrofitting (2014)	https://www.fema.gov/homeowners-guide-retrofitting
FEMA P-259	Engineering Principles and Practices of Retrofitting Floodprone Residential Structures, 3rd Edition (2012)	https://www.fema.gov/media-library/assets/documents/3001
FEMA P-936	Floodproofing Non-Residential Buildings (2013)	https://www.fema.gov/media-library/assets/documents/34270
FEMA P-55	Coastal Construction Manual, 4th Edition (2011)	https://www.fema.gov/media-library/assets/documents/3293

Agency	Guidance/Tool	Resource Website
FEMA	Training Modules	E-273 Managing Floodplain Development through the NFIP https://www.fema.gov/media-library/assets/documents/6029 E-278 National Flood Insurance Program/ Community Rating System https://www.fema.gov/national-flood-insurance-program-community-rating-system
Association of State Flood Plain Managers (ASFPM)	ASFPM website (training and funding opportunities)	www.floods.org
California Department of Water Resources (DWR)	Model Floodplain Management Ordinances	https://www.water.ca.gov/Programs/Flood-Management/Community-Resources/National-Flood-Insurance-Program
Cal OES	Flood Journal (Cal OES Geographic Information Systems [GIS] product)	Contact Cal OES GIS for more information
CGS	Tsunami Inundation Mapping	http://www.conservation.ca.gov/cgs/geohazards/tsunami/maps
FIRE HAZARDS		
FEMA	Wildfire Mitigation Resources	https://www.fema.gov/wildfire-mitigation-faqs-and-resources
National Fire Protection Association	Codes and Standards	https://www.nfpa.org/Codes-and-Standards
California Department of Forestry and Fire Protection (CAL FIRE	Fire and Resource Assessment Program (FRAP)	http://frap.fire.ca.gov/
CAL FIRE	FRAP Very High Fire Hazard Severity Zones	http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps.php
CAL FIRE	Strategic Fire Plan for California	http://osfm.fire.ca.gov/fireplan/fireplanning
CAL FIRE	Fire Prevention Program	http://calfire.ca.gov/fire_prevention/fire_prevention
CAL FIRE	California's Forests and Rangelands: 2017 Assessment	http://frap.fire.ca.gov/assessment/2017/assessment2017 http://frap.fire.ca.gov/assessment/2015/assessment2015
Office of the State Fire Marshal	California Communities at Risk List	http://osfm.fire.ca.gov/fireplan/fireplanning_communities_at_risk.php
Board of Forestry	A Handbook for Fire Planning in the General Plan	http://www.bof.fire.ca.gov/resources/fire_planning_and_the_general_plan_handbook_final_may2014_newtitlepage.pdf
OPR	Fire Hazard Planning: General Plan Technical Advice Series	http://opr.ca.gov/docs/Final_6.26.15.pdf
Cal OES	Fire Situation Awareness Journal – statewide overview of fires	Contact Cal OES GIS for more information
California Fire Safe Council	Grants Clearinghouse	http://www.cafiresafecouncil.org/grants-clearinghouse/
California Fire Science Consortium	Statewide Coordination through University of California (UC), Berkeley	http://www.cafiresci.org/
Joint Fire Science Program	Fire Science Program Website	https://www.firescience.gov/index.cfm

Agency	Guidance/Tool	Resource Website
CLIMATE-RELATED HAZARDS		
General Resources		
U.S. Federal Government	U.S. Climate Resilient Toolkit	https://toolkit.climate.gov/
U.S. Global Change Research	2014 National Climate Assessment	http://nca2014.globalchange.gov/
Intergovernmental Panel on Climate Change	Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Summary for Policy Makers	https://wg1.ipcc.ch/srex/
FEMA	Climate Resilient Mitigation Activities for Hazard Mitigation Assistance	https://www.fema.gov/media-library/assets/documents/110202
FEMA	Green Infrastructure Methods Fact Sheet	https://www.fema.gov/media-library-data/1487161212568-3b313a4502545a8cf6846f36d53e1367/GI_Fact_Sheet_Feb2017_COMPLIANT.pdf
Scripps Institution of Oceanography	California-Nevada Climate Applications Program	https://scripps.ucsd.edu/programs/cnap/climate-tools/
NOAA	Coastal Plan Alignment Compass	https://resilientca.org/topics/plan-alignment/
OPR	California's Integrated Climate Adaptation and Resiliency Program (ICARP) Adaptation Clearinghouse	http://www.opr.ca.gov/clearinghouse/adaptation/
OPR	General Plan Guidelines—Chapters 7 and 8	http://opr.ca.gov/planning/general-plan/guidelines.html
California Natural Resources Agency (CNRA)/OPR/ California Energy Commission (CEC)	California's Fourth Climate Change Assessment	http://www.climateassessment.ca.gov/
CNRA	Safeguarding California Plan	http://resources.ca.gov/climate/safeguarding/
CNRA/Cal OES	California Adaptation Planning Guides	http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/california-climate-adaptation
Various	Cal-Adapt Climate Resources	http://cal-adapt.org/
California Department of Public Health (CDPH) Office of Health Equity (OHE)	California Building Resilience Against Climate Effects (Cal BRACE)	https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx https://www.cdph.ca.gov/Programs/OHE/Pages/ClimateHealthProfileReports.aspx
CDPH	Climate Change & Health Vulnerability Indicators for California (CCHVIs)	https://discovery.cdph.ca.gov/ohe/CCHVIz/
Office of Environmental Health Hazard Assessment (OEHHA)	CalEnviroScreen	https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30
OEHHA	2018 Office of Environmental Health and Hazard Assessment Indicators of Climate Change in California	https://oehha.ca.gov/climate-change/document/indicators-climate-change-california

Agency	Guidance/Tool	Resource Website
State Coastal Conservancy	Climate Ready Program	http://scc.ca.gov/climate-change/
California Air Resources Board (CARB)	Cool California	https://coolcalifornia.arb.ca.gov/
Natural Resources Agency	California Heat Adaptation Tool (CHAT) (developed by Four Twenty Seven)	www.cal-heat.org
Alliance of Regional Collaboratives for Climate Adaptation (ARCCA)	ARCCA website	http://arccacalifornia.org/
Local Government Commission/ARCCA	Adaptation Capability Advancement Toolkit (Adapt-CA)	http://arccacalifornia.org/adapt-ca/
ARCCA	Regional Adaptation Collaborative Toolkit	http://arccacalifornia.org/toolkit/
Georgetown Climate Center	Georgetown Adaptation Clearinghouse	http://www.adaptationclearinghouse.org/
American Planning Association	Climate Change Resources	https://www.planning.org/resources/climatechange/
Extreme Heat-Specific Resources		
CalEPA	Urban Heat Island Index for California	https://calepa.ca.gov/climate/urban-heat-island-index-for-california/urban-heat-island-interactive-maps/
National Weather Service	HeatRisk Forecast	https://www.wrh.noaa.gov/wrh/heatrisk/
CDPH OHE	California Building Resilience Against Climate Effects (CalBRACE) Program	https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx
CNRA	California Heat Assessment Tool	Available in late 2018 at: www.cal-heat.org
Climate Action Team Public Health Workgroup	Preparing California for Extreme Heat: Guidance and Recommendations	http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf
Cal OES	Contingency Plan for Excessive Heat Emergencies	http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/ExcessiveHeatContingencyPlan2014.pdf
Sea-level Rise-Specific Resources		
Ocean Protection Council	Sea-level Rise Guidance Document	http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/
Ocean Protection Council	Rising Seas in California: An Update on Sea-Level Rise Science 2017	http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf
California Coastal Commission (CCC)	Sea-level Rise Policy Guidance	https://www.coastal.ca.gov/climate/slrguidance.html
CCC	Residential Adaptation Policy Guidance	https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/residential/
National Oceanic and Atmospheric Administration (NOAA)	Digital Coast	https://coast.noaa.gov/digitalcoast/
NOAA	Coastal Services Center web viewer	https://coast.noaa.gov/digitalcoast/

Agency	Guidance/Tool	Resource Website
NOAA	Sea the Future: Sea Level Rise and Coastal Flood Web Tools Comparison Matrix	http://sealevel.climatecentral.org/matrix/
U.S. Geological Survey (USGS)	Coastal Storm Modeling System: CoSMoS	https://walrus.wr.usgs.gov/coastal_processes/cosmos/index.html
U.S. Geological Survey (USGS)	Hazard Exposure Reporting and Analytics: HERA (for use in conjunction with CoSMoS)	https://www.usgs.gov/apps/hera/
Our Coast Our Future	Tools for Planning for Sea-level Rise and Storm Hazards along the California Coast	http://data.pointblue.org/apps/ocof/cms/
OPR	ICARP Adaptation Clearinghouse: Ocean and Coast Topic Area	https://resilientca.org/topics/ocean-and-coast/
State Coastal Conservancy (SCC)	Sea-level Rise Adaptation Resources	http://scc.ca.gov/climate-change/climate-change-projects/#slr-adaptation
State Lands Commission (SLC)	Sea-Level Rise Resources	http://www.slc.ca.gov/Programs/Sea_Level_Rise.html
DWR	Quick Guide Coastal Appendix: Planning for Sea-level Rise	https://www.water.ca.gov/LegacyFiles/floodmgmt/lrafmo/fmb/docs/QGCoastalAppendix_FINALDRAFT_2016dec02.pdf
The Nature Conservancy (TNC)	Coastal Resilience California	http://coastalresilience.org/
TNC	Coastal Resilience California Mapping Tool	http://maps.coastalresilience.org/california/#
Climate Central	Surging Seas Risk Finder	http://sealevel.climatecentral.org/ http://sealevel.climatecentral.org/ssrf/help-page
San Francisco Bay Conservation and Development Commission (BCDC)	Adapting to Rising Tides	http://www.adaptingtorisingtides.org/
CNRA	Case Studies in Natural Shoreline Infrastructure in Coastal California	http://www.slc.ca.gov/Programs/Sea_Level_Rise/NaturalShorelineCaseStudy.pdf
Drought-Specific Resources		
Centers for Disease Control	Preparing for the Health Effects of Drought	https://www.cdc.gov/nceh/hsb/cwh/docs/CDC_Drought_Resource_Guide-508.pdf
Department of Food and Agriculture	State Water Efficiency and Enhancement Program	https://www.cdfa.ca.gov/oefi/sweep/
DWR/SWRCB	California Drought Portal	http://www.drought.ca.gov/
DWR	California Water Plan	https://water.ca.gov/Programs/California-Water-Plan
DWR	Water Use and Efficiency Resources	https://water.ca.gov/Programs/Water-Use-And-Efficiency
SOCIOTECHNICAL/TECHNOLOGICAL HAZARDS/THREATS		
FEMA	Integrating Manmade Hazards into Mitigation Planning (FEMA 386-7)	https://www.fema.gov/media-library/assets/documents/4528
Cal OES	2017 State Threat and Hazard Identification and Risk Assessment (THIRA)	http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/threat-and-hazard-identification-risk-assessment

Agency	Guidance/Tool	Resource Website
Cal OES	State Threat Assessment Center	http://www.caloes.ca.gov/cal-oes-divisions/state-threat-assessment-center
Cal OES	California Cyber Security Taskforce	http://www.caloes.ca.gov/for-individuals-families/cybersecurity-task-force

5.3.3 LOCAL COORDINATION AND MITIGATION CAPABILITIES

While California cities and counties are autonomous, state law, policies, and programs have a substantial influence on local land use and hazard mitigation activities. This section addresses state mandated and locally adopted capabilities that can contribute to mitigation activities at the local level and provide the basis for implementing mitigation strategies and actions. Capabilities assessments generally include but are not limited to the following categories: Planning and Regulatory (federal/state/local statutes; land use, building codes, etc.); Administrative and Technical (organization, roles and responsibilities, technical resources); Education and Outreach (training); and Financial (internal and external funding sources).

The California Government Code (Sections 65000 et seq.) contains many of the laws regulating land use planning including general plans, specific plans, subdivisions, and zoning. The state is seldom directly involved in local land use decisions. These have been delegated to the city councils and county boards of supervisors. Local decision-makers adopt their own land use policies based on the state laws and approve individual development projects based on these policies.

5.3.3.1 LEGAL FOUNDATIONS OF LOCAL GOVERNMENT CAPABILITY

State law is the foundation for local government in California. Local governments include cities, counties, and special districts. Their powers are determined both by the State Constitution and by state legislation. All units of local government have powers to undertake hazard mitigation planning and projects.

In California, there are more than 7,000 local government institutions. Most of these are special districts. The remaining entities include 58 counties, 478 cities, and approximately 1,000 school districts. Each of these institutions is involved in local planning, but cities and counties have the most prominent role.

Cities and Counties

Cities and counties are distinct and independent political entities with separately elected governing boards. The authority for cities and counties comes from Article XI, Section 7 of the California Constitution, which states that "A county or city may make and enforce within its limits all local, police, sanitary and other ordinances and regulations not in conflict with general laws." Thus, cities and counties are given the power to develop and enforce land use regulations. State law also requires that each county and city have a legislative body and a planning agency, and to adopt "a comprehensive, long-term general plan for [its] physical development."

Through general plans, local jurisdictions document official decisions and future strategies regarding the location of housing, business, industry, roads, parks, and other land uses; protection of the public from environmental hazards; and conservation of natural resources. Each city and county formally adopts its own general plan and develops implementing regulations, including zoning ordinances, subdivision ordinances, and building codes.

Cities and counties are obligated by law to confer with adjoining jurisdictions when considering adoption or amendment of a general plan and regulatory ordinances. However, there is no requirement that adjoining cities or counties have identical, or even similar, plans and ordinances.

Special Districts

Special districts are local government units with separate taxing authority and their own elected governing boards, formed to address specific issues such as fire protection, geologic hazard abatement, and flood control.

According to the California Special Districts Association (http://www.csda.net/home), "Special districts are a form of local government created by a local community to meet a specific need. Inadequate tax bases and competing demands for existing taxes make it hard for cities and counties to provide all the services their citizens' desire. When residents or landowners want new services or higher levels of existing services, they can form a district to pay for and administer them."

Cities and counties can jointly form special districts and joint powers authorities to address specific issues. Examples include the Sacramento Area Flood Control Agency (SAFCA), a regional flood control district with taxing authority (www.safca.org); and the Association of Bay Area Governments (ABAG) (www.abag.ca.gov), a joint powers authority functioning as a regional planning advisory body.

5.3.3.2 STATE LEGISLATION AFFECTING LHMPS

General Legislative Mandates

Assembly Bill 2140 (AB 2140), adopted by the California legislature in the fall of 2006, provides post-disaster financial incentives for local jurisdictions adopting their LHMPs as part of their general plan safety elements.

Hazard Specific Legislative Mandates

California is at risk to a host of natural hazards, most notably earthquakes, fires, and floods. Over the past century, a number of these have become major disasters resulting in significant losses of life and property. In order to increase public safety and community resilience, California has responded by passing numerous laws and modifying state codes to address these hazards. These hazards are primarily addressed in general plan safety elements (and all elements of a general plan, whether mandatory or optional, must be consistent with one another. The following sections discuss the legal mandates for addressing the three most prominent natural hazards and their influence on community planning. These legal mandates affect the development of general plans, including safety elements, as well as some of the implementation tools discussed later in this section.

Earthquake Hazards

Earthquake Fault Zoning Act

The Earthquake Fault Zoning Act was enacted in 1972. Its purpose is to protect homes and other buildings designed for continuous human occupancy from earthquakes by preventing them from being built across identified fault zone surface ruptures. Under this act, the State Geologist under the Department of Conservation's California Geological Survey is required to identify and map all fault zones in California classified as "active"—Holocene era or later, where movement has occurred within the last 11,000 years. These maps are published and available for local governments to use for policy- and decision-making. The act requires that development be prohibited over surface traces of active fault zones. Before a development is approved, a geologic investigation must be conducted to determine whether structures proposed for human occupancy are set back at least 50 feet from an identified fault surface rupture, as prescribed by state regulations implementing the act. If so, development may proceed. If not, the proposed development must be denied.

The State Geologist periodically updates the fault zone maps. When the maps are updated and disseminated, local governments are required to provide this information to people who may be living in mapped fault zones. Disclosure can be made in general plans, specific plans, property maps, or other plans or maps accessible to the public. Disclosure is also required to all buyers of real estate within these mapped fault zones before transactions are completed.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was passed by the state legislature in 1990. Under this act, the State Geologist under the Department of Conservation's California Geological Survey is required to identify and map all areas at risk for ground shaking, landslides, and liquefaction. These maps must be published and made available to the public so

that local governments can use them in local planning decision-making. Developers in areas of seismic hazard risk must produce a geotechnical report for that location and identify the mitigation actions that will be incorporated into the proposed development. In addition, anyone wishing to sell real estate in seismic hazard areas must disclose to the buyer that the property is located within a seismic hazard area.

While a principal purpose of this act was to provide state mapping leading to more detailed geological mapping and site investigation for use with structural mitigation, another important function is to flag potential hazardous areas where development should not occur, or where land uses allowed by the general plan or zoning should be restricted to minimize exposure to hazards and risk. Designation of these areas can be coupled with land acquisition by a public agency in areas where no development is allowable.

Flood Hazards

Hurricane Katrina in 2005 was a wake-up call to the nation that the United States is not immune to catastrophic disasters. States and local communities began reevaluating hazards and increasing their hazard management efforts, and California was no exception.

One area that was of significant concern to state leaders was the Sacramento-San Joaquin Delta region and the over 1,100 miles of levees that protect it. Levee failure—a critical issue in New Orleans during Hurricane Katrina—became a key issue for the state. Among the efforts that California implemented was new legislation for flood and levee protection in the Delta region and throughout the state. The following is a summary of legislation passed in recent years that affect community planning and flood hazards.

Assembly Bill 162

AB 162 (2007) requires that land use, conservation, safety, and housing elements of local general plans include provisions and flood hazard inundation mapping that will reduce the risk from floods and flood-related issues. Each of the requirements for the elements specified in this bill must be fulfilled before the next revision of the housing element of the local jurisdiction's general plan.

Land use elements are required to include flood maps that are produced by the Federal Emergency Management Agency (FEMA) or the California Department of Water Resources (DWR). These must be updated each year. In addition, the determination of land available for urban development may exclude land that is not adequately protected by flood management infrastructure. The Department of Water Resources has prepared user guidelines for implementation, in coordination with OPR, Cal OES, and other agencies.

Conservation elements must contain detailed information about the floodplain, such as the rivers, creeks, and streams that contribute to it. In addition, information on flood corridors, riparian corridors, and land capable of sustaining floodwater must be identified. This information should be used to inform conservation element policies addressing groundwater recharge and storm water management.

AB 162 also adds requirements for addressing floods in the safety element. Source information includes historical data and flood hazard zone mapping. The safety element (and all elements of a general plan, whether mandatory or optional, must be consistent with one another) must include policies and goals that state how flooding risks for existing and planned development will be reduced, including strategies for deciding how new development can be placed in flood hazard zones, if at all. New development in these areas may be subject to design requirements that reduce the risk from flooding. In addition, the safety element must include policies for protecting public facilities from the risks of flooding and ensuring their continuity during flood events.

The schedules for requirements under AB 162 (2007) and companion bill SB 5 (2007), specifically related to the Central Valley, were extended by the legislature through approval of SB 1278 in 2012. This extension was intended to allow city and county local general plans as well as zoning in the Central Valley to be made consistent with the Central Valley Flood Protection Plan adopted in 2012.

Assembly Bill 70

AB 70 (2007) addresses increased risk to floods as a result of new development in a community. If a city or county approves new development that increases the flood risk to the state, then the city or county must be responsible for a reasonable amount of the liability it has increased. This requirement applies to land that was previously undeveloped and protected by a state flood control project.

Senate Bill 5

Under SB 5 (2007), cities and counties within the Sacramento-San Joaquin Valley are required to include information from the Central Valley Flood Protection Plan (CVFPP) to be adopted by the Central Valley Flood Protection Board. Within 24 months of flood protection plan adoption, each local jurisdiction must include these amendments in its general plan. Each jurisdiction is also required to develop goals and policies in its general plan for protecting people and property from floods and flood-related issues.

Senate Bill 27

SB 27, also known as the Sacramento-San Joaquin Delta Emergency Preparedness Act, was passed in 2008. The act provided direction for the creation of a report outlining specific recommendations to be made to the Legislature and Governor to support the following items: a Delta interagency unified command system, an emergency preparedness and response strategy, and a supporting exercise/training plan. The act directed Cal OES to establish a Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force consisting of representatives from the Delta Protection Commission, California Department of Water Resources, FEMA, and a representative from each of the Delta counties. The Task Force met and developed the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force Report, which it provided to the Legislature and Governor in early 2012. One of the Task Force recommendations was to develop a Delta catastrophic flood incident plan. The 2018 Northern California Catastrophic Flood Response Plan (NCCFRP) supports the emergency preparedness and response strategy outlined in the Task Force Report. The NCCFRP provides a framework outlining how local, state, and federal governments will respond and coordinate in anticipation of and immediately following a catastrophic flood affecting Northern California, with emphasis on impacts to the Delta.

Related Flood Mitigation Laws

The CVFPP was adopted in July 2012. In related actions, the Legislature passed SB 1278 (2012) and AB 1965 (2012) extending the time originally provided by SB 5 (2007) for localities to make their general plans consistent with the CVFPP. Among other things, these bills established a July 2013 deadline for DWR to complete 200-year floodplain mapping within this area, allowed cities and counties in this area to take up to two years after July 2013 to amend their general plans to be consistent with the CVFPP, added a year beyond that to amend their zoning, required amended city and county general plans to include data and analysis contained in the CVFPP and other flood hazard zones mapping, and required cities and counties after July 2016 to make findings related to urban flood protections levels using criteria developed by DWR.

Wildfire Hazards

Government Code Section 65302.5

Under Government Code Section 65302.5, any county that has State Responsibility Areas (SRAs) within its boundaries must adhere to Public Resources Code Section 4128.5, which requires that counties with SRAs submit a copy of the proposed safety element of a general plan to any agency with responsibility for fire protection in the county prior to adoption or amendment. The fire protection agencies may then provide comments on or recommendations for the proposed safety element. The board of supervisors reviewing the general plan must consider these comments and recommendations. If any or all of the recommendations are not accepted, the board must provide written communication to the agency stating why it is not including the recommendations. The board must also state how its own actions regarding land and policies within state responsibility areas will reduce the risk of fire for people, property, and natural resources.

Public Resources Code Section 4290

California Public Resources Code Section 4290 provides authority to State Board of Forestry and Fire Protection to develop and implement fire safety standards for defensible safety on SRA lands. All residential, commercial, and industrial construction on SRA lands approved after January 1, 1991, must follow the regulations established by this board. At a minimum, the regulations will include road standards for fire equipment access; standards for street, road, and building identification signage; minimum levels for private water supply reserves that could be used for emergency fire use; and fuel breaks and greenbelts.

Public Resources Code Section 4291

Public Resources Code Section 4291 provides regulations for protecting properties from wildfires. The code applies to all lands that have flammable vegetation. Any person with ownership or control of buildings on these lands must abide by these regulations. The regulations include several different requirements for how the vegetation surrounding buildings and structures should be managed to create defensible space. Within 100 feet of any building or structure, a firebreak must be created by removing brush, flammable vegetation, or combustible growth. If the distance is required to be greater than 100 feet by any other law or regulation, then that law or regulation supersedes this code section. In areas where soil stabilization is critical, vegetation can be maintained up to 18 inches in height but still must not be within 30 feet of any building or structure. Trees must be maintained to ensure that no part of the tree is within 10 feet of a chimney or stovepipe. Dead or dying parts of trees near buildings must also be removed. Roofs should be maintained so that accumulation of leaves, needles, or other dead vegetation is removed.

Public Resources Code Section 4291 also establishes requirements for building permits. Before construction on any building or rebuilding, a certification must be obtained from the local building official that the structure design adheres to the current code. In addition, after the building construction has been completed, a final inspection must be performed by the building official to verify that the building was built to state and local codes.

Fire Hazard Severity Zones

Public Resources Code Sections 4201 to 4204 and Government Code Sections 51175 to 51189 direct CAL FIRE to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These mapped zones were adopted in 2008 in all SRAs and are referred to as Fire Hazard Severity Zones (FHSZs). As part of the mapping, various mitigation strategies were identified to reduce risk associated with wildland fires, especially in Very High Fire Hazard Severity Zones (VHFHSZs).

Senate Bill 1241 (2012)

SB 1241, a significant law mandating wildfire planning responsibilities of local governments that have jurisdiction in State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs) (detailed in *Section 8.1*), requires inclusion of additional wildfire safety considerations as part of local general plans, together with special findings of fact supporting local approval of new subdivisions in such areas. Provisions of the law passed in 2012 stipulate that wildfire safety be included in several local planning processes including land use, development, and environmental review, and also require the Governor's Office of Planning and Research (OPR) to prepare user guidelines for implementation, in coordination with Cal OES, and other agencies. The OPR guidance provides recommendations and considerations for addressing fire hazards in general plans. This includes integration of fire hazard mitigation strategies developed in LHMPs and coordinating these with community planning strategies established in the general plan.

SB 1241 requires local general plan safety elements be updated in accordance with the fire safety planning guidance issued by OPR. The provisions of SB 1241 are triggered by the scheduled update of the local general plan safety element, or an update to the jurisdiction's required update of the General Plan Housing Element after January 1, 2014. Draft safety element updates must be submitted to CAL FIRE's Board of Forestry and Fire Protection, as well as other local and regional agencies involved with the provision of fire safety, for review and comment 90 days prior to local adoption. Additional details regarding SB 1241 are outlined in *Section 8.1.5.1*.

OPR and CAL FIRE are providing outreach to local jurisdictions on wildfire mitigation planning through the Firewise Communities workshops and the California Fire Safe Communities programs. The Fire Hazard Planning document is part of OPR's General Plan Technical Advice Series.

Climate Change Related Legislation

Senate Bill 375 (2008)

SB 375, the Sustainable Communities and Climate Protection Act of 2008, requires California's urban regions to achieve mandated greenhouse gas (GHG) reductions through coordinated transportation and land use. After its passage, the California Air Resources Board moderated a lively, contentious negotiation process with the state's 18 metropolitan planning organizations (MPOs) to define potential GHG reductions and assign the mandated targets. Each MPO adopts its own "sustainable communities strategy" (SCS), and these reflect regional differences in auto use, air quality, and mobility in the state. SB 375 builds on existing planning processes, particularly for transportation and associated air quality requirements. If the combination of measures in the SCS would not meet the regional targets, the MPO prepares a separate "alternative planning strategy" (APS) to meet the targets. Consult the regional MPO for targets and strategies in place.

Senate Bill 743 (2013)

Senate Bill 743 changes the transportation impact analysis required as part of California Environmental Quality Act (CEQA) compliance. These changes will include elimination of auto delay, level of service, and other similar measures of vehicular capacity or traffic congestion as a basis for determining significant impacts for land use projects and plans in California. Further, parking impacts will not be considered significant impacts on the environment for select development projects within infill areas with nearby frequent transit service. According to the legislative intent contained in SB 743, these changes to current practice were necessary to more appropriately balance the needs of congestion management with statewide goals related to infill development, promotion of public health through active transportation, and reduction of greenhouse gas emissions. The OPR has proposed changes to the CEQA Guidelines that identify vehicle miles traveled (VMT) as the most appropriate metric to evaluate a project's transportation impacts.

Senate Bill 379 (2015)

SB 379 requires all cities and counties to include climate adaptation and resiliency strategies in the safety elements of their general plans upon the next revision beginning January 1, 2017. These are additional requirements beyond those related to seismic, and geologic factors. The climate adaptation update is to include a set of goals, policies, and objectives for cities and counties based on the vulnerability assessment, as well as implementation measures, including the conservation and utilization of natural infrastructure that may be used in adaptation projects.

Other Mitigation-Related Legislation

Senate Bill 244 (2011)

SB 244 requires cities and counties to review and update the land use elements of their general plans on or before the next adoption of a housing element. An updated general plan must: 1) identify, describe and map "island," "fringe" and "legacy unincorporated communities" with the city's sphere of influence or, as to the county, within the county; 2) analyze water, wastewater, drainage, and structural fire protection needs or deficiencies in these communities; and 3) analyze benefit assessment districts or other financing alternatives that could make extension of services to identified communities financially feasible. "Island" communities have the usual definition of that term. "Fringe" communities are simply those within a city's sphere of influence. "Legacy" communities are those that have been inhabited for 50 or more years. Studies of such communities usually require input from public works, fire, fiscal, and community development/planning departments.

SB 244 also requires Local Agency Formation Commissions to 1) deny any application by a city to annex a territory that is contiguous to a "disadvantaged unincorporated community" unless a second application is submitted to

annex the disadvantaged community as well, and 2) evaluate disadvantaged unincorporated communities in a municipal services review upon the next update of a sphere of influence after June 30, 2012.

Assembly Bill 52 (2014)

Under AB 52, California tribes have the ability to establish, through a formal notice letter, a standing request to consult with a lead agency regarding any proposed project subject to CEQA in the geographic area with which the tribe is traditionally and culturally affiliated. California law defines consultation as the "meaningful and timely process of seeking, discussing, and considering carefully the views of others, in a manner that is cognizant of all parties' cultural values and, where feasible, seeking agreement." Respectful, effective consultation consists of in-person meetings between appropriate representatives of the parties, which the tribe may wish to host at its reservation or rancheria. Agencies should be respectful of each tribe's unique history, practices, and culture. Prior to initiating consultation with a tribe, the agency should develop an understanding of that tribe's leadership and governance structures.

Senate Bill 1000 (2016)

Environmental justice is part of the general plan process. Senate Bill 1000, the Planning for Healthy Communities Act of 2016, requires cities and counties to adopt an environmental justice element or integrate environmental justice-related policies, objectives, and goals throughout other elements of their general plans. The legislation includes a process for communities to become meaningfully involved in the decision-making processes that govern land use planning in their neighborhoods. This legislation includes mitigation actions to reduce various vulnerability factors.

A jurisdiction's environmental justice process for the general plan must:

1. Identify objectives and policies to reduce the unique or compounded health risks in disadvantaged communities by means that include, but are not limited to, the reduction of pollution exposure, including the improvement of air quality, and the promotion of public facilities, food access, safe and sanitary homes, and physical activity
2. Identify objectives and policies to promote civil engagement in the public decision-making process
3. Identify objectives and policies that prioritize improvements and programs that address the needs of disadvantaged communities

5.3.3.3 RELATIONSHIPS OF LOCAL PLANNING PROCESSES TO LHMPS

An important interest of FEMA in promoting compliance with the LHMP process (as part of planning for hazard mitigation grants) is integration of mitigation planning with comprehensive planning (i.e., local general plans, Regional Blueprint Plans, and Regional Transportation Plans).

Within this regional and local planning framework, key considerations identified by FEMA in evaluating mitigation planning strategies include considerations such as:

- Compatibility with community goals
- Legal authority
- Ability to implement and enforce mitigation actions
- Technical feasibility
- Financial capability
- Benefit-cost review of a proposed solution
- Priority level of the proposed project among the hazards addressed
- Completeness of the solution

Some benefits of integrating mitigation planning with comprehensive planning include reduction of vulnerability to disasters, stimulation of pre- and post-disaster decision-making, formation of partnerships between planners and emergency managers, expansion of external funding opportunities, and facilitation of post-disaster return of the community to normalcy, as well as resolution of locally sensitive issues with community-based solutions.

A California legislative action reinforcing these principles is Assembly Bill 2140 (2006). This bill encourages cities and counties to adopt LHMPs in accordance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000) as part of their mandated general plan safety elements. As an incentive, it also authorizes the legislature to consider providing to such cities or counties a portion of the state share of local costs exceeding 75 percent of total state-eligible post-disaster costs under the California Disaster Assistance Act.

Cal OES works with the Governor's Office of Planning and Research (OPR) to incorporate information on hazard mitigation planning into the General Plan Guidelines, which provide guidance to California cities and counties in the preparation of their general plans. The 2017 General Plan Guidelines update includes new guidance to local jurisdictions to support response to recent hazard mitigation legislation.

5.3.3.4 GENERAL PLAN REQUIREMENTS

Every city and county in the state must adopt a general plan for the physical development of the county or city and any land outside its boundaries that bears relation to its planning. The general plan offers many opportunities for local agencies to identify, plan for, and mitigate local hazardous conditions such as flood, fire, and geologic events. The legislative body of each city (city council) and county (board of supervisors) adopts zoning, subdivision, and other ordinances to regulate land use and implement general plan policies.

The general plan must cover a local jurisdiction's entire planning area and address the broad range of issues associated with the city's or county's development. The law also requires that general plans include seven elements: land use, circulation, housing, open space, conservation, noise, and safety. The safety element identifies hazard mitigation policies to guide local decisions related to zoning, subdivisions, and entitlement permits. All elements of a general plan, whether mandatory or optional, must be consistent with one another. Each element's data, analyses, goals, policies, and implementation programs must be consistent with and complement one another. Since general plan law requires all elements to be consistent with each other, requirements of the safety element must align with guidance provided in each of the other elements. One example of this alignment is the required consistency between hazards shown in safety element maps and allowed land uses shown in land use element maps. Allowed land uses defined in land use element maps must take into account hazards defined in safety element maps.

The state legislature has declared that decisions involving the future growth of the state, most of which are made and will continue to be made at the local level, should be guided by an effective planning process, including the local general plan. It has also declared that the state's land is an exhaustible resource, not just a commodity, and is essential to the economy, environment, and general well-being of the people of California.

A local government's general plan acts as a "constitution" for future development, bridging the gap between a community's values, vision, and goals, and physical development actions, such as the subdivision of land and public works projects. Information found in the general plan underlies most local land use decisions.

The California Planning and Zoning Law and the Subdivision Map Act require all cities and counties to adopt specific plans and other regulations to implement the general plan. Counties and general law cities are also required to have zoning and specific plans that are consistent (not in conflict) with the general plan. Moreover, the Subdivision Map Act also requires land subdivision to be consistent with the general plan.

Many jurisdictions have written hazard mitigation provisions into local zoning, subdivision, and environmental assessment ordinances and codes for reference in routine project review. Examples of commonly applied zoning and subdivision regulatory approaches to new developments in naturally hazardous areas include:

- Transfer of allowable density from hazardous parts of a site to safer areas
- Restriction of residential densities, reducing the numbers of structures at risk
- Enforcement of building setbacks from flood, landslide, and fault zones
- Adoption of slope-density formulas to limit the number of dwellings on hillsides

- Modification of parcel boundaries and street locations to avoid hazardous areas
- Requirement of multiple access points for emergency access and evacuation
- Provision of adequate street widths for two-directional movement in an emergency
- Assurance of sufficient water pressure for adequate fire flows
- Assurance of sufficient water supply during drought conditions

California legislation reinforces these practices through the 2017 General Plan Guidelines prepared by the Governor's Office of Planning and Research (OPR). The General Plan Guidelines encourage best practices and also emphasize consideration of each local general plan within its regional context. For example, OPR encourages local governments to coordinate planning issues that transcend artificial city or county boundaries. Wildfire, flooding, and air pollution are examples of hazards that can cross jurisdictional boundaries. The role of OPR is not to regulate local government planning, but to provide cities and counties with planning assistance and resources. OPR prepares numerous publications on a variety of planning topics and provides advice and assistance to local planners by phone and email. To download the 2017 General Plan Guidelines, visit: http://opr.ca.gov/planning/general-plan/.

In California, general plans are the vehicle used to outline the policies and regulatory framework for land use decisions at the local level. Tools used to implement local general plans include zoning, development review, subdivision review, capital improvement programs, land acquisitions, and redevelopment. The following is a brief summary of the provisions of California law regarding general plans, implementation tools, and hazard mitigation.

Statutory Mandates

Government Code Section 65300 requires that each municipality develop a general plan as a guide to the long-term development of the community. A general plan must also be adopted by the local legislative body so that it is implemented with the weight of law. General plans may also be known as comprehensive plans or master plans.

The purpose of the general plan is to provide goals, objectives, and policy statements that outline the vision of what a municipality plans to be in the future. The general plan will then be the guide for future development and growth for each respective municipality. Community growth can involve a number of different issues, such as housing, transportation, natural resources, and hazards.

Since each city and county is required to have a general plan that guides growth and development, the plan provides an important tool to local governments for hazards management. Local governments can place policies within their general plans that require new development to be at minimal or no susceptibility to hazards. Growth can then be controlled and concentrated in areas where hazards are far less likely to affect buildings and people.

OPR is the principal state agency that oversees community planning issues for the state. One of its tasks is to develop guidelines for counties and cities to follow for developing general plans. The most recent version of the general plan guidelines was published in 2017 and includes detailed information on what needs to be included in each mandated element. Of most relevant importance to hazards management is the guideline for developing a safety element (and all elements of a general plan, whether mandatory or optional, must be consistent with one another). In addition, there are summaries of laws and government codes that apply to community planning.

Mandated General Plan Elements

In accordance with Government Code Section 65302, a general plan must contain seven elements: Land Use, Circulation, Housing, Conservation, Open Space, Noise, and Safety. The Government Code specifies requirements for what each of these elements must contain. Each of the requirements is just the minimum that is needed. Local governments are welcome to go beyond the minimum requirements and to include other elements or sections. In addition, the elements can be organized in whichever method best fits the policies of that municipality, as long as all the required components are addressed. The following is a brief description of the elements that are most relevant to hazard mitigation.

Safety Element

The safety element is the most important element for hazards management since it contains the most significant requirements to protect people and property from hazards. At a minimum, the safety element must address seismic, geologic, fire, and flood hazards. Local governments often include other components such as crime, hazardous materials, airports, and emergency operations. The safety element includes components from other elements, but it is important to unify these into a single element to more effectively guide policy- and decision-making. General plan law requires all elements to be consistent with each other; thus, requirements of the safety element must align with guidance provided in each of the other elements. One example of this alignment is the required consistency between hazards shown in safety element maps and allowed zoning shown in land use element maps. Zoning defined in land use element maps must take into account hazards defined in safety element maps.

The first priority for the local government is to identify the hazards that are within its boundaries. Hazard identification will include mapping of the hazardous areas. Then, the local government must determine the strategies and policies that will reduce the risks from these hazards.

Other Mandated Elements

Land Use Element

The land use element outlines land use categories and their locations within the community. The categories can include residential, commercial, agriculture, and public facilities. Included in the requirements for this element is a statement of the population density and building intensity for each of the identified land use categories. A recently added requirement (AB 162) is that areas within the community that are subject to flooding must be identified and mapped. This must be reviewed each year.

In addition to providing the required flood mapping, the land use element offers other opportunities for hazard mitigation. In their land use elements, local governments can include policies that land uses of higher value, such as commercial or residential, be located outside likely hazardous areas, which might encompass areas subject to hazards such as landslides, wildfires, and floods or potential human-made hazards. Keeping high-value land uses such as industrial plants and rail yards out of potentially hazardous locations can greatly reduce the loss of life and property.

Circulation Element

The circulation element involves the transportation routes within a city and county. This element can include policies on what the transportation routes will be in the future and where they are located. Transportation can be both vehicular and pedestrian. Vehicular circulation includes local roads, highways, bicycles, and rail. Road widths, street parking, and intersections are a few of the components to planning for vehicular circulation. Pedestrian circulation may include sidewalks, walking trails, and crosswalks. Public utilities to support circulation, such as street signs and traffic lights, are also addressed within this element. Also included are transit facilities, such as bus terminals and railway lines and stations.

The circulation element has substantial potential to promote hazard mitigation within the community. Many transportation routes will be used by emergency services to respond to incidents. They will also be used as evacuation routes for people leaving areas that have been or are about to be affected by a disaster. In their circulation elements, local governments can include requirements that critical roads be wide enough to allow larger vehicles (such as emergency crews) to pass other vehicles so that there are no traffic jams during an event. The element could also require that new developments have multiple access points to expedite response and evacuation. This is important if particular access points or roads are blocked or inaccessible.

Housing Element

The housing element includes projected housing needs for the community and strategies for the community to increase housing supply. The housing projections and strategies analyze a variety of factors, including population

projections and market conditions. Once a strategy is adopted, the city or county may implement the strategy through zoning ordinance modifications or through housing development project approvals.

Under California law, the housing element is the only general plan element requiring periodic review by the State of California and updating every five years. Since the element must be updated every five years, the housing development strategy is a five-year plan of actions to implement the goals and objectives of the element. Under AB 162, local governments must add the latest flood hazard information to their housing elements before forwarding the elements to the State Department of Housing and Community Development for review.

Conservation Element

The conservation element covers natural resources within the city or county. In addition to conservation of natural resources, this element also addresses the responsible development and utilization of these natural resources. Because growth and development can lead to increased demand for natural resources such as open land, the strategies within this element are developed in accordance with the strategies of other elements such as housing, open space, and transportation. Natural resources are also an important component in safety elements in that they include the natural conditions that could lead to hazards for the community. Examples include forested areas within High Fire Severity Zones, rivers, and streams within floodplains, coastal regions susceptible to tsunamis, and hills with landslide risks. Under AB 162, conservation elements must include information on waterways that contribute to or support floodplains.

Open Space Element

The open space element contributes to hazard mitigation primarily through policies for setting aside land for non-development. The motivations behind these policies could include preventing development in hazardous areas. Instead of accommodating development, high-hazard areas could be preserved as open space. Examples include land along earthquake fault zones or within floodplains. Setting aside land can reduce current risk through protection and preservation of natural resources in floodplains. Natural resources such as wetlands and marshes can provide a buffer and absorb the impact of floods. If development is permitted in hazardous areas, open space could serve as a buffer between the development and the hazard. For protection from wildfires, this buffer would provide a built-in firebreak surrounding the development.

Noise Element

The noise element addresses excessive noise levels in areas of the community. The noise element is included for the purpose of minimizing unhealthful impacts from sources of excessive commercial, industrial, and transportation noise. Although the noise element does not directly address natural hazards, it has a bearing on placement of noise-sensitive land uses such as schools, hospitals, and retirement centers that may also be vulnerable to hazards and risks. Areas near the ends of airport runways are characterized not only by extreme noise but also by higher risk of airplane crashes and therefore are not suitable for such land uses.

General Plan Consistency

The required general plan elements are an important component of community planning, but their value can easily be negated if they are in conflict with one another. For this reason, state general plan law requires both internal and external consistency. A general plan is internally consistent if the content of each individual element is consistent with other parts of the same element and with other general plan elements. For example, maps and diagrams must be consistent with the text within the element. External consistency refers to the consistency of the general plan with zoning and other general plan implementation programs and actions.

Consistency Among General Plan Elements

According to Government Code Section 65300.5, each element of the general plan must be consistent and compatible with the others. Therefore, the policies outlined in the general plan must be unified and support one another. Components governing land use must not conflict with circulation, housing, or safety policies. For example, a land use element map designating a high-density residential area in the middle of a landslide area identified on a

safety element map would conflict with safety element policies calling for protection of housing from landslide hazards.

Consistency of Implementing Actions

As will be seen in greater detail in later sections, actions implementing general plans, such as rezonings, site plan reviews, subdivision map approvals, and capital improvement programs, must be consistent with the general plan. This an important underpinning of hazard mitigation because it requires that policies related to minimizing impacts of natural hazards identified in the general plan be followed in the day-to-day actions of city and county governments.

For more information regarding related laws, see *Annex 1: Guide to California Hazard Mitigation Planning Laws, Policies, and Institutions.*

5.3.3.5 ADOPTION OF LOCAL HAZARD MITIGATION PLANS WITH SAFETY ELEMENTS

Under the federal Disaster Mitigation Act of 2000 (DMA2000), each municipality must develop a Local Hazard Mitigation Plan (LHMP) or participate in a multi-jurisdictional LHMP in order to be eligible for pre-disaster mitigation grants or post-disaster recovery assistance from the federal government.

At the state level, AB 2140 (2006) authorizes local governments to adopt their LHMPs into the safety elements of their general plans. Such adoption is not mandated by this law. Instead it is encouraged through a post-disaster financial incentive that authorizes the state to use available California Disaster Assistance Act funds to cover local shares of the 25 percent non-federal portion of grant-funded post-disaster projects.

AB 2140 is one of the most important links between general plans and hazard mitigation in California. As mentioned earlier, California has enormous opportunity to implement hazard mitigation strategies within the safety elements of general plans. Integration of the LHMP into the safety element provides an excellent vehicle for implementation of the LHMP. This integration allows hazard mitigation strategies to be implemented and local hazard awareness to be upgraded and enhanced. In addition, all other elements of the general plan, as well as implementation programs (such as zoning, subdivision maps, specific plans, and capital improvement programs), would be required to comply with an LHMP that it is adopted with the safety element.

As stated in CFR Section 201.6(c)(5), in order for FEMA to consider the LHMP final, formal adoption of the LHMP by the governing boards of each participating jurisdiction must be made following the FEMA designation of the LHMP as "Approved Pending Adoption." In an effort to help California cities and counties to comply with the current state legislative requirements under AB 2140, SB 379, and SB 1241, whereby compliance can be met by adopting the LHMP into the safety element of the general plan, Cal OES is developing sample resolution language inclusive of all three pieces of legislation. The sample language, when completed, will be available on the Cal OES website under the "Hazard Mitigation Local Hazard Mitigation Planning Resources" web page at http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/hazard-mitigation-planning/local-hazard-mitigation-program.

5.3.3.6 COASTAL LAND USE REGULATION

The California Coastal Commission was established in 1972 to protect California's coastal environment. California's coastal management program is carried out through a partnership between state and local governments. The California Coastal Act of 1976 extended the Coastal Commission's authority indefinitely. Section 30253 of the California Coastal Act requires that new development minimize risks to life and property in areas of high geologic, flood, and wildfire hazard.

Implementation of Coastal Act policies is accomplished primarily through the preparation of Local Coastal Programs (LCPs) that are required to be completed by each of the 15 counties and 61 cities located in whole or in part in the coastal zone. Completed LCPs must be submitted to the Commission for review and approval.

An LCP includes a land use plan (LUP) which may be the relevant portion of the local general plan, including any maps necessary to administer it, and the zoning ordinances, zoning district maps, and other legal instruments necessary to implement the LUP. Coastal Act policies are the standards by which the Commission evaluates the adequacy of LCPs. Amendments to certified LUPs and LCPs only become effective after approval by the Commission. To ensure that coastal resources are effectively protected in light of changing circumstances, such as new information and changing development pressures and impacts, the Commission is required to review each certified LCP at least once every five years.

5.3.3.7 ROLE OF CALIFORNIA BUILDING CODES

As discussed above, and at greater length in *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*, general plans and local building, fire, and other codes must be adopted by all California cities and counties. Special districts do not adopt such plans or codes but are generally obligated to follow those of the city or unincorporated area in which they are located.

The California Code of Regulations, Title 24, Parts 2 through 11 contain the California Building Code (CBC), California Residential Code (CRC), California Electrical Code CEC), California Mechanical Code (CMC), California Plumbing Code (CPC), California Energy Code, California Historical Building Code (CHBC), California Fire Code (CFC), California Existing Building Code (CEBC) and the California Green Buildings Standards (CALGreen) Code.

The California Building Code (CBC) contains general building design and construction requirements relating to fire and life safety, structural safety, and access compliance. It also provides references to energy conservation and green building standards. The CBC is a comprehensive code, providing minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all buildings and structures and certain equipment.

California adopts the most recently published International Building Residential and Fire Codes, Uniform Plumbing and Mechanical Codes, and National Electric Code, with proposed California amendments to ensure they are in compliance with new or changing laws and regulations for adoption in California. The CALGreen Code and the California Energy Code are among the leading U.S. codes related to green building standards and energy conservation. Title 24, Part 8 of the California Historical Building Code (CHBC) contains regulations of the State Historical Building Safety Board and contains alternative solutions for the preservation of qualified historical buildings or properties, to provide access for persons with disabilities, to provide a cost-effective approach to preservation, and to provide for the reasonable safety of the occupants or users. The California Building Standards Commission (CBSC) adopts residential and non-residential standards and certain provisions of Title 24, Part 10, the California Existing Building Code, Appendix Chapter A1, Seismic Strengthening Provisions for Unreinforced Masonry Bearing Wall Buildings and Appendix Chapter A3 Prescriptive Provisions for Seismic Strengthening of Cripple Walls and Sill Plate Anchorage of Light, Wood-Frame Residential Buildings. Title 24, Part 9 addresses fire provisions for life safety. Title 24 Part 11—the CALGreen Code addresses—green building standards. Title 24 Part 6—the California Energy Code—contains energy conservation standards applicable to residential and non-residential buildings throughout California, including schools. Lake, Kern, Marin, and Ventura counties have also adopted the International Urban-Wildland Interface Code.

Building and fire codes adopted under the state's laws have created a solid foundation for mitigating impacts of floods, fire, earthquakes, and other natural hazards in new development.

Temporary Modifications to Building Codes to Aid Post-Disaster Emergency Housing

Several recent natural disasters, including fires, floods, and mudflows, as well as a homeless population stemming from social, economic, or other circumstances have exacerbated the lack of affordable housing in California by either destroying house or rendering it unoccupiable. Additionally, the process of designing and constructing a building in full compliance with the requirements of the 2016 California Building Standards Code for the purpose of housing victims of a declared emergency is time-consuming and costly.

Local jurisdictions often must establish and approve emergency housing in a very short timeframe; however, they also need to ensure that the housing provided is durable and safe. Relying on the code is the routine process for permitting and approving residential housing. However, there are options for housing that are available, but not recognized in the code. These housing options may provide a quick, cost-effective, and safe shelter permanently or on a temporary basis. According the California Department of Housing and Community Development (HCD), there are options for housing that are available, but not recognized in the building code.

Under certain post-disaster conditions, building codes may be temporarily modified to allow for more rapid construction of emergency housing. An example of this is the April 2018 adoption of emergency regulations for emergency housing following the wildfires, floods, and mudflows disasters in 2017 and early 2018. These emergency regulations will be effective for a six-month period but may be considered for renewal.

Chapter 786, Statutes of 2017 (AB 932) directs the California Department of Housing and Community Development (HCD) to review and approve draft ordinances from seven local jurisdictions to ensure that they address minimum health and safety standards. This legislation became effective January 1, 2018, and there were no building standards available to specifically address emergency housing. In order to provide a consistent minimum standard by which local agencies may develop emergency housing or shelter ordinances, HCD, prepared emergency regulations for review and adoption by the California Building Standards Commission (CBSC) at its April 18, 2016 meeting.

The emergency regulations will be effective for a six-month period ending October 15, 2018 and must be readopted to remain in effect after the expiration date. HCD anticipates at least one 90-day re-adoption.

Applicable Regulatory Agencies

Building and fire codes are locally enforced by city and county staff, including building inspectors, fire department personnel, and sometimes law enforcement officers. Cities and counties review detailed plans for new construction for conformance with California building, residential fire, electrical, mechanical, plumbing, and green building standards and codes. Local code enforcement agencies arbitrate disputes concerning portions of facilities involved in repairs or upgrades and are tasked with making final decisions on such matters. According to California Health and Safety Code Section 16006, the "enforcement agency" is defined as the agency of a city, city and county, or county responsible for building safety within its jurisdiction. The Division of the State Architect (DSA), within the Department of General Services (DGS), is the review agency for the design and construction of public kindergarten through 12th grade (K-12) school facilities in California and state-owned and state-leased essential services facilities.

Under the National Earthquake Hazards Reduction Program, the California Geological Survey and the U.S. Geological Survey jointly prepare periodic updates of the seismic zone maps for inclusion in the earthquake provisions for model building codes. These agencies operate strong-motion programs that record and analyze the response of engineered structures during earthquakes that form a basis for improved building codes.

Other state agencies with code development and/or regulatory authority include the Office of Statewide Health Planning and Development for hospitals, the Department of Housing and Community Development for mobile homes, the Department of Water Resources for construction in areas protected by the facilities of the Central Valley Flood Protection Plan, the State Lands Commission for engineering standards for marine oil terminals, and the Building Standards Commission.

Applicable State Building Codes

For new and existing buildings, state and local governments enforce the California Code of Regulations, Title 24, California Building Standards Code which includes earthquake safety provisions. Local government building departments use the 2016 California Building Code which will be superseded by the 2019 California Building Code that will take effect in January 2020.

Previously, the California Building Standards Commission adopted the Prescriptive Provisions for Seismic Strengthening of Cripple Walls and Sill Plate Anchorage of Light Wood-Frame Residential Buildings into the California Existing Building Code. This action has helped guide seismic retrofitting of existing homes in a systematic manner.

School seismic safety is addressed by California building codes. In 1933, California passed the Field Act to ensure seismic safety in new public schools. The Field Act establishes regulations for the design and construction of K-12 and community college buildings. The Division of the State Architect (DSA) within the Department of General Services (DGS) enforces the Field Act. The Field Act requires all new school building construction to be designed based on high level building standards adopted by the state; along with plans and specifications prepared by state-registered designers. Assembly Bill 300, enacted 1999, required DGS to survey all public school K-12 buildings in the state for seismic safety issues.

Applicable State Fire Codes

Updated fire codes developed to increase fire resistance in buildings and homes across California took effect in January 2011. The codes, which are enforced by CAL FIRE's Office of the State Fire Marshal (OSFM) and fire and building departments throughout the state, bring California in line with the 2012 International Building, Fire, and Residential Code. The new codes were adopted by the California Building Standards Commission and will increase fire safety and awareness in communities throughout California. A portion of the newly adopted codes focuses on regulations for homes built in the wildland-urban interface in order to make them more ember resistant, increasing structure survivability. Additional amendments relate to tire storage, dry cleaning, and automatic extinguishing systems.

A key component in the 2013 fire code adoption is the addition of requirements for residential fire sprinklers in all new one- and two-family and townhome construction projects. For many years, installation of fire sprinkler systems has only been required in office buildings and multi-family dwellings, like apartments. These sprinkler systems are proven to save lives and extinguish fires. More than 100 jurisdictions in California already have a local residential fire sprinkler ordinance.

For more information about fire and building codes, visit the CAL FIRE – OSFM website: http://osfm.fire.ca.gov.

Local fire safety requirements are governed by state laws established through the legislature and administered through the State Fire Marshal and CAL FIRE, depending upon location. Fire safety enforcement is an important part of local hazard mitigation.

5.3.4 GUIDE TO COMMUNITY PLANNING AND HAZARD MITIGATION

The purpose of this section is to provide general information about community planning to the emergency management community. It highlights the numerous components of community planning that help protect communities from hazards and mitigate their impacts.

In California, community planning is required and offers opportunities for managing hazards at the local level. Community planning tools include general plans, building codes, and development project reviews as well as infrastructure development. In addition, the planning process offers opportunities for input from the public and members of the emergency management community such as fire departments. This section identifies those opportunities so that members of the emergency management community can more actively engage in community planning to further promote hazard mitigation and resilience within their communities.

This section contains summaries of state laws and codes that apply to both community planning and emergency management functions. The section focuses on pre-disaster and post-disaster hazard mitigation as the main emergency management function in which community planning plays a significant role. The section also examines the connection between federal and state laws regarding hazards management. For more detailed information on many of the laws described here, see *Annex 1, Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

5.3.4.1 WHAT IS COMMUNITY PLANNING?

Community planning is a process by which local governments and citizens determine the long-term development pattern of a community in terms of land use, housing, infrastructure, open space, and protection of natural and cultural resources. Decision-makers determine what will be built, where it will be located, and what function it will serve. As described further below, in California, general plans are the vehicle used to outline the policies and regulations for land use decisions at the local level.

Five major dimensions provide the foundation for the community planning process: design, laws and regulations, environmental analysis, socioeconomic analysis, and political approval. These five dimensions are connected and interdependent, forming a comprehensive and symbiotic relationship.

Community and land use planning is a complex system of processes and regulations that assist local governments in meeting challenges in their communities. These processes and regulations also include components that help protect communities from hazards. Among the most important of these components are the general plan law, the Subdivision Map Act, environmental review, and building codes. Knowledge of these tools can help emergency managers and planners understand how community planning can be used to create safer and more resilient communities.

Design

Design focuses on the physical layout of the community or a specific development project. Design includes site planning and urban design of buildings. At the community level, many design guidelines and policies are implemented through general plans. When specific development projects are proposed, the design is assessed based on the policies established in the general plan.

Laws and Regulations

Laws and regulations provide the regulatory framework that shapes the planning process. These are primarily state and local, but in some cases federal laws and regulations apply to community planning as well.

Environmental Analysis

A major dimension of the planning process in California is environmental analysis, due in part to state and federal laws and regulations intended to ensure environmental protection. In community planning, environmental analyses are performed to determine the impact that a plan or development project will have on the environment. These analyses include assessments of the potential for exposure of people or property to environmental conditions such as natural hazards.

Socioeconomic Analysis

Socioeconomic analyses fulfill a vital need for community planning. The analyses examine the social structure of the community and the impact that a proposed plan or development will have on it. Another feature of these analyses is assessment of the community's fiscal health and the effects of proposed plans or developments on fiscal conditions. In addition, such analyses often include a comprehensive assessment of the regional economy. Plans and projects are likely to affect not only the specific community, but also surrounding communities with potential changes in transportation systems, housing, and jobs.

Political Approval

Community planning is a process embedded in the political system and guided largely by state laws as well as the U.S. Constitution. As proposed plans and development projects go through the planning process, there are numerous opportunities for public input. The final step is approval or denial of the plan or project by the elected board for the community (e.g., city council, board of supervisors). Therefore, political support (or lack of objection) from the public and elected officials is critical for proposed plans and projects to be approved.

5.3.4.2 ROLE OF COMMUNITY PLANNING IN EMERGENCY MANAGEMENT

Community planning is important for several reasons. The political, social, economic, and physical environment surrounding communities is continually changing. One of the largest aspects of this change is population growth. Other shifts include changes in demographics, transportation systems, regional economy, political climate, and landscapes. Each of these changes creates burdens and challenges for land use, and community planning is the system in place for managing these challenges.

As the population of California continues to grow, the demand for new housing and public services will increase. This places pressures on communities to provide space to accommodate this growth. One of the most pressing challenges today is that land availability for outward expansion has dramatically decreased over time.

There are two primary ways that communities can provide space for the new growth. Over the past five decades, the most common answer was to expand outward, creating urban sprawl. This approach can force people much farther away from job centers, require more extensive transportation systems, and push development into hazardous areas such as floodplains and areas of high fire hazard. The other alternative is for communities to renovate built areas to increase density. Often this means tearing down older neighborhoods and placing taller or more expansive buildings in their place, a form of redevelopment that commonly called infill development.

The challenge of limited land availability is further complicated by natural hazards. Communities may be pressured into developing areas that are more hazardous, including areas vulnerable to wildfires, earthquakes, landslides, and floods. Placing new developments in these areas can increase the dangers to people and property while also placing more burdens on public safety officials to protect them. In many communities, development has already occurred in hazardous areas. Examples include cities in the San Francisco Bay and Los Angeles metropolitan areas that are at substantial risk of earthquakes. Increasing density within these and other hazardous areas increases the population and property that are subject to hazards. These are the kinds of decisions community leaders will need to consider when determining the future of their communities.

Community planning can have a profound impact on how cities and counties use the land within their jurisdictions. One of the most effective ways to reduce or minimize the impacts of hazards is to responsibly develop land in hazardous areas. Designing communities so that most new development is located in non-hazardous areas can significantly reduce future costs of disasters. Improving building codes and adopting these codes as the standards for new and existing construction can also increase the resilience of built structures within the community. Determining what can be built and at what intensity can increase or decrease risks.

5.3.4.3 KEY PARTICIPANTS

In community planning, multiple participants are involved at different stages in the process. Some participants are involved through most of the process, while others may only have specific roles at specific stages. The following is a summary of the key participants in community planning.

Local Governments

Elected Officials

Local elected officials primarily include city councils and county boards of supervisors. These boards and councils act as the state-mandated legislative bodies. City councils and county boards of supervisors have two discretionary roles, legislative and quasi-judicial. Legislative acts include creating local laws and making policy decisions. In community planning, these acts include zoning ordinance changes and general plan revisions. Quasi-judicial acts include actions on appeals of decisions made by the planning commission, which include the approval or denial of conditional use permits or zoning variances.

Another important role of city councils and boards of supervisors is to appoint the members of the local planning commission. Proposed projects and plans are brought before the planning commission for approval or denial. Traditionally, the planning staff will provide a presentation of the proposed project to the commission along with a

recommendation for approval or denial. After the recommendation is heard, a representative of the project is invited to speak on behalf of the development. Since the planning commission meetings are an open forum, time is also allotted for the public to present comments. Thus, the planning commission is presented with different views and can make a decision on the project after consideration of these opinions. For projects that could potentially lead to increased risks to people and property, members of the emergency management community are encouraged to participate in the approval process and present comments at public meetings.

Planning Agencies

Local planning agencies include the planning director who oversees the planning agency and the staff who work within the planning agency. Local planning staffs are tasked with a variety of planning responsibilities that include reviewing proposed developments, processing building permits, and enforcing codes. In each of these tasks, the staff work with developers and members of the public involved. For example, if corrections are needed in a building permit, the staff will work with the applicant to make the corrections before submitting the permit application for approval. Staff similarly may work with developers on proposed projects to ensure consistency with the general plan and state and local regulations.

How involved the staff is in working with the public or with emergency management agencies can vary greatly. For example, if the developer feels that the staff is against the proposal, they may seek approval before the planning commission with minimal consultation with staff or changes to the proposed project. In either case, it is up to planning staff to recommend to the planning commission that a project be approved or denied and explain why the staff selected this recommendation.

Special Interests

Special interest groups serve a variety of functions in the planning process. One of the most common is the watchdog function. These groups are involved because they have a vested interest in the planning process or the effects of the planning. Examples include neighborhood or citizen groups who wish to preserve the interests of their community. Environmental groups often are heavily involved since development will one way or another affect the environment. Other interest groups involved in local public planning include the local business community, the private real estate industry, and the agriculture industry. Reasons for their involvement vary as much as the nature of each organization. Sometimes a group is involved merely to protect its interests; other times, it may seek to stop a development from going forward.

Private Real Estate and Development Industry

Private real estate interests are the movers and shakers in the public planning process. They own the land, develop the projects, and provide the financial capital for construction and completion. There are six key players in the real estate industry: landowners, developers, builders, lenders, investors, and homebuyers.

Landowners

Landowners are the people who own the property that is influenced by the planning process. Often, these individuals are passive participants in the process. This means that they are not directly involved in the development of zoning ordinances, development projects, or site plans. Planners may hold charrettes or other public meetings to incorporate input and ideas from landowners and the public, but this is not always the case. When plans, ordinances, and development projects come before a public body such as the planning commission or city council, the public has a right to present their views and opinions of the proposals. It is in this role that landowners may be most involved in the planning process.

Developers

Developers often do not own the property that they are trying to develop. Instead, they enter into partnerships with landowners or other investors to develop the land. They are the participants who create the development plans, such as parcel maps and site plans, and present them for approval. Developers work with planning staffs to

ensure that the plans are consistent with the general plan and applicable laws and regulations. The size of development companies can vary greatly, from one person to large organizations.

Builders

When approval for a project is granted, developers will often sell the site or pieces of it to builders who are responsible for construction. In some cases, building companies that are large enough may also act as the developer. In this case, they can ensure that the project will be built to their wishes. In larger subdivision and neighborhood projects, it is common for a single builder to construct the development in phases.

Investors and Lenders

Without financial capital, many of the projects that are proposed could never be built. Even before construction begins, there are several steps to the development process that can involve costs. Fees for applications, permits, and environmental impact reviews can be costly, especially for larger projects.

Investors and lenders look at development as business investments. They are willing to take on risk if they believe the investment will yield a profitable return in the future.

For risky projects, it may be difficult to find investors and lenders willing to provide the needed financial capital. In order to help protect their investment, lenders and investors may place demands or requirements on the development in return for their capital. Examples could include requiring a minimum number and size of homes in the subdivision, or requiring that commercial space be included. These requirements can sometimes significantly change the outcome of the development, highlighting the important role investors and lenders have in the planning process.

Home Buyers

Following completion of a residential project, new homes in residential developments are marketed to potential home buyers.

State Government

The state government of California has been actively involved in community planning since the late 1800s, when the state legislature passed some of the earliest planning laws in the nation. As the state experienced increased growth in the decades since, the role of state government in community planning has also increased. The following subsections provide a brief summary of the role of state legislature and state agencies in community planning.

Legislature

The state legislature in California has a very powerful role in shaping planning and hazard mitigation at the local level. As early as 1893 when it passed the predecessor to the Subdivision Map Act, the California legislature has been involved in developing the framework for local planning decisions and regulations. In addition to the Subdivision Map Act, other examples include the Community Redevelopment Law and the California Environmental Quality Act (CEQA). California does not have a single law that provides all of the guidelines for local planning. Rather, the state operates according to a complex system of multiple laws and policies adopted over the past several decades. Many of these have been amended and changed over time.

Courts

In California, the courts are involved in planning primarily through litigation. Cases are divided into two types, constitutional and statutory. In constitutional cases, a landowner may sue if he or she believes that his or her constitutional rights had been violated. Examples could include instances in which a landowner believes that an ordinance has created undue hardships or that he or she has not been equally protected under the law. Statutory cases involve a plaintiff arguing that a state or federal law has been violated. This is common in California, with interest groups or homeowners suing if there are believed to be inconsistencies between zoning ordinances and general plans, or if an environmental review was not performed for a project under the California Environmental

Quality Act (CEQA) when the plaintiff believes it should have been. In either case, the courts can have an influential role by interpreting and determining the legality of laws and ordinances. Often, the courts may rule only on small sections or a technicality.

Agencies

Numerous state agencies are involved in or influence planning in cities and counties, as shown in Table 5.L. These agencies fall into three broad categories: development and infrastructure agencies, conservation agencies, and regional agencies.

Development and infrastructure agencies are involved in the construction of buildings and infrastructure in California. These agencies have a wide variety of functions, ranging from managing state-owned infrastructure to enforcing development regulations, laws, and codes. These agencies include the California Department of Transportation (Caltrans), the Department of Water Resources (DWR), the Department of Housing and Community Development (HCD), and the Department of General Services (DGS).

Agencies involved in conservation that affects community planning include the Department of Fish and Wildlife, the Department of Forestry and Fire Protection (CAL FIRE), the Department of Conservation, and the Department of Parks and Recreation. They are tasked with protecting and conserving natural resources by enforcing laws and regulations or are involved in land use decisions that affect state-owned land. Most of these agencies are within the California Natural Resources Agency.

There are four regional state agencies in California: the Coastal Commission, the San Francisco Bay Conservation and Development Commission (BCDC), the Tahoe Regional Planning Agency (TRPA), and the Delta Protection Commission. Each is involved with land use and development issues in their regions. Nevada is also a partner in TRPA since Lake Tahoe is partially within the state of Nevada.

Table 5.L: State Agencies Involved in Community Planning

State Agency	Role in Community Planning	Related Laws
California Department of Transportation (Caltrans)	Constructs and maintains the state highway system	
Department of Water Resources	Oversees the State Water Project	
Department of Housing and Community Development	Provides funding for affordable housing; approves housing elements	
Department of General Services	Manages the state's real estate and facility planning	
Department of Fish and Wildlife	Enforces the California Endangered Species Act; manages land reserved for wildlife	California Endangered Species Act
California Department of Forestry and Fire Protection (CAL FIRE)	Influences subdivision planning in forested communities	
Department of Conservation	Preserves agriculture land through the Williamson Act; oversees mining operations	Williamson Act; Surface Mining and Reclamation Act
Department of Parks and Recreation	Participates in land use activities that affect state parks	
Coastal Commission	Review for consistency with the California Coastal Act the planning, permitting, and conservation activities of local governments along the California coast.	California Coastal Act; Coastal Zone Management Act

State Agency	Role in Community Planning	Related Laws
San Francisco Bay Conservation and Development Commission	Regulates bay fill and waterfront development along San Francisco Bay	
Tahoe Regional Planning Agency	Influences land use planning and development in the Lake Tahoe area	
Delta Protection Commission	Influences land use and development in the Delta region	Delta Protection Act

Federal Government

The federal government is involved in community planning and hazards management through multiple means. These include federal laws passed by the United States Congress and functions within several federal agencies. The following subsections provide a summary of the federal role in community planning.

U.S. Congress

Article X of the U.S. Constitution declares that powers not delegated to the federal government in the Constitution are reserved for the states. One of those powers is the ability to control land use decisions. As a result, Congress has not directly been involved in governing land use at the state and local levels. However, Congress has been involved in related issues such as transportation and environmental protection. The reason for this is that these issues transcend political boundaries and affect larger regions or the nation as a whole. Examples include the federal National Environmental Policy Act, Clean Water Act, Clean Air Act, Coastal Zone Management Act, and Federal-Aid Highway Act. For a summary of federal legislation that influences planning and hazard mitigation, see *Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*.

Agencies

The role of federal agencies in community planning focuses on enforcing federal laws, managing federally owned property, and providing financing for community development projects. See Table 5.M for roles of federal agencies in community planning. Federal development agencies include the Bureau of Reclamation, U.S. Department of Transportation (US DOT), Department of Housing and Urban Development (HUD), General Services Administration, and Department of Defense (DOD). Federal conservation agencies include the Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers (USACE), Bureau of Land Management, and U.S. Forest Service.

Table 5.M: Federal Agencies Involved in Community Planning

Federal Agency	Role in Community Planning	Related Laws
Bureau of Reclamation	Building and maintaining water systems; dams; Central Valley Project	
U.S. Department of Transportation (US DOT)	Funding highway and transportation projects	
Department of Housing and Urban Development (HUD)	Subsidizing public housing; administering Community Development Block Grants (CDBGs)	Stafford Act
General Services Administration	Leasing and real estate activities of federal government	
Department of Defense (DOD)	Operating defense installations; redeveloping closed bases	
Environmental Protection Agency (EPA)	Regulating federal environmental protection laws	Clean Air Act, National Environmental Policy Act
U.S. Fish and Wildlife Service	Regulating sensitive habitats for endangered species	Endangered Species Act

Federal Agency	Role in Community Planning	Related Laws
U.S. Army Corps of Engineers (USACE)	Owning/operating dams and regulating wetlands	Clean Water Act
Bureau of Land Management	Managing large areas of desert and mountain areas in California	
U.S. Forest Service	Conserving land conservation and managing resources in national forests	

5.3.4.4 THE CALIFORNIA ENVIRONMENTAL QUALITY ACT

The California Environmental Quality Act (CEQA) was passed in 1970 and since that time has evolved into one of the most prominent components of community planning in California. CEQA applies to discretionary actions, such as a development proposal or general plan amendment.

CEQA has four mandated functions: informing decision-makers about environmental impacts, identifying activities that can mitigate the impact, preventing damage to the environment, and disclosing reasons for approving the discretionary action if it will cause environmental degradation. Through the CEQA process, decision-makers are informed of the natural hazards at proposed development locations and the impacts these hazards may have on people and property.

Overview of Process

State CEQA guidelines mandate a three-step process for local governments to follow. The first step is to determine if the discretionary action qualifies as a project under CEQA. If the project does not fall under the allowed exemptions and is not discretionary, then the project does not have to continue in the CEQA process. If the project does not fall under either of these qualifications, then an initial study must be performed. The initial study will assess the project to determine if it may have a significant impact on the environment. If so, then an environmental impact report (EIR) must be prepared.

One exemption from the CEQA process is for the reconstruction or restoration of damaged or deteriorated buildings or structures to meet current public safety standards. This exemption has been applied, for example, to the strengthening and improvement of levees along the Sacramento and San Joaquin Rivers and in the Delta region. Because of this exemption, these projects were not subject to further steps in the CEQA process.

Environmental Impact Reports

The environmental impact report (EIR) is a comprehensive and detailed report explaining the potential environmental impacts of a project. The planning agency is responsible for overseeing the preparation of the EIR. Given their complexity and amount of time required to complete EIRs, a consultant is often brought in to assist. The consultant can be hired by the developer directly or be selected and overseen by the planning agency. Either way, the costs for preparing the EIR are passed on to the developer. Once an EIR is prepared, it is up to the planning agency to adopt the findings. Depending on the size and complexity of the discretionary action, an EIR can take up to 12 months to prepare and cost several hundred thousand dollars.

5.3.4.5 GENERAL PLAN IMPLEMENTATION

General plan development is just the first significant phase in community planning. The next phase is to implement the general plan. The following sections discuss the tools and processes that are involved in achieving the goals and objectives set by the general plan.

Zoning

Zoning is one of the methods communities use to achieve the goals and objectives of the general plan.

Government Code Section 65850 establishes the legal authority for cities and counties in California to enact zoning ordinances. A community's zoning ordinance places land into a variety of use categories, known as zones. Examples of zones include residential, commercial, public facility, industrial, open space, and agriculture. It is common to find different types of zones for each land use category; for example, residential zones may include single-family, multi-family, and rural. For each zone, the zoning ordinance establishes building requirements, including restrictions on the range of uses allowed, limits on building size and type, requirements for building setbacks (how far a built structure must be from the property lines), and minimum parcel sizes.

In addition to regulating land use, zoning has other functions that relate to hazard management, as summarized below.

Hazard Overlay Zones

Overlay zones establish additional regulations beyond those established by the base zoning of a property. Generally, they are used to help resolve issues that typical zoning classifications do not address.

Hazard overlay zones address risks created by a defined hazard. Common sources of overlay zone mapping include Special Flood Hazard Areas (SFHAs), Fire Hazard Severity Zones (FHSZs), and seismic/geologic hazard zones. The purpose of these zones is to identify the location of the hazards and their potential risks to the community.

Restrictions on development and land use are developed locally for each hazard overlay zone. Local governments can use hazard overlay zones to implement mitigation strategies of their Local Hazard Mitigation Plans (LHMPs).

Zoning Changes

Landowners who wish to develop or build on their property may be restricted because of its current zoning. For example, land zoned for agriculture may have minimum lot size requirements and restrictions on how many houses can be built. In these cases, the landowner could request a zoning change. Local legislative bodies such as city councils and boards of supervisors have the authority to change zoning on parcels. This means that the zoning change request is brought before a public meeting where anyone can comment on the proposed change. Significant opposition to a zoning change from the public could sway the council or board to deny the change. Any changes in zoning must be consistent with the general plan and other requirements placed on that property. Otherwise, the change may be challenged in court as illegal.

Variances

A variance allows variation from a standard zoning requirement. California law does not allow variances from the permitted land uses specified by zoning, but it does allow variances from other zoning requirements if certain conditions are met. An example would be a variance from standard building setback requirements on a lot on which a geologic obstruction, such as a fault zone or landslide, would prohibit construction of a home that complies with the standard requirements.

Usually variances are only granted if it is proven that compliance with the standard zoning requirements would create a hardship for the landowner. In the case of the geologic obstruction, being forced to build a much smaller house or no house at all could reasonably be considered a hardship for the landowner.

Site Plan Review

A local planning agency reviews proposed site plans to confirm that they comply with zoning requirements. Site plan review offers the planning staff the opportunity to apply lessons learned from previous disasters to proposed new development. This could include assessing drainage, vegetation landscaping, building design and locations, soil integrity, and adequate access.

Down-Zoning

Down-zoning refers to a zoning change in which the range or density of allowable uses has been decreased. For example, if the zoning of a parcel is changed so that the allowed number of housing units per acre or other building density is decreased, then the parcel has been down-zoned. This is a relatively common practice and is sometimes necessary to make zoning consistent with the general plan as required by state law. In the 1980s, for example, the City of Los Angeles down-zoned approximately one-third of the city in order to achieve consistency with the general plan.

Challenges of down-zoning include the consequences it has for the landowner. Decreasing the potential density of a parcel can decrease the economic value to the landowner. Landowners are quite sensitive to losing property value and have challenged down-zonings in court as "regulatory takings." Supreme Court rulings of the past several decades have established guidance for local governments in determining the extent to which properties can be reasonably down-zoned.

Specific Plans

California Government Code Section 65450 establishes the legal authority for specific plans, stating that a specific plan may be used to implement the general plan in a certain area. Specific plans are created when unique development standards may be needed for a project site. While general plans must meet specific mandated requirements, specific plans are subject to more general legal guidance. This flexibility allows specific plans to establish zoning and other development standards appropriate for the development project.

Specific plans are required by law to be consistent with general plans. According to Government Code Section 65455, all zoning ordinances, tentative subdivision maps, parcel maps, and public works projects in an area subject to a specific plan must be consistent with the specific plan.

Subdivision Map Act

The Subdivision Map Act (Map Act) is the overarching law for development of subdivisions in California. The first version of Map Act was written in 1907, making it one of the oldest planning laws in California and in the United States. It was written in response to rapid growth in California at the time and provides a process for local governments to follow in order to grow responsibly.

The Map Act has been amended several times during its history, and at present provides authority to local governments to regulate proposed subdivisions within their jurisdiction. Local procedures under the Map Act are uniform and applied statewide. Subdivisions are defined as having more than four lots and are required to include a map that shows approximately what the subdivision would look like if completed.

A key requirement of the Map Act is that a city or county must deny any tentative subdivision map if the map, design, or improvements are inconsistent with the general plan or any applicable specific plan. Thus, if a general plan contains requirements to protect communities from hazards, any subdivision must follow these requirements. For example, a general plan may include policies requiring that subdivisions have adequate water supply for fire suppression, multiple access points, and building design that protects people from earthquakes, fires, and floods.

These provisions are further strengthened by the stipulation that a city or county must deny any tentative subdivision map if the design or improvements are likely to cause environmental damage, substantially and avoidably injure fish or wildlife or their habitat, or cause public health problems. This language provides a basis for linking natural hazards to environmental damage and public health, thereby giving city and county planners the ability to deny or modify maps not meeting these criteria.

Unreinforced Masonry Building Act

In 1986, the California legislature enacted the Unreinforced Masonry Building Act. This law requires that local governments identify every building that has unreinforced masonry (URM) located within a Seismic Zone 4. Once

the buildings are identified, local governments must develop and submit to the state a plan for reducing URM loss during a seismic event. This plan should provide for retrofitting or removing URM buildings. California has forbidden the construction of URM buildings since 1933; however, there are still over 22,000 of these buildings in the state.

As of 2006, approximately 70 percent of all URM buildings in California had been retrofitted. In Los Angeles and Orange Counties, the percentage is 87 percent and 89 percent, respectively. San Francisco has retrofitted 86 percent of all URM buildings. As of 2015, some cities, such as Berkeley have achieved URM retrofit progress in over 90 percent of their URM buildings.

Capital Improvement Programs

Communities are far more than just land and buildings. Capital improvements, also called infrastructure or public works, play a critical role in the health of communities and include transportation, water, power, and sewage systems. These systems form the lifelines of communities; without functioning and efficient infrastructure, the communities would rapidly decline. Capital improvements must be maintained and modernized to continue to meet the needs and demands of the community.

Local jurisdictions typically maintain ongoing capital improvement programs. All capital improvement programs are required to be consistent with the general plan of the community. New development often requires construction of capital improvements. Examples include transportation improvements, such as parking and new roads, and expansion of water and sewer services. Local governments can require developers to build these improvements or levy fees on the development project that will help fund the improvements.

After a disaster, one of the critical functions for short-term recovery is to rebuild and restore critical infrastructure and key resources within the community. This can involve reconstruction of many, if not all, of the same systems that are included within capital improvement programs. Thus, one of the keys to community resilience is to ensure that the infrastructure is built to promote public safety after a disaster. One example is requiring that new development have wider roads and multiple access points to facilitate evacuation and response operations.

Land Acquisition

Local government can buy all or part of a property from a landowner to benefit the community. Examples include land acquired to allow road widening, construction of new roads and freeways, or sale to developers for redevelopment.

Land acquisitions have increasingly been used as tool for hazard mitigation, primarily because they are extremely effective at reducing risk within communities. In California, land acquisitions have been used for property susceptible to landslides and other geologic and seismic hazards.

Most buyouts occur after a disaster or after repeated events on the property. This is largely because land acquisition is the most expensive form of hazard mitigation, and sufficient funds are usually not available until after a disaster has been declared.

Land Conservancies

Supplementing local governments are other quasi-public organizations undertaking hazard mitigation and environmental protection functions. Land conservancies can become land holders with the goal of preserving the natural environment, which may also have hazard mitigation benefits. Land with flood or geologic hazard issues may be kept out of development through the purchase of the land for open space or purchase of the land's development rights. For example, federally sponsored resource conservation districts perform such functions. The Nature Conservancy is a land conservancy that has worked on more than 100 projects and preserves in California since its founding in 1958, although many of its projects are now managed by other organizations.[95]

[95] http://nature.org/wherewework/northamerica/states/california/preserves/

CHAPTER 6 – EARTHQUAKES AND GEOLOGIC HAZARDS: RISKS AND MITIGATION

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About Chapter 6

Chapter 6 assesses earthquake and geologic hazards. Earthquake is considered one of the three primary hazards, as explained in the State Hazard Mitigation Plan (SHMP) Chapter 1. This chapter discusses hazards from earthquakes; landslides and other earth movements, and volcanoes.

For more information on the criteria and template used for hazard risk assessments and a discussion of the hazard classification system, see *Chapter 1: Introduction, Section 1.2.3*.

6.1 EARTHQUAKE HAZARDS, VULNERABILITY, AND RISK ASSESSMENT

This section addresses earthquakes as one of three primary hazards noted in the classification system introduced in *Chapter 1: Introduction, Section, 1.2 Plan Overview*. This risk analysis includes information identifying the following dimensions of this hazard:

- Overview of earthquake hazard
- Locations within the state (i.e., geographic areas) that are affected
- Previous occurrences within the state and the probability of future events (i.e., chances of recurrence)
- Seismic vulnerability and loss assessment efforts
- Current and future seismic mitigation efforts

6.1.1 IDENTIFYING EARTHQUAKE HAZARDS

Overview

Earthquakes represent the most destructive source of hazards, risk, and vulnerability, both in terms of recent state history and the probability of future destruction of greater magnitudes than previously recorded.

Earthquakes are a significant concern for California for several reasons. First, California has a chronic and destructive earthquake history. Second, California has widespread earthquake vulnerability as indicated by California Geological Survey (CGS) mapping of potential earthquake shaking intensity zones, with these zones commonly located near populated areas. Third, nearly all local governments that have submitted Local Hazard Mitigation Plans (LHMPs) have identified earthquakes as a hazard of importance.

In addition to shaking, buildings are also vulnerable to ground displacements associated with primary fault rupture, liquefaction, differential settlement, and landslides. Inundations from tsunamis, seiches, and dam failures can also be major sources of loss to buildings and infrastructure.

Causes of Earthquakes: Plate Tectonics

California is seismically active because it sits on the boundary between two of the earth's tectonic plates. Most of the state—everything east of the San Andreas Fault—is on the North American Plate. The cities of Monterey, Santa Barbara, Los Angeles, and San Diego are on the Pacific Plate, which is constantly moving northwest past the North American Plate. The relative rate of movement is about 2 inches (50 millimeters) per year. The San Andreas Fault is considered the boundary between the two plates, although some of the motion (also known as slip) is taken up on faults as far away as central Utah.

There are over 15,000 identified faults in California. Over 200 of these identified faults are considered very dangerous based on their slip rates in recent geological time (the last 10,000 years).[96] More than 70 percent of the state's 40 million people reside within 30 miles of a known fault where strong ground shaking could occur in the next 30 years.

The motion between the Pacific and North American Plates occurs primarily on the faults of the San Andreas system and the eastern California shear zone. Faults are more likely to have future earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve the accumulating tectonic stresses. Nearly all movement between the two plates is on active faults.

The San Andreas Fault is not the only significant fault/plate boundary in California. The seismicity north of Cape Mendocino is controlled by faults associated with the Cascadia Subduction Zone, a large offshore fault system that separates the Juan de Fuca Plate to the west and the North American Plate to the east. This area is the most seismically active portion of the state. The Cascadia Subduction Zone is capable of producing great earthquakes (magnitudes greater than 8.0) and last ruptured in the year 1700, causing what was likely an earthquake in the Magnitude 9.0 range. The subduction zone is also capable of generating a large tsunami.

Earthquake Hazards: Shaking

Overview

Damage due to ground shaking accounts for significant amount of all building losses in typical earthquakes. Building damage can be both structural and/or non-structural (i.e., damage to building contents) and both types of damage can cause injury or loss of life. More than 70 percent of the state's 40 million people reside within 30 miles of a known fault where strong ground shaking could occur in the next 30 years.

Amplification of Seismic Shaking

Although seismic waves radiate from their source like ripples on a pond, the radiation is not uniform due to the complex nature of an earthquake rupture, different paths the waves follow through the earth, and different rock and soil layers near the earth's surface. Large earthquakes begin to rupture at their hypocenter and the fault ruptures outward from that point. Because the speed of an earthquake rupture on a fault is similar to the speed of seismic waves, waves closer to the epicenter can be compounded by waves from farther along the rupture, creating

[96] Uniform Earthquake Rupture Forecast (UCERF 3 – 2014)

a pulse of very strong seismic waves that move along the fault in the direction of the fault rupture. Seismic waves may also be modified as they travel through the earth's crust. Shaking from the 1989 Loma Prieta Earthquake was concentrated to the north, toward San Francisco and Oakland, possibly due to the reflection of seismic waves off the base of the earth's crust.

As seismic waves approach the ground surface, they commonly enter areas of loose soils where the waves travel more slowly. As the waves slow down, their amplitude increases, resulting in larger waves with frequencies that are more likely to damage structures. Waves can also be trapped within soft sediments between the ground surface and deep, hard basement rocks, their destructive energy multiplying as they bounce back and forth producing much greater shaking at the ground surface. The CGS and the U.S. Geological Survey (USGS) recorded large ground waves at many locations during both the Loma Prieta Earthquake and the 1994 Northridge Earthquake. Topography can also affect the local intensity of earthquake shaking. Topographic highs, such as hills and ridges, enhance shaking and topographic lows, such as valleys, lessen shaking. This phenomenon has been observed in many earthquakes, and "topographic amplification" was quite pronounced in the 2003 San Simeon Earthquake where most of the shaking damage to residential structures occurred at the tops of hills.

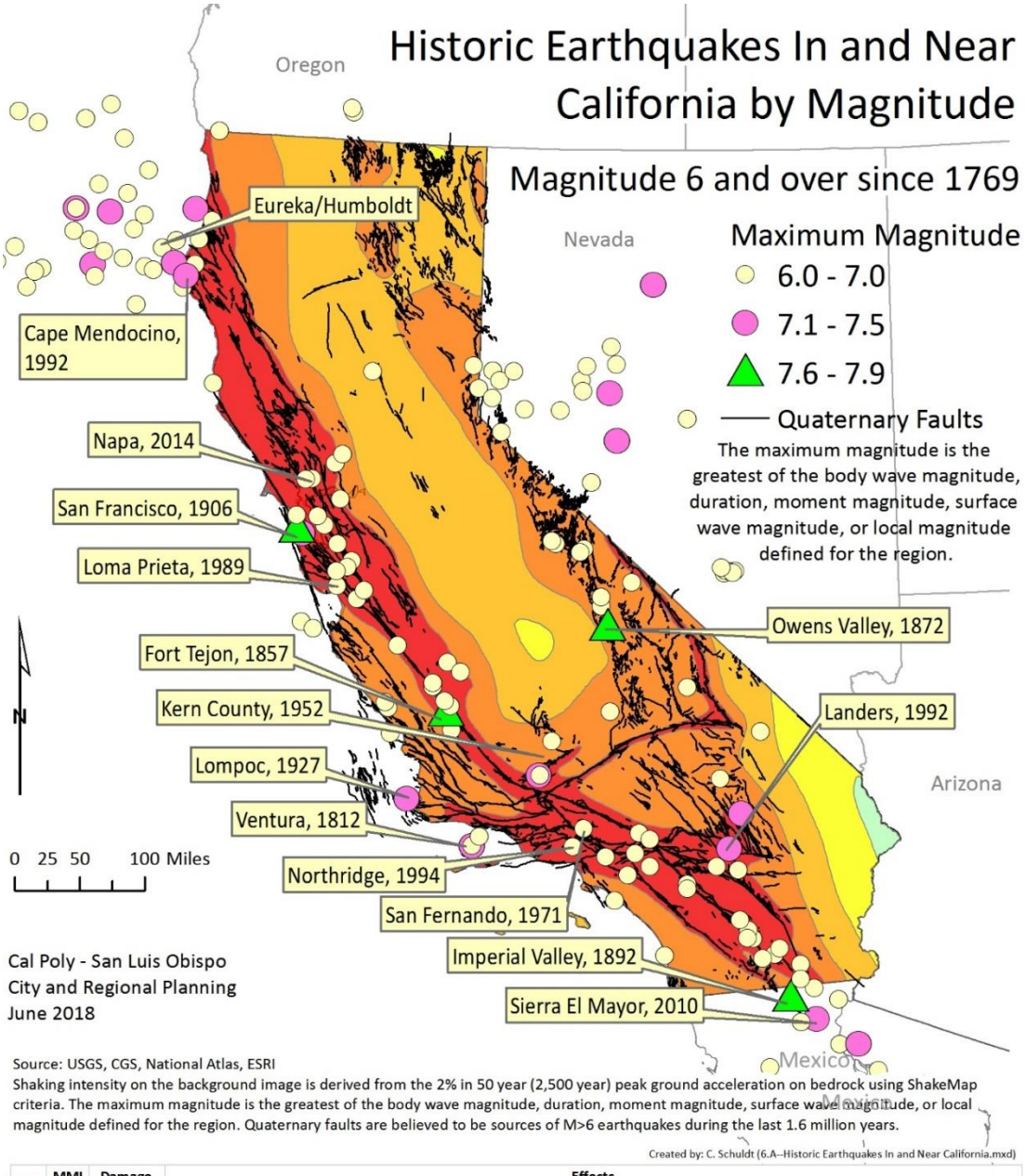
Loma Prieta Earthquake Damage, San Francisco, 1989



Source: U.S .Geological Survey

Unexpectedly large seismic ground waves and their resulting damage may be produced from a relatively distant earthquake. Shaking from the 1999 Hector Mine Earthquake in the Mojave Desert produced seismic waves with amplitudes of up to 15 centimeters in the Los Angeles basin, more than 200 kilometers from the epicenter. While there was little damage from the Hector Mine Earthquake, other large earthquakes have caused damage in distant places. For example, Nevada's 1954 Dixie Valley Earthquake resulted in damage to critical facilities in Sacramento due to water sloshing.

Map 6.A: Historic Earthquakes In and Near California by Magnitude (1769-2017)



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

Map 6.A shows the pattern and selected dates of earthquakes in and near California during the past 240 years.

Earthquake Hazards: Ground Failure

Fissuring, settlement, and permanent horizontal and vertical shifting of the ground often accompany large earthquakes. Although not as pervasive or as costly as the shaking itself, these ground failures can significantly increase damage and under certain circumstances can be the dominant cause of damage. Studies after the 1994 Northridge Earthquake showed that when ground failure was involved, damage to residential dwellings was three to four times greater than average shake damage. Because of their geographic extent, networked infrastructures such as water, power, communication, and transportation lines are particularly vulnerable to ground failures.

Fault Rupture

The sudden sliding of one part of the earth's crust past another releases the vast store of elastic energy in the rocks as an earthquake. The resulting fracture is known as a fault, while the sliding movement of earth on either side of a fault is called fault rupture. Not only is the fault rupture responsible for causing the earthquake and the resulting shaking, when that rupture extends to the earth's surface the displacement can catastrophically damage any structures or utility lines that lie on top or cross it.

Liquefaction

In addition to the primary fault rupture that occurs right along a fault during an earthquake, the ground many miles away can also fail during intense shaking. One common type of failure is liquefaction, which occurs when loose, water-saturated sand is shaken by the earthquake and turns into a fluid-like substance, essentially a "quicksand," causing it to lose the ability to support buildings and other structures. Areas susceptible to liquefaction include places where sandy sediments have been deposited by rivers along their course or by wave action along beaches.

Ground deformation from liquefaction is caused by settlement and/or lateral spreading. Settlement can cause damage when the amount settlement varies significantly across the length of a structure. Lateral spreading occurs when liquefaction occurs on gently sloping ground and the liquefied material at depth allows the area to slide, often toward a vertical discontinuity or "free face" such as a creek or stream channel. Liquefaction can occur in susceptible soils below bodies of water, and settlement and lateral spreading can damage structures built on or adjacent to these areas. Transportation bridges across water bodies, wharves, piers and other structures at ports and harbors, and underwater utility lines can be severely damaged by this hidden hazard.

Landslides

Landslides are the result of the down-slope movement of unstable hillside materials under the influence of gravity. Sudden failure can be triggered by earthquake shaking, excavation of weak slopes, and heavy rainfall, among other factors. Landslides caused by earthquakes can be widespread over the area of highest shaking intensity and also at greater distances if hillsides are in a susceptible condition. Earthquake landslides can significantly damage structures, as well as transportation and utility lifelines, that are located on them or in their downslope paths.

Because landslides often occur without earthquakes, landslide hazards are more thoroughly discussed in a separate section of this chapter, see *Section 6.2*.

Levee Failure

Ground shaking in and around levees resulting from earthquakes 100 kilometers or more away can affect levee performance. The type of foundation the levee is constructed upon (such as peat or alluvium) will influence a levee's performance during a seismic event or under certain static loading conditions *(see Section 7.4, Levee Failure and Safety)*.

Earthquake Hazards: Tsunami

Tsunamis are large waves caused by sudden disturbances in the ocean, usually on the ocean floor. Tsunamis are commonly caused by fault rupture on the ocean floor or by underwater landslides. A separate section of this SHMP addresses this hazard (see *Section 7.3, Tsunami and Seiche Hazards, Vulnerability, and Risk Assessment*).

6.1.2 PROFILING EARTHQUAKE HAZARDS

Recent Earthquake Events

Earthquakes large enough to cause moderate damage to structures—those around Magnitude 5.5—occur three to four times a year in California. For example, the Magnitude 6.5 San Simeon Earthquake of December 22, 2003 caused 2 deaths, 47 injuries, and $263 million in damage. The Magnitude 6.5 Humboldt County Earthquake on January 9, 2010, resulted in zero deaths, 35 injuries, and $43 million dollars in damage. The Magnitude 7.2 El Mayor Cucapah Earthquake (also known as the Sierra El Mayor Earthquake) of April 4, 2010 was located in Northern Baja California at the former mouth of the Colorado River. This event shook not only Mexicali and Tijuana but also a large part of Southern California and parts of southwestern Arizona and Nevada. There were two confirmed deaths in Mexicali and 100 persons were injured between Baja California and Imperial County California. The total estimated damage in Southern California from the El Mayor-Cucapah event was $91 million while the total estimated damage between Southern California and Baja California was estimated to be $1 billion with most of the damage affecting the agriculture industry and irrigation district in Baja California.

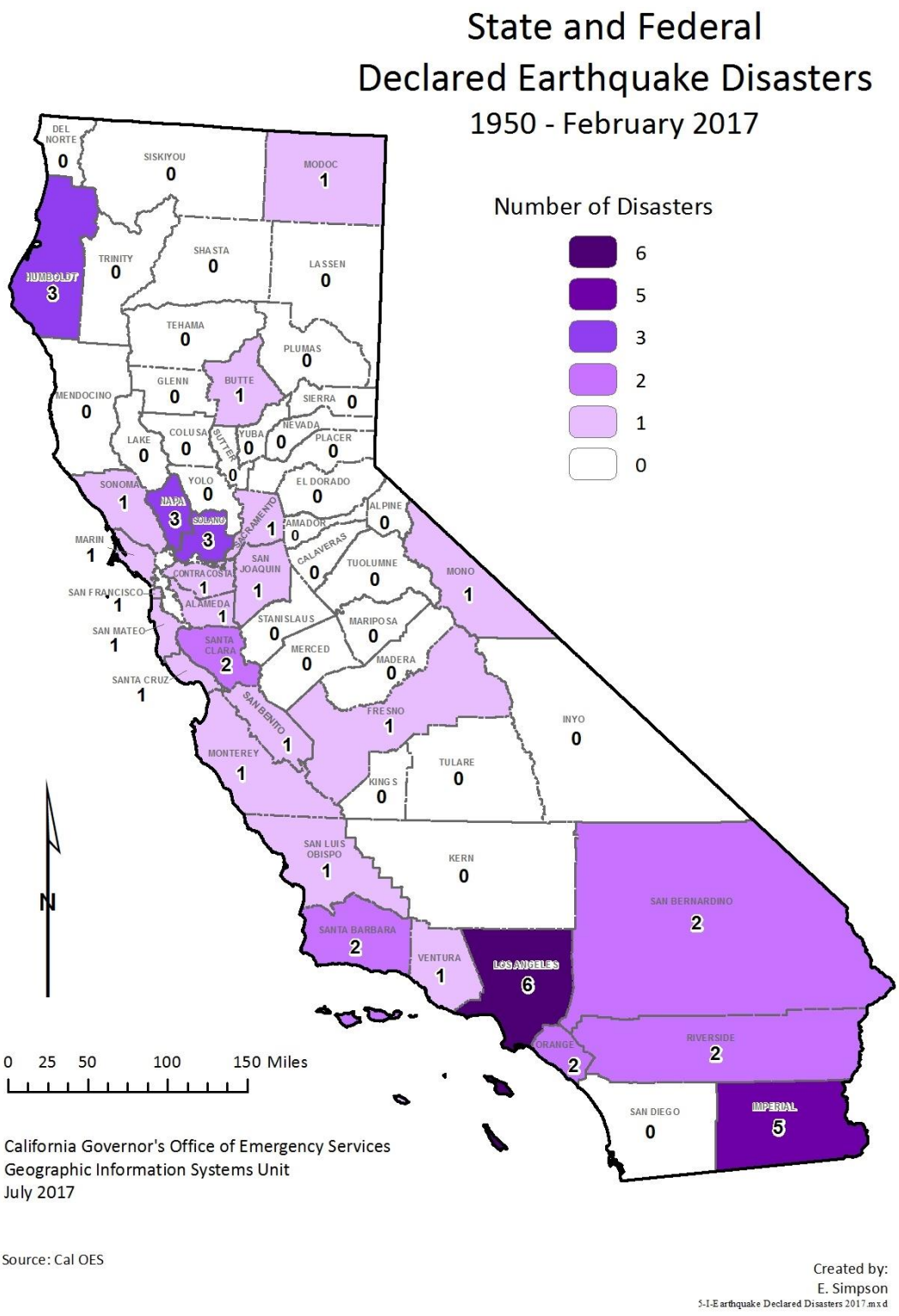
Strong earthquakes of Magnitude 6 to 6.9 strike California on an average of once every two to three years. An earthquake of this size, such as the 1994 Northridge Earthquake (Magnitude 6.7) or the 1983 Coalinga Earthquake (Magnitude 6.7), is capable of causing major damage, if the epicenter is near a densely populated area. The Northridge Earthquake caused over $40 billion of disaster losses, 57 deaths, and 11,846 injuries, while the 2014 earthquake (Magnitude 6.0) in less densely populated area, caused $87 million of disaster losses, 1 death, and 200 injuries.

Major earthquakes (Magnitude 7 to 7.9) occur in California about once every 10 years. Two recent major earthquakes, the 1992 Landers Earthquake (Magnitude 7.3) and the 1999 Hector Mine Earthquake (Magnitude 7.1) caused extensive surface fault rupture but relatively little damage because they occurred in lightly populated areas of the Mojave Desert. In contrast, earthquakes of smaller magnitude but in densely populated areas, such as the 1989 Loma Prieta Earthquake (Magnitude 6.9), have caused extensive damage over large areas.

Map 6.B shows the following numbers of state- and federal-declared earthquake disasters by county (representing 26 of California's 58 counties):

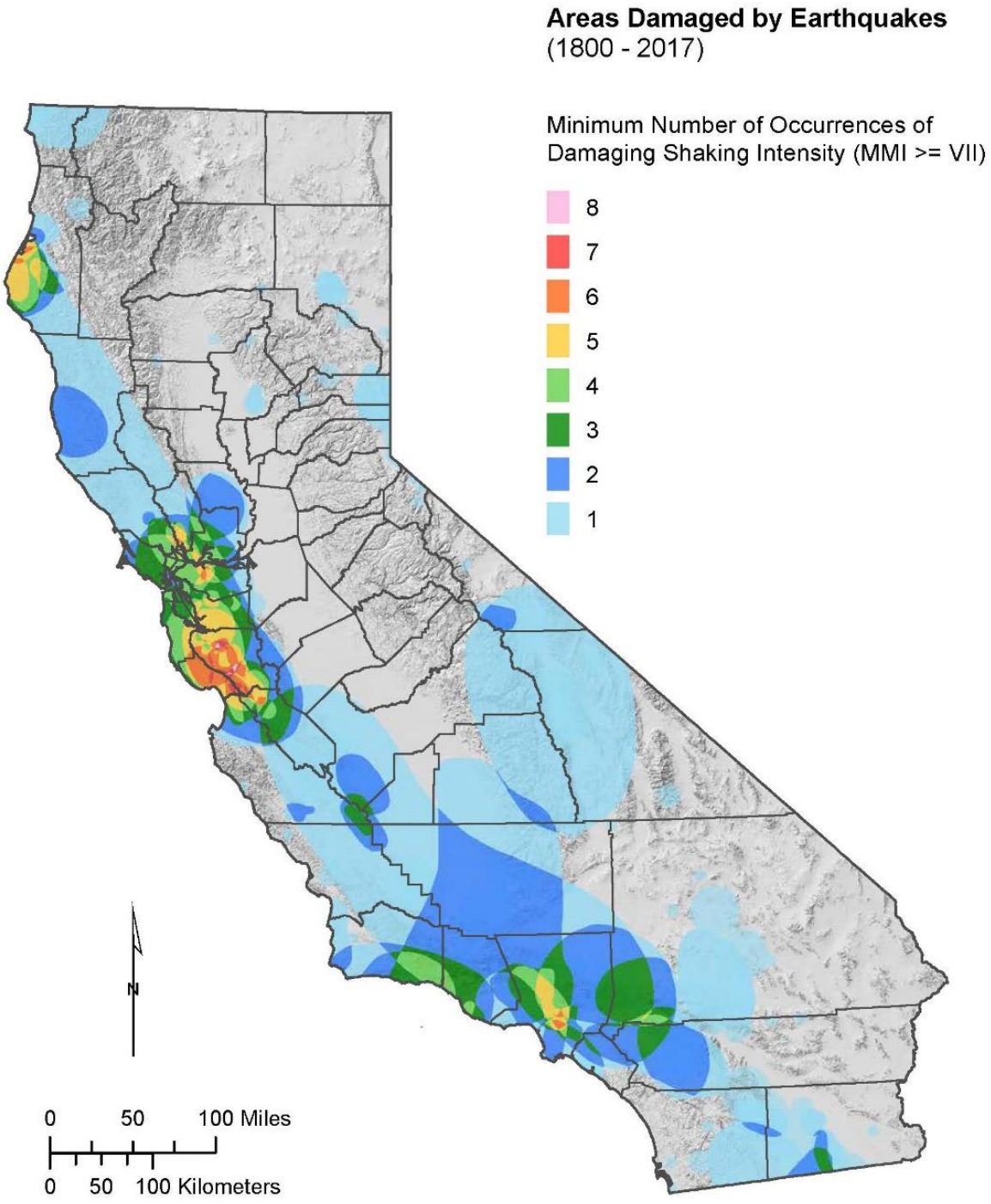
- Los Angeles County – 6
- Imperial County – 5
- Humboldt, Napa, and Solano Counties – 3 in each county
- Orange, Riverside, San Bernardino, Santa Barbara, and Santa Clara Counties – 2 in each county
- Alameda, Butte, Contra Costa, Fresno, Marin, Modoc, Mono, Monterey, Sacramento, San Benito, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Cruz, Sonoma, and Ventura Counties – 1 in each county

Map 6.B: State and Federal Declared Earthquake Disasters, 1950-February 2017



Map 6.B shows the distribution within California of state-proclaimed and federally declared earthquake disasters from 1950 to 2017. The distribution of disasters can be generally related to potential future earthquake shaking hazards levels in California.

Map 6.C: Areas Damaged by Earthquakes, 1800-2017



Source: California Geologic Survey

Map 6.C shows the numbers of historical occurrences of events described as Modified Mercalli Intensity (MMI) Scale VII or greater from 1800 to 2017. Such events notably have been concentrated along the San Andreas Fault system, particularly in the San Francisco Bay, Monterey Bay, and Humboldt County areas. However, a significant earthquake is expected in Southern California in the near future. Such an event would change this map significantly by including both larger areas and more occurrences of damage in Southern California.

California's Catastrophic Earthquake Potential

Two of the largest historic earthquakes in California, the 1857 Fort Tejon Earthquake and the famous 1906 San Francisco Earthquake, were similar in magnitude (Magnitude 7.9 and Magnitude 7.8) and resulted from movement along the San Andreas Fault. Earthquakes of this size (Magnitude 7.7 to Magnitude 7.9) can cause more extensive damage over a larger area than the Magnitude 7.1 to Magnitude 7.4 earthquakes that have struck California in recent decades.

Although a great earthquake (Magnitude 8 or greater) has never been officially recorded in California, evidence suggests that one occurred in the early 18th century. Historical and geological data strongly indicate that a Magnitude 9 earthquake occurred in January 1700 on the Cascadia Subduction Zone, which extends north from Cape Mendocino in Northern California to British Columbia. An earthquake of this size is similar to the one that struck Alaska in 1964 and is capable of extensive damage over a very broad region.

Current Views on Probability of Seismic Hazards Statewide

Based on the most recent earthquake forecast model for California, the USGS and other scientists estimate a 72-percent probability that at least one earthquake of Magnitude 6.7 or greater, capable of causing widespread damage, will strike the San Francisco Bay Area before 2044. For the Los Angeles region, the same model forecasts a 60-percent probability that an earthquake of Magnitude 6.7 or greater will occur before 2044.

These probabilities were updated with the 2014 National Seismic Hazards Map, which included a time-independent version of an earthquake forecast map of California. The map was completed so that information on seismic hazards in California would be consistent with the level of knowledge throughout the rest of the country. In 2014, the USGS and CGS released the time-dependent and time-independent versions of the Uniform California Earthquake Rupture Forecast (UCERF 3) model. These statewide peer-reviewed forecasts are considered the authoritative earthquake forecast for the State of California.

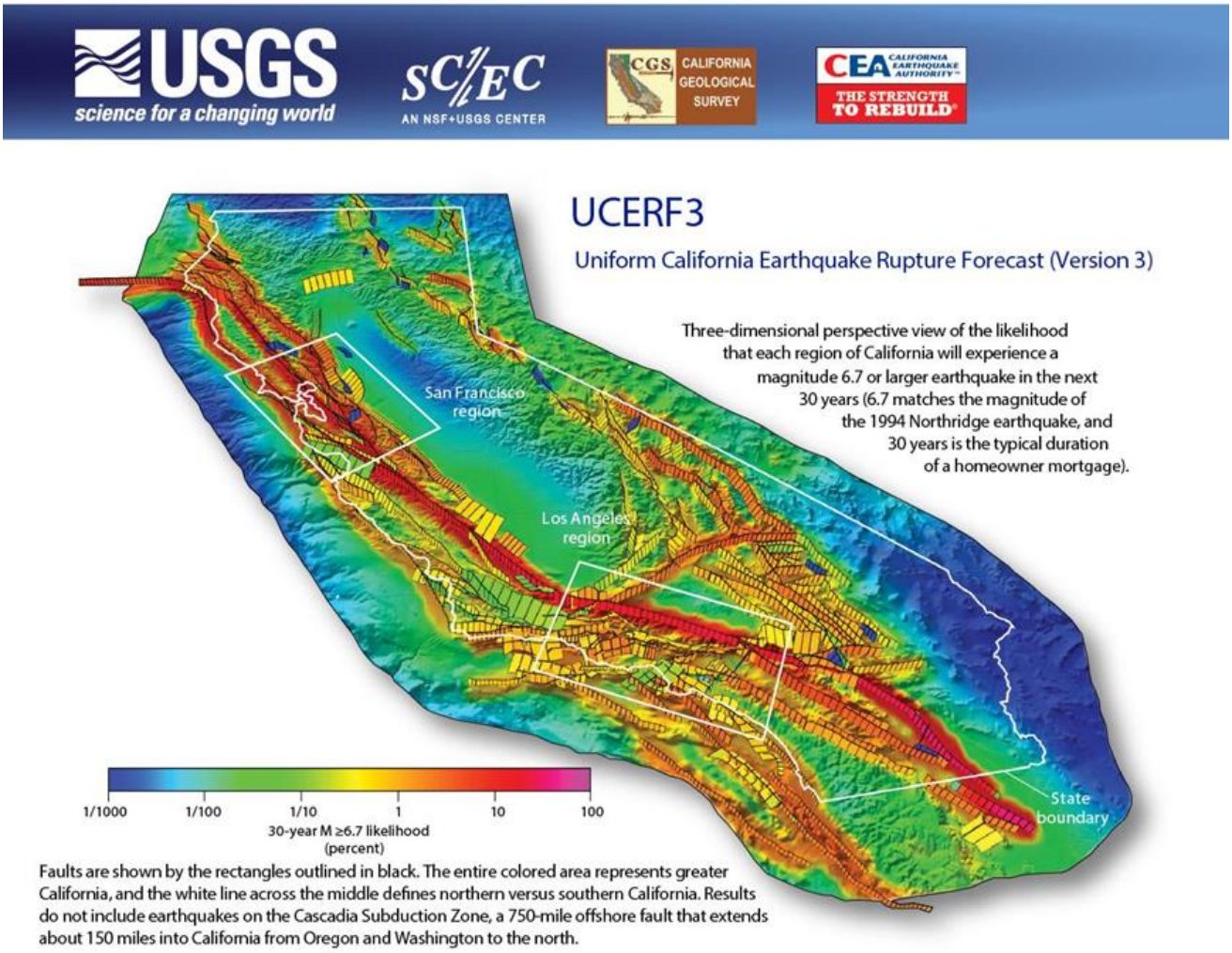
The UCERF 3 results have helped to reduce the uncertainty in estimated 30-year probabilities of strong ground motions in California. The success of the UCERF 3 project has led to interest in the continued development of short-term (less than 1 week) forecasting, appropriate for considering aftershocks, clustering of earthquakes, and earthquakes being triggered by other earthquakes. For more information about the UCERF program, visit: http://www.scec.org/ucerf/.

It is anticipated that the 2014 edition of the National Seismic Hazard Map and related documents will be incorporated into the 2019 California Building Code. This incorporation of seismic map documents will be considered for adoption as part of the 2019 California Building Standards Commission. The models are anticipated to be of great value in helping practitioners assess strong motion shaking throughout California on a regional basis for all classes of buildings and structures. For information on the California Earthquake Authority discussions regarding the impacts of these projects on the residential building stock in California, see *Section 6.1.5.2, Mitigation of Potential Building Losses*.

These models were important in reducing uncertainty in ground motion for seismic hazard assessment throughout California. This reduction of uncertainty in ground motion helps practitioners assess risk potential for new and existing buildings and infrastructure.

Map 6.D depicts probabilities of various magnitude earthquakes greater than Magnitude 6.7 occurring in 30 years in various regions of the state. These probabilities include greater than 99 percent for a Magnitude 6.7 event, 93 percent for a Magnitude 7.0 event, 48 percent for a Magnitude 7.5 event, and 7 percent for a Magnitude 8.0 event.

Map 6.D: Probability of Earthquake Magnitude 6.7 or Greater Occurring in 30 Years, by Region



Source: United States Geological Survey Open File Report 2013-1165

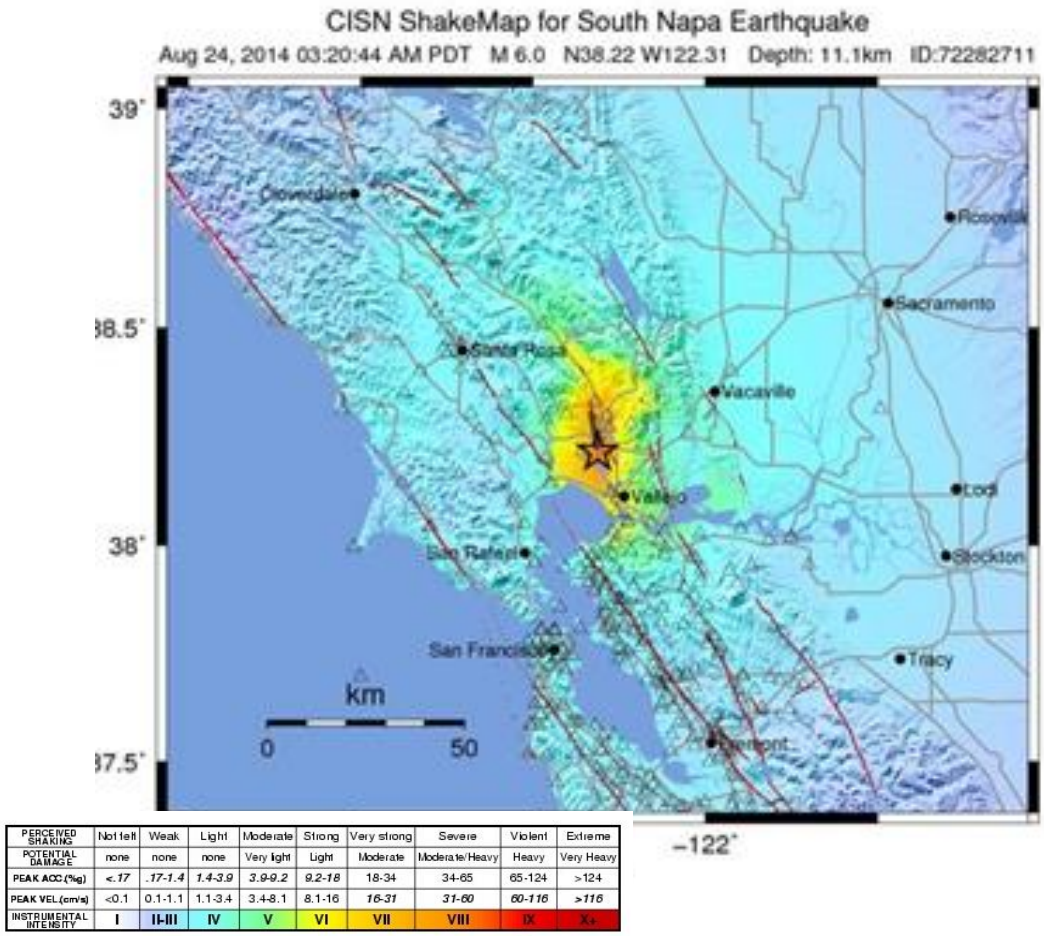
Earthquake "ShakeMaps"

Earthquake shaking is measured by instruments called accelerometers that are triggered by the onset of shaking and record levels of ground motion at strong motion stations throughout the state operated by the California Integrated Seismic Network (CISN). CISN is composed of six core organizations: California Geological Survey (CGS), Caltech Seismological Laboratory, Berkeley Seismological Laboratory, U.S. Geological Survey (USGS) Menlo Park and Pasadena, and the California Governor's Office of Emergency Services (Cal OES). CISN rapidly converts the data from the accelerometers into ShakeMaps to provide near-real-time maps of ground motion and shaking intensity following significant earthquakes. These measures are used to infer shaking intensity expressed as Modified Mercalli Intensity (MMI). To learn more about MMI, visit the following link: https://earthquake.usgs.gov/learn/topics/mercalli.php.

Based on actual measured motions, ShakeMaps, such as Map 6.E for the 2014 South Napa Earthquake, are a major step forward in guiding emergency response to earthquakes. They are used by emergency responders to evaluate the extent and variation of shaking within the area affected by an earthquake and to send resources to the areas that most likely sustained heavy damage. Simulated ShakeMaps are also generated for specific future earthquake

scenarios based on fault rupture and other geophysical models. Immediately following damaging earthquake events, ShakeMap-modeled intensity levels are the basis for HAZUS loss estimates.

Map 6.E: ShakeMap for 2014 South Napa Earthquake



In addition, more sophisticated models of earthquake shaking for a given place consider the potential for all future earthquakes on surrounding faults and their related ground motion affecting that place. Integrating all of the potential for ground motion statewide produces maps that show the long-term probabilistic seismic hazard anywhere in the state. Such maps help identify areas that are particularly vulnerable, which is useful in pre-disaster mitigation planning as well as post-disaster performance evaluations of prior mitigation projects. For more information about CISN, visit: www.cisn.org.

6.1.3 ASSESSMENT OF STATE EARTHQUAKE VULNERABILITY AND POTENTIAL LOSSES

A 2006 study (Kircher, et al.) points out that, since the 1906 San Francisco Earthquake, the Bay Area region's population has increased about ten-fold. Losses in the 1906 earthquake included 3,000 deaths, $524 million in direct building losses in 1906 dollars (which would equal about $42 billion in 2006 dollars), and 28,000 destroyed buildings, many by fire following the earthquake. It was estimated that a repeat of the 1906 earthquake in 2006 would result in 800 to 3,400 deaths, $90 billion to $120 billion in losses, and 90,000 to 127,000 extensively or completely damaged buildings.[97] Table 6.A shows earthquake losses from 1971 to 2018.

[97] Kircher, et al. "When the Big One Strikes Again – Estimated Losses due to a Repeat of the 1906 San Francisco Earthquake." EERI Spectra Vol. 22, No. 52. April 2006.

Table 6.A: Recent Earthquake Losses

Earthquake	Date	Magnitude	Direct Losses[a]	Deaths[d]	Injuries[d]
San Fernando	February 9, 1971	6.6	$2,200[b]	58	2,000
Imperial Valley	October 15, 1979	6.5	$70[b]	0	91
Coalinga	May 2, 1983	6.7	$18[b]	1	47
Whittier Narrows	October 1, 1987	6.0	$522[c]	9	200+
Loma Prieta	October 17 1989	6.9	$10,000[d]	63	3757
Cape Mendocino	April 25, 1992	7.0	$80[c]	0	356
Landers/Big Bear	June 28, 1992	7.3	$120[c]	1	402
Northridge	January 17, 1994	6.7	$46,000[b]	57	11,846
Hector Mine	October 16, 1999	7.1	minor	0	11
San Simeon	December 22, 2003	6.5	$263[e]	2	46
Eureka/Humboldt	January 9, 2010	6.5	$43	0	43
El Meyor Cucapah	April 4, 2010	7.2	$91	0	91
South Napa	August 24, 2014	6.0[f]	$87[g]	1[h]	200[i]

[a] *Estimate in millions of dollars*
[b] *Federal Emergency Management Agency (FEMA) 1997; U.S. Office of Technology Assessment*
[c] *National Research Council, 1994*
[d] *California Governor's Office of Emergency Services (Cal OES)*
[e] *California Seismic Safety Commission (CSSC) 2004-02, 2004*
[f] *https://earthquake.usgs.gov/earthquakes/eventpage/nc72282711#executive*
[g] *www.fema.gov/disasters*
[h] *http://www.usgs.gov/news/media-advisory-south-napa-earthquake-science-briefing*
[i] *http://www.usgs.gov/news/media-advisory-south-napa-earthquake-science-briefing*

6.1.3.1 ESTIMATING LOSSES FROM FUTURE EARTHQUAKES

Generating loss estimates provides the state with estimated figures for use in setting mitigation program priorities, identifying locations with greatest vulnerability, and guiding emergency response and recovery planning. Over the last few decades a number of scenarios have been developed for areas within the state for various purposes.

At $40 billion in losses, the 1994 Northridge Earthquake was the most costly disaster of any type in California's history and still ranks as the third most costly disaster in U.S. history (behind Hurricane Katrina and Superstorm Sandy).

The annualized earthquake loss (AEL) is the estimated long-term value of earthquake losses to the general building stock in any single year in a specified geographic area (e.g., state, county, metropolitan area). According to the HAZUS Estimated Annualized Earthquake Losses for the United States (FEMA P-366 / April 2017), the AEL to the national building stock is $6.1 billion per year. California represents the vast majority of this average annual loss, at 61 percent of such losses ($3.7 billion per year). The West Coast (Oregon and Washington) accounts for an additional 12 percent of the total average annual loss in the U.S., with the remainder of the country (including Alaska, Hawaii, and the U.S. Territories) accounting for 27 percent. The high concentration of loss in California is consistent with the state's high seismic hazard and large structural exposure.

While building-related losses are a reasonable indicator of relative regional earthquake risk, it is important to recognize that these estimates are not absolute determinants of the total risk from earthquakes. This is because factors such as amount of debris generated and social losses including casualty estimates, displaced households, and shelter requirements need to be considered. Seismic risk also depends on other parameters not included herein, such as damages to lifelines and other critical facilities and indirect economic loss. When casualties, debris, and shelter data are aggregated by state, California accounts for over 60 percent of estimated debris generated, 64 percent of displaced households, and 63 percent of short-term shelter needs for the earthquake hazard with a 250-year return period.

Fifty-five metropolitan areas nationally, led by the Los Angeles and San Francisco Bay areas, account for 80 percent of the total AEL. Los Angeles County alone has about 22 percent of the total AEL, and the Los Angeles area and San Francisco Bay area together account for nearly 35 percent of the total AEL. As measured by the annualized earthquake loss ratio (AELR), which expresses estimated annualized loss as a fraction of the building inventory replacement value, many other California communities are within the top 20. El Centro is the metropolitan region with the highest AELR, followed closely by the San Jose and San Francisco metropolitan areas.

With HAZUS, a nationally applicable standardized methodology and Geographic Information Systems (GIS) modeling software developed by the Federal Emergency Management Agency (FEMA), it has become possible to estimate possible losses from future earthquakes in California using ShakeMap scenarios. HAZUS is a regional loss estimation tool that uses population and building data aggregated at a census tract level. Building value and construction cost estimates are adjusted to reflect regional variations. By combining ShakeMaps with a statewide computerized inventory of population and buildings using HAZUS, Cal OES has estimated casualty and damage losses from various potential earthquakes for the two largest metropolitan regions of the state.

However, several qualifications on the probable underestimation of these loss estimates should be made:

1. Use of Decennial Census. Cal OES used the Decennial Census as the basis for estimating population and building inventory. Greater-than-expected growth, increased property values, and construction costs since that time may mean that losses are underestimated.

2. Losses to Critical Infrastructure. Due to lack of critical infrastructure data in the HAZUS model, Cal OES did not include these potential loss estimates.

3. Recovery Costs. HAZUS addresses some recovery issues but does not estimate additional potential losses that may be experienced as a result of a lengthy recovery and reconstruction process resulting from a catastrophic event in an urban area.

4. Earthquake Shaking. The earthquake shaking modeled in ShakeMap scenarios is based on fault rupture models, ground motion attenuation relationships, geologic material velocity models, and other considerations. Because of the assumptions that go into these models, actual earthquake shaking intensities and the resulting losses will be more complex and variable.

5. Consideration of Aftershocks and Multiple Earthquakes. Omori's law of magnitude distribution describes the number of aftershocks relative to magnitude. An earthquake triggers a series of aftershocks, with a larger earthquake creating the potential for large aftershocks, and for greater total number of aftershocks. Then, each subsequent aftershock triggers its own series of aftershocks in an "epidemic" model. The HAZUS model cannot account for increased loss due to the increase in building fragility as a result of repeated exposure to earthquake shaking. Likewise, HAZUS cannot discount losses for any buildings already destroyed in prior shocks.

Progress Summary 6.A: HAZUS Earthquake Loss Estimation for California

Progress as of 2018: Earthquake loss estimation and planning scenarios quantify seismic risk based on seismic hazard and exposure and vulnerability of the built environment. Such studies need to be frequently updated because of continuing development of the built environment and evolving technology in earthquake ground motion prediction and seismic hazard assessments. The California Geological Survey (CGS) has developed and participated in the development of many planning scenarios since 1980. The CGS also updates its scenario- and probabilistic-based loss estimations when significant developments occur in ground motion hazard analyses and in the built environment.

Using the latest Hazards United States (HAZUS) default information for built environment and demographics, the CGS updated statewide annualized earthquake losses (AELs) for California in September 2016. This AEL update is based on ground motions from the 2014 update of the U.S. Geological Survey National Seismic Hazard Model.

The updated AEL estimated $3.7 billion in potential losses, with 30 percent of the state's potential loss occurring in Los Angeles County due to its very high economic exposure and population and proximity to many seismically active faults. To download the 2016 Update of HAZUS Annualized Earthquake Loss Estimates for California Report, visit: http://www.conservation.ca.gov/cgs/rghm/loss/Pages/2016_Analysis.aspx.

Map 6.F, from the 2016 HAZUS Annualized Earthquake Loss Estimates for California report, shows both annualized earthquake losses (AELs) for buildings and annualized percent loss. Eighty percent of the state's AEL occurs in 10 of the state's 58 counties: Los Angeles, Santa Clara, Alameda, Orange, San Bernardino, Riverside, Contra Costa, San Francisco, San Mateo, and San Diego.

Map 6.F: Annualized Earthquake Loss, by County

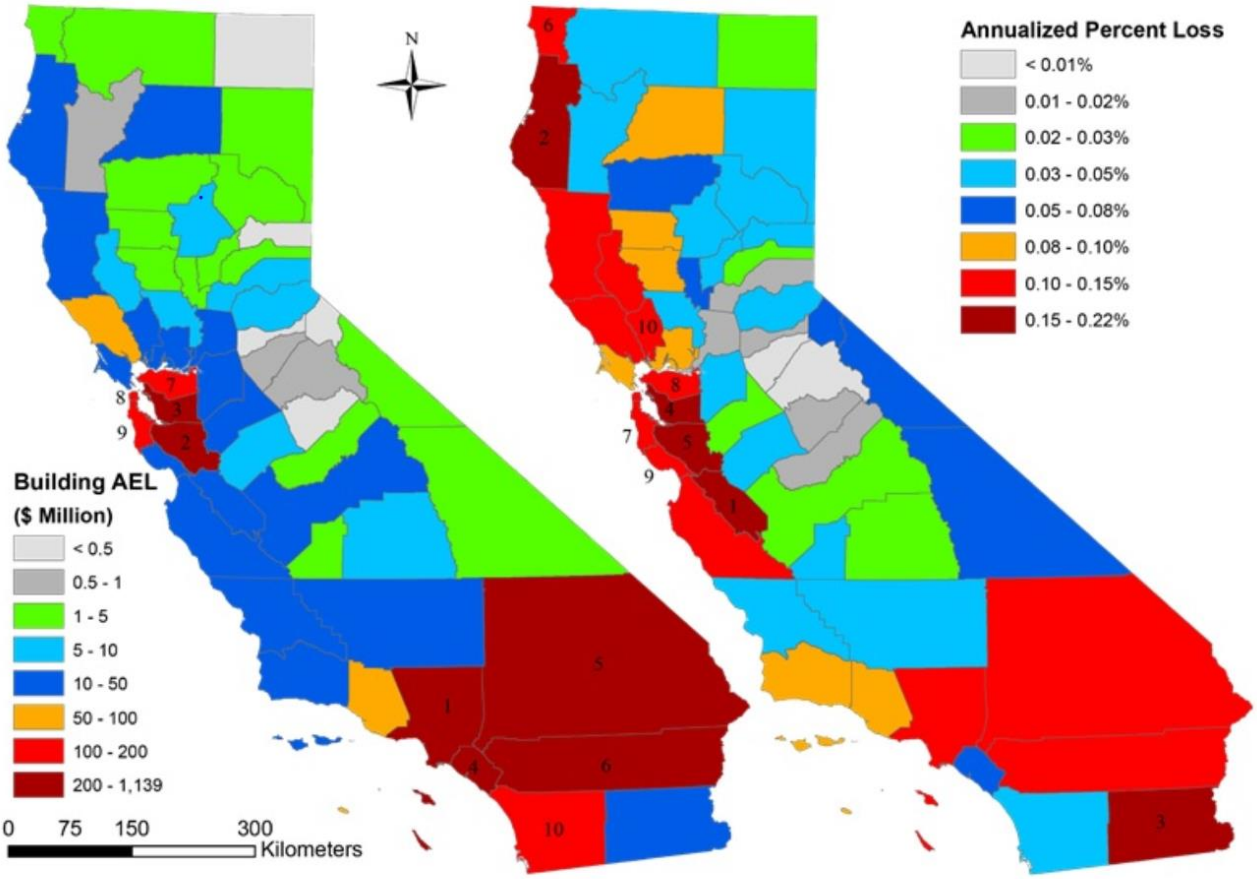


Figure 1. Distribution of building (a) annualized economic loss (AEL) and (b) annualized percent earthquake loss (APEL) in California by county (based on sensitivity case 1, site condition approximated using V_{S30} groups). The top 10 counties with the highest AEL (ranked by numbers in a) are Los Angeles, Santa Clara, Alameda, Orange, San Bernardino, Riverside, Contra Costa, San Francisco, San Mateo, and San Diego. More than 80% of the state total AEL occurs in the top 10 counties, and about 55% of the state total AEL occurs in the top 4 counties. The top 10 counties with the highest APEL (ranked as indicated by numbers in b) are San Benito, Humboldt, Imperial, Alameda, Santa Clara, Del Norte, San Mateo, Contra Costa, Santa Cruz, and Napa.

Source: Department of Conservation, California Geologic Survey, http://www.conservation.ca.gov/cgs/Pages/Program-SHP/2016_Analysis.aspx

Table 6.B: Projected Earthquake Scenario Losses, Northern California

Potential Earthquake Scenarios[a]	M_w[b]	Projected Building Damage	Projected Range of Deaths[c]	Projected Range of Injuries[c]
San Andreas Fault: Repeat of the 1906 San Francisco Earthquake[c]	7.8	$98,328,305,100	220-7,851	427-1,953
San Andreas Fault: Santa Cruz, Peninsula, and North Coast Segments[c]	7.9	$26,781,199,900	36-210	19-990
San Andreas Fault: Santa Cruz and Peninsula Segments[d]	7.5	$22,708,915,200	28-158	14-768
San Andreas Fault: Santa Cruz Segment[d]	7.1	$4,555,235,200	0-1	0-21
San Andreas Fault: Peninsula Segment[d]	7.2	$15,945,699,900	4-22	2-181
Southern Hayward[d,e]	6.8	$15,168,660,800	7-32	3-231
Northern Hayward[d]	6.6	$8,011,156,100	1-5	1-63
Southern Hayward and Northern Hayward[d]	7.0	$19,738,847,000	11-55	6-357
Rodgers Creek[d]	7.3	$24,735,265,700	18-87	9-521
Southern Calaveras and Central Calaveras[d]	6.5	$3,308,444,200	0-1	0-16
Northern Calaveras[d]	6.9	$9,263,162,700	1-9	1-77
Southern, Central, and Northern Calaveras[d]	7.0	$11,367,886,900	2-15	1-114
Concord[d]	6.5	$7,515,843,500	8-38	4-194
Green Valley[d]	6.3	$4,809,402,700	0-1	0-32
Concord and Green Valley[d]	6.8	$6,798,081,100	2-9	1-71
San Gregorio[d]	7.5	$9,053,091,400	2-12	1-97
Mount Diablo[d]	6.7	$7,901,880,900	1-8	0-73

Source: Produced by Cal OES GIS, based on data from HAZUS and California Geological Survey earthquake scenarios

[a] Based on earthquake scenarios as of August 2018

[b] Mw is an earthquake magnitude scale

[c] Range of deaths/injuries represent three time-of-day scenario intervals (2am, 2pm, 5pm)

[d] FEMA- Region IX, 2018, Southern California Catastrophic Earthquake Plan, "Hazus: Earthquake Global Risk Report

[e] A HAZUS run of the 1868 Southern Hayward scenario was not performed due to insufficient ShakeMap data. A comparable scenario—the Southern Hayward M6.8 scenario—was run as a substitute.

Table 6.B and Table 6.C provide total building damage dollar loss estimates for 17 separate possible earthquake scenarios in Northern California and 14 in Southern California. Table 6.B reflects updated figures from the previously cited Charles Kircher study[98] in 2006, which modified HAZUS data with customized, more locally accurate data producing two scenarios, one for a repeat of the 1906 San Francisco Earthquake and the other for a projected alternative scenario Magnitude 7.9 earthquake in the San Francisco Bay region and surrounding counties. This scenario portraying a repeat of the 1906 San Francisco Earthquake has been updated to reflect an estimated total dollar loss of over $98 billion.

[98] Kircher, et al. "When the Big One Strikes Again – Estimated Losses due to a Repeat of the 1906 San Francisco Earthquake." EERI Spectra Vol. 22, No. 52. April 2006.

Table 6.C: Projected Earthquake Scenario Losses, Southern California

Potential Earthquake Scenarios[a]	Mw[b]	Projected Building Damage	Projected Range of Deaths[c]	Projected Range of Injuries[c]
ShakeOut Scenario 2008[e]	7.8	$30,359,868,100	233-1,395	129-4,627
San Andreas Fault: Repeat of 1857 Earthquake[d,e]	7.8	$17,215,858,700	84-636	46-2,124
Puente Hills Fault[d]	7.1	$106,386,098,000	721-3,533	376-11,709
Newport-Inglewood[d]	6.9	$44,490,764,700	114-495	60-2,033
Palos Verdes[d]	7.1	$26,257,763,500	51-233	27-949
Whittier Fault[d]	6.8	$21,780,360,100	7 -49	4-360
Verdugo Fault[d]	6.7	$32,125,450,300	49-231	26-1,046
San Andreas Fault: Southern Rupture[d]	7.4	$13,922,337,300	51-246	29-908
Santa Monica[d]	6.6	$22,310,270,900	12-36	7-290
Raymond Fault[d]	6.5	$22,566,981,900	13-58	7-375
San Joaquin Hills[d]	6.6	$21,965,633,000	26-129	14-620
Rose Canyon[d]	6.9	$13,116,742,700	24-81	12-385
San Jacinto[d]	6.7	$6,788,267,400	6-33	4-181
Elsinore Fault[d]	6.8	$4,125,402,300	1-9	1-57

Source: Produced by Cal OES GIS, based on data from HAZUS and California Geological Survey earthquake scenarios
[a] Based on earthquake scenarios as of August 2018
[b] Mw is an earthquake magnitude scale
[c] Range of deaths/injuries represent three time-of-day scenario intervals (2am, 2pm, 5pm)
[d] FEMA- Region IX, 2018, Southern California Catastrophic Earthquake Plan, "Hazus: Earthquake Global Risk Report"
[e] 1857 Fort Tejon Earthquake Special Report, 2007, Risk Management Solutions

The 2007 SHMP estimated maximum potential earthquake building damage loss to state-owned and leased facilities using best available data. Of the total 24,313 state-owned and -leased buildings, Table 6.D, in *Section 6.1.3.3*, identifies total risk exposures of $48 billion for 15,255 buildings in areas potentially subject to Peak Ground Acceleration (PGA) of 31 to 175 percent (g) in an earthquake and $26 billion for buildings in areas subject to PGA of 11- to 30-percent (g).

Note that these figures overstate potential losses for two reasons: 1) earthquakes are centered within one region or another (and do not occur in all regions at once), and 2) only a portion of the inventory within a region affected by a large magnitude earthquake would suffer building collapse or substantial damage. However, since the science of earthquake prediction is in its infancy and the location and magnitude of damaging earthquakes are essentially unknown, this broad inventory provides an indication of maximum exposure, which should inform state policy-makers and managers on the scope of potential seismic upgrades needed for continuity of operations.

2016 Bay Area Earthquake Plan

The Bay Area Earthquake Plan (BAEP) was developed by the U.S. Department of Homeland Security (DHS)/Federal Emergency Management Agency (FEMA) Region IX and the California Governor's Office of Emergency Services (Cal OES) with guidance from a Senior Leader Steering Committee that consisted of representatives from FEMA Region IX and Cal OES and the following entities: American Red Cross (ARC), California National Guard (CNG), Bay Area Urban Area Security Initiative (UASI), California Utilities Emergency Association (CUEA), 16 Bay Area counties, California Health and Human Services Agency (CHHS), U.S. Department of Defense (DOD) Defense Coordinating Element, and California Highway Patrol (CHP). Additionally, the BAEP was prepared through the cooperation and involvement of more than 70 local, regional, state, federal, and private sector entities.

Scenarios were developed by FEMA to inform the preparation of the BAEP. Published in 2016, the BAEP is an update to the San Francisco Bay Area Earthquake Readiness Response: Concept of Operations Plan dated September 23, 2008 and was developed to describe the joint state and federal response to a catastrophic earthquake in the Bay Area.

FEMA Hazards United States (HAZUS) modeling was completed for two severe earthquake scenarios in the Bay Area: a Magnitude 7.8 earthquake occurring along the San Andreas Fault and a Magnitude 7.0 earthquake occurring along the Hayward Fault. Both models show areas of violent and very violent shaking in densely populated areas. Figure 6.A depicts the HAZUS modeling results for damage, injuries, and other impacts.

Figure 6.A: FEMA HAZUS Modeling

SCENARIO	POPULATION	DEATHS	TRAUMA	HOSPITALIZED	ED	OUTPATIENT	EMS TRANSPORTS
Hayward	6,119,027	464	121	606	21,653	38,509	1,455
San Andreas	7,748,954	2,550	566	2,401	82,971	139,942	7,270

	BUILDINGS	Damage Complete	Damage Extensive	Damage Moderate	Debris	Economic Loss
Hayward	3,038,798	13,557	39,886	150,800	14.4M tons	$54 billion
San Andreas	3,085,867	13,357	59,005	112.363	10M tons	$60.5 billion

	Households	Day 1 w/o Power	Day 3 w/o Power	Day 7 w/o Power	Displaced Households	Short-term Shelter
Hayward	3,597,846	38%	17%	5.4%	76,501	55,295
San Andreas	3,679,700	56%	32%	14.5%	49,774	29,151

	Households	Day 1-3 w/o Water	Day 7 w/o Water	Day 30 w/o Water	Day 90 w/o Water	
Hayward	3,597,846	47%	43%	36%	25%	
San Andreas	3,679,700	60%	58%	48%	30.5%	

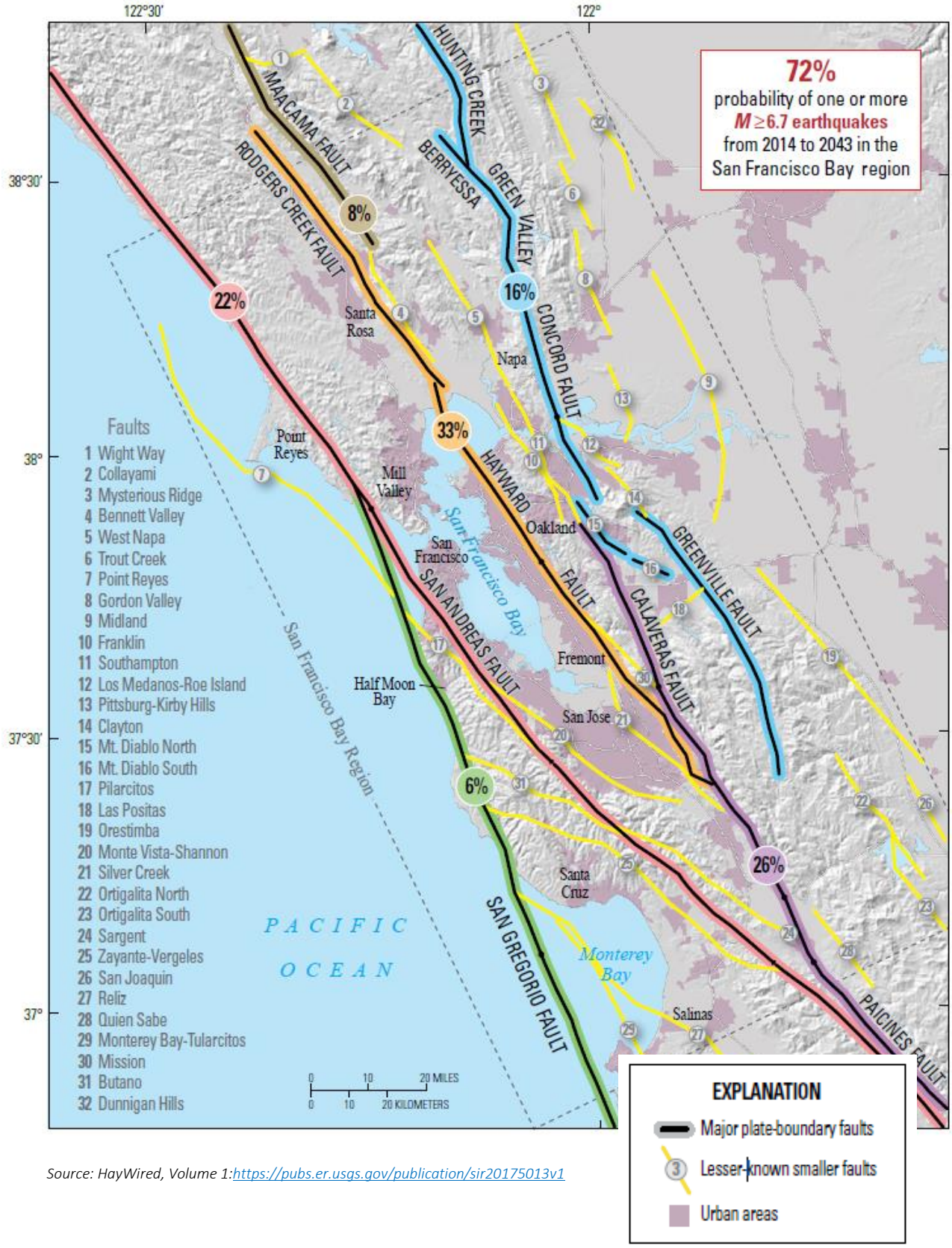
Source: Bay Area Earthquake Plan, 2016

For additional information, visit: http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/catastrophic-planning. Or to download the BAEP, visit: http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/BayAreaEQConops(Pub_Version)_2016.pdf.

Map 6.G depicts active geologic faults in the San Francisco Bay region, including the Hayward Fault, along with earthquake probabilities on these faults. The 72 percent probability of a Magnitude 6.7 or greater earthquake in the region includes well-known major plate-boundary faults, lesser-known faults, and unknown faults. The percentage shown within each colored circle is the probability that a Magnitude 6.7 or greater earthquake will occur somewhere on that fault system by the year 2043. The probability that a Magnitude 6.7 or greater earthquake will involve one of the lesser known faults is greater than or equal to 13 percent.[99]

[99] Aagaard and others, 2016

Map 6.G: Earthquake Outlook for the San Francisco Bay Region 2014-2043



Source: HayWired, Volume 1:https://pubs.er.usgs.gov/publication/sir20175013v1

Survey Science Application for Risk Reduction Program and the HayWired Earthquake Scenario

The HayWired scenario is the latest in a series projects led by the USGS Science Application for Risk Reduction (SAFRR) Program, which focuses on potential impacts when the Hayward Fault again ruptures through the east side of the San Francisco Bay region, as it last did in 1868.

Twelve large earthquakes have occurred on the Hayward Fault over the past 1,900 years, with the most recent nearly 150 years ago. There is a 1 in 3 chance of a Magnitude 6.7 or larger earthquake on the Hayward Fault, or the adjoining Rodgers Creek Fault, in the next 30 years. HayWired anticipates the impacts of a hypothetical Magnitude 7.0 earthquake on the Hayward Fault, which runs through the densely urbanized corridor of the East Bay in the San Francisco Bay region and is among the most active and dangerous in the United States.

This hypothetical earthquake is only one of many plausible events that could be the region's next big earthquake. The scenario name "HayWired" speaks to the threat of earthquakes on the Hayward Fault and the vulnerabilities and strengths posed by the interconnectedness of the bay region's people, utilities, roads, and economy—including the digital economy. The scenario was released in two volumes, with a third volume pending release in late 2018.

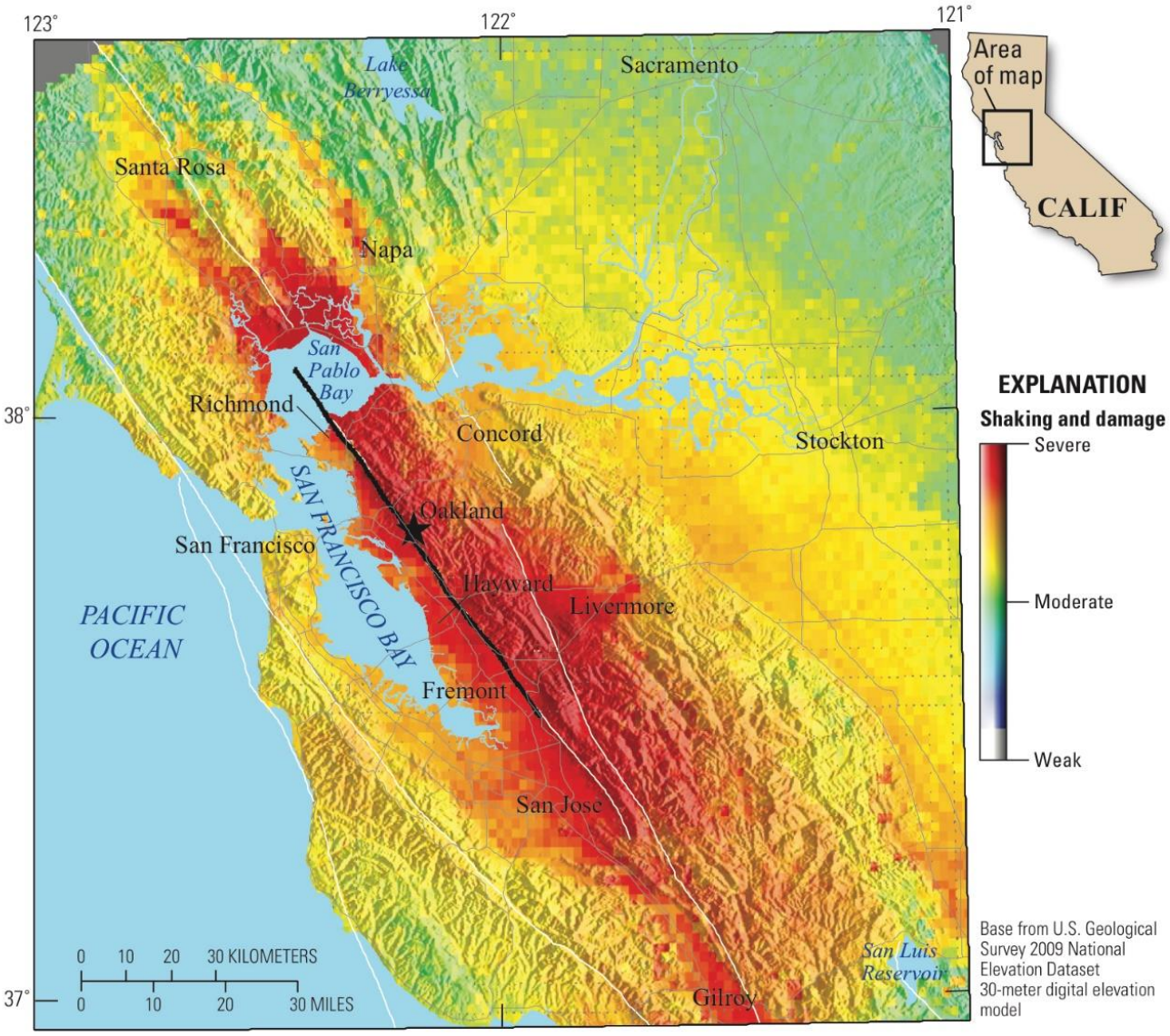
Volume 1, released in 2017, details the earthquake science and hazards information of the scenario, including the ground rupture model and analyses of potential co-seismic and post-seismic slip along the faults as well as liquefaction and earthquake-generated landslides around the region. Volume 2, released on April 18, 2018, the anniversary of the Magnitude 7.6 1906 San Francisco Earthquake, focuses on the immediate impacts on people, buildings, and infrastructure, including fires that erupt in the aftermath of such a major earthquake. Volume 3 will focus primarily on impacts on information and communications technology, along with effects on jobs and the regional economy.

The HayWired scenario earthquake occurs at 4:18 p.m. on April 18, 2018, is centered in Oakland, and ruptures both northward and southward along the Hayward Fault for about 52 miles. East Bay cities—from Richmond in the north to Fremont in the south—are hardest hit by violent ground shaking, but strong shaking is felt throughout the San Francisco Bay region. Map 6.H shows the simulated shaking intensity and damage severity of the HayWired scenario. The epicenter or mainshock location in Oakland is denoted on the map with a star.

The HayWired scenario earthquake results in 800 deaths and 18,000 injuries from building and structural damage caused by ground shaking and liquefaction hazards. More than 2,500 people in the region could require rescue from collapsed buildings, and more than 22,000 people might need to be rescued from stalled elevators. Property damage and direct business disruption losses due to ground shaking damage, liquefaction, and landslides from the mainshock and aftershock sequence are estimated to be more than $82 billion (in 2016 dollars). Twenty percent of the shaking damage to buildings accrues from aftershocks. However, damage from the mainshock could render older, steel-frame, high-rise office buildings and newer reinforced-concrete residential buildings in downtown Oakland and San Francisco unusable for as long as 10 months.

Potable water systems in most of the region would be affected, but East Bay residents could lose water service for six weeks (some for as long as six months). Damage from the HayWired mainshock could trigger up to 400 fires that would kill hundreds more people, destroy the equivalent of 52,000 single-family homes, displace more people from their homes, and cause property losses approaching $30 billion losses. Over 400,000 people could be displaced from their homes and communities due to residential building damage and extended infrastructure outages.

Map 6.H: HayWired Scenario Ground Shaking for the Hypothetical Mainshock Magnitude 7.0 Earthquake on Hayward Fault

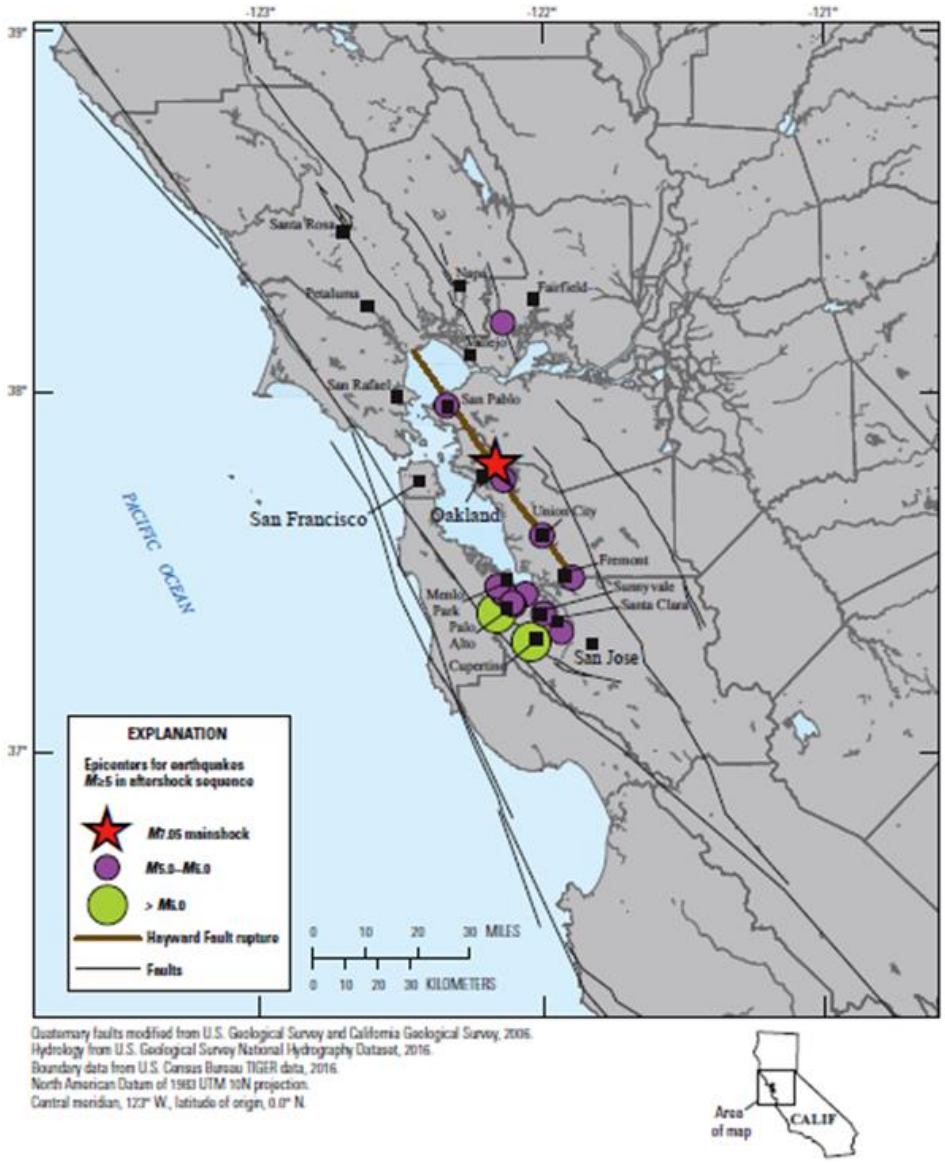


Source: U.S. Geological Survey, Haywired Earthquake Scenario reports, https://pubs.er.usgs.gov/publication/sir20175013/

The HayWired scenario also includes a sequence of hypothetical aftershocks happening in the minutes to years following the mainshock; 175 earthquakes of Magnitude 4 or larger and 14 earthquakes of Magnitude 5 or larger occurring over a two-year period.

Map 6.I shows the locations of the 14 Magnitude 5 or larger aftershocks in the scenario sequence. The largest hypothetical aftershock is a Magnitude 6.4 earthquake that occurs on October 1, 2018 and is centered in Cupertino. The HayWired scenario mainshock produces ground surface displacement across the fault of nearly 8 feet in the Richmond area and 3 to 4 feet at many locations from Berkeley to Hayward.

Map 6.I: Epicenters to Magnitude 5 or larger Aftershocks in the HayWired Scenario



Source: U.S. Geological Survey, Haywired Earthquake Scenario reports, https://pubs.er.usgs.gov/publication/sir20175013/

The HayWired team is building on the engineering analyses to further explore the societal consequences of the scenario. These studies will be released in Volume 3 of the scenario in October 2018, around the 29th anniversary of the Magnitude 7.1 Loma Prieta Earthquake, the last major earthquake to strike the region. The studies will review impacts on information and communications technology, effects on jobs and the regional economy, and issues for community recovery, including population displacement, social vulnerability, interim housing, and financing for long-term recovery planning.

The USGS and its partners in the HayWired Coalition and the HayWired Campaign are working to energize residents and businesses to engage in new and ongoing efforts to prepare the region for such a future earthquake. The Outsmart Disaster website (https://outsmartdisaster.com) provides actionable science for making informed decisions.

The HayWired Earthquake Scenario reports can be found at: https://pubs.er.usgs.gov/publication/sir20175013/.
The HayWired Earthquake Scenario movie is at: https://www.youtube.com/embed/aRLb3PmIYFc.

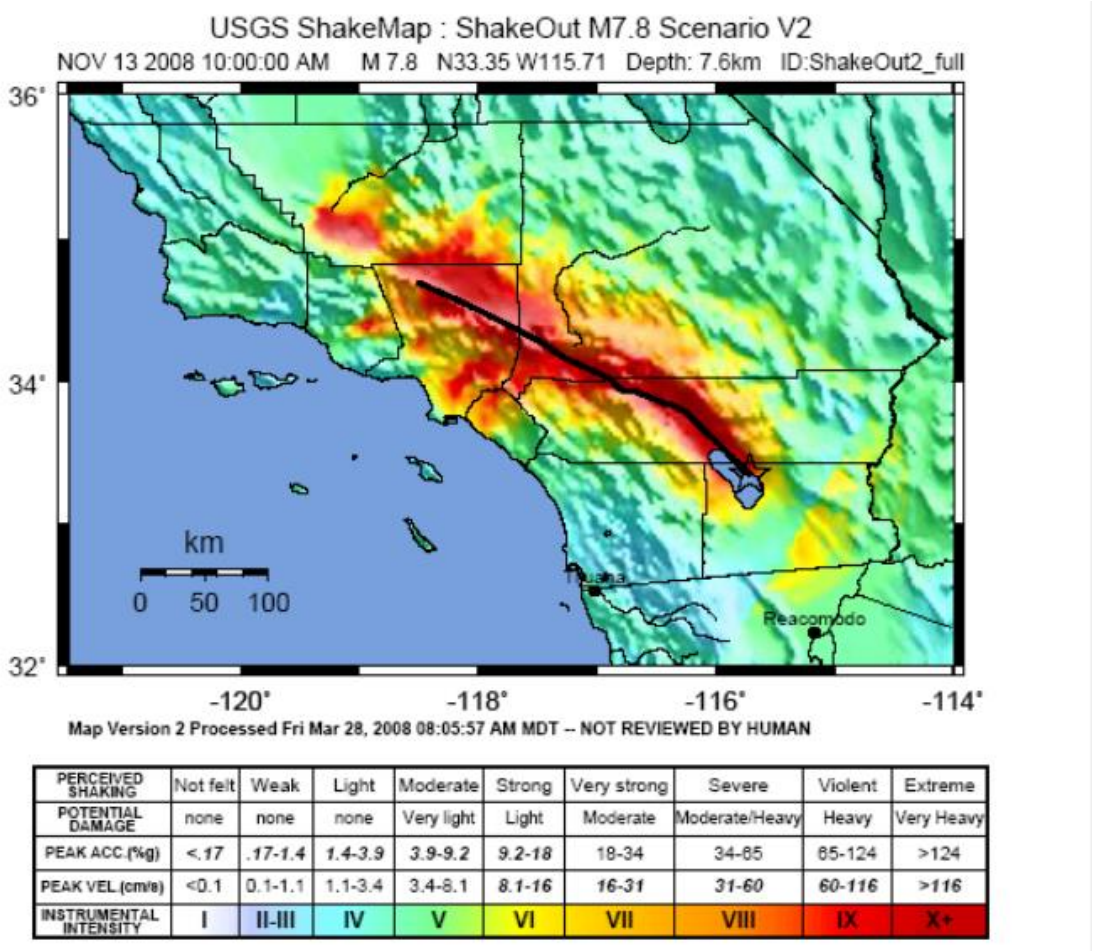
The Great California ShakeOut Scenario

An effort to integrate science and disaster management at the federal level, the Multi-Hazards Demonstration Project was initiated by the USGS with a five-year pilot project in 2006. The project's goal is to improve California community's resiliency to earthquakes, floods, wildfires, tsunamis, and other hazards. That goal is being accomplished by applying science to community decision-making and emergency response, particularly through the use of a collaborative process and multi-hazard frameworks to create scenarios. The project is intended to help communities reduce their natural hazard threats by directing new and existing science toward identifying significant vulnerabilities and producing innovative hazard and risk communication products. These comprehensive and well-constructed "what-if" hazard scenarios are put to use in assessing and practicing mitigation preparedness, response, and recovery planning.

The ShakeOut Scenario, completed in May 2008 with hundreds of partners, was the first major product of the USGS Multi-Hazards Demonstration Project. This scenario designed a plausible large earthquake on the southern San Andreas Fault and then studied the effects of fault rupture and shaking as well as secondary hazards including liquefaction and landslides. The scenario considered direct physical impacts as well as long-term, social, cultural, and economic consequences.

Map 6.J is a USGS "ShakeMap" created for the ShakeOut Scenario showing the geographic distribution of shaking levels on a Modified Mercalli Scale for a hypothetical Magnitude 7.8 earthquake with a 200-mile rupture along the southern San Andreas Fault starting in the Salton Sea and progressing northward.

Map 6.J: Great ShakeOut Magnitude 7.8 Earthquake Scenario on Southern San Andreas Fault



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Source: U.S. Geological Survey

To review the initial ShakeOut Scenario report, visit the USGS Earthquake Hazards Program website: https://pubs.usgs.gov/of/2008/1150.

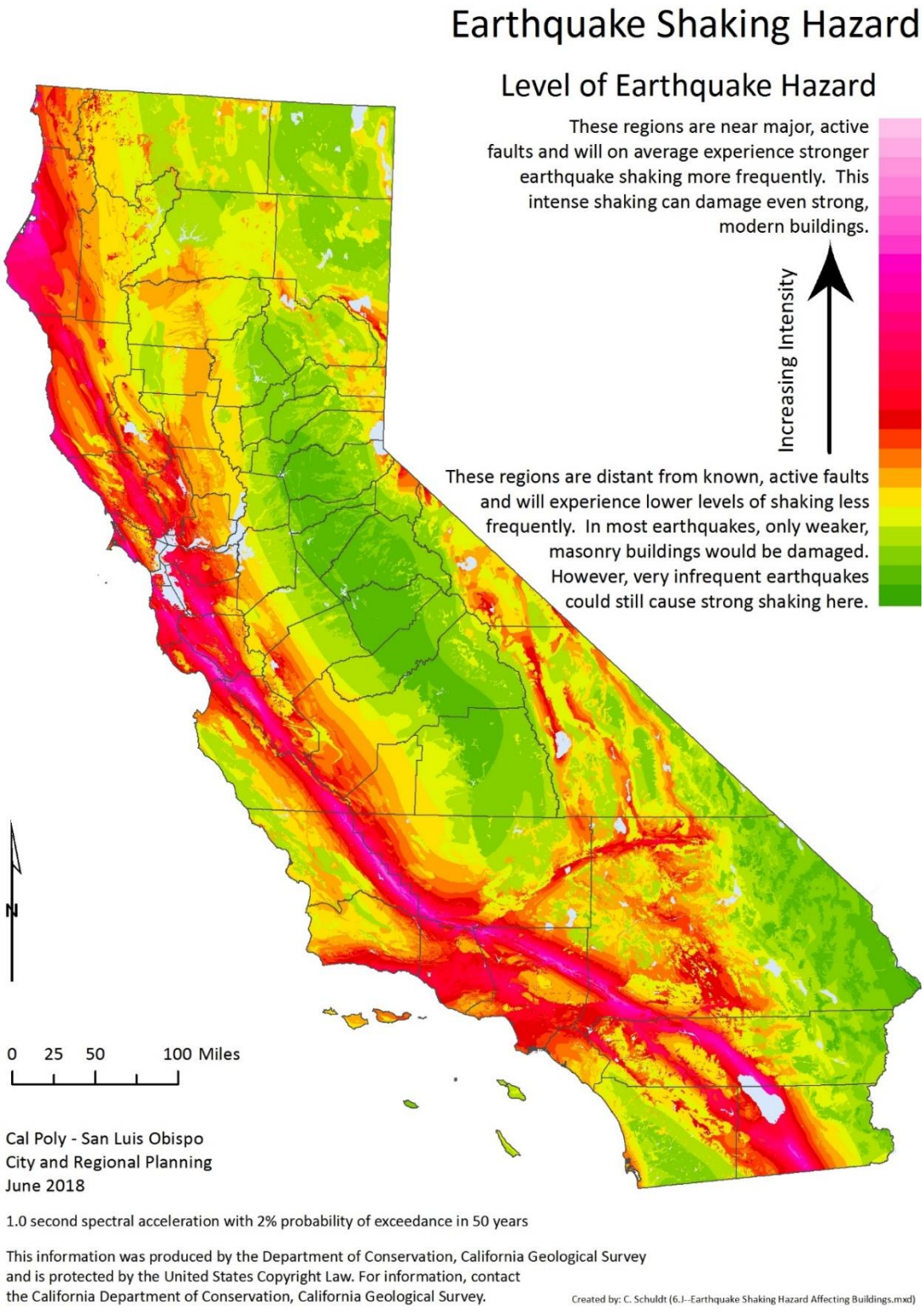
The first Great ShakeOut earthquake drill, based on the ShakeOut Scenario, was performed as part of the Golden Guardian exercise in California in 2008. Since then the drills have evolved into an annual statewide exercise, which has led to improved preparedness though better understanding of possible disaster outcomes. For more information on the Great California Shakeout Drill Program, see Progress Summary 6.L.

Immediately after publication, it was clear that the ShakeOut Scenario made a difference. It encouraged new discoveries and applications in research fields as diverse as earthquake physics and disaster economics, broadening the foundation for future advances. Most importantly, it inspired the largest-ever participation in earthquake preparedness drills, among both the emergency response community and the general public, across the country and around the globe.

In January 2012, this Southern California pilot project evolved into the national Science Application for Risk Reduction (SAFRR) project, which has launched the ShakeOut, ARkStorm, and SAFRR Tsunami scenarios. The latest SAFRR project, HayWired, will be launched in 2018.

For more information regarding the HayWired, ShakeOut, ARkStorm, and SAFRR Tsunami Scenario projects, visit the USGS website: https://www.usgs.gov/science-explorer-results?es=SAFRR&classification=science_project.

Map 6.K: Earthquake Shaking Hazard Affecting Buildings



Map 6.K shows the distribution of earthquake shaking hazards affecting buildings, according to the CGS, USGS, and others. The most intense potential shaking areas parallel the coast between the borders with Mexico and Oregon, primarily along the San Andreas Fault and the Cascadia Subduction Zone.

6.1.3.2 EARTHQUAKE VULNERABLE AREAS AND POPULATIONS

Earthquake vulnerability is primarily based upon population and the built environment. Urban areas with high earthquake hazard potential tend to be the most vulnerable, while uninhabited areas generally are less vulnerable. In the past, the CGS and USGS have done considerable work using GIS technology to identify populations in areas with high seismic hazard.

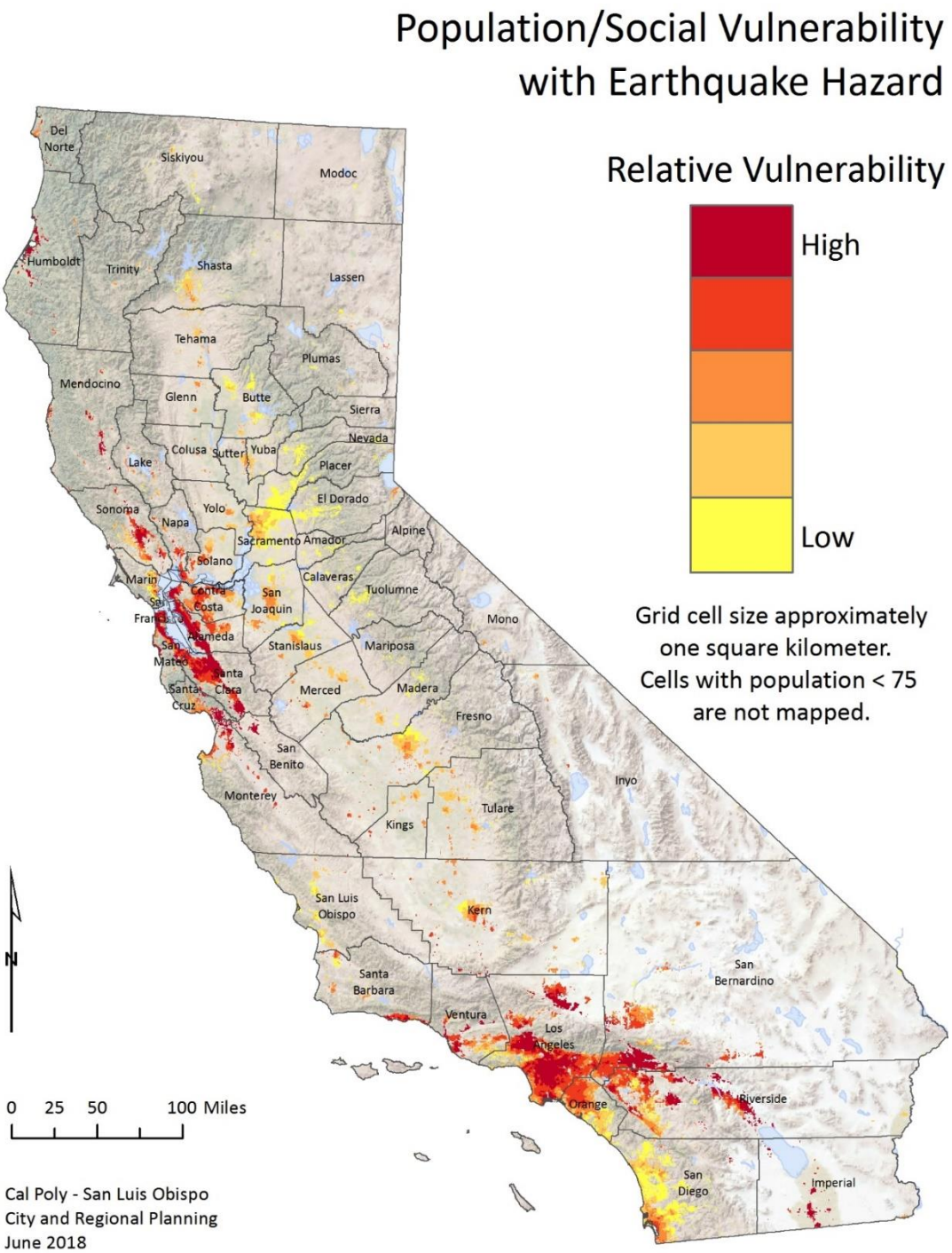
Hurricane Katrina and other recent disaster events have brought to the public's attention the increased vulnerability of groups within the general population that may have fewer or differential access to resources, linguistic isolation, or less mobility than others, resulting in greater vulnerability to hazards events, such as earthquakes.

Map 6.L shows high concentrations of socially vulnerable populations throughout high earthquake hazard areas in the state's most heavily populated counties of Southern California, the Monterey Bay Area, and the San Francisco Bay Area. For an expanded discussion of social vulnerability, see *Section 4.4*.

Unfortunately, the number and variations of all potential earthquakes are so large that it is not possible to develop scenarios for all of them, nor would it be possible to rank them by importance if such scenarios were developed. To get an idea of the overall scope of the risk of losses from earthquakes and to determine which areas are most vulnerable, the CGS and USGS use an alternate approach based on probabilistic seismic hazard analysis (PSHA), which considers all possible earthquakes on all possible sources and then evaluates the effects of this modeled shaking on inventories of structures that are in FEMA's HAZUS computer program.

Past earthquakes may not provide a realistic estimate of future earthquakes' effects. Large earthquakes in lightly populated regions, such as Landers and Hector Mine, show the potential earthquake shaking from major earthquakes, while moderate earthquakes in populated areas, particularly Northridge, give a sense of California's vulnerability to earthquake shaking. A major earthquake near one of California's urban centers could cause unprecedented losses.

Map 6.L: Earthquake Hazard and Social Vulnerability



EQ hazard information from the Department of Conservation, California Geological Survey is protected by the United States Copyright Law. For information, contact the California Department of Conservation, California Geological Survey.
Population data source: Source: ORNL LandScan 2015 Global Population Database. UT-Battelle, LLC; 2015 American Community Survey (ACS) 5-year estimates.

Created by: C. Schuldt (4.J & 6.K--Pop-Soc Vuln with Earthquake Hazard.mxd)

6.1.3.3 ESTIMATING EARTHQUAKE LOSSES TO STATE-OWNED AND LEASED BUILDINGS

Overview

Although multiple state databases exist for state-owned, -leased, and -operated facilities, there is no single statewide data source on these crucial resources. Given the size and complexity of California's economy and extent of its infrastructure, together with its inherent earthquake vulnerability, the problem of estimating potential dollar losses for state-owned and -operated facilities is an overwhelming economic modeling challenge.

A reasonable representation of a worst-case scenario for dollar losses for state-owned facilities might be reflected in a repeat of any of the great earthquakes experienced in the past two centuries. In light of California's catastrophic earthquake potential, a Magnitude 7.9 earthquake could be said to represent the worst-case dollar loss scenario for state-owned, -leased, or -operated facilities—far worse than dollar losses from disasters triggered by any other hazards including the other primary hazards, flooding and wildfires.

Table 6.D: Estimating Earthquake Dollar Loss for State Owned and Leased Buildings, as of 2007

	State Ownership Status	Number of Buildings	Square Feet	$ Value at Risk (billions)
Low: 0-10%g Peak Ground Acceleration[a]	Own	2,821	8,467,822	2.96
	Lease	69	194,984	0.07
	Total	**2,890**	**8,662,806**	**$3.00[b]**
Medium: 11-30%g Peak Ground Acceleration	Own	5,280	64,215,398	22.48
	Lease	888	9,495,449	3.32
	Total	**6,168**	**73,710,847**	**$26.00[b]**
High: 31-175%g Peak Ground Acceleration	Own	14,167	131,178,132	45.91
	Lease	1,088	6,688,122	2.34
	Total	**15,255**	**137,866,254**	**$48.00[b]**
Overall Total Dollar Value at Risk				**$77.00[b]**

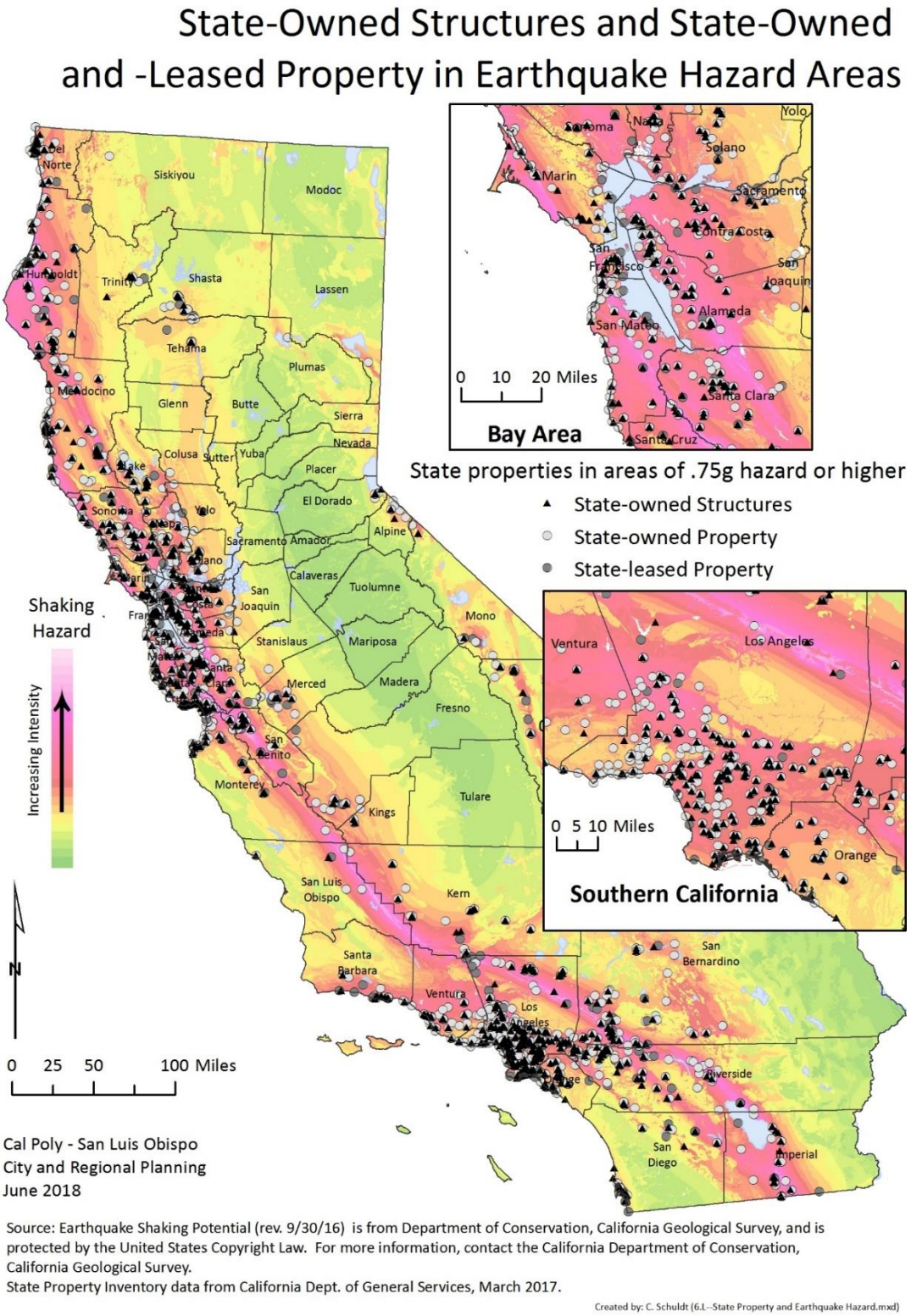
[a] *Sources: Department of General Services, California Governor's Office of Emergency Services (Cal OES), California Geological Survey (CGS)*
[b] *number rounded*

The Real Estate Division of the Department of General Services (DGS) maintains the State Property Inventory, which is a centralized real estate management information system. This database consists of a comprehensive inventory of all leased facilities reported to the Department of General Services and all state proprietary land holdings except for the California Department of Transportation (Caltrans) highway operating right of way and airspace. As agencies notify the DGS of changes, they are entered into the State Property Inventory. Maps created using these data show the physical location of real property as listed in the State Property Inventory, however the physical locations of structures owned by the state were determined using the address for each structure, and some of these addresses were not specific enough to place them on the map. (Please note that only properties "reported to the DGS" are included.)

This inventory includes structures with a wide range of vulnerability to earthquake risk. While some structures have been seismically upgraded under Proposition 122 (1990) bond funds and other funding sources, others remain vulnerable to damage and are in need of retrofitting.

The value of overall risk exposure to state-owned buildings from earthquake shaking hazards is noted in Table 6.D as roughly $77 billion. This is far greater than the value of potential risk exposure of state owned buildings from flood and wildfire hazards, which are on the order of approximately $2.0 billion each (see Tables 7.B and 8.D). Therefore, the seismic vulnerability of state-owned buildings is of great concern to the state.

Map 6.M: State-Owned Structures and State-Owned and Leased Property in Earthquake Hazard Areas



Map 6.M shows the location of state-owned buildings and state-owned and -leased properties in potential strong ground shaking areas that are listed in the State Property Inventory.[100] Large concentrations are found in Southern

[100] 1.0 second spectral acceleration with 2-percent probability of exceedance in 50 years.

California and the San Francisco Bay Area. At a statewide scale, it is difficult to differentiate individual locations of every state structure or property; however, this map's primary purpose is to illustrate the large concentrations of state structures and properties located in areas of stronger intensity shaking hazard.

Vulnerabilities of State Inventory

The following building types, representing a mix of structural type and function, are discussed in this subsection:

1. State Critical Services Buildings
2. Other State-Owned Normal Occupancy Facilities
3. State Criminal Justice Buildings
4. State-Owned Health Services Facilities
5. Public Universities
6. Community Colleges

Cutting across all sub-inventories of vulnerable buildings by function and type are the state-owned and -leased buildings. There are over 25,000 state-owned structures, including over 5,000 university buildings. In addition, there are 2,300 state-leased buildings, with lease terms varying in length. This section discusses the numbers, distribution, square footage, and value of state-owned and -leased properties in high earthquake hazard areas. *Section 6.1.5.2* discusses specific mitigation efforts underway for the inventory types listed below.

1. State Critical Services Facilities

California has no statewide inventory of state critical services facilities, including fire, police, ambulance, and emergency communication facilities. Most of these facilities were built before state standards were adopted governing the design and construction of essential services structures. Therefore, they are not expected to be reliably functional after earthquakes, delaying emergency response and in some cases posing significant risks to life. Key state agencies owning essential services facilities include:

- The California Department of Forestry and Fire Protection (CAL FIRE)
- Caltrans
- The California Highway Patrol (CHP)
- The Department of Water Resources (DWR)
- California Governor's Office of Emergency Services (Cal OES)

2. Other State-Owned Normal Occupancy Facilities

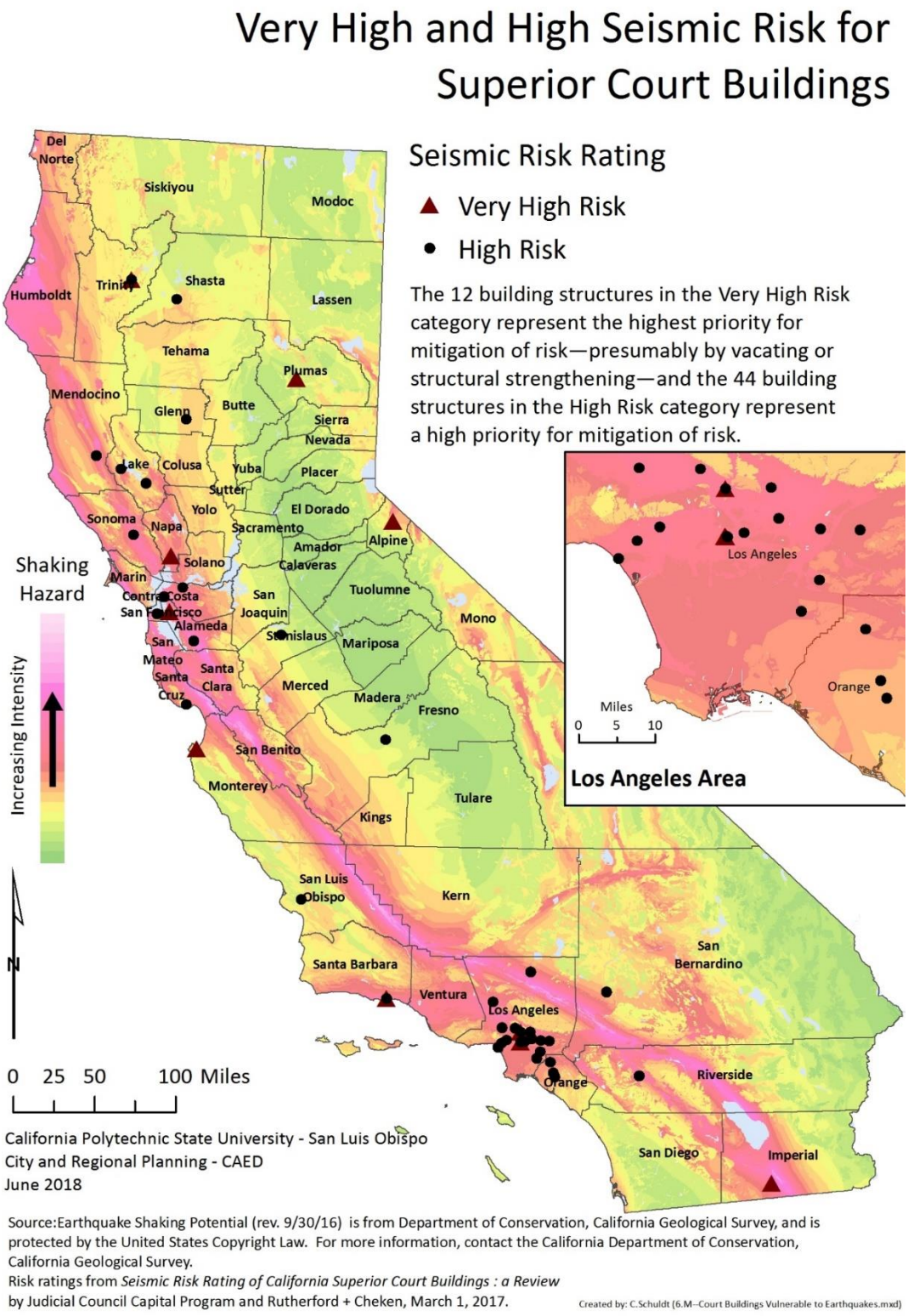
California has an asset management program for non-university buildings that maintains an inventory of over 25,000 buildings with a total of almost 240 million square feet of space.

3. State Criminal Justice and Judicial Court Buildings

A 1979-1980 renovation and planning study funded by the Department of Corrections included seismic evaluations and identification of remedial actions for major state prison buildings. In March 2017, a Seismic Risk Rating Study of California Superior Court Buildings report was published by the Judicial Council Program. This study updated results of a seismic assessment program initiated in 2003, updating building inventory, and enhancing the functionality of the 2003 seismic risk ratings database.

As part of the 2017 study, a Seismic Risk Assessment tool was developed to evaluate risk and prioritize future mitigation for the 145 judicial structures identified as Risk Level V (risk of collapse or major risk to life). The assessment tool uses FEMA's HAZUS modeling algorithm.

Map 6.N: Court Buildings Vulnerable to Earthquakes



Map 6.N shows locations of court buildings determined by the assessment to be at high or very high risk in relation to shaking hazard potential throughout the state. To review the assessment report, visit: http://www.courts.ca.gov/documents/Seismic-Risk-Rating-of-California-Superior-Court-Buildings.pdf.

4. State-Owned Health Services Facilities

The State of California manages seismic risk in its health care facilities through the Department of General Services (DGS), California Department of Health Care Services, and California Department of Developmental Services. The state owns:

- Five mental health hospitals with over 6 million square feet of space
- Three developmental centers with 3.5 million square feet of space
- Two public health laboratories

5. Public Universities

The University of California (UC) and California State University (CSU) systems together have 192 primary and satellite campuses and 10,000 buildings with 138 million square feet of space. Since the early 1970s, UC has been evaluating and retrofitting buildings on its campuses. The system has ranked the seismic safety of its major buildings from "good" to "very poor" (known as III to VI in the 2017 updated version of UC's seismic safety policy) and has embarked on capital outlay programs to retrofit those that are ranked "poor" (or V in accordance with the updated policy) or "very poor" (or VI in accordance with the updated policy). In the early 1990s, CSU initiated a similar program.

6. Community Colleges

In 2000, the community colleges chancellor's office funded a rapid seismic evaluation of buildings constructed to early Field Act standards. The survey found that the community college system has 20 district offices, 108 campuses, 54 off-campus centers, 4,366 buildings overall, and 52.2 million square feet of space. Of the total buildings, 1,600 were given a rapid seismic evaluation to identify retrofit needs that are now integrated into future capital outlay plans.

California Vital Infrastructure Vulnerability Assessment (Cal VIVA)

The California Vital Infrastructure Vulnerability Assessment (Cal VIVA) was begun during preparation of the 2010 SHMP. Its purpose was to develop and test a methodology for assessing the seismic vulnerability of state-owned building stock and critical infrastructure to seismic and other hazards and determine minimum retrofit measures to protect its occupants from harm during a disaster and facilitate recovery by making it quickly operable after a disaster.

The vision for Cal VIVA was to 1) create an infrastructure resiliency planning and evaluation system that includes the long-term systematic screening of the state-owned building inventory, 2) determine potential vulnerabilities within that inventory, 3) systematically plan and set priorities for vulnerable building strengthening, and 4) execute initial building retrofit assessments, subject to project funding, design, and development.

The original Cal VIVA efforts focused on establishing methods for assessing seismic vulnerability of state-owned buildings and recommending retrofit actions. The screening approach/methodology was tested on 19 buildings from four departments: Department of Forestry and Fire Protection (CAL FIRE), California Highway Patrol (CHP), California Department of Transportation (Caltrans), and California Department of Water Resources (DWR). For these selected facilities, the project made recommendations and developed associated costs for mitigating structural and non-structural seismic vulnerabilities should funding become available. There is, however, a remaining gap to identify state-owned or -operated critical facilities and to consider California's highest risk hazards that are also subject to impacts of climate change.

Progress Summary 6.B: Cal VIVA III and the Climate Adaptation Strategy Project 6A

Progress as of 2018: Three increments of the California Vital Infrastructure Vulnerability Assessment (Cal VIVA) have been initiated and completed. Final reports for the first and second projects Cal VIVA I and II were completed in March 2013. Cal VIVA I had three primary activities: 1) develop a standardized methodology to identify necessary mitigations of seismic vulnerabilities in buildings that are critical to response and recovery efforts after an earthquake, 2) test the methodology and 3) improve the methodology based on lessons learned.

Cal VIVA II, the second project used the seismic vulnerability assessment methodology developed in Cal VIVA I to examine two areas: 1) the conceptual development of a prototypical department plan for mitigation of seismic vulnerabilities in critical state-owned buildings, and 2) determination of the seismic vulnerability with resultant mitigation of selected state-owned, high-occupancy office buildings housing state employees critically needed for post-earthquake response and recovery operations.

The third project, Cal VIVA III, prepared in association with the Earthquake Engineering Research Institute (EERI), was completed in November 2013. Cal VIVA III tested and refined the Cal VIVA II prototypical department plan with an individual user department and produced a template that can be used by departments and agencies within state government to systematically address critical building vulnerability and potential retrofits on a long-term basis.

Since 2015, portions of the Cal VIVA project assessment model have been used as the basis for a new project from the Fourth Climate Change Assessment called "*Assessing Vulnerability and Improving Resilience of Critical Emergency Management Infrastructure in a Changing Climate,*" also known as "Project 6A." Project 6A seeks to establish and implement an ongoing system to prioritize projects in relation to their relative importance to the continuity of state government and recovery operations following a natural disaster, with particular emphasis on providing resilience to disadvantaged communities. Whereas Cal VIVA was a system to assess seismic integrity of state owned buildings, it did not address other climate change variables nor did it establish a way to set budget priorities or how to choose the importance of the infrastructure to state needs after a disaster event. This project pulls from and fills some of the gaps in the Cal VIVA effort, by providing data related to the risk scores for assets and critical infrastructure systems, and their operators.

6.1.4 ASSESSMENT OF LOCAL EARTHQUAKE VULNERABILITY AND POTENTIAL LOSSES

This section addresses local earthquake hazard vulnerability and potential losses based on estimates provided in local risk assessments, comparing those with findings of the state risk exposure findings presented in the GIS analysis in *Section 4.4.4* of *Chapter 4: Profiling California's Setting*.

6.1.4.1 EARTHQUAKE VULNERABILITY OF BUILDINGS

This section discusses statewide and local vulnerability of buildings susceptible to earthquake damage, the greatest single factor contributing to California's potential future losses from earthquakes. It provides an overview of building vulnerability and potential structural losses from fires following earthquakes. It then reviews vulnerability with respect to a series of building sub-inventories, including private structures as well as state-owned and -leased buildings. The section is organized to provide the link between vulnerabilities of key building inventories by function and structural type. Mitigation progress for the building inventories described below is discussed in *Section 6.1.5.2*.

Building Vulnerability to Earthquake Damage

Compared to other earthquake vulnerabilities, buildings pose the largest risk to life, injury, property, and economic welfare. California has approximately 14 million buildings, with an average of 2.7 occupants per building. Approximately 95 percent are low-rise (one to three stories), 5 percent are medium-rise (four to seven stories), and 0.03 percent are high-rise buildings (eight or more stories).[101] Observations after earthquakes indicate that building

[101] Jones, et al. ATC 13.

safety is most often compromised by poor quality in design and construction, inadequate maintenance, lack of code enforcement at the time of original construction, and improper alterations to the original building.[102]

A less common cause of damage is the poor performance of older buildings built to earlier seismic codes. Approximately 13 percent of California's buildings were constructed before 1933, when explicit requirements for earthquakes first began to be incorporated into building codes and the state first required local governments to create building departments and issue permits.

About 18 percent of California's buildings were constructed before 1940, when the first significant strong motion recording was made in El Centro. About 40 percent of the state's buildings were constructed before the Structural Engineers Association of California's first statewide consensus on recommended earthquake provisions were published in 1960. About 60 percent were built before the mid- to late-1970s, when significant improvements to lateral force requirements began to be enforced throughout the state. California did not have uniform adoption of the same edition of model codes in every jurisdiction until the early 1990s. Thus, well over half of all existing buildings in California are built to earlier standards that, in many cases, can result in inadequate earthquake performance.

Nonstructural building components can also become vulnerable to damage during earthquakes. Ceilings, air conditioning equipment, plumbing and water heaters, windows, chimneys, appliances, and stone veneer are examples of non-structural components that may become damaged as a result of earthquake ground shaking.

Vulnerabilities by Building Sub-Inventories

The following building types, representing a mix of structural type and function, are discussed in this section:

1. Locally Regulated Critical Services Facilities
2. Local Kindergarten through 12th Grade (K-12) Public Schools
3. Hospitals
4. Steel-Frame Buildings
5. High-Rise Buildings
6. Locally Regulated Non-Ductile Concrete Buildings
7. Locally Regulated Unreinforced Masonry (URM) Buildings
8. Tilt-Up Buildings
9. "Soft-Story" Buildings
10. Multi-Unit Wood-Frame Residential Buildings
11. Single-Family Wood-Frame Dwellings
12. Mobile/Manufactured Homes

[102] California Seismic Safety Commission, "Turning Loss to Gain," CSSC 95-01.

2014 South Napa Earthquake, Non-Structural Damage: Chimney Collapse



Source: Janiele Maffei, California Earthquake Authority

Among the more vulnerable structures susceptible to potential loss in earthquakes are 25,945 unreinforced masonry (URM) buildings in high seismicity regions (as of 2006, 70 percent retrofitted or replaced), and approximately 4,000 URM buildings in moderate seismicity regions, as well as approximately 57,000 tilt-up buildings, over 20,000 non-ductile concrete structures,[103] 46,000 soft-story apartments, 1.5 million vulnerable single-family dwellings, and approximately 560,000 mobile homes,[104] in varying stages of retrofit.

1. Locally Regulated Critical Services Facilities

California has no statewide inventory of locally regulated essential services facilities, including fire, police, ambulance, and emergency communication facilities. Most of these facilities were built prior to 1986, before state standards began to require enhanced seismic safety, and are not expected to be reliably functional after severe earthquakes, delaying emergency response and in some cases posing significant risks to life. The Department of General Services (DGS) estimates there are approximately 900 fire stations, 400 emergency operations centers, and 450 police stations throughout California.

[103] Comartin et. al., 2011. Retrieved on April 25, 2018 from http://www.concretecoalition.org/

[104] Understanding the Seismic Vulnerability of Manufactured Homes Report, AIR, October 23, 2017. Retrieved on April 25, 2018. http://www.air-worldwide.com/Publications/AIR-Currents/2017/Understanding-the-Seismic-Vulnerability-of-Manufactured-Homes/

2. *Local K-12 Public Schools*

The California Department of Education reports there are over 10,000 public schools in California. Since 1933, public schools have been constructed in accordance with the Field Act, which requires thorough reviews of construction plans, strict inspections, and quality control by the Division of the State Architect (DSA). By 1977, nearly all public schools that were built before the Field Act had either been retrofitted or were no longer being used for instructional purposes.

The Field Act did not begin to regulate non-structural systems and building contents in schools until the 1970s. Many schools, particularly older public schools, contain falling hazards that can injure occupants. Assembly Bill 300, enacted in 1999, required DGS to survey all the public school buildings (K-12) in the state for seismic safety issues.

3. *Hospitals*

Since 1973, hospitals have been required to be built to higher standards than other buildings so they can be reoccupied after major earthquakes. However, most hospitals built before 1973 still remain in service, and some of them pose risks to life or are not expected to be available for occupation after future earthquakes. The 1973 Alquist Hospital Facilities Seismic Safety Act (HFSSA) designated the Office of Statewide Health Planning and Development (OSHPD) as the enforcement agency of the HFSSA mandates. OSHPD's primary objective is to safeguard the public health, safety, and general welfare through regulation of the design and construction of healthcare facilities, to ensure they are capable of providing sustained services to the public.

4. *Steel-Frame Buildings*

A welded steel moment-frame building is an assembly of beams and columns, rigidly joined together to resist both vertical and lateral forces. The buildings are designed to rely on these connections between beams and columns to resist ground movements caused by earthquakes. Until the 1994 Northridge Earthquake, this type of construction was considered an effective seismic-resistant structural system. At the time of the Northridge Earthquake, there were about 2,000 welded steel-frame buildings in Los Angeles. The city required an inspection of nearly 200 buildings in areas that experienced the most intense ground shaking; about 30 of those buildings sustained significant damage.

A FEMA study found that the damage sustained by steel-frame buildings was the result of a number of factors, including construction defects such as welds that were not bonded well with steel columns, changes in material properties of weld metal and structural steel, and a prescriptive design spelled out in building codes whose connection configurations became problematic and unreliable when used with large beams and columns. (For additional study details go to: https://www.fema.gov/news-release/2001/04/18/study-earthquake-proof-steel-frame-high-rises-concluded-fema-issues-new.) Elsewhere in the state no surveys of such buildings exist, although several similarly damaged buildings were discovered in the Bay Area years after the 1989 Loma Prieta Earthquake. An article published in the April 2017 issue of the Journal of the International Association for Earthquake Engineering estimated that the expected annual losses from earthquakes on steel moment frame buildings varies from 0.38 percent to 0.74 percent over the building life expectancy.

5. *High-Rise Buildings*

There is no statewide inventory of high-rise buildings. Only approximately 0.03 percent of all buildings in the state have eight or more stories. However, much of California's corporate, finance, legal, and insurance commerce takes place in these buildings. The potential for loss of market share in the economy from the closure of these buildings after earthquakes due to non-structural damage is significant. The Council on Tall Buildings and Urban Habitat maintains an inventory of high-rise buildings at: www.ctbuh.org.

6. Locally Regulated Non-Ductile Concrete Buildings

There is no statewide inventory of concrete buildings. However, the Concrete Coalition estimated in 2011, that there are approximately 20,000 to 23,000 non-ductile concrete buildings within California, including residential, commercial, school, and critical services buildings, of which 16,000 to 17,000 are in high seismicity areas.[105] According to the Concrete Coalition, the City of Los Angeles alone has over 1,500 older concrete buildings and San Francisco has an estimated 3,000 older concrete buildings.

These buildings, particularly older ones with high numbers of occupants, can collapse and kill hundreds. This type of building is the fastest-growing cause of earthquake losses around the world.[106] California instituted changes in building codes in the mid-1970s that were intended to stem losses in newer buildings constructed to later standards. However, the great majority of these buildings constructed before the mid-1970s have not been evaluated or retrofitted.

Two specific types of non-ductile concrete construction are flat slabs and lift slabs. With lift slab construction, concrete slabs are cast on the ground, lifted into place, and then connected to columns. Flat slabs are cast-in-place, and connect to columns without beams. Historically, both types of construction were often designed without adequately accounting for the full movement a building will experience during an earthquake and older such buildings can therefore be prone to slab failure during a large earthquake.

7. Locally Regulated Unreinforced Masonry Buildings

Unreinforced masonry (URM) buildings are made of brick, stone, or other types of masonry and have no reinforcing steel to keep them from collapsing or partially collapsing in earthquakes. Most URM buildings have features that can threaten lives during earthquakes. These include parapets, walls, and roofs that are poorly connected to each other. When earthquakes occur, inadequate connections in these buildings can allow masonry to fall, placing occupants and passersby in harm's way. Floors and roofs can also collapse.

The risk to life from URM buildings can be significantly reduced by the regulation of alterations to existing buildings and seismic retrofits. California has prohibited the construction of new URM buildings since 1933. However, many URM buildings still remain in use today in California's older commercial and industrial districts in high seismic hazard regions.

8. Tilt-Up Buildings

Tilt-up buildings are typically one- or two-story buildings constructed of concrete walls that are poured horizontally, tilted into vertical positions, and connected to each other and to roofs. If the connections between the walls and roofs are weak, the walls can pull away from roofs and collapse during ground shaking.

There is no statewide inventory of tilt-up buildings. However, a 1991 estimate suggested that there were approximately 57,000 throughout the state.[107] Forty percent of these were built prior to 1976, after which building codes began to require stronger wall-to-roof connections. Many tilt-up buildings have been constructed in the past decade, generally to more current construction standards. Additional enhancements to the building code for new tilt-up construction were adopted in 1997.

[105] Comartin, C., Bonowitz, D., Greene, M, McCormick, D., May, P., Seymour, E. (2011). The Concrete Coalition and the California Inventory Project: An Estimate of the number of Pre-1980 Concrete Buildings in the State. Final Draft. August. Oakland, CA: The Earthquake Engineering Research Institute.
[106] Coburn, 2002
[107] EQE, 1991

2014 South Napa Earthquake, Unreinforced Masonry Wall Collapse



Source: Janiele Maffei, California Earthquake Authority

9. "Soft-Story" Buildings

Multi-unit residential structures with soft, weak, or open fronts are commonly referred to as "soft-story" buildings. Soft-story residential buildings are multi-story wood-frame structures with inadequately braced lower stories that may not be able to resist earthquake motion.

Soft-story buildings are an important component of the state's housing stock and are in jeopardy of being lost in the event of severe shaking. For example, the Association of Bay Area Governments (ABAG) has estimated that soft-story residential buildings will be responsible for 66 percent of the uninhabitable housing following an earthquake on the Hayward Fault. The failure of soft-story residential buildings is estimated by ABAG to be the source of a disproportionate share of the public shelter population because such structures tend to be occupied by the very poor, very old, and very young.

10. Multi-Unit Wood-Frame Residential Buildings

There is no statewide inventory of multi-unit wood-frame residential buildings. However, the approximate number of buildings can be inferred from local inventories available from select cities as summarized below. A significant number (perhaps one-third) of all apartments and condominiums have parking at the lower levels, which can create earthquake vulnerabilities. These buildings can collapse and cause casualties and property loss and be rendered uninhabitable after earthquakes. Up to 84 percent of the loss of housing in a Hayward Fault earthquake scenario is expected to occur in multi-family residential buildings.[108]

[108] ABAG, 1999

11. Single-Family Wood-Frame Dwellings

Approximately 1.5 million single-family dwellings were built in California before 1960, when jurisdictions began to require adequately braced walls. Homes can slide or fall off their foundations if not adequately anchored and braced.

The primary risk posed by single-family wood-frame buildings is the potential for loss of housing and property after earthquakes. In addition, poorly braced homes on steep hillsides can slide down hills and present significant threats to life. Falling chimneys can also cause casualties and damage.

12. Mobile/Manufactured Homes

California has approximately 393,000 mobile/manufactured homes within mobile home parks. The Department of Housing and Community Development (HCD) regulates mobile/manufactured home installations in approximately 3,648 of the state's 4,556 mobile home parks and inspects alterations to all state mobile/manufactured homes. Local governments have enforcement jurisdiction over 908 mobile/manufactured home parks, as well as mobile/manufactured home installations outside of parks.

In 1994, HCD began to require engineered tie-down devices during mobile/manufactured home installations to resist wind loads of 15 pounds per square foot or the design wind load of the homes, whichever is greater. However, most homes installed prior to 1994 are not attached to engineered tie-down systems to resist horizontal loads.

Homes on inadequate foundations can shift and fall several feet in earthquakes, severing gas lines. During the Northridge Earthquake, approximately 95 percent of unbraced mobile homes fell off their foundations. Risk of fire during an earthquake event is also increased as a result of broken gas connection lines when mobile homes collapse or shift off their foundations. Doors can become stuck, trapping occupants and creating serious threats to life in events with fires.[109]

Fires Following Earthquake

While ground shaking may be the predominant agent of damage in most earthquakes, fires following earthquakes can also lead to catastrophic damage depending on the combination of building characteristics and density, meteorological conditions, and other factors. Fires following the 1906 San Francisco Earthquake, 1923 Tokyo Earthquake, and 1995 Kobe Earthquake caused extensive damage and killed thousands.

Fires following the 1906 San Francisco Earthquake led to more damage than was caused by ground shaking. Most recently, fires in the Marina District of San Francisco following the 1989 Loma Prieta Earthquake and in Los Angeles following the 1994 Northridge Earthquake demonstrate that fires following earthquakes pose a significant hazard, especially in densely populated urban areas, and a potentially serious problem due to severe strain on the fire departments that must respond to multiple simultaneous ignitions. Fire department response is often affected by impaired communications, water supply, and transportation, together with other emergency demands such as structural collapses, hazardous materials releases, and emergency medical aid.

Fires following earthquakes may result from multiple causes (e.g., overturned burning candles, electrical sparking from downed power lines, and broken natural gas pipelines[110]). Numerous instances of serious fires following earthquakes have occurred in major urban areas. Fires following earthquakes can occur immediately after an earthquake or may be delayed. Causes of fires occurring immediately after include power lines that are fused or broken, with the resulting arcing coming into contact with combustible fuel; water heaters, stoves, and lighting fixtures/lamps that are dislodged and come into contact with combustible fuel; natural gas mains, lines, and service that are severed, with the released gas finding a source of ignition; and combustible liquids that leak and find a source of ignition.

[109] SSC 95-01, Turning Loss to Gain

[110] A complete list may be found in Fire Following Earthquake, Edited by Charles Scawthorn, John Eidinger, and Anshel Schiff. Technical Council on Lifeline Earthquake Engineering, Monograph No. 26. Published by the American Society of Civil Engineers. January 2005.

Fires that are delayed are generally human-caused or preventable (for example, fire caused by the restoration of electricity to an area not properly checked and secured). When power is restored, heating of electrical appliances can occur followed by ignition. Inexperienced people can start fires by trying to relight gas pilots. Vulnerability to fires following earthquake can be assessed for communities by well-established simulation models.

Several computer programs (e.g., HAZUS, EQEFIRE, URAMP, SERA, and RiskLink) are available to assess the fire-following-earthquake vulnerability of a community in future earthquakes. Details of various computer-modeling techniques are described in the book Fire Following Earthquake.[111]

6.1.4.2 EARTHQUAKE VULNERABILITY OF LIFELINE INFRASTRUCTURE

California's lifeline infrastructure is extensive and complex. Lifeline infrastructure is any continuously engineered system providing transportation, communication, water, power or other distributed utility services.

There is no comprehensive database for seismic hazard assessment or mitigation for lifelines as a group or for particular types of lifelines. However, various groups have collected data on the performance of utilities and transportation systems during and after earthquakes in California and elsewhere. The data collection and analysis effort has been applied on an irregular basis to various utility components. This is primarily due to the fact that a great deal of California's lifeline infrastructure has been in existence since before the 1971 San Fernando Earthquake. As new standards and guidelines have been developed, lifeline providers have been using new data and design techniques to assess seismic hazards for power plants, electrical transmission and distribution systems, natural gas pipelines, water supply lines (including canals and aqueducts), and dams for new projects and seismic retrofit projects. Caltrans and local governments have also been retrofitting bridges using new design techniques and new standards and guidelines.

Data regarding locally owned transportation retrofit activities are not monitored in California. However, several facilities and utility providers are known to have taken action for seismic hazard mitigation. These facilities include ports and airports, and utility providers include the Port of Los Angeles, East Bay Municipal Utility District (EBMUD), Pacific Gas & Electric, and Bay Area Rapid Transit.

Experience gained after assessing earthquake performance of utilities and transportation systems points to the following:

1. Various degrees of damage affect the functionality of utilities, roads, bridges, ports, or airports. The extent of damage is related to the severity of the seismic hazard at the facilities in question, quality of the soils or rock at and adjacent to the site, design criteria used in building the facilities, and age and condition of the facilities. Those facilities of high-quality construction and built on good soil or rock tend to perform better than those built on poor soils.

2. Typical design standards for utilities and transportation systems focus on preventing the loss of lives and reducing property damage but do not guarantee that the facility will remain functional after an earthquake.

3. Fault rupture and seismic-induced landslides have caused breakage of pipes and offsets in the foundations of electrical power towers, roads, and buildings.

[111] Scawthorn, et al. January 2005.

Observations of damage from California earthquakes have also shown that ground shaking may be locally attenuated but then be amplified farther away due to differential soil conditions and structural response. Such was the case in the 1999 Hector Mine Earthquake when an oil storage tank near Wilmington (over 100 miles from the epicenter) was damaged while minimal or no damage was observed in cities between the epicenter and the tank. Ground shaking may also damage aboveground pipelines and their support framing in a similar manner.

This section discusses the following:
1. Electrical utilities
2. Pipeline networks: oil and natural gas
3. Petrochemical facilities: oil refineries and liquefied natural gas facilities
4. Localized water and wastewater pipelines and treatment facilities
5. Statewide water system: aqueducts, canals, levees, dams, and reservoirs
6. Solid waste disposal systems
7. Transportation systems
8. Ports and harbors
9. Communication systems

For additional information regarding lifeline systems, see *Annex 3* of this document.

1. Electrical Utilities

California has 31,721 miles of electric transmission lines and up to double that amount in the electric distribution system. In addition, California has 188 operational power plants varying in size from 50 megawatts to over 2,000 megawatts, generating a total of up to 53,700 megawatts. California also imports, to various degrees throughout the year, electric power from outside of the state. Several assessments of electric power generation, transmission, and distribution systems have been performed following California earthquakes as well as earthquakes in Japan and elsewhere. See Map 6.O for an overview of the state electrical grid.

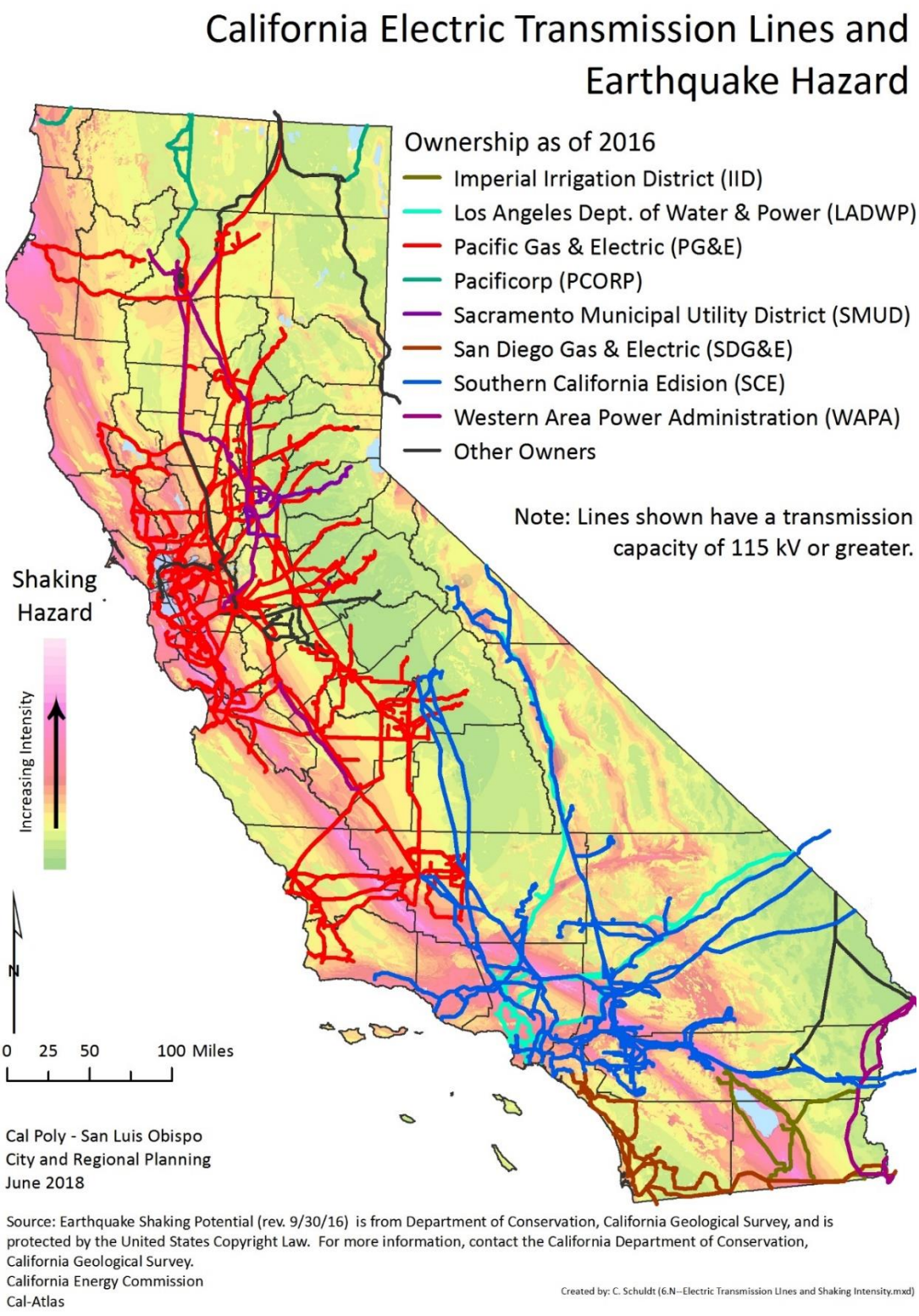
Vulnerabilities

No statewide, comprehensive seismic hazard vulnerability inventory for electrical power generation, transmission, and distribution exists in California. However, some individual electric utilities have assessed their system vulnerability with respect to seismic hazard. Additionally, through HAZUS and other earthquake planning scenarios developed for Northern and Southern California, potential vulnerability has been identified. See *Section 6.1.3.1* for more information.

The greatest vulnerability is from strong ground shaking. High-voltage sub-stations or switchyards are particularly vulnerable for two reasons: 1) sub-stations and switchyards tend to be key facilities in the ability of a distribution or transmission system to reroute power around or to areas affected by earthquakes, and 2) some high-voltage sub-station and switchyard equipment is relatively brittle.

The amounts of recorded sub-station and switchyard damage after the 1971 San Fernando Earthquake, 1986 Palm Springs Earthquake, and 1994 Northridge Earthquake highlight these two vulnerabilities. The ground motion hazard is generally the greatest hazard overall. In regions struck by earthquakes, it is likely that vulnerable electric power equipment is in the area of strong ground shaking. Earthquake shaking can cause electrical lines to slap together, causing the lines to catch fire. Shaking can also result in dynamic response of transformers and other structural components, resulting in damage and loss of transmission.

Map 6.O: Electric Transmission Lines and Earthquake Hazard



As shown in Map 6.O, the highest concentration of electrical transmission lines in both Northern and Southern California are in areas at risk from high shaking intensity.

In California, significant seismic hazard mitigation research has been conducted by electric utilities and researchers through organizations such as the Pacific Earthquake Engineering Research Center. Mitigation research products and results are making their way into new construction, purchasing, and siting decisions for all aspects of the electric utility industry in California.

Other vulnerable aspects of electrical transmission distribution and generation facilities include:

- Landslides that can damage electric transmission or distribution towers, substations, or switchyards.
- Ground deformation such as subsidence or lateral spreading from liquefaction that can cause a misalignment in the power train of an electric power plant. Typically, such problems can be mitigated by careful assessment of the potential for on-site liquefaction and the proper design of foundations.

Interdependency on Electric Power

A key aspect of vulnerability is the potential for loss of electrical power in:

- Natural gas pipelines, including compressor and pumping stations
- Oil transmission pipelines and pumping stations
- Oil, natural gas, or water storage facilities
- Water supply systems and pumping stations
- Wastewater treatment and disposal systems

All of these systems rely on electric power; so when power is disrupted the services are interrupted. In some cases, automatic shut-off valves and emergency power systems such as diesel generators have reduced this risk. Ground waves move at the speed of sound while electronic signals travel at the speed of light providing an opportunity for smart valve intervention.

2. Pipeline Networks: Oil and Natural Gas

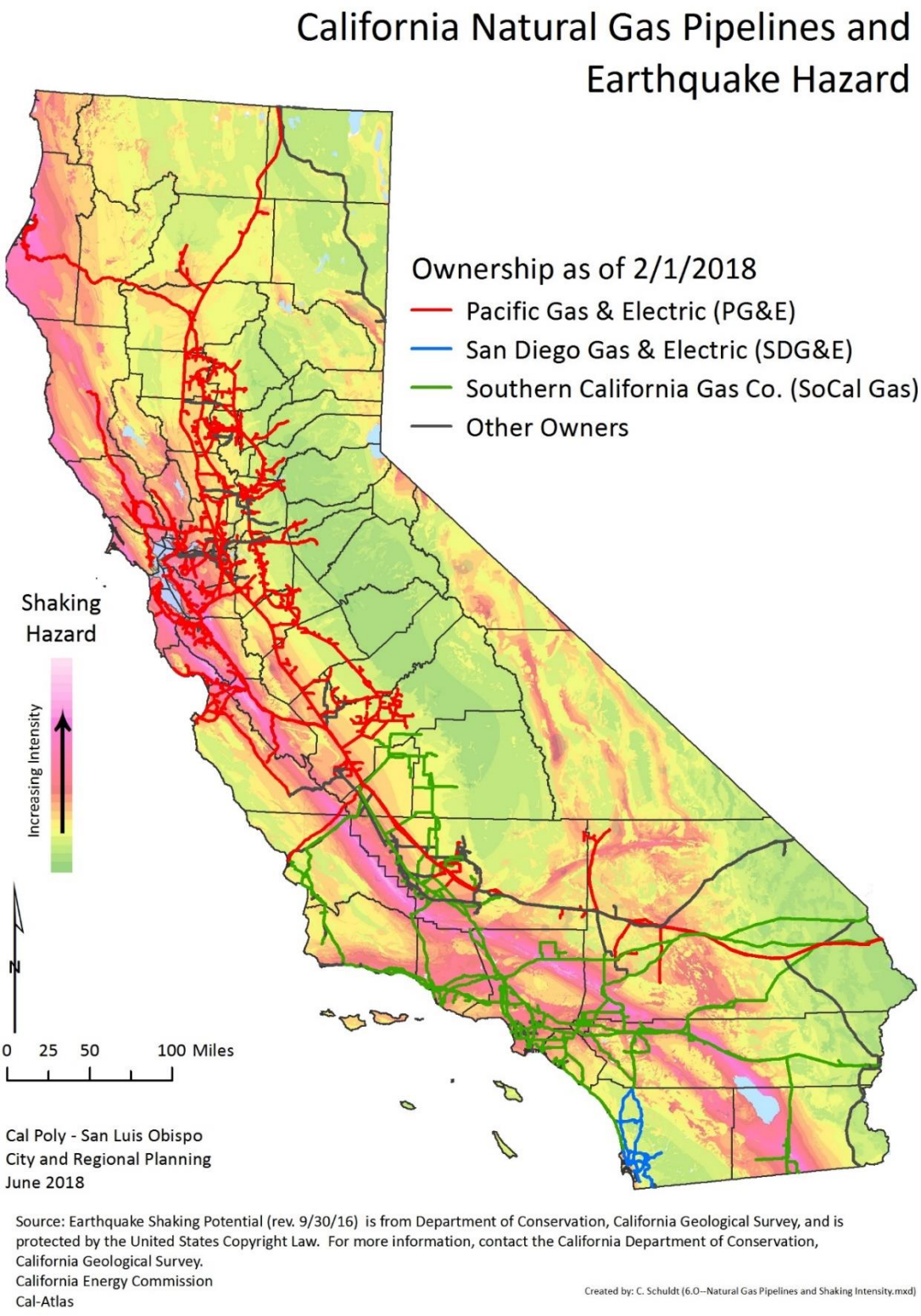
California is reported to have 12,414 miles of natural gas transmission pipeline (*see Section 9.2.3*) and for more information on California's natural gas pipelines). No comprehensive statewide seismic hazard vulnerability inventory for pipeline networks exists in California. However, several regional utilities have assessed their natural gas pipe works with respect to seismic hazard. Municipalities, special jurisdictions, and the state also own pipelines. Additionally, through HAZUS and other earthquake planning scenarios developed for Northern and Southern California, potential vulnerability has been identified.

A significant contributor to pipeline failure after an earthquake is liquefaction. When soil liquefies it can lose shear strength or shear resistance, essentially becoming a fluid with the density of soil. If a pipeline or any other underground structure has a density less than the liquefied soil, it is then subjected to buoyant forces and thrust to the surface. This happens with underground pipes, tanks, and other low-density structural and non-structural components. In the larger view, severe disruptive impacts of a catastrophic earthquake could occur in California due to inadequate design and/or deteriorating conditions of aging gas transmission pipelines.

The recent earthquakes around Christchurch, New Zealand, have provided useful data on pipe performance. O'Rourke et al (2014) found that high-density polyethylene used for gas mains handled large ground deformations with the least amount of loss of service when compared to other pipe material types. Ongoing research has shown that this material can also sustain deformations from fault rupture, slides, and other large strain mechanisms.[112]

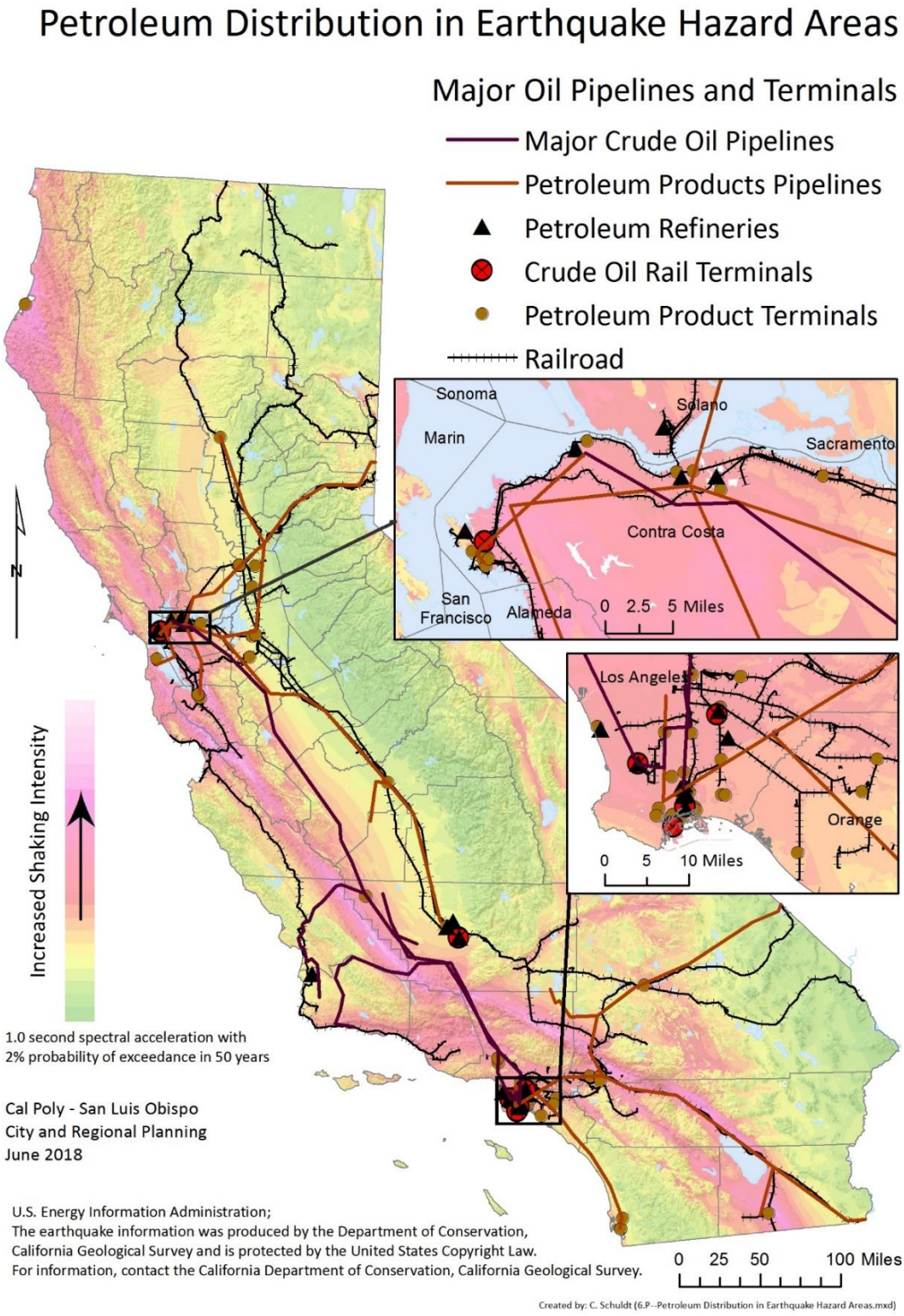
[112] Thomas D. O'Rourke, Sang-Soo Jeon, Selcuk Toprak, Misko Cubrinovski, Matthew Hughes, Sjoerd van Ballegooy, and Dimitra Bouziou (2014) Earthquake Response of Underground Pipeline Networks in Christchurch, NZ. Earthquake Spectra: February 2014, Vol. 30, No. 1, pp. 183-204.

Map 6.P: Natural Gas Pipelines and Earthquake Hazard



Map 6.P shows that, as with electrical transmission lines (as shown in Map 6.O), the highest concentration of natural gas pipelines in both Northern and Southern California are in areas at risk from high shaking intensity.

Map 6.Q: California's Petroleum Distribution System and Earthquake Hazard



Map 6.Q illustrates the location of the petroleum distribution system within California and the potential vulnerability to seismic shaking.

3. *Petrochemical Facilities: Oil Refineries and Liquefied Natural Gas Facilities*

California has major petrochemical facilities that include:

- Oil refineries
- Oil storage facilities
- Gasoline storage facilities
- Liquefied natural gas facilities
- Marine oil terminals

4. *Localized Water and Wastewater Pipelines and Treatment Facilities*

Water filtration plants and wastewater treatment facilities are often located in areas subject to severe ground shaking and liquefaction, flooding, or tsunami inundation. Damage to water filtration plants can result in disruptions of clean water supplies. Damage to wastewater treatment facilities or their intake pipe works or effluent disposal systems can result in immediate serious public health hazards. Loss of power can also lead to discharges of partially treated or untreated effluent into waterways or the ocean.

In addition to the potential hazards from damage to filtration systems, impacts on water quality, and infectious disease concerns, there is also a chance for chemical releases of disinfection products, such as chlorine, used in waste and other water treatment facilities to occur during a seismic event.

The epicenter of the 1994 Magnitude 6.7 Northridge Earthquake was near the middle of the San Fernando Valley in Los Angeles. Strong ground motion caused moderate damage to two wastewater treatment plants, one owned by the Los Angeles Department of Water and Power (LADWP) and the other by the Metropolitan Water District of Southern California. LADWP had approximately 1,000 pipeline failures including about 35 in transmission lines. Most of the failures occurred in cast iron pipe. About half of San Fernando Valley was without water, and restoring household service took nearly two weeks. Restoring full functionality took much longer.

In the larger view, severe disruptive impacts of a catastrophic earthquake could occur in California due to inadequate design and/or deteriorating conditions of aging water transmission pipelines and wastewater collection pipelines. This is especially true for Southern California, where much of the water supply is transported from long distances, through 900 miles of canals and tunnels. The 2008 Great ShakeOut scenario in Southern California identified fires and serious long-term disruptions to imported water delivery as potential consequences from severed gas and water transmission pipelines in a Magnitude 7.8 earthquake, particularly for pipelines crossing the San Andreas Fault. Scawthorn's 2003 Earthquake Engineering Handbook documented the need for greater attention in urban areas to potential fires following earthquakes and disruption of water supply for fire-fighting response where water systems are damaged or destroyed by earthquakes.[113]

It has been found that in recent seismic events that polyvinyl chloride (PVC) has outperformed other materials for gravity wastewater pipes. Polyethylene performed well for pressurized water main pipes and is recognized as having good seismically resilience properties.[114]

Map 6.R shows the proximity of Southern California water supply infrastructure to faults and risk of exposure to high shaking intensity. This infrastructure, along with dams and reservoirs throughout the state, are major sources of water supply. These sources are supplemented by a complex water delivery system that provides water directly to the user.

[113] Scawthorn, et al. January 2005.

[114] Bill Noell (2013) Seismic Performance of Plastic Pipe Systems in 2010/2011 Canterbury Earthquakes. https://www.pdp.co.nz/wp-content/uploads/2018/04/2015-Noell-Seismic-performance-of-plastic-pipes-systems-in-2010-111.pdf

The 2014 South Napa Earthquake highlighted the vulnerability of water and wastewater systems to earthquake-related ground failure, the additional fire hazards that earthquake-related water-system failures can pose, and the fiscal challenges that public agencies face in improving the seismic resiliency of these systems, both pre- and post-earthquake.[115]

In the 1989 Loma Prieta Earthquake, 90 percent of the water main breaks were due to liquefaction, primarily in the Marina District of San Francisco. The East Bay Municipal Utility District (EBMUD), which services Alameda and Contra Costa Counties, also suffered breakages that raised concerns about the vulnerability of its system. This spurred EBMUD to review its entire water distribution network, including the major transmission pipes critical to water delivery, 4,100 miles of distribution system pipes, 140 pumping plants, 170 neighborhood reservoirs (tanks storing treated drinking water), and five treatment plants.

Scenarios developed by FEMA to inform the preparation of the Bay Area Earthquake Plan (BAEP), using the HAZUS model, projected that, in response to a 7.0 Magnitude earthquake occurring on the Hayward Fault or a 7.8 Magnitude earthquake occurring on the San Andreas Fault, over 3.5 million residents would be without water, with 25 percent to 30 percent still not having water restored after 90 days.

5. Statewide Water System: Aqueducts, Canals, Levees, Dams, and Reservoirs

California uses over 1,200 dams and thousands of miles of levees to meet its water supply, conveyance, and flood protection demands. Although two-thirds of California's water supply generally originates in the northern third of the state, two-thirds of the population resides in the southern third. Southern California is heavily dependent upon water brought by the canals and tunnels comprising the Los Angeles Aqueduct, Colorado River Aqueduct, and State Water Project. The greatest weakness of this system is liquefaction-induced failures caused by strong ground shaking.[116]

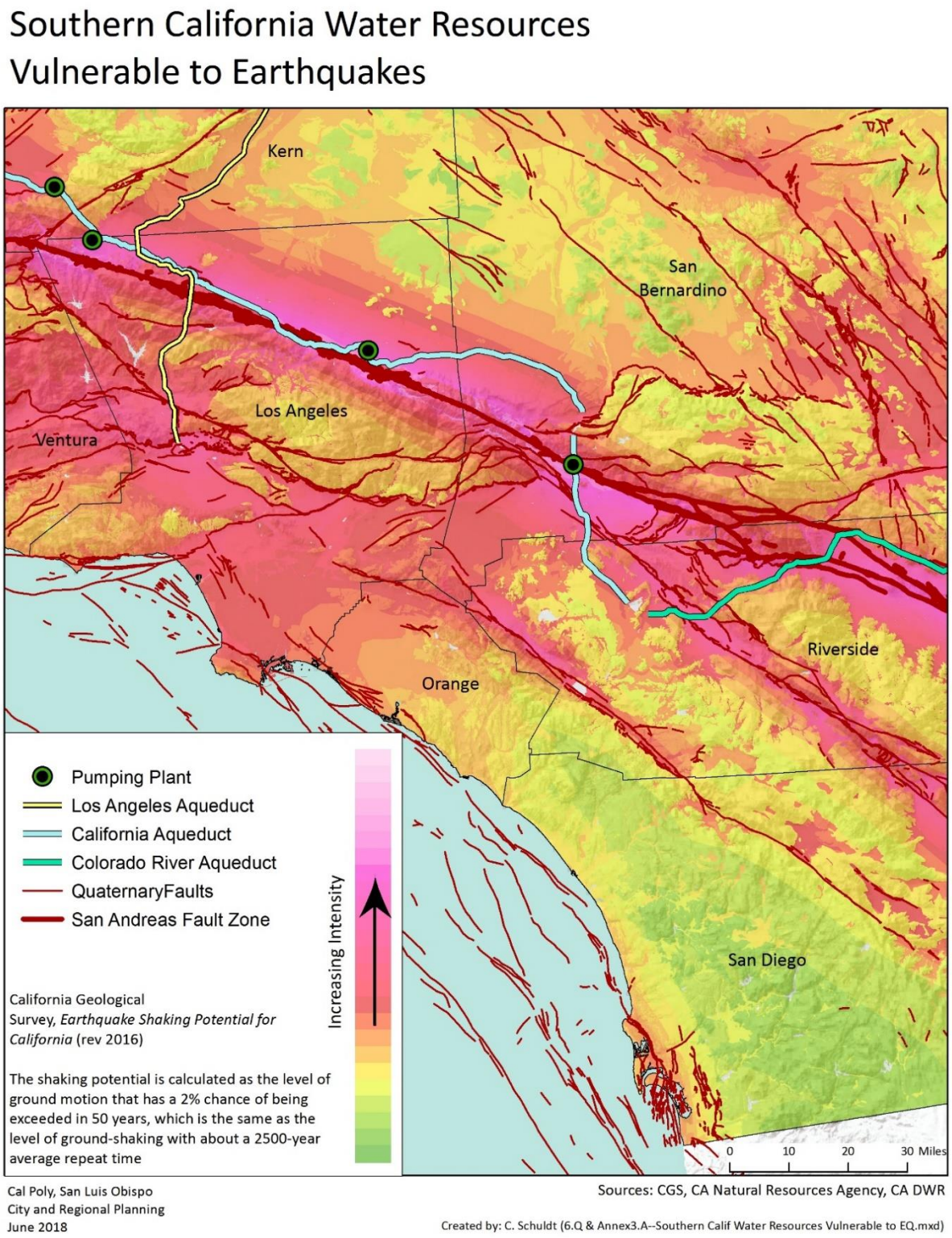
Dams are a major component of this water collection and delivery system. Earthquake instrumentation of dams was begun after the 1971 Sylmar Earthquake, and though the effort continues with strong motion instrumentation projects conducted by the California Geological Survey (CGS) and Department of Water Resources (DWR), fewer than 45 dams have adequate instrumentation as of late 2017. Modern adequate instrumentation can provide the data to assist with rapid assessment of the health of a dam after significant earthquakes.

During the 1971 Sylmar Earthquake, the Lower San Fernando Dam, which is upstream from a heavily populated area, was severely damaged from liquefaction. Though heavily damaged, the dam was not breached and no dam failure-induced flooding occurred. The 1971 earthquake also initiated a major slide on the downstream slope of the Upper San Fernando Dam, which was also damaged as a result of the earthquake. The Lower San Fernando Dam, which was being used only for flood control purposes, was damaged again during the 1994 Northridge Earthquake.

Several other dams have experienced damage during earthquakes. The Department of Water Resources (DWR) Division of Safety of Dams (DSOD) regulates approximately 1,250 dams and has been working with dam owners to periodically assess dam safety. Several dam owners have rehabilitated their dams.

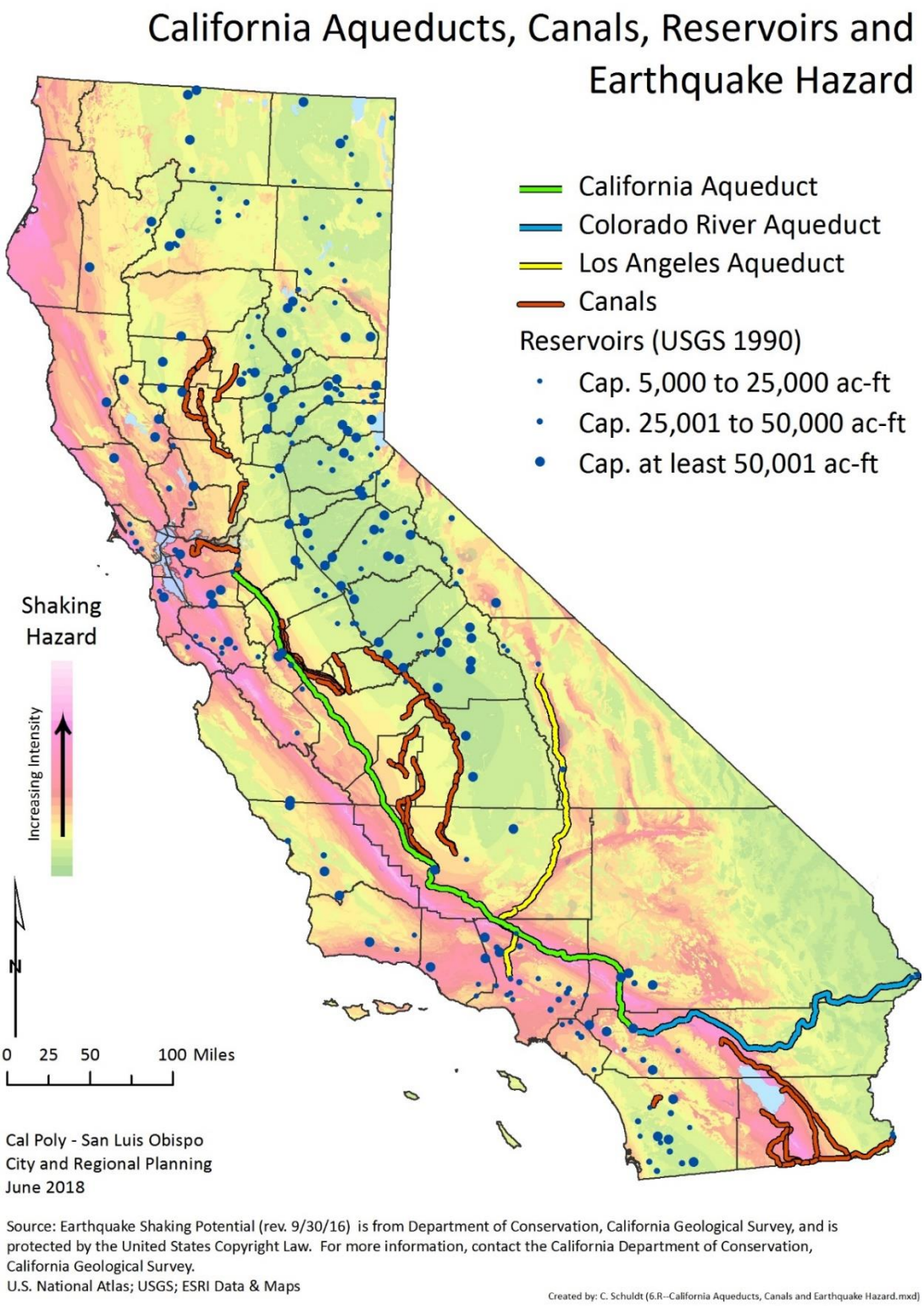
[115] California Seismic Safety Commission
[116] Torres, et al., 2000

Map 6.R: Southern California Water Resources Vulnerability to Earthquakes



Map 6.R shows an example of a location where the state's water conveyance system is located in areas with high shaking intensity potential.

Map 6.S: California Aqueducts, Canals, Reservoirs, and Earthquake Hazard



Map 6.S shows the massive, complex system of state and federal aqueducts and canals by which water is transferred within the 10 hydrologic regions of California. The three major aqueducts transporting water to Southern California together traverse nearly 1,000 miles.

6. Solid Waste Disposal Systems (Municipal and Hazardous Waste Landfills)

There are more than 200 municipal and hazardous waste landfills in California. There is no inventory of municipal or hazardous waste landfill seismic hazard mitigation activities. During the siting, permitting, or closure process, a landfill owner may be required to submit a stability analysis for the liner and/or final cover systems. The purpose of the liners and the final cover is to prevent the uncontrolled release of leachate or landfill gas (a gas that is made up mainly of methane) from the landfill. This may vary from a simple analysis for flat slopes to a sophisticated seismic hazard assessment and slope stability analysis.

In general, the greatest vulnerability for landfills with respect to seismic hazards may be the damage to the final cover or the landfill gas collection and control system caused by ground deformation (in this case the deformation of the landfill). Another significant vulnerability of landfills is the loss of electrical power to run leachate collection and control systems and landfill gas collection and control systems.

7. Transportation Systems

Transportation systems are generally categorized as follows:

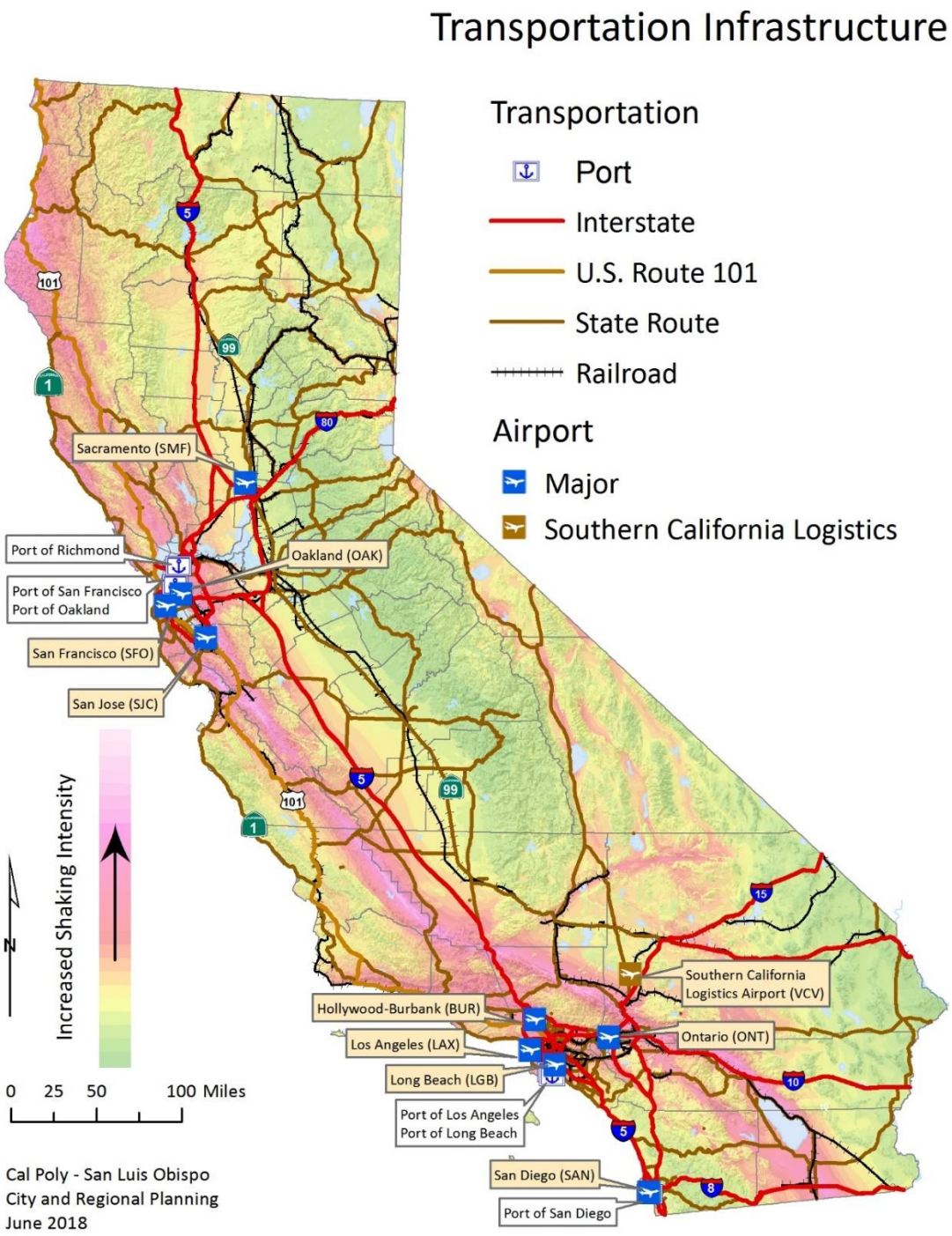
- Highways (including freeways)
- Bridges
- County or city roadways
- Railways

California has approximately 50,000 lane miles of highways. Since there is no single database including all roadways in the state, the total lane miles of county and city roadways are unknown. Bridge fragility and liquefaction represent hazards for these roadways. In addition, the seismic compression of embankment fills can cause minor damage at many locations affected by shaking resulting in an expensive overall fix. This was evidenced by the 2010 Chilean earthquake.[117]

Map 6.T illustrates the locations of major transportation systems in the state in relation to potential shaking hazard.

[117] Arduino, P., Ashford, S., Assimaki, D., Bray, J., Eldridge, T., Frost, D., & Kayen, R. (2010). Geo-engineering reconnaissance of the 2010 Maule, Chile earthquake. GEER Association Report No. GEER-022, 1.

Map 6.T: Transportation Infrastructure and Shaking Intensity



8. Ports and Harbors

There is no systematic integrated database or inventory on seismic hazard assessment or mitigation for ports and harbors in California. However, most of the large ports and harbors have initiated seismic hazard studies for various projects in recent years.

Ground deformation is a significant vulnerability in various ports and harbors since significant piers and quays are built out of dredge tailings or fill. Landfills do not typically perform well in large earthquakes, as evidenced by damage to human-made ground in the Marina District of San Francisco in the Loma Prieta Earthquake in 1989 and in 1995 in Kobe, Japan. Ground deformation on landfills at ports and harbors can affect harbors and ports by changing the alignments of tracks for large cranes used to load or off-load cargo ships. Such deformation may occur from lateral spreading, liquefaction, dynamic compaction, or secondary ground rupture. After the 1989 Loma Prieta Earthquake, some of the Oakland Airport's runways experienced severe ground deformation. This damage affected airport operations.

Ports, harbors, or other waterways containing a marine oil terminal pose a secondary hazard of potential oil spills or post-earthquake fire ignitions. Additionally, the spill clean-up efforts could result in port or harbor closures, affecting both response and recovery efforts.

Depending on the location, geometry, and depth of the port or harbor, it may be susceptible to a tsunami or seiche. Seismic waves traveling through shallow water and tsunamis in ports, harbors, and other waterways can significantly affect vessel operations and safety. For example, vessels in ports can bottom out in either event, or in a tsunami, vessels and other port and harbor systems (e.g., tanks, containers, etc.) can become moving hazards. Since 1946, when tsunami damage started to be more thoroughly documented, California has had at least eight tsunamis that have caused minor to major damage to ports and harbors. The most significant of these events was the March 11, 2011 tsunami from Japan, which caused over $100 million in damage to 27 harbors statewide. For more information about tsunami and seiche hazards for harbors, and products that are being developed to respond to and mitigate these hazards, see *Section 7.3: Tsunami and Seiche Hazards*.

Map 6.T shows major transportation infrastructure in California including freeways, other highways, railroads, international airports, and ports. Major north-south travel corridors include Interstates 5 and 99 and U.S. Highway 101. Major east-west travel corridors include Interstates 80, 15, 10, and 8. Major ports include San Francisco, Oakland, Richmond, Los Angeles-Long Beach, and San Diego. Much of this transportation infrastructure is in areas with potential for strong shaking intensity.

9. Communication Systems

California has no seismic hazard inventory for its communication systems. However, there is a guideline for the improvement of performance during earthquakes titled Methods of Achieving Improved Seismic Performance of Communications Systems (Tang and Schiff, 1996).

The vulnerability of communication systems depends the type of system under consideration. For example, switches and other aboveground components tend to be more affected by strong ground shaking than by liquefaction, while belowground conduits may be more affected by liquefaction than by shaking. In prior strong urban earthquakes, there has been little damage to cellular telephone or internet systems. However, their use has grown exponentially since the 1994 Northridge Earthquake. Their typical vulnerabilities stem from the loss of electrical power and from surges in customer use potentially swamping the capacity of the systems.

The seismic vulnerability of radio and television communication systems is typically from the loss of power and shaking damage to unsecured equipment.

The HayWired Scenario under development by the U.S. Geological Survey (USGS), the California Geological Survey (CGS) and other partners will provide new information regarding communications systems vulnerability. For more information about HayWired, see *Section 6.1.3.1*.

6.1.4.3 AGRICULTURE VULNERABILITIES TO EARTHQUAKE

California agriculture is large, diverse, and complex. While farm and ranches are at the center of agriculture, the sector necessarily includes upstream farm supply industries and downstream processing, distribution and marketing. Earthquakes have the potential to cause damage and the loss of infrastructure that supports agricultural production, storage, and transport. Damage to lifelines including power, water, transportation, and communication are likely to be temporary and unlikely to cause long-term disruptions; however, damage to major hubs, including ports may have more substantial impacts.

In 2014, an academic research report was prepared for the California Seismic Safety Commission (CSSC) to assess the potential vulnerabilities of agriculture in the state based on several case studies, including the 2010 and 2012 earthquake affecting Imperial County, and an assessment of the Salinas Valley in Monterey County. The study documented that significant losses are a concern for primarily rural food and agricultural industries and concluded:

- Large areas of California agriculture, along the Mexican border, along the central and southern coast, and near the Sacramento-San Joaquin Delta are especially vulnerable to seismic activity
- The California produce industry is perhaps more vulnerable than any other to seismic disruptions because of both its location and the high levels of perishability. The Monterey County produce industry ships a high proportion of the nation's vegetables and berries during its peak season, so disruptions would affect consumers as well as producers
- The most important dairy production and processing regions, in the Southern San Joaquin Valley, are less prone to seismic events than the coastal counties and Imperial County. Nonetheless, given extreme perishability and animal welfare concerns, dairies do need to have a high level of awareness of seismic risks

A full copy of the report (Earthquakes and California Agriculture: Where are the Vulnerabilities?) can be found at: http://ssc.ca.gov/forms_pubs/earthquakes_and_california_agriculture_revised2.pdf.

6.1.4.4 LOCAL HAZARD MITIGATION PLAN HAZARD RANKINGS

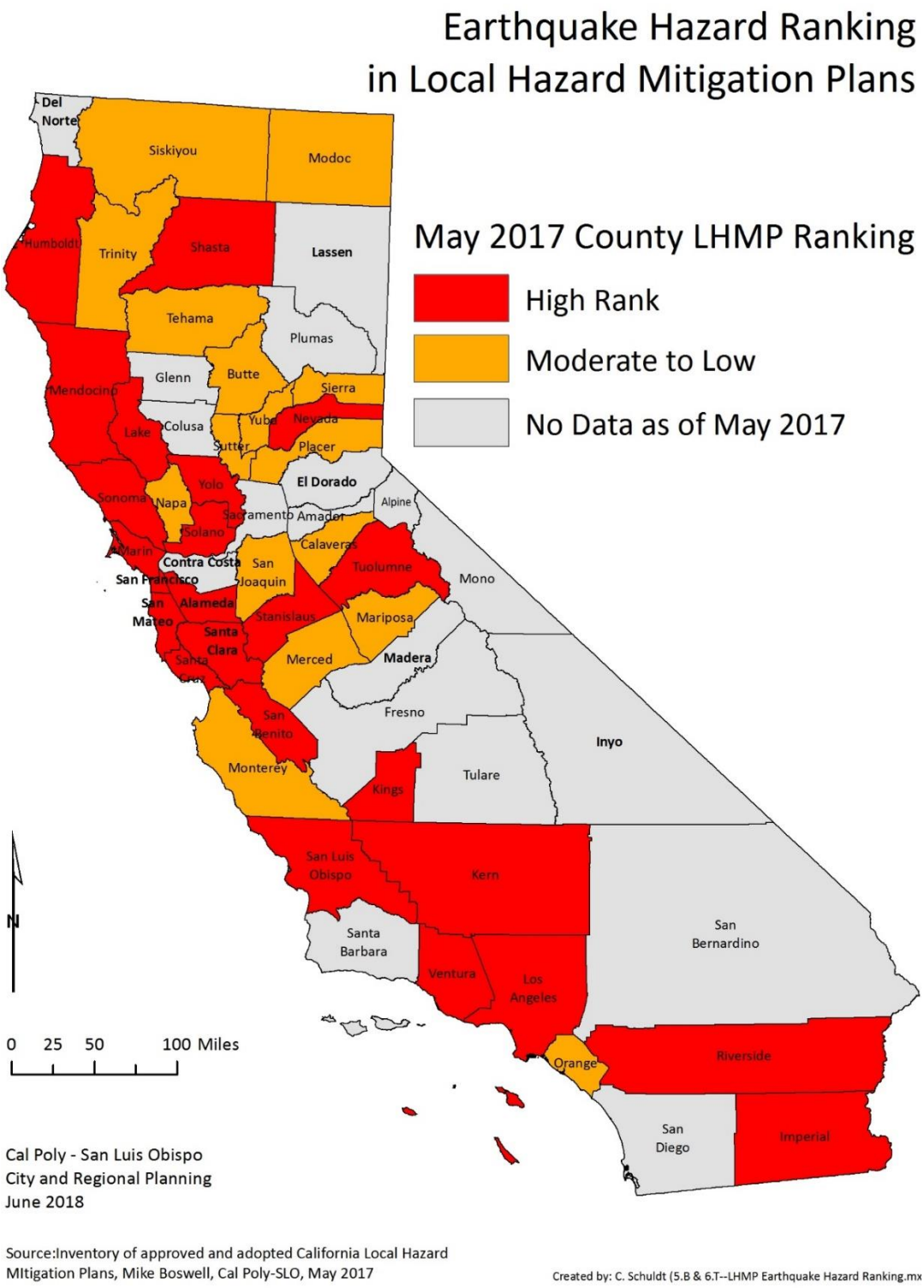
An important source of local perceptions regarding vulnerability to earthquake threats is found in the collection of FEMA-approved and adopted Local Hazard Mitigation Plans (LHMPs) adopted by cities, counties, and special districts as of May 2017.

The most significant hazards reported in this review are earthquakes, floods, and wildfires—the three primary hazards also identified on a statewide basis by the 2010, 2013, and 2018 SHMPs. Including these three primary hazards, LHMPs identified a total of 58 distinct local hazards.

Map 6.U summarizes relative rankings of earthquake hazards in the 2017 review of LHMPs. Displayed are predominant earthquake hazard rankings shown as high (red) or moderate to low (orange) given by at least 51 percent of the jurisdictions with LHMPs within each county. Counties shown with gray color represent either jurisdictions not having a FEMA-approved and adopted LHMP or counties where data are missing or problematic.

For a detailed evaluation of LHMPs approved as of May 2017, see *Chapter 5: California Local Hazard Mitigation Planning*.

Map 6.U: Earthquake Hazard Ranking in Local Hazard Mitigation Plans



Map 6.U identifies earthquake hazards as being a predominant concern in the 2017 LHMP review for all Southern California counties with approved LHMPs, as well as most San Francisco Bay Area counties. For those counties labeled as "no data," either the approved LHMP did not include earthquake as a risk or there is no approved LHMP for that county.

Implications for Local Loss Potential

Local hazard rankings are highly variable, responding to a wide variety of very specific local conditions. Each county and city has its own set of variables conditioning earthquake loss potential within its jurisdictions. Descriptions of loss potential are very specific within individual LHMPs and are not consistently drawn up between plans, nor is there even coverage of all cities and unincorporated areas. Such variability will diminish as more cities and counties prepare LHMPs and greater standardization enables comparability of local data with statewide data.

Comparisons with Statewide Vulnerability

The majority of LHMPs reviewed in 2017 in all Southern California and nearly all San Francisco Bay Area counties rated earthquakes high in their hazard rankings, as shown in Map 6.U. Additionally, most Central Coast and North Coast counties and two eastern Sierra counties also rated earthquakes high. This is consistent overall with the patterns of earthquake hazards and population/social vulnerability patterns identified and discussed in *Section 4.4* of *Chapter 4: Profiling California's Setting*.

6.1.5 CURRENT EARTHQUAKE HAZARD MITIGATION EFFORTS

The preceding discussion included a description of most recent earthquake events and earthquake hazard vulnerabilities by type of buildings, infrastructure, and transportation. In recent decades California has invested significant funds in seismic mitigation efforts. This is an indicator of the level of effort to mitigate seismic hazards and reduce life and property loss after earthquakes.

6.1.5.1 EARTHQUAKE GROUND FAILURE MITIGATION

Earthquake Zones of Required Investigation

The State of California has developed a unique method to mitigate hazards related to ground failures caused by earthquakes. Through the Alquist-Priolo Earthquake Fault Zoning Act of 1972, which addresses hazards associated with surface fault rupture, and the Seismic Hazards Mapping Act of 1990, addressing hazards from soil liquefaction, landslides, amplified shaking, and tsunamis, the California Geological Survey (CGS) delineates regulatory earthquake zones of required investigation over the state's most populated areas and most hazardous faults. Other than strong ground shaking, earthquake hazards are not generally addressed in building codes and therefore have not always been treated consistently throughout the state.

The zones delineated by the CGS are regulatory in that local lead agencies are required by statute to incorporate them into their local ordinances, safety elements of general plans, and other planning documents, and are required to use them in the course of approving development plans for structures for human occupancy. Specifically, local governments must require site-specific investigations for hazards identified by the zones and cannot approve projects, that is, issue permits, unless the investigations either show the hazard does not exist or incorporate mitigation measures into the development plans. Another important aspect of the regulatory zones is that California disclosure laws require real estate sellers to inform buyers if a property for sale is located within these hazard zones.

Three basic premises are involved in this mitigation approach. First, earthquake hazards are best identified and mitigated at the site-specific level. Regional hazard identification maps—such as landslide or liquefaction inventories—do not provide enough information on potential future occurrences of these hazards, and susceptibility maps typically identify multiple levels of hazard that are not easily or uniformly implemented, if implemented at all. CGS hazard zones are developed with the best available geologic, geotechnical, terrain, and hydrogeologic data and evaluated with the best available analysis techniques so that they can be relied upon as a screening tool for requiring site-specific investigations. The second premise is that oversight and implementation of hazard mitigation measures are best applied by local lead agencies who have the authority to approve projects and the responsibility to protect their citizens from earthquake hazards. While lead agencies have some leeway in the implementation of hazard mitigation, with detailed guidance documents and outreach from the CGS, lead agencies throughout the state are addressing hazards to a consistent standard-of-practice where hazard zones exist. Finally, mitigation activities are

best applied prior to or during development construction – it is far more expensive to investigate and mitigate ground failure hazards after structures have been built. Building mitigation measures into new developments makes them resilient to future earthquakes, saving lives and reducing earthquake recovery costs.

Progress Summary 6.C: Earthquake Zones of Required Investigation (formerly called Seismic Hazards Mapping Projects) and Other Earthquake Data

Progress as of 2018: Progress as of 2018: Since 2013, 10 Official Seismic Hazard Zone Maps have been issued by the California Geological Survey (CGS): four in Contra Costa County, four in Riverside County, and two in San Mateo County. This brings the total number of Official Seismic Hazard Zone Maps issued since the program's inception to 124, affecting 170 cities and 10 counties. This total represents roughly one third of the identified high risk areas in the state where these zones are needed to increase mitigation efforts for liquefaction and landslide hazards. It is anticipated that funding from the Federal Emergency Management Agency (FEMA)/California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Grant Program will increase the rate at which these important zones are delineated.

Also since 2013, 21 new and revised Alquist-Priolo Earthquake Fault Zone Maps have been issued, affecting the following counties: El Dorado, Orange, Los Angeles, Napa, Riverside, San Bernardino, and Solano. This brings the total number of maps issued since the program's inception in 1972 to 560, affecting 119 cities and 37 counties. Progress in fault zoning is continuing in Southern California along the Rose Canyon and Elsinore Faults, and along the West Napa, Rodgers Creek, and Healdsburg Faults in Northern California.

Special Publication 42, which provides guidance on identifying and mitigating hazards from surface fault rupture, was significantly revised in 2017.

In 2017, all regulatory zone data were re-processed and modernized, and are now available multiple formats. Portable document file (PDF) maps and reports, as well as tiled Geographic Information Systems (GIS) data, are available through the CGS Information Warehouse: http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html.

GIS data are also available as web and feature services: https://spatialservices.conservation.ca.gov/arcgis/rest/services/CGS_Earthquake_Hazard_Zones.

To assist property owners, real estate professionals, and prospective property buyers, the CGS has created a Regulatory Zone GeoApplication that includes Earthquake Fault Zones, Landslide Zones, and Liquefaction Zones, based on a pre-processed California State parcel dataset: https://maps.conservation.ca.gov/cgs/EQZApp/.

Progress Summary 6.D: EQ Zapp: California Earthquake Hazards Zone Application

Progress as of 2018: The California Geological Survey (CGS) has launched the California Earthquake Hazards Zone Application (EQ Zapp), an online mapping tool that that allows anyone with a computer, tablet, or smartphone to conveniently check whether a property is in an earthquake hazard zone.

With EQ Zapp, the user can type in an address or use the location capability in the computer or device to determine whether a property lies within any of the CGS's mapped earthquake hazard zones. It will also indicate if the CGS has not yet evaluated the hazards in that area. Earthquake hazard zones define areas subject to three distinct types of geologic ground failures:

- Fault rupture, in which the surface of the earth breaks along a fault
- Liquefaction, in which the soil temporarily turns to quicksand and cannot support structures
- Earthquake-induced landslides

Although strong ground shaking is responsible for most earthquake-related damage, these zones identify areas where earthquake hazards other than structural shaking—specifically ground failures during an earthquake—are more likely. The zones trigger geologic and engineering investigations that can identify and mitigate the ground failure hazard before construction begins, thereby making the structure itself more resilient to potential shaking.

The CGS also provides the earthquake hazard zone data as portable data file (PDF) maps and reports, or as Geographic Information Systems (GIS) shapefiles through the CGS Information Warehouse. GIS data available from the CGS can be reviewed through the Geologic Hazards Data Viewer and Data List, at the following links:
http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps
https://maps.conservation.ca.gov/geologichazards/#dataviewer
https://maps.conservation.ca.gov/geologichazards/#datalist

Prior to launching EQ Zapp, the CGS completely updated all of the regulatory hazard zones, including Alquist-Priolo fault zones and Seismic Hazard Zones. This included updating PDF, GIS, and report data, and relocating them from multiple servers to a single, more logical and comprehensive location. That project was completed in the spring of 2017 with a release of statewide web services/interactive maps and updates to the CGS Information Warehouse where project information can be obtained as tiled data.

For more information, visit: http://www.conservation.ca.gov/cgs/Pages/SH_EQZ_App.aspx.

Maps 6.V and 6.W show progress in meeting long-term program goals for seismic hazard mapping.

Best Practices Highlight 6.A: Successful Update of Alquist-Priolo Map for Lake Tahoe Area Clarifies Fault Location

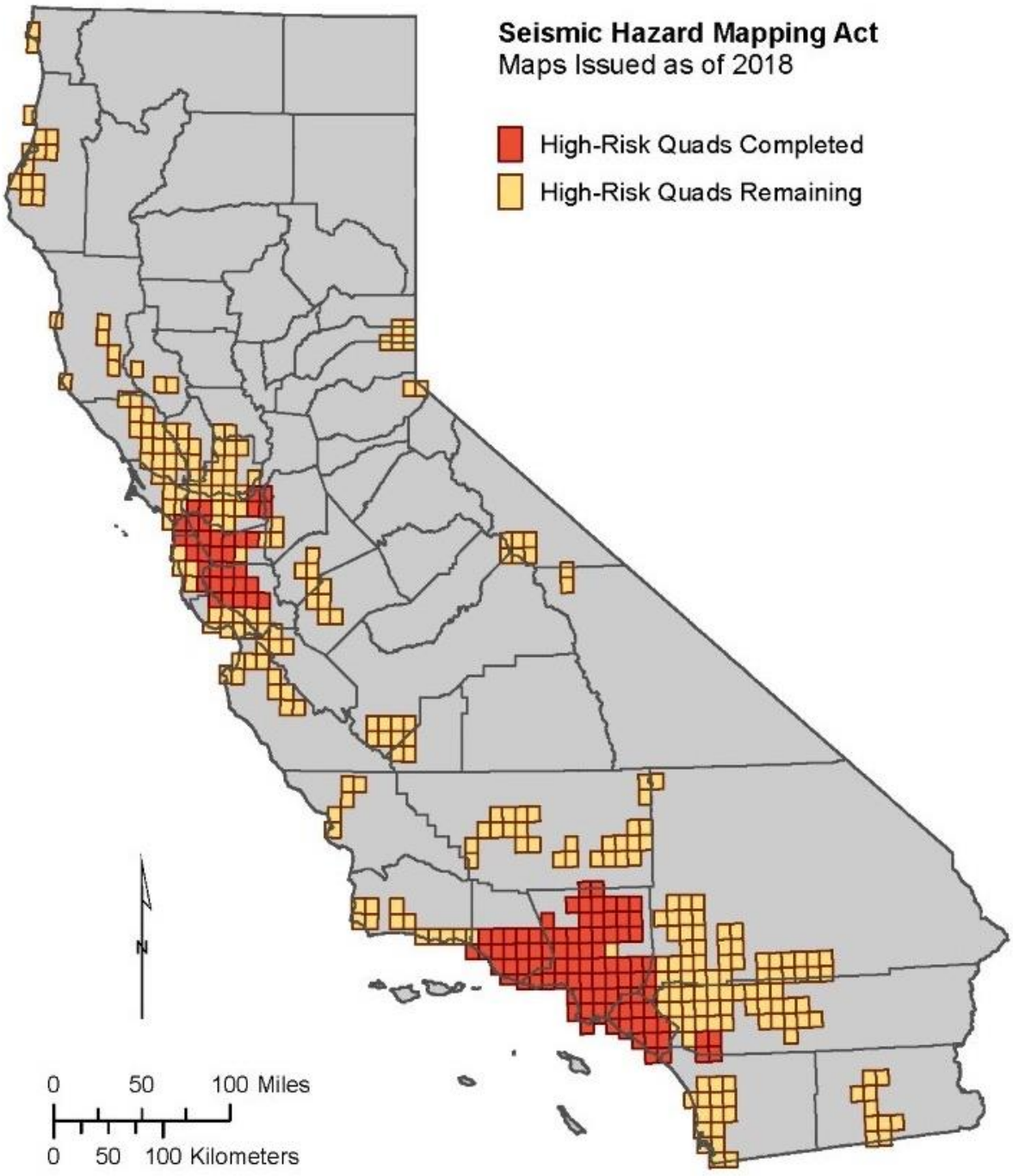
Mitigating Surface Faulting Hazards in the Lake Tahoe Basin

The Alquist-Priolo Earthquake Fault Zoning Act provides a mechanism for reducing losses from surface fault rupture on a statewide basis by having the California Geological Survey (CGS) identify earthquake zones of required investigation around active faults. Public safety is enhanced by lead agencies in requiring site-specific fault investigations for developments within these zones and mitigating fault rupture hazards by avoidance.

For many years, geologists suspected that several faults in the Lake Tahoe Basin were active but were unsure of their exact locations onshore. In addition, the great depth of Lake Tahoe prevented careful study of these faults on the lake bottom. Several state and federally funded research efforts over the past decade were used to identify and characterize active faulting in the Lake Tahoe Basin. The research efforts resulted in high-resolution bathymetric and topographic images of the Tahoe Basin area that could be used to accurately locate the faults and measure the timing and amount of past earthquake fault ruptures. Three active fault traces are now known to cross the onshore portions of the basin and the lake floor. These faults are among the most significant seismic sources in the region and, where these faults exist onshore, present a significant surface rupture hazard to buildings.

A CGS fault-trenching research study of the West Tahoe Fault (funded by the U.S. Geological Survey [USGS] External Grants Program) at the south end of the lake provided direct evidence of three large-magnitude earthquakes in the past 10,000 years that had significant surface ruptures. Based on all the recent studies, the CGS delineated earthquake fault zones in the southern onshore portion of the West Tahoe Fault. The earthquake fault zones cover portions of two 7.5-minute topographic quadrangle maps in El Dorado County that are now the basis for mitigating the hazard from surface faulting. Future plans consist of preparing a series of fault zone maps for the active faults that are located on the north side of Lake Tahoe and continue through the city of Truckee. Additionally, other earthquake hazard zone mapping is planned to include liquefaction, earthquake-triggered landslides, and tsunami wave inundation.

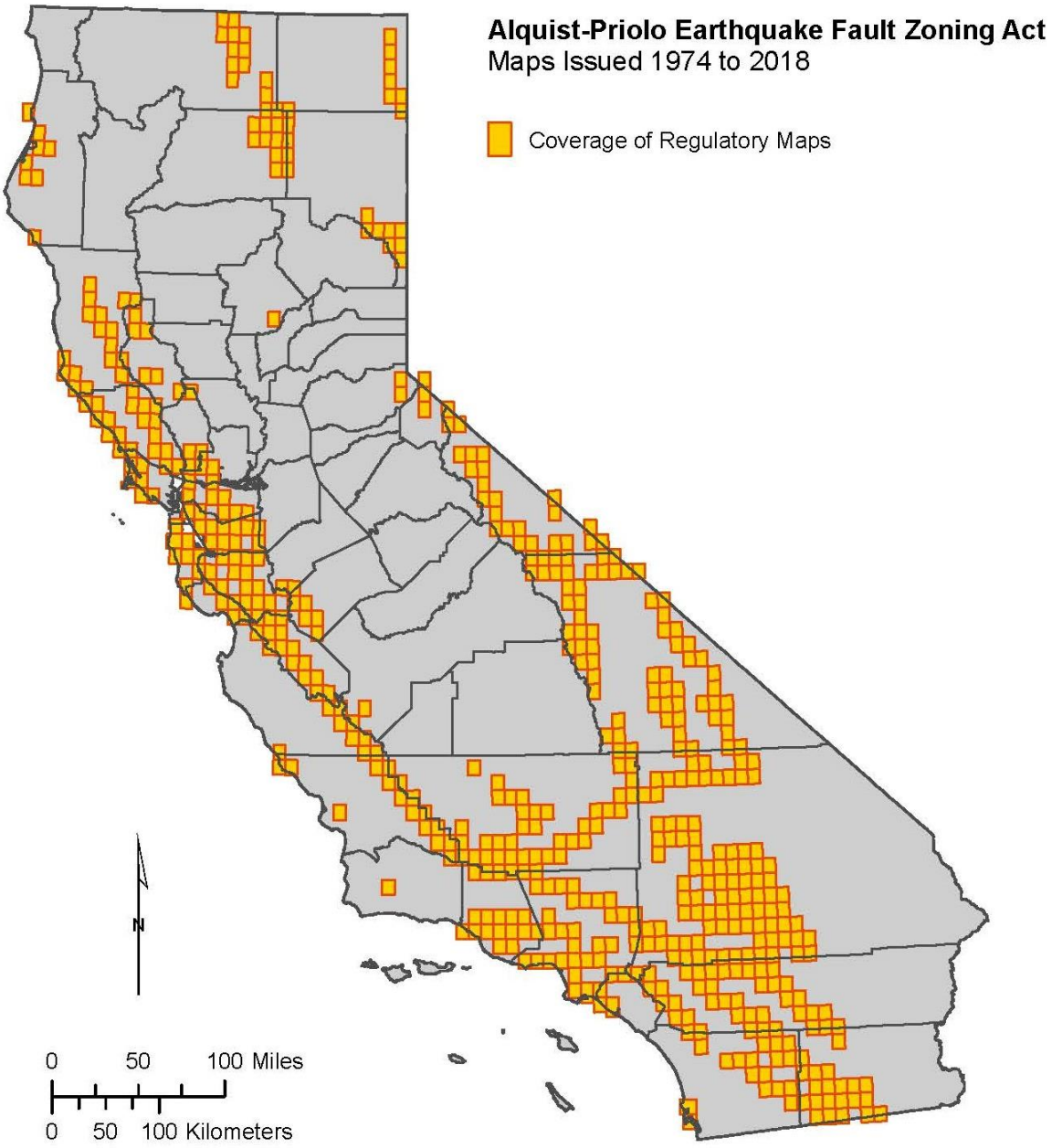
Map 6.V: Seismic Hazards Mapping Act Progress as of 2018



Source: California Geological Survey

Map 6.V shows completion of Seismic Hazards Mapping Act mapping in areas of high seismic risk, primarily in Southern California and the San Francisco Bay Area.

Map 6.W: Alquist-Priolo Earthquake Fault Zoning Map as of 2018



Source: California Geological Survey

Map 6.W shows the areas of the state covered by Alquist-Priolo Earthquake Fault Zoning Act maps issued as of early 2018. Most recent maps completed have been in El Dorado, Los Angeles, Napa, Orange, Riverside, and San Bernardino Counties.

Post-Earthquake Damage Assessment - California Earthquake Clearinghouse

California Public Resources Code requires the California Geological Survey (CGS) to operate a clearinghouse for post-event earth science investigations. In addition, the National Earthquake Hazards Reduction Program (NEHRP) directs state and federal agencies to coordinate on the collection of post-earthquake information through a clearinghouse. Over the years, this function has evolved into what is known as the California Earthquake Clearinghouse, which is run jointly by the CGS, Earthquake Engineering Research Institute, Cal OES, USGS, and California Seismic Safety Commission (CSSC). Following large and damaging earthquakes, the Clearinghouse activates and establishes a physical location and a virtual/online presence provided by the Clearinghouse website. A federal disaster declaration is not required for Clearinghouse activation. The principal function of the Clearinghouse is to promptly gather information on ground failure, structural damage, and other consequences from significant seismic events and share it with state and federal disaster response managers and the scientific and engineering communities.

In order to accomplish information sharing objectives, the Clearinghouse leverages XchangeCore (formerly known as Unified Incident Command and Decision Support [UICDS]) technology, which was developed by the U. S. Department of Homeland Security (DHS) and Department of Defense DOD) for information exchange via web services. The Clearinghouse information-sharing capabilities can simultaneously serve and receive geospatial and non-geospatial information from scientists and engineers in the field, operational area Emergency Operation Centers, and multiple organizations, all using many different XchangeCore-connected applications. The Clearinghouse provides all users with free access to the SpotOnResponse application, a crowd-sourcing and location-based situational awareness mobile and web application. In addition to emergency response, Clearinghouse information-sharing capabilities also support pre-event preparedness planning, risk assessment/mitigation decision-making, understanding interdependencies of critical infrastructure, and developing regional earthquake resilience to promote more rapid recovery. For more information on the California Earthquake Clearinghouse, activations, exercises, and information-sharing tools and capabilities, please visit: http://californiaeqclearinghouse.org/.

Best Practices Highlight 6.B: California Earthquake Clearinghouse Achievements 2010-2017

National Recognition: Clearinghouse-information sharing and technology interoperability efforts received the following recognition at the national level:

- 2014 recommendation from the U.S. Geological Survey (USGS) - Open Geospatial Consortium Interoperability Assessment to use XchangeCore as exemplified by the California Earthquake Clearinghouse
- 2015 recognition of Clearinghouse information sharing achievements as "Geospatial Concept of Operations Best Practice" by the U.S. Department of Homeland Security (DHS)

Earthquake Response: The Clearinghouse has supported state response to two earthquakes, including a federally declared disaster:

- 2014 Magnitude 5.0 La Habra Earthquake.
- 2014 Magnitude 6.0 South Napa Earthquake (DR-4193*)

Earthquake Exercises: The clearinghouse participated in nine federal, state, and military earthquake-themed exercises between 2011 and 2016, partnering with:

- 10 federal agencies
- 22 state and local governmental agencies
- 7 academic and research organizations
- 12 non-governmental organizations
- 12 neighboring states and international jurisdictions (for Cascadia and other tsunami exercises)
- 16 private sector organizations

Funding: The Clearinghouse has no sustained funding, but accomplishes goals through the following competitive grants:

- 2013 National Earthquake Hazards Reduction Program (NEHRP) grant: $85,000

- 2014 NEHRP grant: $70,000
- 2015 Federal Emergency Management Agency (FEMA) grant: $50,000
- 2016 FEMA grant: $50,000
- 2017 FEMA grant: $30,000

Operational Improvements: The Clearinghouse has been advancing the use of digital field data collection by providing improved cross-platform, real-time data sharing through the

- SpotOnResponse mobile field data collection and situational awareness application. Available in a web browser or on smart phones or tablets

Outreach: The Clearinghouse depends on the collaboration of partner organizations and has conducted a wide range of outreach activities, including:

- Nine statewide outreach events. The Clearinghouse conducts outreach events to inform partners of important activities, and to allow partners to provide feedback to define Clearinghouse priorities.
- Twelve one-hour training sessions conducted with partners on Clearinghouse information-sharing capabilities, recorded and available on YouTube
- Weekly coordination calls (for the last 6+ years)
- Information sharing training guides for XchangeCore connected applications

** Federal Disaster Designation Number*

6.1.5.2 MITIGATION OF POTENTIAL BUILDING LOSSES

Overview

Seismic shaking, which caused over 98 percent of the losses in the Loma Prieta Earthquake, has long been recognized as the main threat to structures during earthquakes. To mitigate this hazard, building codes have been steadily improved over the past 80 years as the understanding of seismic shaking has improved based on strong motion data gathered by the CGS and USGS. Current California building codes include provisions for considering the potential shaking from earthquakes, including stronger shaking near faults and amplification by soft soils.

The most effective single element in mitigating earthquake losses to buildings is the consistent application of a modern set of design and construction standards, such as those incorporated in modern building codes. The codes are updated regularly to include the most effective design and construction measures that have been found by testing and research or observed in recent earthquakes to reduce building damage and losses.

The building code has been the main mitigation tool for seismic shaking in most buildings, although hospitals, schools, and other critical facilities are subject to additional mitigation measures, as discussed below. The following are the current building codes and standards upon which state and local codes are based.

- The 2018 International Building Code, which offers the most current and innovative set of regulations for new commercial construction
- The 2018 International Residential Building Code, which covers requirements for new residential construction
- The 2018 International Existing Building Code, which contains requirements intended to encourage the use and reuse of existing buildings including provisions for seismic retrofit

(The above are being considered for adoption as part of the 2019 California Building Standards Code.)

The 2016 California Building Codes are based on the 2015 edition of the International Building Code. Design standards for existing and new construction that are incorporated into the International Building Code and the California Building Codes are based on state-of-the-art knowledge, developed through a peer review process by the American Society of Civil Engineers (ASCE) and the Structural Engineering Institute (SEI). Their most recent publications governing seismic design and retrofit include:

- ASCE/SEI 41-13: Seismic Evaluation and Retrofit of Existing Buildings

- ASCE/SEI 7; Minimum Design Loads and Associated Criteria For Buildings and Other Structures (New Construction)

The 2016 California Building Standards Code, also referred to as Title 24 (effective January 1, 2017) provides design standards for existing and new construction, and includes the following parts:

- The California Building Code
- The California Residential Code (for new construction)
- The California Existing Building Code (for existing structures)
- The California Electrical, Mechanical, Plumbing, Energy, and Green Building Standards (CALGreen) Codes
- The California Historic Building Code
- The California Fire Code

As of early 2018, local government building departments use the 2016 California Building Code, and the 2016 California Existing California Building Code, adopted from the 2015 International Building Code and the International Existing Building Code with local amendments to regulate the vast majority of buildings. Acute care hospitals, public K-12 schools, and state-owned buildings, are regulated by the 2016 California Building Code and more stringent amendments prepared by applicable state agencies, as noted in the following discussion.

For new buildings, state and local governments will enforce the 2016 California Building Standards Code which includes earthquake safety provisions from the 2015 International Building Code with enhancements for hospitals, public schools, and essential services buildings. The adoption date of the 2018 International Building Code is January 2019 with an effective date of January 1, 2020.

A small percentage of older buildings have been strengthened or "retrofitted" to improve their resistance to earthquake shaking. Observations after recent earthquakes suggest that retrofitted buildings on the whole perform noticeably better than similar buildings that have not been retrofitted (ATC 31, 1992, CSSC 94-06, WJE 1994).

Fewer than five percent of California's existing buildings have been structurally retrofitted; the actual number has not been determined. However, the California Earthquake Authority's Earthquake Brace+Bolt program (EBB) has provided grants for more than 5,000 code-compliant retrofits for single-family wood-frame dwellings between 2013 and mid-2018. The EBB program expects to fund a minimum of another 6,000 retrofits between 2018 and 2021. The California Building Code generally allows retrofits of any nature provided that they make existing buildings no less safe. These regulations and the 2015 and 2018 International Existing Building Codes are available for use at the discretion of all state and local regulatory agencies. They include a compilation of seismic evaluation and retrofit provisions for unreinforced masonry, tilt-up, wood-frame dwellings, and older concrete buildings. A separate California Historical Building Code (California Building Standards Code 2016b) contains provisions for evaluating, rehabilitating, and altering historical buildings. The California Seismic Safety Commission published a Guide to Identify and Manage Seismic Risks of Buildings for Local Governments to assist local government agencies in assessing the vulnerability of their building stock.

Mitigation measures for ground failure hazards include avoiding the hazard, strengthening foundations, and modifying soils below foundations. Refer to CGS Special Publication 117, "Guidelines for Evaluating and Mitigating Seismic Hazards in California" (http://www.conservation.ca.gov/cgs/shzp/webdocs/Documents/sp117.pdf) and CGS Special Publication 42, "Earthquake Fault Zones in California, A Guide for Government Agencies, Geoscience Practitioners, and Property Owners/Developers" (ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf).

Mitigation of Buildings by Type or Sub-Inventory

1. Mitigation for State-Owned and-Leased Structures

The California Vital Infrastructure Vulnerability Assessment (Cal VIVA) was begun during preparation of the 2010 SHMP. Its purpose was to develop and test a methodology for assessing the vulnerability of state-owned building stock and critical infrastructure to seismic and other hazards and determine minimum retrofit measures to protect

its occupants from harm during a disaster and facilitate recovery by making facilities quickly operable after a disaster. Cal VIVA III, prepared in association with EERI, tested and refined the Cal VIVA II prototypical department plan with an individual user department and produced a template that can be used by departments and agencies within state government to systematically address critical building vulnerability and support planning for potential retrofits on a long-term basis.

2. Mitigation for State-Regulated Essential Services Buildings

California enacted the Essential Services Buildings Seismic Safety Act of 1986 and DSA adopted regulations that apply to all new construction (Title 24, Part 1). For existing essential services buildings owned by the state, the California Building Standards Commission adopted regulations in Part 10 of the 2016 California Building Code that apply to building seismic evaluations and retrofits. California has also adopted a national standard, ASCE/SEI 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, and ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings, as a retrofit standard for state-owned essential services buildings.

3. Mitigation for Other State-Owned Normal Occupancy Facilities

In 1990, the state passed the Earthquake Safety and Public Buildings Rehabilitation Bond Act (Proposition 122), which authorized $250 million for the identification and seismic retrofit of deficient state-owned buildings and $50 million for seismic retrofit of local government essential services facilities. According to a Proposition 122 progress report issued in December 2008 by the Department of General Services (DGS), program funds had benefited 85 projects, with 55 completed, 1 under construction, 26 in various preparatory stages of design, and only 3 cancelled. According to DGS, the Proposition 122 program will ultimately result in the retrofit of over 145 buildings, totaling over 5 million square feet. Most importantly, the retrofits will protect a population of more than 70,000 employees and individuals in institutions.[118] According to a 2002 assessment by the California Seismic Safety Commission, 61 state buildings were retrofitted, and 132 local government buildings were retrofitted with matching funds. A 2002 report by the DGS noted that nearly all Proposition 122 funds have been expended or are earmarked for projects.

In 1999, the DGS Real Estate Services Division estimated the cost for retrofitting all state buildings as $0.84 to $1.7 billion. In 2002, the state began a program to transfer facility funding and operations for county courthouses to the Judicial Council. Seismic evaluations are required as part of the negotiation between the counties and the state.

For existing buildings owned by the state, the California Building Standards Commission adopted regulations now in Part 10 of the 2016 California Building Code that apply to seismic evaluations and retrofits.

4. Mitigation for State Criminal Justice and Judicial Court Buildings

Since the Department of Corrections 1979-1980 renovation and planning study identified required seismic remediations, some prisons have been retrofitted in conjunction with other planned modernization projects. Together the Department of Corrections, Department of Justice, and California Youth Authority own:

- 33 prisons
- 38 correctional conservation camps
- 11 youthful offender institutions
- 12 crime laboratories

The California Building Standards Commission has adopted regulations now in Part 10 of the 2016 California Building Code for the seismic evaluation and retrofit of state criminal justice buildings, as well as ASCE 41-13 and ASCE/SEI 7-16.

The Judicial Council Program published the Seismic Risk Rating Study of California Superior Court Buildings report in March 2017. Action plans are provided in the Recommended Action Plans and Follow-up Activities section of the report to address selected judicial structures identified as Risk Level V (risk of collapse or major risk to life).

[118]California Department of General Services. "State-Owned Buildings Bond Act Expenditures Status Report." December 2008.

5. Mitigation for State-Owned Health Services

The state's acute care hospitals are exempt from the Alquist Hospital Seismic Safety Act. However, the state remains responsible for the public's seismic safety in these facilities. For state-owned buildings, the California Building Standards Commission has adopted regulations (see Chapter 34 of the 2013 California Building Code) that are applicable to seismic evaluations and retrofits. California has also adopted a national standard, ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings, as a retrofit standard for state-owned buildings.

6. Mitigation for Public Universities

As of early 2018, the University of California (UC) system includes approximately 133 million gross square feet of space in over 5,970 buildings. These buildings include classrooms, offices, laboratories, specialized research facilities, libraries, and residential space to house students. Since the early 1970s, UC has been evaluating and retrofitting buildings on its campuses. The system has ranked the seismic safety of its major buildings from "good" to "very poor" (known as III to VI in the 2017 updated version of UC's seismic safety policy) and has embarked on capital outlay programs to retrofit those that are ranked "poor" (or V) in accordance with the updated policy or "very poor" (or VI in accordance with the updated policy). In the early 1990s, the California State University (CSU) system initiated a similar program. As of 2003, CSU had evaluated 1,364 major facilities, identified 145 as potentially hazardous and required further evaluation and retrofits in many cases.

As discussed further below, most facilities identified as hazardous now have retrofit projects undergoing design or construction or completed. The greatest vulnerability aspects of public universities are the potential for loss of life, research, and educational functions and damage to state property.

For existing public university buildings owned by the CSU and UC systems, the California Building Standards Commission has adopted regulations (see Part 10 of the 2016 California Building Code) that are applicable to seismic evaluations and retrofits. Both university systems have active seismic safety programs with major long-term capital programs including billions of dollars in mitigation investments.

CSU Seismic Peer Review Board.

Since 1993, CSU has had a vigorous program of reducing the unacceptable seismic risk of existing buildings and managing current construction programs to limit future seismic risk to acceptable levels. Seismic peer review is a mandatory part of the CSU construction process. Consistent with Title 24, CSU has adopted minimum seismic parameters. These campus-specific coefficients seek to provide more accurate guidance for structural calculations. Site-specific soil conditions are determined by a geotechnical engineer as part of the development of each project.

CSU has a seismic emergency response protocol that was adopted in 2000 based on efforts of the Seismic Peer Review Board established in 1992. CSU Seismic Safety Requirements strive to build and maintain facilities "that provide an acceptable level of earthquake safety for students, employees and the public." The Seismic Review Board is comprised of seven independent engineers (six structural and one geotechnical) who review and advise CSU of existing policy and code requirements. The six structural engineers are assigned specific campuses and have developed a base of knowledge about each campus, site-specific soil issues, and fault proximity.

The Seismic Policy includes provisions for emergency response by the Seismic Review Board in the event of a significant seismic event. The Chairman of the Seismic Review Board acts as the Designated Building Official for the purposes of safety determination of structures. When an earthquake occurs, the Designated Building Official evaluates the safety of buildings on campus and indicates recommendations for engineering investigations to determine the condition of individual buildings.

The CSU Risk Management Authority performs a tri-annual appraisal of approximately 3,000 buildings ($14 billion approximate value). The appraisal methodology identifies buildings in flood plains and with earthquake exposure.

CSU has funded and implemented $22.48 million in system-wide seismic retrofit projects between 2005- 2006 and 2009-2010. The Seismic Retrofit Program has another $503.6 million in projects in the budget for 2010-2011 through 2014-2015.

University of California System-Wide Seismic Safety Program.
The University of California (UC) Seismic Safety Program was initiated following the 1971 San Fernando Earthquake, with the governing Board of Regents adopting policies in 1975 calling for acceptable levels of seismic safety. Structural reviews to identify and set priorities for hazard mitigation were initiated in 1978 and continue on an ongoing basis. Each campus is presently working toward completing corrections on all remaining buildings with a seismic rating V and VI.

From 1979 to 2008, seismic retrofit corrective and mitigation work was completed in more than 230 structures (67 percent of buildings needing seismic work), involving 16 million gross square feet. The cost of this work has been approximately $1 billion (not adjusted for inflation and excluding FEMA funding).

In addition to its academic facilities, UC operates five major medical centers and is the largest public health care provider in the nation besides the federal Veterans Administration. All hospital facilities are being seismically retrofitted in accordance with the Alquist Hospital Seismic Safety Act as part of the seismic retrofit and replacement program.

Progress Summary 6.E: University of California Retrofits

Progress as of 2018: The University of California is committed to reducing, preventing or eliminating potential risks and impacts of natural and human-caused disasters and keeping campus communities as safe and disaster-resilient as possible. The University of California (UC)'s Seismic Safety Program is an ongoing system-wide structural retrofit program overseen by each campus. Proposed seismic correctional work is coordinated with fire protection, health and safety upgrades, and rehabilitation or renovations for functional and programmatic improvements, and integrated into UC's Capital Improvement Program. From 1979 to 2016, seismic retrofit corrective and mitigation work has been a part of more than 329 structural improvement projects, 247 of which had been completed as of 2013.

Between 1979 and 2010-11, UC invested more than $4 billion in seismic safety retrofits, hospital replacement, and various seismic hazard mitigation projects. Since 2011, UC has devoted more than $1.2 billion to projects that included seismic and life-safety corrections work. Major projects include UC Berkeley's Student Union and Memorial Stadium, both of which had major seismic components to their multi-faceted renovations, and projects that involve complete demolition and rebuild, such as the UC Berkeley Tolman Hall seismic replacement project. Furthermore, UC has undertaken at least 39 smaller seismic projects on nine campuses and at three medical centers with total construction costs of $174 million (excluding "soft costs" such as design and engineering). Seismic hazard mitigation represents the vast majority of all UC investment in hazard mitigation, commensurate with the degree of catastrophic risk.

Best Practices Highlight 6.C University of California Seismic Mitigation

The University of California (UC) system-wide Hazard Vulnerability Assessment (HVA) initiative completed in 2005 identified catastrophic earthquake as the highest risk threat for most UC campuses and provides the UC system with a road map on how to most effectively rank and manage a wide range of catastrophic risks.

"Be Smart About Safety" Program

Since 2008, funding for many campus hazard mitigation projects and programs have been funded through the "Be Smart About Safety" loss prevention program. From 2001 to 2016 "Be Smart About Safety" funded 153 mitigation projects and programs directly related to these threats, returning more than $12 million to the campus locations to invest in hazard mitigation for all hazard types. The following 14 seismic hazard mitigation projects funded by the "Be Smart About Safety" program have been implemented by the campuses since 2011.

- UC Berkeley non-structural bracing of library shelves
- UC Irvine seismic review of buildings of potential concern
- UC Irvine non-structural bracing of lab equipment
- UC Irvine bracing platform for data center
- UC Irvine seismic isolation platforms for protecting information technology equipment
- UC Irvine non-structural bracing of furniture and equipment
- UC Irvine structural engineering review of theater
- UCLA automatic gas shutoff valve installations
- UCSF non-structural bracing of furniture and equipment
- UCSF non-structural bracing of research equipment
- UC Santa Cruz automatic gas shutoff valve installations
- UC Santa Cruz gas line work enabling automatic gas shutoff valve

Systemwide Building Seismic Gas Shutoff Valve Program

The UC Office of the President Risk Services created a campus reimbursement program funded by a policyholder insurance rebate to install seismic gas shutoff valves on natural gas mains outside campus buildings to prevent the possibility of an uncontrolled release of gas into buildings that could lead to catastrophic fire loss. Property loss prevention building evaluations were conducted in 2007-2009 by the insurer's engineering personnel on all UC buildings with total property value of at least $10 million.

As part of this engineering assessment, a prioritized list of campus buildings needing shutoff valves was developed based on the likelihood of a gas main leak/break and the severity of impact should that occur. Likelihood was based on seismicity (earthquake zones), whereas the assessment of severity was based on building fire protection (sprinkler systems). Gas main size was also taken into account for both likelihood and severity, as larger gas mains are inherently less flexible and therefore more likely to break during an earthquake, releasing larger volumes of gas into buildings resulting in more severe fire conditions. To date, under this program eight locations have installed valves at a total cost of $99,481.

7. Mitigation for Community Colleges

Up until June 30, 2006, community colleges also had to comply with the Field Act. On and after July 1, 2006, community colleges could choose not to comply with the seismic safety provisions of the Field Act. This change in law was triggered by the passage of Proposition 1D on the November 2006 ballot pursuant to Assembly Bill (AB) 127 (Nunez, Education Code Section 81052) which provided funds for Field Act seismic upgrades.

At this time, no information is available regarding efforts to mitigate known vulnerable community college buildings.

8. Mitigation for Locally Regulated Essential Services Facilities

To mitigate the impact of earthquakes on locally regulated essential services facilities, California enacted the Essential Services Buildings Seismic Safety Act in 1986. Pursuant to the act, the Division of the State Architect (DSA)

within DGS adopted regulations that apply to the construction of all new essential services buildings (California Code of Regulations, Title 24, Part 1, Sections 4-201 to 4-249). There are no statewide regulations for evaluating and retrofitting locally regulated essential services buildings that existed prior to 1986 except for unreinforced masonry (URM) buildings in some jurisdictions. Some local governments and state agencies have voluntarily retrofitted or replaced their vulnerable buildings using current design standards such as ASCE41-13.

9. Mitigation for K-12 Public Schools

Since 1933, public schools have been constructed in accordance with the Field Act, which requires thorough reviews of construction plans, strict inspections, and quality control. The Garrison Act of 1939 set the criteria for use or abandonment of pre-1933 school buildings, becoming the first retrofit legislation passed for public schools in California.

In 2002, the Department of General Services (DGS) released a report on a survey of early Field Act buildings that were constructed to regulations that, for certain types of construction, are no longer considered to provide reliable life safety.[119] Survey results include the following:

- 42,000 Field Act building construction projects were submitted to DSA before the major building code changes effective in 1978.
- Buildings built before 1933 were either removed from use or retrofitted by 1976.
- 9,659 buildings (92 million square feet of space) with non-wood construction were constructed prior to 1978 when major changes were made to the Field Act regulations. Of these, 2,122 Category 1 buildings are expected to perform well and achieve life safety and 7,537 Category 2 buildings are not expected to perform as well as Category 1 buildings and will require more seismic evaluations.

In November 2006, Proposition 1D authorized up to $199.5 million for purposes of seismic repair, reconstruction, or replacement of Kindergarten through 12th grade (K-12) school facilities. By November 2014, $50.5 million in bond funds had been apportioned to projects, $6.6 million in projects had received unfunded approval, and there was $142.4 million remaining in bond authority. As of April 2016, the State Allocation Board, which oversees state bond allocations, reported approximately $86.2 million in remaining Proposition 1D bond authority. By April 2018, the entire $199.5 million made available under Proposition 1D had been allocated to projects that had previously received unfunded approval.

At its April 2018 meeting, the State Allocation Board took action to permit remaining unfunded approved projects previously submitted for funding under the Seismic Retrofit Program under Proposition 1D to be considered for funding under Proposition 51. Proposition 51 passed on the November 2016 statewide ballot, authorizing $9 billion in bonds to fund construction and improvement of K-12 and community college facilities. A portion of Proposition 51 funds are also available for new seismic retrofit projects under the Facility Hardship Program.

DGS's Office of Public School Construction published a Seismic Mitigation Program Handbook in April 2015 to assist school districts in applying for and obtaining "grant" funds for the purposes of performing seismic mitigation work on school facilities. It is intended to be an overview of the program for use by school districts, architects, and other parties interested in how a school district or county superintendent of schools becomes eligible and applies for the different types of available state funding. The Office of Public School Construction, in conjunction with the Department of Education, offers training workshops and training videos that provide planning and technical assistance to potential applicants. These resources are available on the Office of Public School Construction website at: https://www.documents.dgs.ca.gov/opsc/Resources/SMP_Handbook.pdf.

The Guide and Checklist for Nonstructural Earthquake Hazards in California Schools is available for download at: http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/Nonstructural_EQ_Hazards_For_Schools_July2011.pdf.

[119] California Department of General Services, Division of the State Architect. "Seismic Safety Inventory of California Public Schools." November 15, 2002.

Progress Summary 6.F: School Retrofit Progress in the Los Angeles Unified School District

Progress as of 2018: Second largest in the nation, the Los Angeles Unified School District (LAUSD) enrolls more than 640,000 students in Kindergarten through 12th grade, at over 900 schools, and 187 public charter schools. The boundaries spread over 720 square miles and include the City of Los Angeles as well as all or parts of 31 smaller municipalities plus several unincorporated sections of Southern California.[120]

LAUSD has been systematically reducing the risk to its facilities and students from geologic hazards through an aggressive program to identify and retrofit hazardous structures. The key to this successful program has been the combination of assessing vulnerability of buildings and facilities, building seismic retrofit into the LAUSD Master Plan, and securing funding for improvements from local and state bond measures and federal grants.

Although a great deal of structural and non-structural seismic retrofit was accomplished following the 1994 Northridge Earthquake as part of the disaster recovery process, the passage of Assembly Bill (AB) 300 in 1999 triggered a more comprehensive approach to addressing LAUSD's earthquake risk.

AB 300 required the Department of General Services (DGS) to survey the state's public school buildings (Kindergarten through 12th grade) for earthquake safety, and to submit a report of its findings to the Legislature. The DGS report, released in 2002, identified 269 of LAUSD's nearly 13,000 buildings for detailed seismic evaluation.

In 2006, analysis conducted by LAUSD, including site visits and field investigations, identified a total of 667 buildings that warranted seismic evaluation based upon AB 300 criteria and LAUSD's higher standards. Since that time, seismic evaluations have been performed on school buildings found to be the most seismically vulnerable, and projects have been developed to address the buildings determined to be in the greatest need of structural upgrades.[121]

Priorities for seismic retrofit were based on type of construction, age of building, and occupancy, as follows:

- Priority 1 - Most Critical Type Regardless of Fault Presence (26 buildings)
- Priority 1A: Tilt-Up Buildings
- Priority 1B: Non-Ductile Framed Building Types
- Priority 2 - Buildings within 2 Kilometers (km) of an Active Fault (165 buildings)
- Priority 3 - Buildings 2 to 5 km of an Active Fault (223 buildings)
- Priority 4 - Buildings More than 5 km of an Active Fault (253 buildings)

The Seismic Mitigation Plan was integrated into LAUSD's master planning process with other modernization programs, ensuring that seismic mitigation would be built into future building upgrades, and facilitating access to available school construction funds

Funds to implement the Seismic Mitigation Plan were provided through local and state bond measures as well as federal hazard mitigation grant funds. Five local bond measures (Proposition BB, and Measures R, K, Y, and Q) were passed by the required two-thirds vote between 1997 and 2008, authorizing LAUSD to issue more than $20 billion in bonds for the construction of new schools and the repair and upgrade of existing buildings, including seismic retrofit or replacement.[122]

In addition to local bond funds, statewide Proposition 1D passed in November 2006 authorized up to $199.5 million for purposes of seismic repair, reconstruction, or replacement of Kindergarten through 12th grade school facilities, providing a supplemental source of funding for LAUSD's Seismic Retrofit Program.

Between 2004 and 2018, hazard mitigation grants were provided on a 75/25 percent match basis through the Federal Emergency Management Agency (FEMA)'s Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) program, as shown in Table 6.E.

[120] https://achieve.lausd.net/about
[121] http://www.laschools.org/new-site/ab300/
[122] http://www.laschools.org/new-site/legislation-grants-funding/funding-programs

Table 6.E: Hazard Mitigation Grant Funded Seismic LAUSD Retrofit Projects

Program	Year	Amount	Project
Hazard Mitigation Grant Program (HMGP)	2004	$100,000.00	Hazard Mitigation Plan
Pre-Disaster Mitigation (PDM)	2005	$2,999,901.00	Seismic Retrofit - Relocatable Classrooms
LPDM	2008	$999,809.00	Seismic Retrofit Tilt-Up
HMGP	2008	$3,000,000.00	Seismic Retrofit Tilt-Ups
HMGP	2009	$2,000,000.00	Seismic Retrofit - 3 Buildings
PDM	2017	$150,000.00	Hazard Mitigation Plan
PDM	2018	$2,300,000.00	Seismic Retrofit

10. Mitigation for Hospitals

Since 1973, hospitals have been required to be built to higher standards than other buildings so they can be reoccupied after major earthquakes. However, many hospitals built before 1973 still remain in service, and some of them pose risks to life or are not expected to be available for occupation after future earthquakes. The 1973 Alquist Hospital Facilities Seismic Safety Act (HFSSA) designated the Office of Statewide Health Planning and Development (OSHPD) as the enforcement agency of the HFSSA mandates. OSHPD's primary objective is to safeguard the public health, safety, and general welfare through regulation of the design and construction of healthcare facilities, to ensure they are capable of providing sustained services to the public.

Senate Bill (SB) 1953, enacted in 1994 after the Northridge Earthquake, expanded the scope of the 1973 Alquist Hospital Seismic Safety Act. The law as amended required that: 1) hospital owners survey the earthquake vulnerability of their buildings and submit to OSHPD their seismic evaluations reports as well as their compliance plans no later than January 1, 2001; 2) by 2013, all hospital buildings built before 1973 that pose threat to life be replaced or retrofitted so they can reliably survive earthquakes without collapsing or posing threats of significant loss of life; and 3) by 2030, all hospital buildings be reasonably capable of providing services to the public after disasters. Furthermore, hospitals were required to have the necessary nonstructural components and systems (emergency generator[s], oxygen tanks, etc.) strengthened by 2002 in order to be able to administer adequate and orderly evacuation of patient and staff, if needed. SB 1953 applies to all acute care facilities (including those built after 1973) and affects approximately 3,083 buildings across 423 hospital facilities. State-owned hospitals are exempt from the seismic compliance requirements of HFSSA (SB 1953).

As of August 2016, more than 91 percent of California's acute care hospitals are no longer at significant risk of collapse in a strong earthquake. Between 2002 and 2016, the inventory of buildings at risk of collapse declined from 1,313 to 251.

SB 1661, SB 499, SB 90, and some subsequent bills which were amendments to the HFSSA, allow hospitals that pose a significant risk of collapse, classified as Structural Performance Category (SPC-1), an extension on the timelines for seismic compliance which could vary from two to up to seven years if progress toward seismic compliance is being made. All SPC-1 hospital buildings must, by 2020 (and in one particular case, by 2022), either be upgraded to SPC-2 (buildings that do not significantly jeopardize life, but may not be repairable or functional after a strong ground motion) or be removed from General Acute Care service. Additional rankings include SPC-3,-4,-4D, and 5, and are largely based on structural capability to provide services following an earthquake and compliance requirements for the January 1, 2030 deadline. SPC-4D is a new Structural Performance Category that is part of the 2016 California Building Standards Code, which allows non-compliant buildings to go past the 2030 seismic compliance deadline. For a detailed list of SPC rankings, please see:
https://www.oshpd.ca.gov/FDD/seismic_compliance/SB1953/SeisPerfRatings.html.
For an updated list of hospital SPC rankings in the state, please see: https://apps.oshpd.ca.gov/fdd/spc.html.

OSHPD has adopted and enforces regulations for the seismic evaluation and retrofit of existing hospital buildings (see Chapter 6 of the 2016 California Administrative Code and Part 10 of the 2016 California Building Code) that are applicable to all existing acute care hospitals, as well as ASCE41-13 and ASCE/SEI 7-16.

Table 6.F: Hospital Structural Performance as of December 2017

Type	Category	Number of Buildings	Percent
Structural Performance Category (SPC)	SPC-1[a]	200	6.5
	SPC-2	640	20.8
	SPC-3/3s	382	12.4
	SPC-4/4s	805	26.1
	SPC-5/5s	1027	33.3
	Not Assigned	29	0.9
Total SPC Buildings		*3083*	*100*
Non-Structural Performance Category (NPC)	NPC-1	170	5.3
	NPC-2	1825	56.7
	NPC-3	235	7.3
	NPC-4	908	28.2
	NPC-5	13	0.4
	Not Assigned	67	2.1
Total NPC Structures[c]		3218	100

Source: Office of Statewide Health Planning and Development (OSHPD), www.oshpd.ca.gov

[a] *SPC and NPC are on a scale where 1 is the most vulnerable and 5 is the least vulnerable*

[b] *3s, 4s, and 5s indicate seismic performance ratings self-reported by the hospital and not verified by OSHPD*

[c] *NPC structures includes tunnels and equipment yards that are not assigned SPC ratings*

Table 6.F summarizes the seismic (structural/nonstructural) performance for hospitals. SPC-1 is the most vulnerable ranking for buildings. Many SPC-1 hospitals pose significant collapse risks. SPC-5 hospitals pose the least structural risk.

11. Repair of Steel-Frame Buildings

The cities of Los Angeles and Santa Monica have post-earthquake repair ordinances. Los Angeles required owners to remove the finishes from joints in 242 buildings and repair the ones that were cracked. As of February 2006, the City of Los Angeles has reported cracks repaired in welds in 500 buildings in the region of strongest Northridge Earthquake shaking. The most current recommended evaluation and retrofit provisions are in ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings, FEMA 350 to FEMA 353 and the American Institute of Steel Construction Seismic Provisions (AISC 341). See www.aisc.org for more information.

12. Mitigation for High-Rise Buildings

Guidelines are available for the retrofit of building contents and non-structural building systems, such as ceilings, light fixtures, and mechanical equipment (FEMA 74). Structural retrofits can be accomplished using ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings) or the 2015 or 2018 International Existing Building Code.

The Pacific Earthquake Engineering Research Center (PEER) issued "Guidelines for Performance-Based Seismic Design of Tall Buildings" as part of the Tall Buildings Initiative launched by the cities of Los Angeles and San Francisco in 2010. The 84-page performance-based engineering guide supports design of more economical and constructible future new tall buildings that will perform better during seismic events. To download the guidelines, go to: http://peer.berkeley.edu/tbi/.

13. Locally Regulated Non-Ductile Concrete Buildings

Non-Ductile Concrete Building Inventories

In 2006 PEER was awarded a $3.6 million grant from the National Earthquake Engineering Simulation Center to assess collapse risks for locally regulated non-ductile concrete buildings and develop enhanced risk management methods.[123] PEER administers the Network for Earthquake Engineering Simulation Grand Challenge project on existing hazardous concrete buildings (NSF Award# CMMI-0402490). The project team completed an inventory of older non-ductile concrete buildings in the City of Los Angeles in 2013, including detailed information on building location, age, configuration, and occupancy.

Prior to this project, this critical information was not available to policy makers, engineers, and researchers in an organized single source. The immediate impact of this inventory was demonstrated as it served as the backbone for earthquake scenario loss studies to help inform the City of Los Angeles on the extent and character of the vulnerability. Laboratory studies have identified critical building components, and earthquake simulation studies have extended those findings to identify building characteristics that make a building most susceptible to collapse. The project is leveraging its work with the Concrete Coalition, FEMA, and National Institute of Standards and Technology (NIST)-funded companion projects to help practicing engineers identify those buildings with highest risk by developing guidelines for assessing vulnerability and methodologies to effectively strengthen the most critical elements that will prevent collapse and save lives.

Under a Hazard Mitigation Grant Program (HMGP) grant, the Concrete Coalition—a network of individuals, governments, institutions, and agencies — has been assessing risks associated with dangerous non-ductile concrete buildings and developing strategies for fixing them. Since 2008, the Concrete Coalition has prepared estimates of the number of pre-1980 concrete buildings in the 22 high-seismic-risk counties in the state.

In 2010, a statewide volunteer effort coordinated by the Earthquake Engineering Research Institute (EERI), through its Concrete Coalition Project, canvassed cities throughout the state to determine how many pre-1980 non-ductile concrete buildings they may have within their jurisdictions. As a result of this effort approximately 16,000 to 17,000 pre-1980 non-ductile buildings were identified in the 22 high risk counties. Not all of these buildings are necessarily dangerous or at risk of collapse. The final report from this phase is available at: https://www.eeri.org/2011/09/concrete-coalition-california-inventory-project-report-now-available/.

The next step is to gain a better understanding of which of these represent the highest risk. This is a serious issue for the older, larger cities. San Francisco, for example, has over 3,000 non-ductile buildings. Although many of these will perform adequately in an earthquake, it is important to understand which ones will not and why. The collapse of even one large, high-occupancy building could have devastating consequences for a single community. In 2012-2013, a new phase of the Concrete Coalition work, also supported by an HMGP grant, is focusing on developing tools that help decision-makers understand the dimensions of the problem, as well as help engineers develop techniques to categorize which of these buildings are most vulnerable.

City of Los Angeles Mandatory Non-Ductile Concrete Building Retrofit Program

In 2016, the City of Los Angeles passed Ordinance 183893, which requires the retrofit of all pre-1977 non-ductile concrete buildings. The goal of the mandatory retrofit program, under the ordinance, is to reduce these structural deficiencies and improve the performance of these buildings during earthquakes. Without proper strengthening, these vulnerable buildings may be subjected to structural failure during and/or after an earthquake.

The City of Los Angeles Department of Building and Safety (LADBS) is in the process of identifying the concrete buildings subject to the retrofit ordinance. Following receipt of an Order to Comply from LADBS, the retrofit program requires owners to take retrofit actions within the following time frames:

- 3 years: Submit a completed checklist for review to determine if the building is a non-ductile concrete building
- 10 years: Submit proof of previous retrofit, or plans to retrofit or plans to demolish the building
- 25 years: Complete construction

[123] http://peer.berkeley.edu/

For more information about the City of Los Angeles Mandatory Non-Ductile Concrete Building Retrofit Program, visit the program website: http://www.ladbs.org/services/core-services/plan-check-permit/plan-check-permit-special-assistance/mandatory-retrofit-programs/non-ductile-concrete-retrofit-program.

The most current retrofit provisions are available in ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings and in the 2015 and 2018 International Existing Building Codes.

14. Mitigation for Locally Regulated Unreinforced Masonry Buildings

In 1986, California passed a law requiring local governments in high seismic regions nearest active faults to inventory their URM buildings, establish a risk reduction program, and report to the CSSC. Ninety-three percent of the jurisdictions affected by the URM law comply with its provisions. State government buildings are exempt from the URM law but are partially addressed by other laws and regulations.

In 1990, there were an estimated 30,000 URM buildings statewide; approximately 26,000 were located in Seismic Zone 4 (now called high seismicity regions) with the remainder in Seismic Zone 3 (now called moderate seismicity regions). Ninety-eight percent of the URM buildings in Seismic Zone 4 (high seismicity regions) (283 jurisdictions) have been inventoried and over 70 percent had been retrofitted, demolished, and/or replaced by 2006. Statewide, URM buildings average 10,000 square feet of floor area. Retrofit costs average $60 per square foot with a range of $10 to $150 per square foot.

The CSSC stopped tracking retrofit progress in 2006 for four reasons: 1) budget priorities were established by the Seismic Safety Commission, 2) progress had slowed to the point that changes in overall URM mitigation progress were below 1 percent per year, 3) the costs of the reporting burden imposed on local governments no longer justified the benefits of frequent updates, and 4) Cal OES requests such information through its multi-hazard mitigation program, thus rendering the CSSC's future surveys redundant. An unfortunate result is that most local governments no longer maintain records of their URMs and do not have ready, current, and comprehensive access to that information in the event of damaging earthquakes. The state adopted retrofit standards for URM buildings in Title 24, Part 10 of the 2016 California Building Standards Code. These reference the 2015 International Existing Building Code. Of California's cities and counties, 169 have adopted some form of these standards. See "Status of the Unreinforced Masonry Building Law" (SSC 2006-04) for the mitigation status of each jurisdiction affected by the state's URM law.

A 2016 report published by the California Seismic Safety Commission (CSSC) in partnership with the Pacific Earthquake Engineering Research Center (PEER) found that the City of Napa's program to seismically retrofit URM buildings was successful in reducing damage and the risk to life safety posed by these buildings in the 2014 South Napa Earthquake.

Best Practices Highlight 6.D: URM Retrofit Program Success in San Luis Obispo

What does it take to make significant hazard mitigation progress? For San Luis Obispo, California, it took the reality of an earthquake 40 miles away and the cooperation of businesses and property owners to make their downtown more resilient. More than 100 unreinforced masonry (URM) buildings have been retrofitted against earthquake forces, largely during the past decade, saving historic buildings, creating downtown vitality, and increasing public safety

Initial Challenge

Following adoption of the Unreinforced Masonry Building Law (Alquist) of 1986, City of San Luis Obispo building officials identified 126 hazardous URMs–76 of which were in the downtown core. In 1997 the city's first seismic retrofit ordinance required full strengthening by 2017. By 2004, only 27 of the 127 hazardous buildings had addressed the seismic retrofit requirements.

San Simeon Earthquake – A Wake-Up Call

On December 22, 2003, the need for strengthening took on renewed urgency with the Magnitude 6.5 San Simeon Earthquake. The San Simeon Earthquake resulted in two deaths due to URM building collapse and a range of building damage in northern San Luis Obispo County as well as chimney collapses in San Luis Obispo. Recognizing the risk posed to the city's vulnerable buildings, the San Luis Obispo City Council resolved to reassess the effectiveness of the URM ordinance. The San Luis Obispo Chamber of Commerce, tasked with enhancing the economic health of the area, was eager to collaborate with city officials and reconvened its Seismic Task Force, a group including building owners, business owners, and city staff.

New Ordinance

In 2004 the 1997 seismic retrofit ordinance was revised to shorten the 2017 deadline to 2010 for completion of all seismic retrofits to hazardous URMs within the city. The Chamber of Commerce pushed for a seismic coordinator who could help its members facilitate plans, engineering, and permits in short order. As part of the 1997 incentive program update, a seismic coordinator was hired who reported to the Economic Development Department overseen by the City Manager. The seismic coordinator had individual contact with every building owner and was responsible for communicating rules and resources via presentations at outreach events and via periodic publications.

Lessons Learned

As of 2015, San Luis Obispo has identified five key lessons were learned through this process:

- *Internal Advocate*: Having an internal advocate, the seismic coordinator, made a difference in connecting the people with the law.
- *Willing Players*: Having a few property owners who understood the requirement and made the first step to bring their buildings into compliance got the ball rolling for other building owners.
- *Buy-In from Building Owners*: Working with building owners to achieve understanding and buy-in was essential.
- *Progress-Over-Penalty Approach:* Issuing credits for cooperation was effective in moving many projects forward and enhancing public safety sooner than later.
- *Reasonable Deadlines*: Setting a deadline not too far into the future provided an incentive for work to get done without creating a timeline that was impossible to meet.

Progress as of 2015

By 2010, San Luis Obispo had already seen major URM retrofit progress. As of late 2012 all but 14 of the original 126 buildings had been strengthened. Of these, five retrofit projects were in construction, and eight were scheduled to begin construction in 2013, subject to a new deadline of July 1, 2015. As of late 2015, all but eight of the original 126 buildings had been strengthened. Of the eight remaining buildings, two are partially retrofitted and six are under construction.

Source: City of San Luis Obispo; Claire Clark and Monica Fiscalini

15. Mitigation for Tilt-Up Buildings

The average size of older tilt-up buildings is 30,000 square feet. Average retrofit costs are $5 per square foot in 2007 dollars. Many of California's light industrial and commercial properties contain tilt-up buildings or buildings with reinforced masonry or concrete walls with vulnerabilities in connections between walls, roofs, and floors. These buildings pose significant risks of casualties and losses in business continuity and California's market share from earthquake damage.

Current retrofit provisions are available in the 2015 or 2018 International Existing Building Code or ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings. The state also encourages sellers of tilt-up buildings and other vulnerable commercial buildings to disclose to buyers any typical earthquake weaknesses defined in the Commercial Property Owner's Guide to Earthquake Safety. State law encourages the disclosure of earthquake weaknesses in commercial properties at the time of sale.

16. Mitigation for "Soft-Story" Buildings

In 2005, the state legislature passed AB 304, which encourages cities and counties to address the seismic safety of soft-story residential buildings and encourages local governments to initiate efforts to reduce the seismic risk in vulnerable soft-story residential buildings. AB 304 requires the seismic retrofit of these buildings to comply with a nationally recognized model code relating to the retrofit of existing buildings or substantially equivalent standards. It replaces the word "reconstruction" with "seismic retrofit" in provisions governing earthquake hazardous building reconstruction and defines seismic retrofit for purposes of provisions governing earthquake protection. "Seismic retrofit" means either structural strengthening or providing the means necessary to modify the seismic response that would otherwise be expected by an existing building during an earthquake, to significantly reduce hazards to life and safety.

The following are hazard mitigation strategies recently undertaken locally for "soft-story" buildings in California.

Soft-Story Building Inventories

The cities of Alameda, Berkeley, Fremont, Oakland, San Francisco, San Leandro, and San Jose, as well as other Santa Clara County cities, in addition to Santa Rosa, Los Angeles, Concord, Rohnert Park, Burbank, Pasadena, Santa Monica, and Santa Barbara, all have either undertaken or are in the process of beginning a soft-story building inventory.

Soft-story inventories in California range from those mandated by ordinance (Alameda, San Francisco, and Los Angeles) to those that are voluntary. Since 2006, hundreds of soft-story buildings have been retrofitted. For example, Los Angeles went from 90 retrofitted buildings in 2006 to over 800 retrofitted soft-story buildings by 2009. There is still work to do, though, as most cities with inventories report thousands to tens of thousands of soft-story units.

In addition, the CEA has applied for several HMGP grants (DR-4344 and DR-4353) to assist homeowners with retrofitting of single-family soft-story buildings in San Francisco and Oakland.

San Francisco CAPSS Report

In 2009, as part of the Community Action Plan for Seismic Safety (CAPSS) in the City and County of San Francisco published "Here Today – Here Tomorrow: Earthquake Safety for Soft-Story Buildings."

Recommendations in the report pertain to "multi-unit soft-story buildings," defined as, "wood-frame structures, three stories or more, with five or more residential units, built before May 1973, and having a 'soft-story' condition on the ground floor."

Key recommendations included the following:

- The Department of Building Inspection should establish a program that requires owners of wood-frame buildings built before May 21, 1973 with three or more stories and five or more residential units to evaluate the seismic safety of their buildings and to retrofit them if they are found to be seismically deficient.
- Buildings should be retrofitted to a standard that will allow many of them to be occupied after a large earthquake.
- The City should immediately offer incentives to encourage voluntary retrofits. To get owners moving on making their buildings safer, the City should offer incentives to owners who retrofit, including expediting plan review, rebating permit fees, offering planning incentives, and seeking voter approval of a City-funded loan program.
- The Department of Building Inspection should form a working group to develop a detailed plan to implement the recommended program.

For more information about CAPSS, visit: http://sfgov.org/esip/capss.

Best Practices Highlight 6.E: San Francisco Community Action Plan for Seismic Safety and San Francisco's Soft Story Ordinance

Soft Story Ordinance

On the 107th anniversary of the 1906 San Francisco Earthquake, Mayor Edwin Lee signed into law the Mandatory Seismic Retrofit Program for Soft-Story Wood-Frame Buildings, which will lead to seismic strengthening of several thousand buildings in San Francisco. The new ordinance was approved unanimously by the Board of Supervisors with an 11-0 vote following years of work among City officials, property owners, tenants, and community members to reach a retrofitting plan.

More than 58,000 San Francisco residents live in the estimated 3,000 or more wood-frame soft story buildings that are targeted for seismic retrofit by the soft-story ordinance. These same buildings also house approximately 2,000 businesses with an estimated 7,000 employees. The primary goal of the soft-story ordinance is to protect San Franciscans and the city's housing stock, thus ensuring more rapid recovery from future earthquakes. The Community Action Plan for Seismic Safety (CAPSS) study showed that the retrofitting of soft-story buildings, as required by the new ordinance, would result in a reduction of earthquake collapse hazards, allowing the city to retain significant amounts of housing stock following a moderate earthquake event (Magnitude 7.2) and shortening the recovery time from such an earthquake. Thus, the ordinance promotes the resiliency goals identified in the Community Safety Element of the San Francisco General Plan. The retrofits will also greatly increase the likelihood that these buildings will remain useable (or "safe enough to stay") for their residents following a major earthquake (SPUR Safe Enough to Stay/Shelter in Place). Allowing San Franciscans to remain in the city will also greatly ensure and quicken recovery.

The soft-story ordinance expanded the reach of the CAPSS report to apply to wood-frame buildings built before January 1, 1978. These buildings consist of at least two stories over a weak ground-floor level or garage with five or more residential units. The ordinance is now being implemented through The Mandatory Soft Story Retrofit Program (MSSP) which was created in 2013 as a multi-year community-based effort led by the Earthquake Safety Implementation Program and enforced by the Department of Building Inspection to ensure the safety and resilience of San Francisco's housing stock through the retrofit of older, wood-framed, multi-family buildings with a soft-story condition.

As part of this program, all affected property owners received notices beginning in September 2013 and were required to have submitted their screening forms to the Department of Building Inspection by September 15, 2014. The Department of Building Inspection has achieved over 99 percent response to the program. Buildings that have not complied with this requirement have been placarded and issued Notices of Violation. A Wood Frame Compliance Tier and Timeline was developed with the goal of completing all retrofits by September 2020.

The Mandatory Soft Story Retrofit Program provides a weekly update on the status of properties identified as soft story, including an interactive map of all properties. The updates can be found at http://sfdbi.org/soft-story-properties-list.

City of Los Angeles' Mandatory Soft-Story Retrofit Program

In 2016, the City of Los Angeles passed Ordinance 183893, which requires the retrofit of pre-1978 wood-frame soft-story buildings. The goal of the mandatory retrofit program, under the ordinance, is to reduce these structural deficiencies and improve the performance of these buildings during earthquakes. Without proper strengthening, these vulnerable buildings may be subjected to structural failure during and/or after an earthquake.

In early 2016, the Los Angeles Department of Building and Safety (LADBS) began issuing Orders to Comply to the first priority tier of soft-story structures (buildings with 16 or more dwelling units). Second priority structures received orders to complete in late 2016. Orders to Comply will be issued the third priority structures through late 2017. The retrofit program requires that, following receipt of an Order to Comply from LADBS, owners to take retrofit actions within the following time frames:

- 2 years: Submit proof of previous retrofit, or plans to retrofit or demolish

- 3.5 years: Obtain permit to start construction or demolition
- 7 years: Complete construction

A progress-over-penalty approach—issuing credits for cooperation—was effective at moving many projects forward and enhancing public safety sooner rather than later.

For more information about the City of Los Angeles Mandatory Soft-Story Retrofit Program, visit the program website: http://www.ladbs.org/services/core-services/plan-check-permit/plan-check-permit-special-assistance/mandatory-retrofit-programs/soft-story-retrofit-program.

Current Soft-Story Retrofit Provisions
The most current retrofit provisions for soft-story buildings are available in the International Existing Building Code 2015 or 2018 Editions or ASCE/SEI 41-13, Seismic Evaluation and Retrofit of Existing Buildings. Local jurisdictions including the cities of San Francisco and Berkeley have enacted voluntary and mandatory retrofit ordinances. The California Building Code allows these references as acceptable alternatives to existing regulations.

17. Mitigation for Multi-Unit Wood-Frame Residential Buildings

California contains a total of 160,000 apartment buildings with five or more units, according to the California Department of Finance. Approximately 130,000 apartment buildings, including 46,000 soft-story buildings, are in regions of high seismicity. The statewide average is 16 units per building.

Progress Summary 6.G: California Residential Mitigation Program

Progress as of 2018:
Adoption of Chapter A3: In the fall of 2009, the California Earthquake Authority (CEA) held scoping sessions in Sacramento, Los Angeles, and Oakland to collect informed recommendations from related experts on future opportunities for the seismic retrofitting of residential structures in California. Stakeholders for the CEA mitigation program include California homeowners and renters, the California residential construction industry, the California Governor's Office of Emergency Services (Cal OES), the Association of Bay Area Governments, the Southern California Association of Governments, the California Seismic Safety Commission (CSSC), Earthquake Country Alliance, and others. The participants at the scoping sessions suggested that a statewide standard was needed. The CEA subsequently worked with the Office of the Governor, Department of Housing and Community Development, CSSC, and California Building Standards Commission to facilitate the August 16, 2010 adoption of the first California Building Code for existing residential structures (Appendix A3 of the 2009 International Building Code -- "Prescriptive Provisions for the Seismic Strengthening of Cripple Walls and Sill Plate Anchorage of Light Wood-Frame Residential Buildings"). The current provisions are found in the 2016 California Existing Building Code.

Establishing the California Residential Mitigation Program: In August 2011, the CEA and the California Emergency Management Agency (CalEMA) (now Cal OES) entered into a joint powers agreement to create the California Residential Mitigation Program (CRMP) to carry out a joint mitigation program. The board of directors of the CalEMA/CEA Joint Powers Agreement (JPA) manages the CRMP, which has been designed to provide financial incentives to homeowners who complete seismic retrofit projects on their dwellings. Buildings retrofitted through the CRMP are required to be code-compliant and pass local building department inspections.

Earthquake Brace+Bolt: The CRMP piloted the Earthquake Brace+Bolt (EBB) program in 2013, providing up to $3,000 to homeowners who retrofitted their houses in accordance with program rules and the requirements of Chapter A3 of the California Existing Building Code (raised floor with cripple walls less than 4 feet tall, etc.). Areas in Oakland and Los Angeles selected for the pilot were determined using U.S. Geological Survey (USGS) and census data to identify areas of high seismicity that were also dense with houses built before 1979. These houses were built prior to uniform compliance with seismic-related building codes and are at greater risk of collapsing and sliding off their foundations.

The program, available in more than 180 ZIP codes, also allows for the use of Standard Plan Sets A for the Bay Area and Los Angeles. The CEA estimated that, as of mid-June 2018, more than 5,000 houses had been retrofitted. The EBB program expects to retrofit an additional 6,000 houses between 2018 and 2021.

By requiring compliance with Chapter A3 the goal was, and is, to:

- Strengthen cripple walls to enable them to function as shear members, significantly protecting the dwelling from collapsing;
- Bolt sill plates to the foundation, enabling the dwelling to remain in place rather than sliding off the foundation during an earthquake; and
- Properly strap the water heater to reduce the likelihood of water and fire damage, and to protect the water supply.

Initial funding for EBB was provided through the CEA Loss Mitigation Fund (LMF). The CEA funds LMF through interest earned from CEA investments equivalent to 5 percent (not to exceed $5,000,000) annually. Additional funding was provided by the State of California in the amount of $3,000,000 in 2016, and again in 2017. These funds were distributed through the California Department of Insurance. The CRMP sought and received $300,000 in Federal Emergency Management Agency (FEMA) Hazard Mitigation Grant Program (HMGP) funds to establish an EBB program in Napa. The CEA has applied for additional FEMA funding through HMGP for DRs 4308, 4344, and 4353. If these grants are awarded, EBB could receive between $3 million and $28 million to retrofit single-family, wood-framed dwellings and an additional $5 million to $15 million to retrofit soft-story dwellings in San Francisco and Oakland.

Homeowners seeking to participate in EBB must meet specific program requirements including living in a program ZIP code and providing receipts and documentation of the retrofit and a copy of a building permit approving and signifying that the retrofit was done in accordance with the current building code.

Since 2013, the CRMP has issued grants to over 5,000 homeowners. The program will continue as long as funding is available. EBB has the potential to expand the types of houses that can participate in the program as additional engineered prescription solutions become available and codified. Additional information on EBB can be found at: www.earthquakebracebolt.com.

18. Mitigation for Single-Family Wood-Frame Dwellings

A 1999 survey by the Association of Bay Area Governments (ABAG) determined that from 2 percent to 38 percent of Bay Area homes were retrofitted depending upon jurisdiction, with an average retrofit rate well below 10 percent. Similarly, the California Earthquake Authority (CEA) has found that about 6 percent of policyholders have retrofitted their homes.

The following cities have voluntary dwelling retrofit programs:

- Los Angeles – 6,000 dwellings retrofitted as of February 2006 (also adopted a voluntary hillside dwelling retrofit ordinance)
- Berkeley
- San Leandro
- Oakland
- Santa Barbara
- Santa Monica

The most current retrofit provisions are available the 2018 International Existing Building Code. Local governments in the San Francisco Bay region have adopted more stringent retrofit provisions called Standard Plan Set AA. The City of Los Angeles also has an approved Plan Set (LA Standard Plan Set No. 1) for the retrofit of single-family wood-frame dwellings.

The state also requires sellers of dwelling buildings to disclose to buyers any typical earthquake weaknesses defined in the Homeowner's Guide to Earthquake Safety

Best Practices Highlight 6.F: Mitigating Seismic Vulnerability of Housing

Residential Hazard, Vulnerability, Risk, and Mitigation Assessment
Role of California Earthquake Authority (CEA)

Seismic Vulnerability of Statewide Housing Stock

Approximately 38 million people reside in California in approximately 14 million residential units (see Table 6.G). Housing represents the largest class of occupied buildings in the state. The majority of Californians live south of the Tehachapi Mountains or in the San Francisco Bay Area. Both areas have numerous extensive faults running through and near them and are subject to strong levels of earthquake shaking potential. It is generally acknowledged that inadequately constructed and/or maintained buildings, situated on poorly performing soils, tend not to perform well during earthquakes. A statewide study of the performance of the California residential building stock has never been conducted. Studies of residential units, in general, have been localized and completed only after earthquakes have occurred.

Several studies of earthquake effects on housing have been completed, including those associated with the San Francisco Bay Area and the Los Angeles metropolitan area in 2007 and 2008 through the Community Action Plan for Seismic Safety (CAPSS) program in the San Francisco Bay Area and the Great California ShakeOut drills in 2008 and 2009. For a detailed discussion of the Great ShakeOut, see *Section 6.1.3*.

Residential construction increasingly has been influenced by natural hazard issues in California. Faulty performance of building stock during earthquakes has required numerous changes in building codes affecting subsequent construction, design, practices, and materials used. To date, neither a statewide assessment of California residential building stock nor statewide tracking of completed seismic retrofitting of housing has been funded or completed in California. Therefore, the losses that could be avoided by the seismic retrofitting of residential units have not been calculated or otherwise determined. The availability of this information would be useful in the development of future earthquake mitigation activities and could be an area of ongoing surveillance and study should the Federal Emergency Management Agency (FEMA) decide to pursue it.

Table 6.G identifies the numbers and percent of housing units in California by type. It indicates that a majority of units (57.8 percent) are single-family detached.

Table 6.G: California Housing Units by Type, 2017

Units in Structure	Number of Units	Percent of Total
1 unit detached	8,128,817	57.8%
1 unit attached	980,957	6.9%
2 to 4 units	1,126,344	8.0%
5+ units	3,273,164	23.2%
Mobile homes	561,586	3.9%
Total housing units	**14,070,868**	**100%***

Source: Table E-5, County/State Population and Housing Estimates, State of California, Department of Finance, January 1, 2017.
** Percentages do not add to 100% due to rounding*

Impediments to Seismic Hazard Mitigation for Housing

The following are potential impediments to seismic hazard mitigation for residential units, along with actions being taken or needed to overcome these impediments:

1. Lack of Standardization. Seismic retrofits standards, specifications, and plans have generally not been standardized and included in the California Existing Building Code. The CEA recently worked with the Office of the Governor, Department of Housing and Community Development, California Seismic Safety Commission, and California Building Standards Commission to adopt (on August 16, 2010) the first California Existing Building Code for the seismic retrofitting of wood frame dwellings: 2009 International Existing Building Code Appendix Chapter A3—Prescriptive Provisions for the Seismic Strengthening of Cripple Walls and Sill Plate Anchorage of Light, Wood-Frame Residential Buildings—by amending the 2010 and 2013 California Existing Building Code) for existing residential structures.

The CEA has since joined forces with the Federal Emergency Management Agency (FEMA) to develop comprehensive guidelines for evaluating and seismically retrofitting single-family dwellings. These guidelines will include additional prescriptive provisions for certain earthquake deficiencies in single-family dwellings (such as cripple walls greater than 4 feet in height and dwellings with a living space over a garage) as well as detailed provisions for use by registered design professionals. The CEA has also begun a research program seeking to determine the percentage of damage that may be reduced if the seismic/structural retrofitting of a house is done correctly. Considering its present form, the California Building Code may require revisions to determine whether a seismic retrofit of a 1- to 4-family residence should also trigger other, unrelated code-upgrade requirements.

2. Need for Training. Building officials need to be trained to identify and evaluate seismic retrofit standards, specifications, and plans. Building contractors and related craftspeople also need to be trained to understand standards, specifications, and plans in order to successfully install the seismic retrofits into existing 1- to 4-family residences. The CEA is requesting that the Federal Emergency Management Agency and the International Code Council update their respective training materials to incorporate the new California Existing Building Code adopted in January 2017 for the seismic retrofitting of residential structures.

Statewide Initiatives for Mitigating the Effects of Seismic Hazards on Housing

At present, aside from the state's property tax reappraisal exclusion and tax credits for nationally registered historical homes, the only other statewide seismic hazard mitigation incentives for residences are related to those offered by residential earthquake insurance providers.

In 2018, the CEA is the largest provider of earthquake insurance in California and has more than $15 billion in claim-paying capacity. The CEA is privately financed through insurance premiums and is a publicly managed instrumentality of the state. Private insurers that write residential property insurance in California may, at their option, and upon meeting participation requirements, participate in the CEA. Once they become CEA participants, insurers no longer write residential property earthquake insurance coverage and instead satisfy their legal obligation to offer earthquake insurance to their residential property policyholders by offering a CEA policy. Insurers that participate in the CEA are referred to as "Participating Insurers."

The CEA has maintained an A.M: Best Company financial-strength rating of "A minus (Excellent)" since 2002. The CEA is working with the California Governor's Office of Emergency Services (Cal OES) to distribute financial incentives to homeowners to help offset the cost of residential structural retrofits.

Under California law, the CEA is required to offer a mitigation discount on an insured's CEA earthquake insurance annual premium if an insured has met certain mitigation criteria. Not all houses qualify for this discount. Section 10089.40(d) of the California Insurance Code describes the minimum effort needed for a CEA policyholder of a residential dwelling to qualify for a 5-percent premium discount.

Current requirements for qualifying for the premium discount are:

- Dwelling was built prior to 1979
- Dwelling is tied to its foundation
- Dwelling has cripple walls braced with plywood or its equivalent
- Water heater is secured to the building frame

The same code section states, "The CEA Governing Board may approve a premium discount or credit above 5 percent, as long as the discount or credit is determined actuarially sound by the authority."

In January 2016, CEA introduced discounts of up to 20 percent for properly retrofitted older houses. A 23 percent discount, on average, is available for mobile homes reinforced by an earthquake-resistant bracing system certified by the California Department of Housing and Community Development.

CEA enabling legislation calls for mitigation activities, including research, development, and consumer education, as well as contents mitigation and structural retrofitting. The CEA is continuing to work with stakeholders to determine how to specifically approach the seismic retrofitting of residential structures. For a discussion of this initiative, see Progress Summary 6.G.

Residential Earthquake Insurance as a Loss Reduction Tool

Depending on the homeowner's earthquake insurance provider, the successful utilization of the seismic retrofit standards and general plans may be considered when awarding discount points to homeowners to lower their earthquake insurance premiums. It is anticipated that the resiliency added to correctly retrofitted homes will help lower the potential for loss of life, injury, and structural and non-structural damage as well as contents damage resulting from earthquakes. The impact on mitigation activity levels and the benefits gained from incentives such as lowering residential earthquake insurance premiums for seismically retrofitted housing units are unknown.

Non-Structural Mitigation Items Provided to Californians by the CEA

The CEA has provided funding to help the U.S. Geological Survey (USGS) and other agencies jointly develop and publish several guides on earthquake safety and preparedness, including "Staying Safe Where the Earth Shakes," which covers 57 counties and replaced "Putting Down Roots in Earthquake Country," which covered Southern California and the Bay Area, and "Living on Shaky Ground," which covers the North Coast Region. Other guides on home earthquake safety and preparedness include the California Seismic Safety Commission's "Homeowner's Guide to Earthquake Safety", and "Improving Natural Gas Safety in Earthquakes."

The CEA also has an ongoing hazard mitigation-funding program. The CEA's commitment to mitigation is reflected in its Strategic Plan adopted by the CEA Governing Board in 2003. The plan calls for the CEA to "educate residents about their earthquake risk and motivate them to protect themselves and their property." The CEA board sets aside funding each calendar year (equal to 5 percent of its investment income, up to $5 million annually) for funding mitigation. This annual allocation requirement is set forth in California Insurance Code Section 10089.37. The CEA also has raised more than $1 million for the American Red Cross to support disaster-relief efforts and assist communities in preparing for disasters.

Progress Summary 6.H: Seismic Evaluation of Single-Family Dwellings

Progress as of 2018: The California Earthquake Authority (CEA) has joined forces with the Federal Emergency Management Agency (FEMA) to develop comprehensive guidelines for evaluating and seismically retrofitting single-family dwellings. These guidelines will include additional prescriptive provisions for certain earthquake deficiencies in single-family dwellings (such as cripple walls greater than 4 feet in height and dwellings with a living space over a garage) as well as detailed provisions for use by registered design professionals. The CEA also began a research program seeking to determine the percentage of damage that may be reduced if the seismic/structural retrofitting of a house is done correctly. Considering its present form, the California Building Code may require revisions to determine whether a seismic retrofit of a one to four-family residence should also trigger other, unrelated code-upgrade requirements.

With the publication of the Simplified Seismic Assessment of Detached, Single-Family, Wood-Frame Dwellings (FEMA P-50) in 2012, FEMA provided home inspection and retrofit professionals with methods to assess seismic and structural vulnerabilities of an individual house and assign a Seismic Performance Grade for the dwelling and identify portions of the dwelling in need of retrofit. Seismic Retrofit Guidelines for Detached, Single-Family, Wood-Frame Dwellings (FEMA P-50-1) includes specific guidance for retrofitting a dwelling's seismic deficiencies (identified using the FEMA P-50 Simplified Seismic Assessment Form) and potentially improving its Seismic Performance Grade.

The CEA, a contributing partner in the development of the documents, began coordinating trainings in use of FEMA P-50, covering expenses in part with National Earthquake Hazards Reduction Program (NEHRP) funding. Since 2015, over 250 seismic inspection professionals have completed the training.

In an effort to build a cadre of inspection professionals proficient in use of FEMA P-50, the CEA collaborated with the California Real Estate Inspection Association to develop the Simplified Seismic Assessment Certification. With the assistance of Applied Technology Council (ATC) a training program is under development with plans to implement in 2018.

In 201, the CEA developed a web-based application based upon the FEMA P-50 Simplified Seismic Assessment Form. QuakeGrade™ is available on mobile devices (smart phones and tablets), laptops, and desktop computers. Hazard scores for shaking, fault rupture, landslide, and liquefaction risks are automatically calculated using real time data from the U.S. Geological Survey (USGS) and California Geological Survey (CGS). The resulting report identifies structural vulnerabilities with retrofit potential in an easy to understand format for homeowners. While the assessment is "simplified" it does require comprehensive knowledge and understanding of structural components of detached, single-family, wood-frame dwellings. Because of this, CEA limits access to the application to licensed and certified inspection professionals only.

19. Mitigation for Mobile/Manufactured Homes

In 1983, the state began to regulate the design and construction of optional Earthquake-Resistant Bracing Systems (ERBS) that can be installed under existing mobile/manufactured homes at the owners' discretion. When properly installed, ERBS are intended to resist seismic forces and vertical movement of mobile/manufactured homes.

Foundation system requirements for mobile homes, similar to wood-frame dwellings, to reduce or prevent collapse during an earthquake event include the following:

- Earthquake-Resistant Bracing Systems (ERBS)
- Engineered tie-down systems (ETS)
- Reinforced concrete or reinforced masonry foundation

ERBS installed in California mobile homes must be certified and comply with California code.[124]

[124] CA Adm. Code, Title 25, Chapter 2, Art. 7.5.

Other recommended retrofits of mobile homes include bracing water heaters and installing a flexible connector from gas meters and automatic gas shutoff devices.

The California Department of Housing and Community Development (HCD), Division of Business, Consumer Services and Housing oversees the Mobile Home Parks Program, funded by the Mobile Home Parks Special Occupancy Parks Revolving Fund, which has statewide jurisdiction over manufactured/mobile home installations and park construction and investigates health and safety inquiries. Since 1994, the Mobile Home Parks Program has permitted installation or reinstallation of approximately 65,800 units with the state engineered tie-down systems, or other approved systems, to resist horizontal and/or vertical loads.

Progress Summary 6.I: Mobile Homes

Progress as of 2018: Regulations that became effective April 1, 2013, now apply the current California Residential Code structural standards to any alteration of a mobile/manufactured home built after 1958. Previously, there were no structural requirements for mobile homes built between 1958 and 1971. This will add to the structural and lateral stability of mobile/manufactured housing when altered, modified, or converted.

In 2015, Cal OES worked with FEMA and EERI to create an informational guide on methods for seismic retrofit of mobile homes. This flyer was translated into Spanish in 2016. To download the two-page guide visit the Cal OES webpage: http://www.caloes.ca.gov/EarthquakeTsunamiVolcanoProgramsSite/Documents/Mobile-Homes-in-Earthquakes.pdf.

20. Mitigation of Losses in Non-Structural Systems

Overview

California did not begin to regulate the earthquake safety of non-structural systems in buildings, such as water heaters, ceilings, light fixtures, and heating equipment, until the 1970s. Buildings built before the 1970s and newer buildings that were not regulated and that have unbraced systems can be made safer with retrofit or replacement projects. FEMA offers guidelines for the evaluation and retrofit of building contents and non-structural building systems (FEMA 74). These retrofits can significantly reduce the risks of injuries and business interruption from earthquakes and are often feasible at very low costs.

Cal OES offers guidelines for evaluating and retrofitting non-structural falling hazards common to schools at: www.caloes.ca.gov. The Homeowner's Guide to Earthquake Safety and the Commercial Property Owner's Guide to Earthquake Safety also contain recommendations on how to identify and retrofit contents and non-structural systems in buildings that are vulnerable to earthquakes. In addition, the "Dare to Prepare" campaign of the Earthquake Country Alliance website, http://www.daretoprepare.org/, has information for securing non-structural items. Water heater bracing kits that are certified for use by the Division of the State Architect are available at most hardware stores. The Division of the State Architect also offers seismic strapping instructions on its website, at www.dgs.ca.gov/dsa/Resources/pubs.aspx. Since 2014, Cal OES Earthquake Program has partnered significantly with QuakeSmart, a National Earthquake Hazards Reduction Program (NEHRP) funded mitigation education program for business to create online materials encouraging non-structural mitigation for businesses and organizations. Based on a Cal OES Earthquake Program priority, QuakeSmart partnered with the Los Angeles County Fire Department to pilot a voluntary non-structural assessment program, delivered by the fire department as part of annual business fire inspections.

Bracing can prevent fires and serious water damage caused by toppled water heaters. State law requires all replacement water heaters to be braced and all existing residential water heaters to be braced upon sale of buildings (Health and Safety Code Section 19210, et seq). For more information on seismic hazard risks from non-structural building components, visit:
http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/Nonstructural_EQ_Hazards_For_Schools_July2011.pdf.

Mitigation of Natural Gas Systems in Buildings

The CSSC has developed guidance for local governments for mitigating natural gas systems in buildings, titled Improving Natural Gas Safety in Earthquakes (SSC 02-03). The most cost-effective mitigation method is training the public to know when and how to manually shut off existing gas valves. Table 6.H shows local governments that have adopted mandatory seismic gas shutoff valve ordinances.

Table 6.H: Seismic Gas Shutoff Valves Ordinances

Jurisdiction	Ordinance Number(s)	Year(s) Adopted
Los Angeles[a]	171874, 174343	1995, 1998, 2002
Martinez	1269	1999
Contra Costa County	2000-11	2000
Richmond	32-00	2000
Alameda County	02001-54, 0-2001-55	2001
Marin County	322	2001
Hercules	9-2.09	2001
West Hollywood	01-592	2001
Brentwood	715	2002
Concord	02.9	2002
Danville	2007-08	2007

Source: California Seismic Safety Commission

[a] Los Angeles installed 168,000 valves as of February 2006

https://ssc.ca.gov/forms_pubs/cssc_2002-03_natural_gas_safety.pdf

21. Mitigation of Fires Following Earthquakes

A general framework for fire mitigation includes the following components provided in advance of an earthquake disaster: 1) reduction in damage through advance planning and preparation; 2) presence of functioning automatic sprinklers or other suppression systems; 3) citizens able to extinguish the fire if water is available or to call the fire department; 4) functioning communications (i.e., telephone) required to contact fire departments; 5) available fire department personnel and their assets (i.e., apparatus); 6) functioning transportation networks (i.e., roads); 7) an adequate water supply; and 8) advance provision of firebreaks, via the urban planning process.

In addition, mitigation for the prevention of natural gas system leakage has included localized upgrading of natural gas pipelines and automatic seismic shut-off switches that cut off natural gas to customers. It is critical that restoration of gas service following an earthquake be coordinated through the local gas utility and the fire department to ensure that service is not restored until leak detection and minimum safety requirements are met on the distribution side of the gas meter. Restoration of gas and electrical services for areas known or suspected to have sustained damage may not occur until the utilities and the fire department are prepared to have service restored.

An additional mitigation technique is the use of seismic pressure wave-triggered automatic garage door openers and alarms at fire stations. These devices help ensure that firefighters and fire equipment are not trapped in damaged fire stations following earthquakes.

6.1.5.3 EARTHQUAKE MITIGATION FOR LIFELINE INFRASTRUCTURE

1. Mitigation for Electrical Utilities

The California Public Utilities Commission (CPUC) mitigates geologic hazards to electric infrastructure in California through its role in permitting electric infrastructure projects, including transmission and substation facilities. CPUC staff oversee the development of environmental documents in accordance with the California Environmental Quality Act (CEQA). Among other elements, CEQA requires each project to be assessed in relation to potential impacts from geology and soils-related hazards. Included are potential exposure of people or structures to earthquake fault rupture, strong seismic ground shaking, and ground failure including liquefaction, landslides and landslide

susceptibility, lateral spreading, subsidence, expansive soils, and soil erosion. The CPUC website contains a listing of current and past projects, including those that have been approved or denied. Additional information may be found at http://www.cpuc.ca.gov/ceqa/.

2. *Mitigation for Pipeline Networks – Oil and Natural Gas*

Pipelines subjected to significant displacement may develop leaks or breaks. These may be caused by ground deformation or by strong ground shaking. Ground deformation may include fault rupture as well as landslides, liquefaction, or subsidence. Typical mitigation measures to offset this vulnerability include assessing siting requirements, flexible couplings, and aboveground fault crossings. Mitigation for fault crossings may also be accomplished by making pipes flexible enough and pipe supports big enough to allow pipelines to move to accommodate the anticipated ground displacements without rupture. Seismic mitigation for pipeline supports may also include reducing friction at pipe supports.

Mitigation of areas prone to landslides prior to installation or rerouting of pipelines is possible. Ground deformation can cause significant damage to older pipe works made of cast iron or clay. For more discussion of natural gas pipeline hazards, see *Chapter 9, Section 9.2.3*.

In recent years, several natural major water supply pipeline replacement projects have been undertaken in California. These projects tend to focus on replacing older pipes, valves, and pumps in an effort to maintain the reliability and modernize systems. For example, the East Bay Municipal Utility District (EBMUD) recently completed a $662 million Seismic Improvement Program. The San Francisco Public Utilities Commission (SFPUC) is in process on a water system improvement program to be completed in 2019.[125] This program includes a Bay Tunnel project to improve reliability of water delivery against earthquake hazards; see Best Practices Highlight 6.G.

Best Practices Highlight 6.G: San Francisco Public Utilities Commission's Water System Improvement Program

A large portion of the damage in San Francisco during the 1906 San Francisco Earthquake resulted from subsequent fires burning unchecked across the city due to broken water mains preventing firefighters from extinguishing fires. Today it is understood that keeping critical water supplies and other utilities functional following a major earthquake is essential to preventing cascading hazards, such as fire, from causing additional damage.

The San Francisco Public Utilities Commission (SFPUC) manages over 1,200 miles of pipes that deliver Hetch Hetchy water to San Francisco and other cities in the region, serving more than 2.6 million Bay Area residents. Since 2003, the SFPUC has been at work on a $4.8 billion program to renovate the aging Hetch Hetchy water system, following approval of a bond measure approved by San Francisco voters in November 2002. The project, called the Water System Improvement Program (WSIP), will be paid for by retail customers in San Francisco, as well as 26 wholesale customers serving Alameda, San Mateo, and Santa Clara Counties. The program features a total of 83 projects, 35 of which are within San Francisco and the other 48 of which are regional projects spread over seven counties.

The objectives of the WSIP include the following:

- Improve the system to provide high-quality water that reliably meets all current and foreseeable local, state, and federal requirements
- Reduce vulnerability of the water system to damage from earthquakes
- Increase system reliability to deliver water by providing the redundancy needed to accommodate outages
- Provide improvements related to water supply/drought protection
- Enhance sustainability through improvements that optimize protection of the natural and human environment

As of June 30, 2016, the WSIP is approximately 91 percent complete, with construction finished on 35 local projects and 37 regional projects in the Hetch Hetchy water system. Work is underway on eight regional projects valued at $2.1 billion, while construction has been completed on 37 regional projects valued at $1.6 billion. Only one regional project—the Alameda Creek Recapture Project—remains in pre-construction.

[125] www.SFWater.org

The draft environmental impact report (EIR) for this project is scheduled to be released November 30, 2016, with an anticipated certification in June 2017.

The eight regional WSIP projects underway as of June 30, 2016 are:

- *Alameda Creek Recapture Project (ACRP):* This project, still in the pre-construction phase, will recapture water released and bypassed at Calaveras Dam and the Alameda Creek Diversion Dam and return it to the SFPUC water system.
- *Bioregional Habitat Restoration*: In accordance with the objective for sustainability and protection of the natural environment, this project will provide a coordinated and consolidated approach to compensate for habitat impacts that result from implementation of the WSIP projects.
- *Calaveras Dam Replacement:* This project includes the replacement and relocation of the existing, seismically unsafe dam with a new dam located downstream. The new dam will restore the reservoir water storage to its original capacity.
- *Fish Passage Facilities within Alameda Creek Watershed:* This project will upgrade the existing Alameda Creek Diversion Dam with a new fish passage and stream diversion facilities.
- *New Irvington Tunnel*: The new tunnel will run parallel to the existing tunnel and will include connections for the Alameda Siphons and Bay Division Pipeline.
- *Peninsula Pipelines Seismic Upgrade*: This project includes seismic upgrades of three Hetch Hetchy regional water delivery pipelines located in San Mateo County.
- *Regional Groundwater Storage and Recovery:* This project will balance the use of both groundwater and surface water to increase supply reliability during dry years or in emergencies.
- *Seismic Upgrade of Bay Division Pipeline Nos. 3 and 4:* This improvement project will address seismic system vulnerabilities in the vicinity of the Hayward Fault.

The program is expected to be completed in full by the spring of 2019, after the 18-month construction period of the Alameda Creek Recapture Project. More information about the program can be found at: http://www.sfwater.org/index.aspx?page=114.

The California Public Utilities Commission (CPUC) ensures that intra-state natural gas and liquid petroleum gas pipeline systems are designed, constructed, operated, and maintained according to safety standards set by the CPUC and the federal government. The CPUC enforces natural gas and liquid petroleum gas safety regulations; inspects construction, operation, and maintenance activities; and makes necessary amendments to regulations to protect and promote the safety of the public, the utility employees that work on the gas pipeline systems, and the environment. This includes reviewing each project for compliance with CEQA requirements. The CPUC also conducts audits and inspections of gas facilities owned and operated by mobile home parks and conducts inspections of propane gas pipeline distributions systems.[126]

Intra-state hazardous liquid pipelines are regulated by the Office of the State Fire Marshall (OSFM). Interstate pipelines are regulated by the Pipeline and Hazardous Materials Safety Administration (PHMSA).
For additional details, see *Section 9.2.3: Natural Gas Pipeline Hazards and Section 9.2.2: Oil Spills*.

3. *Mitigation for Petrochemical Facilities: Oil Refineries and Liquefied Natural Gas Facilities*

The following guidelines and California Building Code provisions address seismic hazards in petrochemical facilities:

- Guidelines for Seismic Evaluation and Design of Petrochemical Facilities by the American Society of Civil Engineers (ASCE)
- Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) by the California State Lands Commission (CSLC) Marine Environmental Protection Division, which is codified as California Code of Regulations Title 24, Part 2, California Building Code, Chapter 31F – Marine Oil Terminals

[126] www.CPUC.ca.gov

Both documents contain general seismic hazard assessment and mitigation for design information. The Guidelines for Seismic Evaluation and Design of Petrochemical Facilities provide information for engineers to develop project-specific seismic hazard mitigation designs and also contain information for emergency contingency planning, post-earthquake damage assessment and seismic retrofit design.

Liquefied natural gas facilities follow the National Fire Protection Association (NFPA) 59A Standard for the Production, Storage, and Handling of Liquefied Natural Gas, which has very specific and detailed guidelines on seismic design.

Application of MOTEMS

The California State Lands Commission (CSLC) regulates all (approximately 34) marine oil terminals in California, including enforcement of state building standards. Most marine oil terminals in California were built in the early 1900s when oil was carried by ships much smaller than the size of today's tankers, and before modern seismic safety standards and environmental review requirements were established.

The Marine Oil Terminal Engineering and Maintenance Standards, known as MOTEMS, are rigorous building standards adopted to upgrade aging terminals and design new terminals to ensure better resistance to earthquakes, protect public health and the environment, and reduce the potential of an oil spill. The MOTEMS, as part of the 2016 California Building Code (California Code of Regulations, Title 24, Chapter 31F et. seq), apply to all marine oil terminals in California and establish minimum engineering, inspection, and maintenance criteria for marine oil terminals to protect public health, safety, and the environment.

The MOTEMS are one of the only comprehensive engineering standards for marine structures in the industry. The MOTEMS are thus frequently applied to marine and waterfront facilities worldwide, regardless of whether the facilities transfer oil, are located in California, or are within the CSLC's jurisdiction. Many standards, guidelines, and other applications also reference versions of the MOTEMS in part or whole.

Progress Summary 6.J: Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) Audit Manual

Progress as of 2018: The Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) require that operators of marine oil terminals conduct periodic audits and inspections, both above and below the water line, to assess structural and non-structural systems integrity. These audits and inspections involve structural, seismic, geotechnical, mooring, berthing, fire protection, pipeline/piping, mechanical, electrical, and corrosion evaluations.

The MOTEMS Audit Manual was developed to help marine oil terminal operators conduct audits to comply with the 2016 MOTEMS. The manual provides a structured template for methodically documenting a marine oil terminal's characteristics and assessing compliance during MOTEMS audits. The manual is a compilation of 11 checklists, one for each substantive division/section of the MOTEMS. While not required for MOTEMS compliance purposes, these checklists have proven to be useful tools for compliance assessment and communications between terminal owners and operators, MOTEMS audit teams, and the California State Lands Commission (CSLC). The Audit Manual is available through the CSLC website at: http://www.slc.ca.gov/Programs/MOTEMS_More.html.

Criteria for Liquid Natural Gas Receiving Terminals

In the last decade, a number of liquid natural gas (LNG) receiving terminals were proposed offshore of the California coast. None of these proposed projects were constructed. The current MOTEMS do not specify any distinctly different requirements for LNG terminals. However, the California State Lands Commission (CSLC) acknowledges that there should be significant differences in the design criteria for LNG terminals because of the hazards involved in handling and transferring LNG between shore and ships. Since 2010, there has been considerable discussion of LNG exports instead of imports as the oil industry is considering possibilities for LNG extraction from shale gas. The CSLC will address the issue of managing LNG hazards as the national policy on LNG export becomes clearer.

Prior to publication of the 2010 SHMP, at a time when LNG receiving terminals were being proposed for California, the development of draft LNG Terminal Engineering and Maintenance Standards (LNGTEMS) was initiated under the direction of the CSLC Marine Facilities Division (MFD). As of November 2011, there were no proposals contemplated for any new LNG terminals in California, and further development of the draft was terminated. The draft set of regulations was not expected to be carried forward because it appeared to be unneeded in California at that time. However, recognizing that the fundamental work may be of value for other states or in other areas of the world where LNG terminal construction is still likely, the CSLC staff released the last draft of LNGTEMS to the public, to serve as a resource for state/federal agencies, terminal operators, and consultants.

4. Mitigation for Localized Water and Wastewater Pipelines and Treatment Facilities

One mitigation technique to prevent an effluent discharge due to the loss of power at water and wastewater treatment facilities is to include back up power at such plants to keep facilities operational. See *Annex 3* for detailed discussion on lifelines infrastructure and hazard mitigation planning, including water supply infrastructure such as the facilities illustrated in Map 6.R.

Additional mitigation measure that can be taken for these facilities include:

- Seismic retrofit pipes with flexible joints
- Reinforce settling tanks
- Harden or replace transmission lines with earthquake resilient designs
- Secure aboveground pipes
- Install earthquake shutoff valves

Section 15.3 of ASCE 7/NEHRP (National Earthquake Hazards Reduction Program) Recommended Seismic Provisions provides extensive guidance on the design of non-building structures, including water storage tanks, water treatment plants, and pipeline systems.[127]

An article published in the August 2017 issue of Safety Science concluded that additional work is needed to better understand the seismic vulnerability of municipal or industrial wastewater treatment plants and develop new vulnerability functions based on documented damage observations from earthquakes, the article also states that municipal water treatment plants are more vulnerable to earthquakes, and that non-structural components (sedimentation basins and digesters) are less resilient.

5. Mitigation for Statewide Water System: Aqueducts, Canals, Levees, Dams, and Reservoirs

Major seismic hazard mitigation efforts include the East Side Reservoir Project in Riverside County, the Olivehain Dam in San Diego County, and the Calaveras Dam Replacement Project (see *Annex 2, Section 2.4.3* for more information). The East Side Reservoir Project includes canals, pipeworks, a new dam, and a reservoir intended to provide water to a large portion of the Los Angeles metropolitan region for up to six months should an earthquake take the California Aqueduct out of service. The Olivehain Dam and reservoir are intended to provide San Diego with water should there be interruptions of water from the Colorado River after earthquakes. For full discussion of dam failure hazards and current mitigation efforts, see *Chapter 7, Section 7.5, Dam Failure and Safety*.

The San Francisco Bay-San Joaquin-Sacramento Delta region contains levees critical for delivering irrigation water to 3 million acres and drinking water to over 23 million people. A failure in one of the Delta levees in 1972 interrupted the state and federal water supply systems and required approximately 500,000 acre-feet of fresh water to restore export water to acceptable quality, according to Senate hearings on the 1972 levee failure at Andrus-Brannan Islands. Recent studies indicate that the levees in the Delta are susceptible to significant damage in a near-field seismic event. For full discussion on levees, see *Chapter 7, Section 7.4, Levee Failure, and Safety*.

[127] FEMA P-751 and P-752 (2013).

6. Mitigation for Solid Waste Disposal Systems (Municipal and Hazardous Waste Landfills)

The 1994 Northridge Earthquake shook many landfills and caused sliding and damage, primarily in the cover systems. This information has since been used to improve the seismic design of landfills and landfill systems.[128] The risk of vulnerability associated with seismic activity at landfills is lessened through implementation of seismic design standards. These standards ensure that a structure is designed to withstand ground movement while taking into consideration the proximity and the geology between the location of the structure and faults.

The foundation or base of the landfill is constructed so it can provide support for the structures and withstand hydraulic pressure gradients to prevent failure due to settlement, compression, or uplift along with all effects of ground motions resulting from an earthquake. Also, based on the landfill classification and the proximity to known Holocene faults throughout California, the design would be able to withstand a range of earthquake magnitudes. Lastly, for any landfills seeking closure status, a slope stability analysis would be necessary to evaluate the integrity of the slopes to protect public health and safety and prevent damage to post-closure land uses, roads, structures, utilities, gas monitoring and control systems, and leachate collection and control systems to prevent public contact with leachate and to prevent exposure of waste.

7. Mitigation for Transportation Systems

Caltrans transportation system mitigation actions include the following:

- The Highway Bridge Program to replace or rehabilitate public highway bridges over waterways, other highways, or railroads when the state and the Federal Highway Administration determine that a bridge is significantly important and is unsafe because of structural deficiencies, physical deterioration, or functional obsolescence. Approximately $240 million in federal funds are made available to local agencies annually under the Transportation Equity Act for the 21st Century (TEA21).

- The Culvert Inspection Program, intended to preserve and upgrade the state's investment in highway drainage infrastructure. The inspections identify drainage and structural deficiencies to be addressed by major maintenance and capital rehabilitation/replacement contracts.

Progress Summary 6.K: Highway Bridge Retrofits

Progress as of 2018: Since the 1989 Loma Prieta Earthquake, approximately $14 billion in state highway earthquake retrofit improvement funds have been committed and largely completed. The following is a brief statewide synopsis of California state transportation system mitigation outcomes for highway bridge retrofits.

State and Local Bridge Improvements

There are over 12,800 state and 12,300 local bridges in California. Of the 2,194 state bridges previously determined to need seismic retrofitting (identified for retrofit in two phases), all but one have been retrofitted as of May 2018. The final project left to complete is the replacement of the Schuyler Heim Bridge in Long Beach. Anticipated completion date is late 2020 or 2021. As of December 2016, the current expenditure of bridge retrofit Phases 1 and 2 is $2.583 billion. The final cost will total $2.827 billion.

Highway bridges retrofitted as part of the state's $12-billion highway bridge earthquake strengthening program have demonstrated resilience in large earthquakes. According to a study released by the California Seismic Safety Commission in 2016, the 2014 South Napa Earthquake demonstrated how recently retrofitted bridges performed as compared to those with no substructure retrofit.[129] Prior to 2014, all 412 state-owned highway bridges in Solano, Napa, and Sonoma Counties had been evaluated and 54 retrofitted. New and recently retrofitted state-owned bridges outlasted the Magnitude 6.0 earthquake without any serious damage. The Napa Slough Bridge did not have a sub-structure retrofit and experienced serious damage to its pile extensions.

[128] Bray, J. D., Augello, A. J., Leonards, G. A., Repetto, P. C., & Byrne, R. J. (1995). Seismic stability procedures for solid-waste landfills. Journal of geotechnical engineering, 121(2), 139-151.

[129] http://peer.berkeley.edu/publications/peer_reports/reports_2016/CSSC1603-PEER201604_FINAL_7.20.16.pdf

Toll Bridge Improvements
Senate Bills 60 and 226 established the Toll Bridge Program and provided initial retrofit funding. Assembly Bills 1171, 144 and 1175 established current funding for the nine bridges in the toll bridge System. Seismic retrofitting has been completed on all nine bridges in the toll bridge system as of December 2016 at a cost of $9.435 billion.

San Francisco-Oakland Bay Bridge
Among the toll bridges recently retrofitted, the new separately funded $6.416 billion Bay Bridge, straddling two major faults and connecting San Francisco and Oakland, is now the largest and most expensive single-tower, self-anchored suspension bridge in the world. While the project was initiated after the 1989 Loma Prieta Earthquake, the groundbreaking took place 13 years later in 2002, at twice the cost originally estimated. The first approved design met seismic safety objectives but was rejected by the public in 1997 because it did not do justice to the bridge's prominence symbolically, physically, or economically. The ensuing public process illustrates how competing values can affect mitigation efforts, including the risk inherent in delay.

The comprehensive retrofit of this bridge was completed in 2013 and the entire span of the San Francisco-Oakland Bay Bridge was reopened to traffic on September 2, 2013. The new bridge is designed to meet the most stringent earthquake standards and to act as a regional lifeline structure, opening quickly to traffic after the strongest ground motions that engineers expect in a 1,500-year period. This is in sharp contrast to the original East Span (Oakland-Yerba Buena Island), which was designed with truckloads and winds, rather than seismic safety, in mind. The new structure, including the bridge and its approaches, is 8.4 miles long. This length extends from the MacArthur Maze freeway interchange in Oakland to the end of the Fifth Street off-ramps in San Francisco. Both the East and West Spans of the bridge have undergone seismic retrofits. The bridge was recognized as the world's widest bridge as of December 2016, with a total deck width of 258.33 feet, and is the first in the Bay Area to feature pedestrian and bicycle paths.

The new East Span consists of a self-anchored suspension bridge with a single steel tower and a 1.2-mile-long elevated skyway viaduct that descends gradually toward the Oakland shoreline. This new span has been made seismically resilient with new technology and enhancements, some never before used in bridge building. Seismic innovations, such as fusible shear links in the tower, battered piles in the skyway's foundations, and hinge pipe beams in the road decks, have been designed to absorb the damage from an earthquake and to protect the structural elements of the bridge. The self-anchored suspension required 67,000 tons of steel for its superstructure and tower. These innovations will allow the bridge not only to withstand heavy seismic activity, but to last for its expected 150-year lifespan. As of December 2016, the East Span is world's longest self-anchored suspension bridge, totaling 2,047 feet. The West Span of the bridge between San Francisco and Yerba Buena Island underwent extensive seismic retrofitting yet retains its original appearance. On the west approach, a 1-mile stretch of Interstate 80 in San Francisco, six on- and off-ramps were demolished and rebuilt. The upper and lower decks were given independent columns and foundation support systems. On the West Span, a half million original rivets were replaced with nearly twice as many high-strength bolts. Seventeen million pounds of structural steel were added, and new bracing was installed under both decks. The "laced" diagonal crossbeams connecting the upper and lower road-decks were replaced with perforated steel.

Embedded throughout the bridge is monitoring equipment installed and maintained by the California Geological Survey that will collect information on earthquake shaking from nearby earthquakes. These devices, called accelerographs, will monitor and measure how the bridge responds to ground motion in an earthquake. There are 86 sensors in the self-anchored suspension, 80 in the West Span, 73 in the skyway, 28 in the Yerba Buena Island section, and 12 in the Oakland touchdown area. After an earthquake, the sensors will transmit the data to create a digital map showing the location and intensity of seismic activity and ground motion. Crews can use the maps to determine potential damage to infrastructure including road and water lines.

For more information regarding the Bay Bridge seismic retrofit, visit the project website: http://www.baybridgeinfo.org/.

8. Ports and Harbors

The American Society of Civil Engineers has created Seismic Guidelines for Ports (ASCE 61-14). The guidelines provide generalized information for assessing seismic hazards for use in developing seismic hazard mitigation design criteria. The guidelines are based on observations of the performance of ports and harbors after earthquakes around the world. Several ports and harbors have also conducted seismic hazard mitigation projects. These guidelines will be superseded by ASCE 61-19, which is still under development, as of early 2018.

9. Communication Systems

The U.S. Geological Survey (USGS), the California Geologic Survey (CGS), and other partners developed the HayWired scenario as a tool to enable further actions that can change the outcome when the next major earthquake strikes. The HayWired scenario is the latest in a series of projects through the USGS Science Application for Risk Reduction (SAFRR) Program, which focuses on potential impacts when the Hayward Fault again ruptures through the east side of the San Francisco Bay region, as it last did in 1868. Cities in the East Bay along the Richmond, Oakland, and Fremont corridor would be hit hardest by earthquake ground shaking, surface fault rupture, aftershocks, and fault afterslip, but the impacts would reach throughout the bay region and far beyond. The HayWired scenario name reflects California's increased reliance on the Internet and telecommunications and also alludes to the interconnectedness of infrastructure, society, and California's economy.

By illuminating the likely impacts on the present-day built environment, well-constructed scenarios can and have spurred officials and citizens to take steps that change the outcomes the scenario describes, whether used to guide more realistic response and recovery exercises or to launch mitigation measures that will reduce future risk.

The first volume of the Haywired scenario report was published in 2017 and covers the physical aspects of what might happen—shaking, fault rupture, liquefaction, landslides, and aftershocks. Subsequent volumes will address the consequences and estimated losses.

To download the HayWired Earthquake Scenario – Earthquake Hazards report, visit: https://pubs.er.usgs.gov/publication/sir20175013.

6.1.5.4 PUBLIC OUTREACH AND EARTHQUAKE AWARENESS

Great California ShakeOut Earthquake Drill

The Great California ShakeOut earthquake drill is an annual initiative where the public is encouraged to practice self-protective measures and to take other actions that promote earthquake resiliency.

ShakeOut registration not only encourages drill participation, but also promotes mitigation and preparedness. Moreover, it leverages the broad public visibility of the drill day to get people talking about preparedness and mitigation with people they care about. This promotion of "social milling" is based on social science indicating that people are most likely to change behavior around earthquake preparedness and mitigation if they talk about it with people they know, and when they see people like themselves taking action. The "hook" for ShakeOut is a "Drop, Cover, and Hold On" drill to encourage people to practice how to protect themselves during strong shaking. The ShakeOut initiative also provides information on "The Seven Steps to Earthquake Safety."

ShakeOut as Part of Earthquake Education Stakeholder Networking

ShakeOut would not be possible if "led" in a traditional way by a single organization. It is coordinated by a broad coalition of organizations across sectors. Government jurisdictions, agencies, organizations, schools, community groups, and individuals are all encouraged to register and "create their own drill" that meets their organization's goals. Outreach for ShakeOut depends on the Earthquake Country Alliance (ECA), a collaboration among three regional coalitions as well as statewide organizations, each attracting a broad base of stakeholders.

ECA broadens the definition of earthquake mitigation/education stakeholders. It is a statewide public-private partnership of people, organizations, and regional alliances that work together to improve preparedness, mitigation, and resiliency. ECA's goal is to create a culture of resiliency for all Californians; ECA therefore depends on leveraging efforts and sharing strengths. This network is an important platform to deliver preparedness and mitigation information to all sectors, but it is also an important method for coordinating and unifying messages across various regions and organizations that develop and deliver such messages.

ECA's regional partners include the Southern California Earthquake Alliance, the Bay Area Earthquake Alliance, and the Redwood Coast Tsunami Work Group. Strategic partner organizations include the California Governor's Office of Emergency Services (Cal OES), U.S. Geological Survey (USGS), California Earthquake Authority (CEA), Southern California Earthquake Center, California Geological Survey (CGS), Federal Emergency Management Agency (FEMA), American Red Cross (ARC), State Farm Insurance, and many others.

Mitigation Outreach as Part of "Readiness"

The Great ShakeOut is not advertised specifically as a mitigation event. "Mitigation" is a technical term used more by professionals; it does not typically resonate with the public in the same way as other emergency management terms like "preparedness" or "recovery." ShakeOut does carry mitigation as an important part of its comprehensive public message. Mitigation information is presented as part of every ShakeOut, with "Secure Your Stuff" (non-structural mitigation). The ShakeOut initiative and the underlying structure of ECA will continue to offer potential value for future mitigation efforts. They have educated millions of people about their proximity to earthquake hazards. The hope is that the increased consciousness of risk will translate into interest in mitigation as well as preparedness.

The Great California ShakeOut also has potential mitigation benefits as a result of the networks it has created. ShakeOut continues to seek partners with an interest in reducing disaster losses and building communities of concerned individuals. These individuals and communities can be called on in the future to review mitigation actions, suggest mitigation improvements, assist in collecting data, and implement mitigation measures,

As agencies prepare for each upcoming ShakeOut, participants are encouraged to include mitigation as part of their message. This can include providing additional mitigation information on the ShakeOut website. Central to the ECA's mission is a broad approach to public and community readiness and resilience. This broad approach is designed to integrate mitigation into a comprehensive public message that will "shift the culture of readiness in California."

ShakeOut emphasizes actions the public can take to increase their earthquake readiness and their ability to recover. On drill day, businesses, organizations, and municipalities are encouraged to participate in the drill with additional activities beyond the "Drop, Cover, and Hold On" drill, including "Hazard Hunts" for non-structural hazards. To further promote drill registration and participation, ShakeOut includes many pre-drill events across the state.

ShakeOut Partners: CEA and Red Cross

Since 2012, the CEA has sponsored the "Get Prepared, California!" Auction to raise funds for American Red Cross (ARC) disaster-preparedness and relief efforts in California. Total funds raised over this period exceed $1,060,000.

The CEA continues to develop communications programming that seeks to make earthquake preparedness a part of California culture and give the state's residents the strength to rebuild after the next damaging earthquake.

Progress Summary 6.L: Great California ShakeOut Earthquake Drill and Public Readiness Initiative

Progress as of 2018: In 2008, approximately 5.5 million Southern Californians participated in the first Great Southern California ShakeOut earthquake drill. In 2009, the drill became a statewide annual event in California. The event has seen its participation continue to grow annually and has garnered increased public interest, with 6.9 million Californians registered as participants in 2009, 10.4 million in 2014, and nearly 10.6 million in 2017.

In addition, ShakeOut has spread to other states, territories, and countries, with over 58 million participants worldwide in 2017.[130] The California ShakeOut website now maintains a schedule for the next three ShakeOut drills; the 2017 ShakeOut was held on October 19, 2017, and the next annual ShakeOut will occur on October 18, 2018.

For more information about the Great California ShakeOut visit the program webpage: http://www.shakeout.org/california/index.html.

California's Earthquake Early Warning System

Background

California has a long history of seismic monitoring efforts beginning in the late 19th century. Small clusters of early measuring instruments were deployed around the University of California (UC), Berkeley in Northern California and the California Institute of Technology (Caltech) in Southern California. Over time, the sophistication of instruments improved and the small cluster of seismometers grew into regional seismic networks around these two universities. The goals of these early monitoring efforts were to better understand the earthquake rupture process and train students in the new science of seismology and geophysics. Before the early 1990s, the seismic network offered very little to those charged with response to damaging earthquakes; it simply took too long to collect and analyze data to provide information for emergency response. Beginning in the mid-1990s, improvements in seismic instruments, data analysis software, and high-speed communications made it possible to determine the magnitude and location of an earthquake within a few minutes and communicate this information to emergency responders via radio pagers.

Established in 1971, the strong motion instrumentation program operates a monitoring system with more than 8,500 sensors in place at over 1,100 monitoring stations located in structures such as dams, bridges, hospitals, high-rise buildings, and industrial facilities, as well as open land.

Improvements in earthquake monitoring following the 1994 Northridge Earthquake brought new innovations for monitoring earthquakes, and in 2002, based on recommendations from the emergency management community, the regional networks in Northern and Southern California agreed to form the California Integrated Seismic Network (CISN).

CISN is a collaboration of six organizations that seeks to mitigate the impact of future earthquakes by collecting, processing, and disseminating critical earthquake information. CISN supports improvements to earthquake resilience through the distribution of information for the benefit of public safety, emergency response, and loss mitigation. Core members of the CISN are the California Geological Survey (CGS), California Institute of Technology (Caltech) Seismological Laboratory, UC Berkeley Seismological Laboratory, USGS Menlo Park, USGS Pasadena, and the California Governor's Office of Emergency Services (Cal OES).

As of early 2018, CISN consists of hundreds of seismic sensors throughout California that feed into processing centers to generate and distribute data to produce ground shaking intensity maps such as ShakeMap and other products for emergency response, post-earthquake recovery, earthquake engineering, and seismological research.

By 2006, scientist and engineering partners that make up the CISN began to experiment with new technology that would enable the rapid detection and dissemination of earthquake data, allowing an alert to be generated to warn some areas before strong shaking arrives. The USGS developed and operates a prototype of earthquake early

[130] https://www.shakeout.org/statistics/index.php?params=YTozOntpOjA7czo0OiIyMTIwIjtpOjE7czo0OiIyMDIwIjtpOjI7czo0OiIyNDIwIjt9

warning called ShakeAlert. The ShakeAlert system is designed to identify and characterize an earthquake a few seconds after it begins and deliver a warning to people and critical infrastructure that could be affected.

Development of the ShakeAlert earthquake early warning system was recognized as a significant mitigation step, and in September 2013 Senate Bill (SB) 135 passed, requiring Cal OES core partners to develop a comprehensive statewide earthquake early warning system through public-private partnerships. California Government Code Section 8587.11 states that the California Integrated Seismic Network (CISN) shall be responsible for the generation of an earthquake early warning alert. The strong motion instrumentation program is converting a number of its field instruments to incorporate the early warning system.

The 2016-2017 budget passed by the Legislature and signed by the Governor included $10 million in funding to support the installation of 183 new seismic sensors and four permanent positions to perform research on necessary technology and other technical aspects that will integrate public and private infrastructure, provide public education, and conduct education and training. In September 2016, SB 438 was signed into law to further advance the development of the early warning system by establishing a governance structure to coordinate and direct activities related to the establishment of a statewide system. The implementation of the California Earthquake Early Warning Program (CEEWP) establishes Cal OES as the lead for implementing the statewide system and ensuring its continued long-term success.

Mitigation Benefits

Advances in scientific understanding of earthquakes and technological developments have resulted in the capacity to rapidly analyze earthquakes and provide products that are vital to emergency management and public safety. One such advancement is the capability to provide early warning of an earthquake a few to several seconds prior to the actual arrival of destructive ground motions from a large and damaging seismic event.

The seconds or minutes of advance warning can provide people with an opportunity to take actions like "Drop, Cover, and Hold On" to protect life and property from destructive shaking. An earthquake early warning system can give enough time to slow and stop trains and taxiing planes, to prevent cars from entering bridges and tunnels, to move away from dangerous machines or chemicals in work environments and to take cover under a desk, or to automatically shut down and isolate industrial systems.

Taking such actions before shaking starts can reduce damage and casualties during an earthquake. It can also prevent cascading failures in the aftermath of an event. For example, isolating utilities before shaking starts can reduce the number of fire initiations. This effort aligns with state hazard mitigation goals and objectives to protect life loss and property.

Countries around the world including Mexico, Japan, Turkey, Romania, China, Italy, and Taiwan have implemented earthquake early warning systems. During the 2011 Magnitude 9.0 earthquake in Japan, the televised warning gave viewers more than a minute of notice before the strongest shaking arrived in Tokyo. In September 2017, Mexico experienced a Magnitude 7.1 earthquake that killed over 230 people. Mexico City, which is located about 75 miles away from the epicenter, had more than 20 seconds of siren warning to prepare for the impending shaking, enough time for people to flee vulnerable buildings and take protective measures.

Case Study: 2014 South Napa Earthquake – A Milestone for California's Earthquake Early Warning System

In August 2012, Bay Area Rapid Transit (BART) became the first transit agency in the United States to adopt an earthquake early warning system. If the system senses an earthquake above Magnitude 4.0 for local earthquakes and Magnitude 5.0 for farther away, the BART central computers that manage train movement will automatically slow trains down to 26 miles per hour. The system can provide up to 50 seconds of warning if the shaking is far away. The automated earthquake early warning signals to trains have the advantage of not requiring human reaction time, increasing the potential of saving lives during a major earthquake.

On August 24, 2014, at roughly 3:20 a.m. local time, an earthquake occurred in and around the City of Napa, California. The epicenter was located south of Napa, approximately 3.7 miles northwest of American Canyon near the West Napa Fault. The earthquake, measuring Magnitude 6.0, was the largest earthquake in the Bay Area since the 1989 Loma Prieta Earthquake. The South Napa Earthquake resulted in 1 death and approximately 200 people injured. Shortly after, Governor Jerry Brown declared a state of emergency due to the damage and the possibility of damage resulting from aftershocks. It is estimated that the earthquake caused over $400 million in damage.

The 2014 South Napa Earthquake served as important milestone for California's earthquake early warning system for two reasons: It was the first true test of the system, and the system successfully provided warning to nearby communities. On-site warning systems installed at five fire stations in Vallejo in 2002 successfully commanded the bay doors to open at these fire stations before the earthquake arrived. Similarly, had BART trains been operating, the system would have received a six-second warning, enough time to reduce the speed of trains by 12 miles per hour (or 2 miles per second), significantly reducing the likelihood of derailment.

Program Technology

The objective of earthquake early warning systems is to rapidly detect the occurrence of an earthquake, estimate the level of ground shaking to be expected, issue a warning before significant ground shaking begins, and estimate the location and the magnitude of the earthquake.

When an earthquake occurs, it produces different types of shock waves, which travel at different speeds. The fastest and weakest of these waves are called P-waves. Technology exists that can detect the energy from P-waves to estimate the location and the magnitude of the earthquake. This method can provide warning before the more destructive S-wave arrives. The S-wave is typically responsible for most of the strong shaking that usually creates the most damage during earthquakes.

The amount of warning time at a particular location depends on the distance from the earthquake epicenter. Locations very close to the earthquake epicenter will receive relatively little or no warning whereas locations far removed from the earthquake epicenter will have more warning time but may not experience damaging shaking.

Studies on earthquake early warning methods in California concluded that the warning time would range from a few seconds to a few tens of seconds, depending on the distance from the earthquake epicenter. However, very large earthquakes emanating from the San Andreas Fault could produce significantly more warning time because the affected area would be much larger.

The time required to detect and issue a warning for an earthquake is dependent on several factors:

1. *Distance between the earthquake source and the closest seismic network seismometer (station).* It takes a finite amount of time (about one second) for seismic waves to travel from the source (i.e., the location where the earthquake started) to the seismic station. The first waves to arrive at a station are the less damaging P-waves that travel at on average of 3 to 4 miles per second, and the more damaging S waves travel at approximately 1 to 2 miles per second. The closer a station is to the source, the more rapidly the ground motion measurements from earthquake are identified, and the more rapidly the information about the earthquake is sent to the data processing center.

2. *Transfer of information to the regional networks.* Data from multiple stations must be collected and analyzed by the regional seismic networks to issue a warning. Ground motion information must be transferred from each station to the processing center. The existing network uses a variety of methods including radio links, phone lines, public/private internet, and satellite links to send data back to the processing center. Delays from packaging and transmitting the data from the station to the processing center and the processing center to the recipient must be reduced to provide useful warning times.

3. *Detection and characterization of an earthquake.* Real-time ground motion information received from the stations is used to detect an earthquake and rapidly determine the location and magnitude of the event. Multiple algorithms (a mathematical procedure used to compute a desired result) are used to estimate the earthquake information as rapidly as possible.

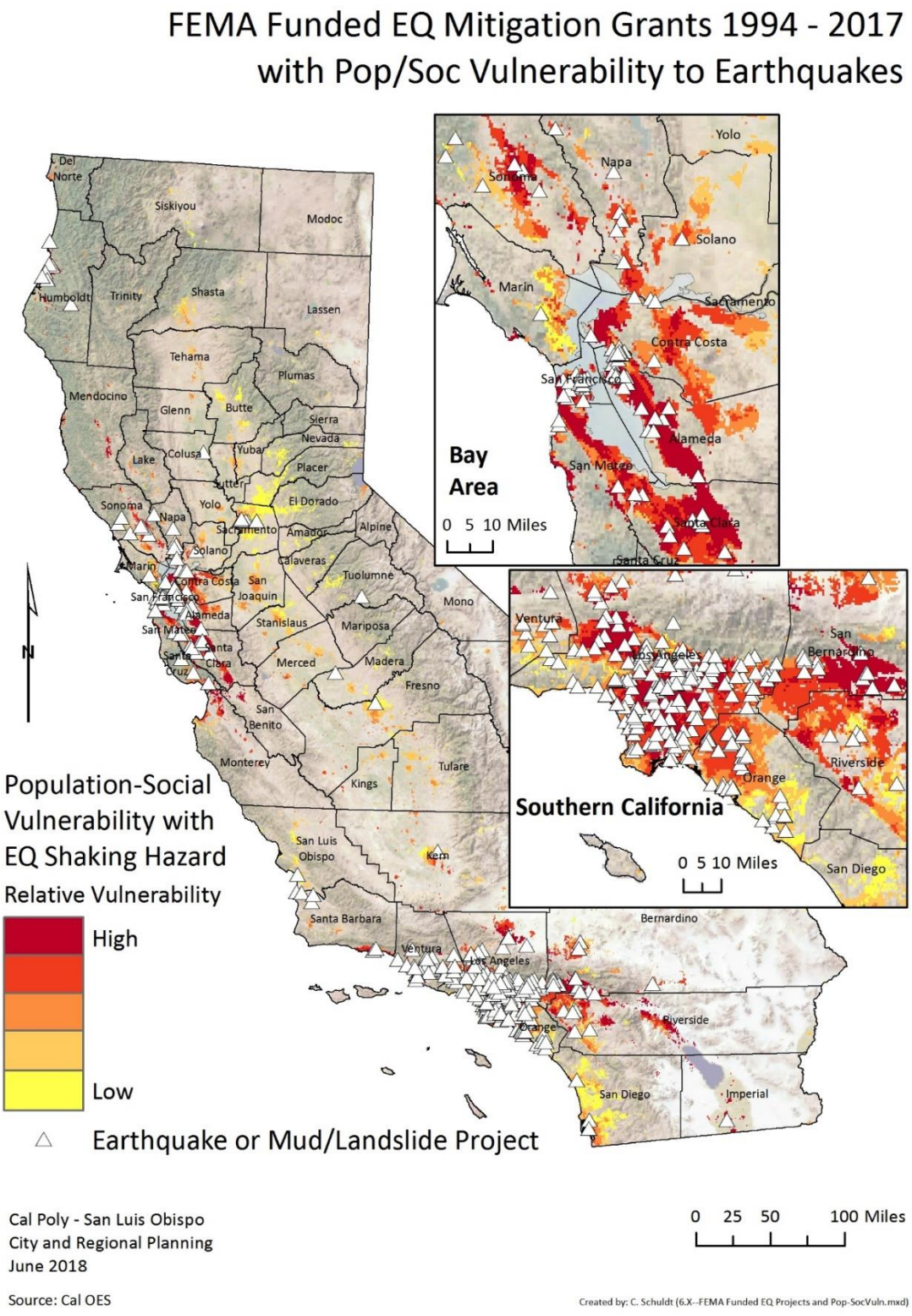
Regardless of the warning time, earthquake early warning systems can provide adequate time to slow down and stop trains, stop cars from entering tunnels, automatically shut down dangerous machinery, and countless other benefits. Taking such actions before an earthquake arrives can reduce damage and casualties during and after an earthquake.

For more information, visit the ShakeAlert program website: http://www.shakealert.org/.

6.1.5.5 FEMA-FUNDED SEISMIC HAZARD MITIGATION PROJECTS

Map 6.X shows the distribution of earthquake-related FEMA Hazard Mitigation Assistance grant funded projects in relation to vulnerable populations (based on the index described in *Appendix N*) in high earthquake hazard areas. More mitigation projects are in Southern California and the San Francisco Bay Area than in other parts of the state, coinciding with areas of higher population and social vulnerability to earthquake hazards.

Map 6.X: FEMA Funded Earthquake Mitigation Projects and Population Vulnerability, 1994-2017



6.1.6 ADDITIONAL EARTHQUAKE HAZARD MITIGATION OPPORTUNITIES

In partnership with the Pacific Earthquake Engineering Research Center (PEER), the California Seismic Safety Commission (CSSC) published "The MW 6.0 Earthquake in South Napa Earthquake of August 24, 2014: A Wake-Up Call for Renewed Investment in Seismic Resilience across California" in June 2016. The report discusses 20 findings and priority recommendations (summarized in Tables 6.I and 6.J) into the categories of Geosciences, Infrastructure, Buildings, People and Business, and Government and Institutions.

Table 6.I: 2016 Napa Earthquake Report Findings

No.	Finding
1. Geosciences	
1.1	The South Napa Earthquake is the first earthquake to produce significant surface rupture in Northern California since 1906, and the first surface fault rupture to impact housing in the 40 years of the Alquist-Priolo Earthquake Fault Zoning Act.
1.2	Afterslip on the West Napa Fault following the 2014 earthquake produced further damage and necessitated a regional-scale geologic investigation, on-going monitoring, and technical guidance for federal, state and local government, utilities, and property owners.
1.3	The South Napa Earthquake identified some critical gaps in mapping coverage and guidance that affected the abilities of city, county, and state agencies to identify and map seismic hazard zones and mitigate seismic hazards to protect public health and safety in accordance with the provisions of the Seismic Hazard Mapping Act of 1990.
1.4	Investments in strong-motion instrumentation and earthquake alerting systems, applications of advance remote sensing techniques, and activation of the California Earthquake Clearinghouse all were demonstrably valuable in assisting damage assessment and emergency response, even in a moderate earthquake.
2. Infrastructure	
2.1	The 2014 South Napa Earthquake demonstrated the long-term benefits of the state's $12 billion highway bridge earthquake strengthening program, which has screened and retrofitted (as needed) more than 2,200 structures statewide to prevent collapse during future earthquakes.
2.2	The South Napa Earthquake highlighted the vulnerability of natural gas transmission and distributions systems to earthquake-related ground failure.
2.3	The South Napa Earthquake highlighted the vulnerability of water and wastewater systems to earthquake-related ground failure, the additional fire hazards that earthquake-related water-system failures can pose, and the fiscal challenges that public agencies face in improving the seismic resiliency of these systems, both pre- and post-earthquake.
3. Buildings	
3.1	The South Napa Earthquake helped to identify important gaps in building safety evaluations and procedures to barricade unsafe areas that should be addressed statewide before the next major earthquakes strikes.
3.2	The City of Napa's program to seismically retrofit unreinforced masonry buildings was successful in reducing damage and the risk to life safety posed by these buildings.
3.3	While modern buildings generally met or exceeded code performance standards in the Magnitude 6.0 earthquake, damage to non-structural components was the greatest contributor to property losses.
3.4	There was generally good performance across a range of wood-frame residential construction vintages and styles. The vast majority of damage was caused by two well-known seismic deficiencies: unbraced chimneys and cripple walls foundations.
3.5	The significant damage to manufactured housing in the 2014 South Napa Earthquake was almost exclusively associated with support systems rather than the homes themselves.
4. People and Business	
4.1	Deaths and injuries sustained in the South Napa Earthquake point to continuing gaps in public awareness and education on earthquake safety and preparedness.

No.	Finding
4.2	The 2014 South Napa Earthquake highlighted significant gaps in earthquake insurance coverage for both homeowners and businesses, and the need to improve both the affordability and terms of insurance coverage and plan for housing and business recovery funding needs ahead of a major urban earthquake in the state.
4.3	The delay in authorization of the federal Individual Assistance program hindered community recovery.
4.4	Insights from the 2014 South Napa Earthquake provide an opportunity to consider how state emergency proclamation provisions can accelerate and improve post-earthquake recovery for residents and businesses.
5. Government and Institutions	
5.1	The state's Standardized Emergency Management System was effective in mobilizing a multi-jurisdictional, multi-level emergency response following the South Napa Earthquake but some significant areas for improvement and training, particularly with smaller jurisdictions, have been identified.
5.2	The 2014 earthquake identified problems with the damage assessment and declaration processes and financing of local government post-disaster assistance that need to be addressed ahead of the next major urban earthquake in the state.
5.3	The 2014 earthquake highlighted significant gaps in contingency planning at many key government and critical facility operations.
5.4	More pre-disaster planning and training for post-disaster recovery is needed at both the state and local levels.

Table 6.J: Priority Recommendations of the 2016 Napa Earthquake Report

No.	Recommendation
1. Geosciences	
1.1	Identify the locations of complex and integrated fault zones in the state, like the West Napa fault zone, and prioritize these for evaluation and mapping and potential designation as Alquist-Priolo Earthquake Fault Zones.
1.2	Evaluate the aggregate effects of current amendments and exemptions under the Alquist-Priolo Earthquake Fault Zone Act and accompanying regulations, and study ways to better regulate and fund geologic investigations and structural mitigation in Alquist-Priolo Earthquake Fault Zones.
2. Infrastructure	
2.1	Ensure that all state-required gas safety plans address the mitigation of system risks to seismic hazards.
2.2	Convene a state task force that includes local water and wastewater providers as well as fire departments across the state to identify vulnerabilities, mitigation options, and financial mechanisms to enhance the seismic resilience of local water and wastewater systems, particularly in areas vulnerable to widespread ground failure and that lack alternative water supplies for firefighting.
3. Buildings	
3.1	Work with the Federal Emergency Management Agency, the California Building Officials, and other professional engineering and architectural organizations to: ensure that curricula for training and certification of safety assessors are effective and more widely implemented, particularly for local government personnel; improve protocols for deploying and compensating safety assessors; expand the use of Building Occupancy Resumption Programs; and grant safety assessment authority to the Division of the State Architect for public Kindergarten-12th Grade (K-12) schools and state-owned buildings.
3.2	Work with the California Building Officials and professional engineering and architectural organizations, including the American Institute of Architects California Chapter and Structural Engineers Association of California, to develop guidance for local jurisdictions on effective coordination and management of post-earthquake safety assessment processes.
3.3	Develop guidance and training for local fire departments and building owners and operators on alternative procedures to safely turn off damaged sprinkler systems following earthquakes.

No.	Recommendation
3.4	Evaluate and enhance, as needed, training and inspection materials for school districts and staff to seismically secure non-structural systems, equipment, contents, and furnishings in public and private schools.
4. People and Business	
4.1	Establish a state task force to consider the risks posed to the state by the large proportion of uninsured residents and businesses in high-seismic hazard areas, and identify options for improving the take-up, affordability, and terms of earthquake insurance coverage for California residents and businesses, as well as alternative earthquake recovery funding sources for both residents and businesses.
4.2	Evaluate and enhance, as needed, penalties and other consumer protections against post-disaster scamming by contractors and cost inflation.
5. Government and Institutions	
5.1	Strengthen seismic performance standards and contingency planning for all state and local correctional facilities.
5.2	Review and revise, as needed, state regulations guiding the transfer and housing of inmates in county jails during times of emergency.

6.2 LANDSLIDE AND OTHER EARTH MOVEMENT HAZARDS, VULNERABILITY, AND RISK ASSESSMENT

6.2.1 IDENTIFYING LANDSLIDE HAZARDS

Like its earthquake-generating faults, California's mountainous terrain is also a consequence of dynamic geologic processes in operation as the Pacific Plate grinds past the North American Plate. More than one-third of California is mountainous terrain that generally trends parallel to the coast, forming a barrier that captures moisture from offshore storms originating in the Gulf of Alaska and Mexico. Steep topography, weak rocks, heavy winter rains, and occasional earthquakes all lead to slope failures more frequently than would otherwise occur under gravity alone.

A landslide is the breaking away and gravity-driven downward movement of hill slope materials, which can travel at speeds ranging from fractions of an inch per year to tens of miles per hour depending on the slope steepness and water content of the rock/soil mass. Landslides range from the size of an automobile to a mile or more in length and width and, due to their sheer weight and speed, can cause serious damage and loss of life. Their secondary effects can be far-reaching; for example, catastrophic flooding can result from the sudden release of river water impounded by landslide debris or slope failure of an earthen dam.

Although the area affected by a single landslide is less than that of earthquakes, landslides are pervasive in California's mountainous terrain and occur far more often, resulting in average annual landslide losses estimated at about $200 million.[131] Because landslides occur as isolated events in both time and location, and there is presently no systematic means in place for documenting their losses, landslide hazard is often underestimated or goes unrecognized in the policy arena, even though landslides continue to cause millions of dollars in cumulative damage to California's homes, businesses, and infrastructure.

Deep-Seated Landslides

Deep-seated landslides (greater than 10 to 15 feet deep) tend to be triggered by deep infiltration of rainfall over a period of weeks to months. Some deep-seated landslides move very slowly while others can move quickly with little notice. These types of landslides generally cause extensive property damage, but rarely result in loss of life.

Debris Flows

When slope material becomes saturated with water, a debris flow may develop. From a geologic perspective, there are generally two types of debris flows.

Debris Flows Related to Shallow Landslides

The first type of debris flow occurs on hillslope due to soil failure in which soil liquefies and runs downhill. This type of debris flow generally results from a shallow landslide (less than 10 to 15 feet deep) and has a discrete initiation zone depositional area. Shallow landslides tend to occur in winter but are most likely after prolonged periods of heavy rainfall when soil materials are saturated. Debris flows are typically more dangerous because they are fast moving, causing both property damage and loss of life.

Post-Wildfire Debris Flows

The second type of debris flow is a result of post-fire conditions, where burned soil surfaces enhance rainfall runoff that concentrates in a channel and picks up debris as it moves. The post-fire debris flow has a less discrete initiation zone but is similar to a debris flow derived from hillslopes, in that it may result in inundation and a detrimental impact on lives and property within its zone of runout and deposition, and it can result in flooding downstream.

[131] Based on 2018 cost adjusted data from Brabb, E.E., 1989, Landslides: Extent and economic significance in the United States in Proceedings 28th International Geological Congress Symposium on Landslides, Washington D.C., 17 July 1989: A.A. Balkema Publishers, Rotterdam, p 25-50.

An example of a catastrophic post-fire debris flow is the event that occurred in Santa Barbara County on January 9, 2018, when, after the Thomas Fire, numerous canyons deposited debris flows onto urbanized alluvial fans in Montecito and Carpinteria.

Alluvial Fans

Alluvial fans are geologic features built by successive runoff spreading out on the broad fan-like surface as debris-laden floods or debris flows are deposited. The processes that formed these fan landforms become increasingly active with the occurrence of earthquakes, wildfires, and strong winter storms.

As residential and business land uses have expanded onto mountain-front alluvial fan areas, more lives and property are at risk from occurrence of debris-laden floods and debris flows in alluvial fan areas.

6.2.2 PROFILING LANDSLIDE HAZARDS

Landslides are classified into many different types based on form and type of movement. They range from slow-moving rotational slumps and earth flows, which can slowly distress structures but are less threatening to personal safety, to fast-moving rock avalanches and debris flows that are a serious threat to structures and have been responsible for most fatalities during landslide events. Many large landslides are complex, being a combination of more than one landslide type. This is well illustrated by the famous La Conchita landslide that lies along the coastal bluffs in Ventura County. Historically active since the turn of the 19th century, it was reactivated as a slow-moving rotation slide during the 1995 winter rains that destroyed six homes in the subdivision below. The slow movement allowed homeowners to evacuate safely, resulting in no injuries during the event. A portion of the same landslide moved again during the 2005 heavy winter rains as a fast-moving debris flow, which destroyed 30 more homes but also caused 10 fatalities as the occupants had no time to escape.

Areas of Landslide Risk

Landslide hazards are present in many regions of California. Landslide probability is notably high in the coastal regions of California, which are home to much of the state's population, industry, and infrastructure. Particularly hazardous terrain lies where weak rock layers are inclined in the same direction as the mountain slope, a condition found in many areas of California. The Franciscan Formation, which makes up much of the Northern California Coast Ranges, contains weak rock that is both easily eroded and landslide-prone. Through the decades, development has been continuing to spread into mountainous terrain where hazard exposure is high. Most reported landslide losses occur in these regions, as illustrated in the cumulative landslide occurrences resulting from the 1995 El Nino winter storms, shown in Map 6.Y.

Debris Flows and Alluvial Fans

Alluvial fans are a type of landform where debris flows tend to deposit. They range from small features on the order of an acre, to massive landforms that are visible from space. According to U.S. Geological Survey (USGS), about 10 inches of seasonal rain are necessary for ground saturation in Southern California. Once the ground is saturated, as little as 0.2 inch of rain per hour has the potential to trigger a debris flow that could deposit on an alluvial fan.

With post-fire debris flows, wildfire can significantly alter the hydrologic response of a watershed to the extent that even moderate rainstorms can produce dangerous flash floods and debris flows. Seasonal rain accumulations on burn areas have little influence on debris flow generation. However, short-duration, intense rainfall, generally greater than 0.5 inch per hour, has the potential to trigger post-fire debris flows. As the rainfall intensity increases above this value, the magnitude and impacts of the debris flows also increase. For example, the January 9, 2018 storm in Santa Barbara County triggered debris flows when rainfall intensities reached 6.48 inches per hour. This storm event initiated several debris flows within the Santa Ynez Mountains that inundated urbanized alluvial fan areas within Montecito and Carpinteria in Santa Barbara County, causing 21 fatalities and 28 injuries, destroying 127 homes and 6 commercial buildings, and damaging 307 homes and 17 commercial buildings.

A Santa Clara County Debris Flow Triggered by Winter Storms Following the Loma Fire, 2017



Source: Brian Swanson, California Geologic Survey

Hazard mitigation planning through hazard identification and mapping has not been completed with respect to debris flows hazards on alluvial fans. However, general alluvial fan awareness mapping was completed by the California Geological Survey (CGS), working with the California Department of Water Resources (DWR) Alluvial Fan Floodplain Evaluation and Delineation (AFFED) project, has developed geologic maps of Quaternary surficial deposits for nearly 35,000 square miles of Southern California. These maps provide geologic information on the general distribution of alluvial fans, as well as differentiation of geologic deposits that may represent the location of potential debris-laden floods and debris flows. As part of the AFFED project, these maps are intended to provide local agencies making land use decisions with the necessary tools to understand the characteristics and potential hazards.

Debris flows in the Santa Rosa Mountains in San Diego County Spread Out on an Alluvial Fan



Photo by Jeremy Lancaster, California Geological Survey

It has been recognized that debris-laden floods and debris flows on alluvial fan floodplains often originate from watersheds that burned during the previous fire season.[132] The concern for debris flows following wildfires is particularly acute in the Los Angeles Basin where urban areas encroach upon alluvial fans. Research by the US Geological Survey (USGS) in the western United States has refined the understanding of debris flows generated from recently burned watersheds.[133] Post-fire debris flow hazards assessments prepared by the USGS can be found at the following website: https://landslides.usgs.gov/hazards/postfire_debrisflow/.

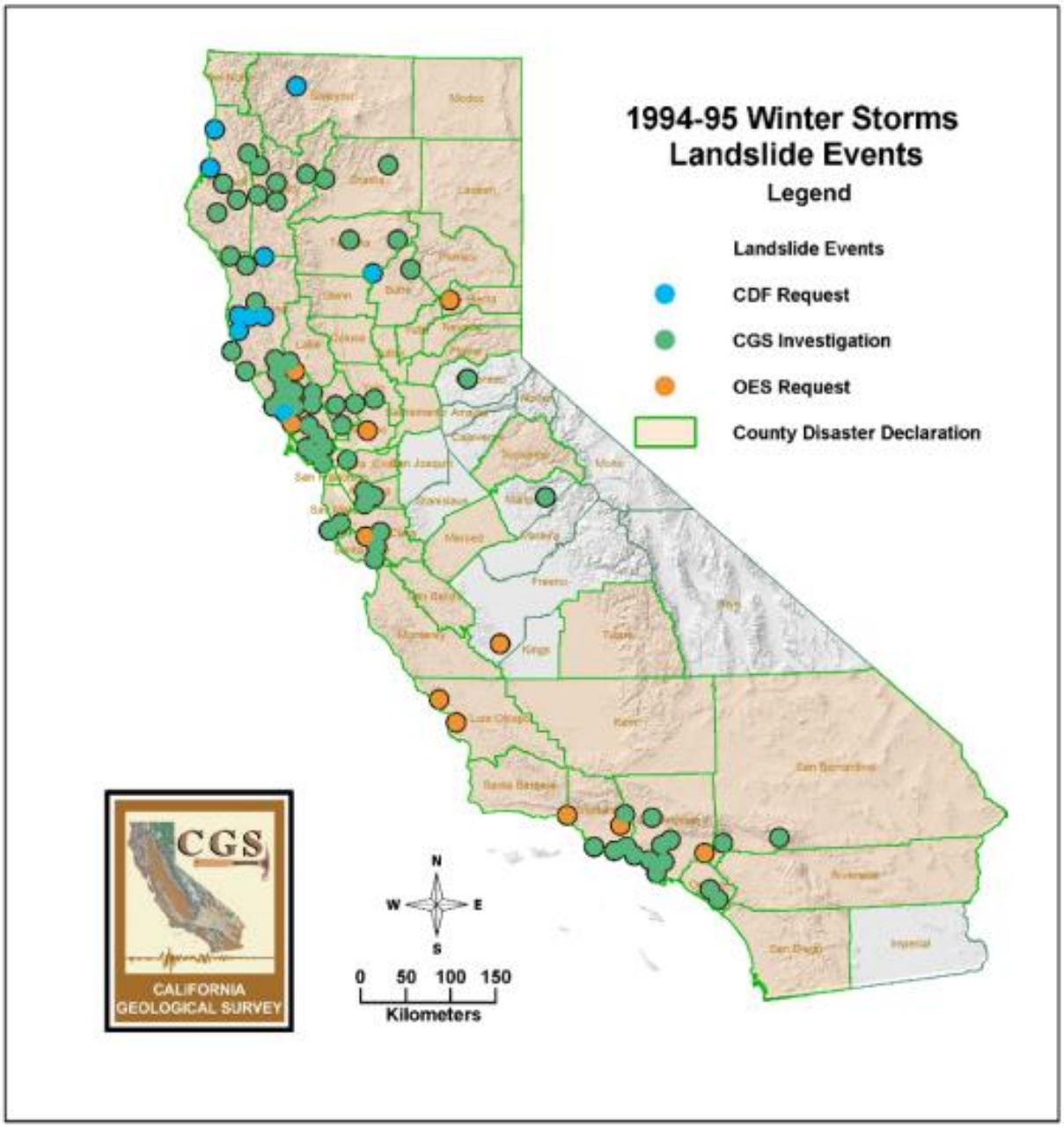
Winter Storms and Landslide Events

Map 6.Y shows the statewide distribution of landslide damage reports investigated by the California Geological Survey (CGS) during the 1995 El Nino winter storms. Orange-shaded counties are those declared federal disaster areas during the 1994-1995 winter season. While subsequent years have generated various landslide events in Northern and Southern California, there has not been a statewide landslide response since this map was prepared in 1995. However, landslides triggered during the February 2017 severe winter storms caused damage across a large portion of the state, with a major disaster declaration issued for 44 California counties and one tribe.

It should be noted that while Map 6.Y is over 20 years old, it is included in this document because it still demonstrates the relationship between extreme winter storm events and the potential for landslides to occur. As noted above, since there has not been a statewide landslide response since 1995, there is not a more recent version of Map 6.Y.

[132] Eaton, 1935
[133] USGS, 2005

Map 6.Y: 1994-1995 Winter Storm Landslide Events



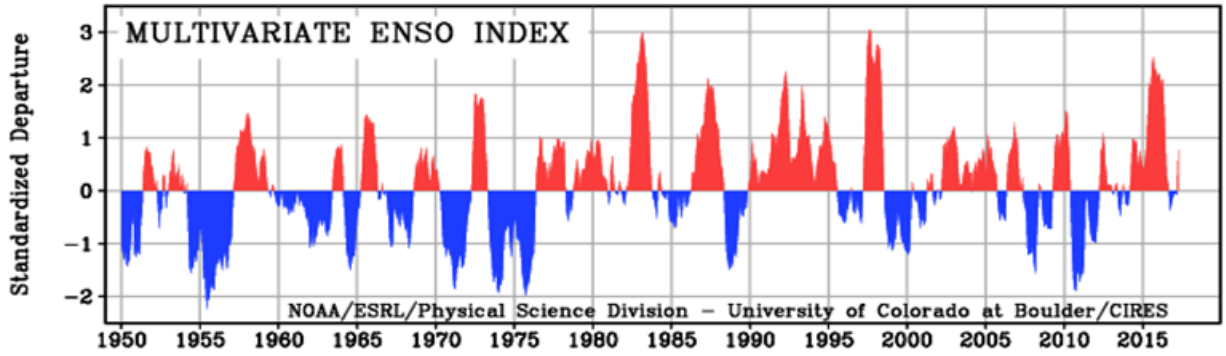
Other El Nino or high rainfall winter seasons that have strong atmospheric river storm events reveal similar patterns of landslide occurrences across the state. Even though Map 6.Y shows only one season, it illustrates a pattern of landslide propensity in certain regions when soils become saturated.

This statewide pattern of landslide occurrences repeats itself during heavy winter seasons, which may coincide with El Nino Southern Oscillation in the Pacific Ocean. Every few years, warm equatorial waters are driven to the eastern Pacific, bringing moisture-laden air that results in more frequent and severe winter storms in California. While El Nino is a condition that can result in high total rainfalls, there are other conditions that may result in record levels of rainfall, even in a non-El Nino year. The February 2017 severe storms were an example of an instance where

record-breaking rainfall occurred in a non-El Nino condition year with wet conditions instead resulting from many atmospheric rivers making landfall in the midst of a Madden Julian Oscillation event.[134]

During heavy rainfall conditions, the added weight of rain-saturated hill slopes and the weakening of slopes caused by the pressure the groundwater exerts on porous hillside materials are triggering agents of slope failure. Improved forecasting of El Nino events or other potentially high rainfall years now provides advanced warning which allows for better preparation and response to potential slope failures and flood events.

Chart 6.A: Multivariate El Nino Southern Oscillation Index

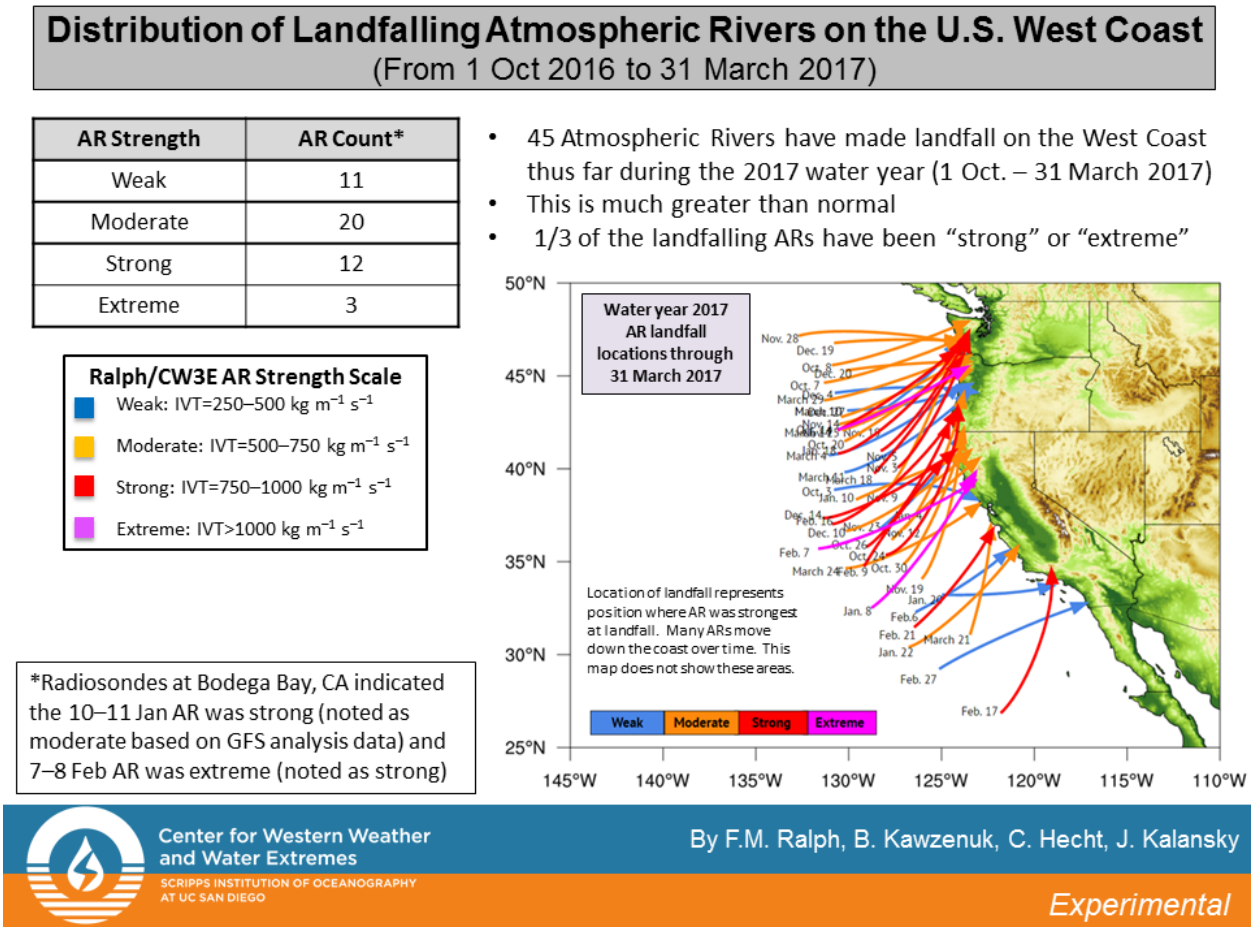


Source: NOAA, Earth System Research Laboratory, https://www.esrl.noaa.gov/psd/enso/mei/ (retrieved June 1, 2017)

Chart 6.A shows a history of El Nino occurrences. El Niño Southern Oscillation (ENSO) is the most important coupled ocean-atmosphere phenomenon to cause global climate variability on interannual time scales. The red region corresponds to warmer sea surface temperatures, which bring unusually moist air into the north Pacific, producing wetter winters and more intense landslide and debris flow activity in California.

[134] NOAA Climate Prediction Center, http://www.cpc.noaa.gov/, https://www.climate.gov/

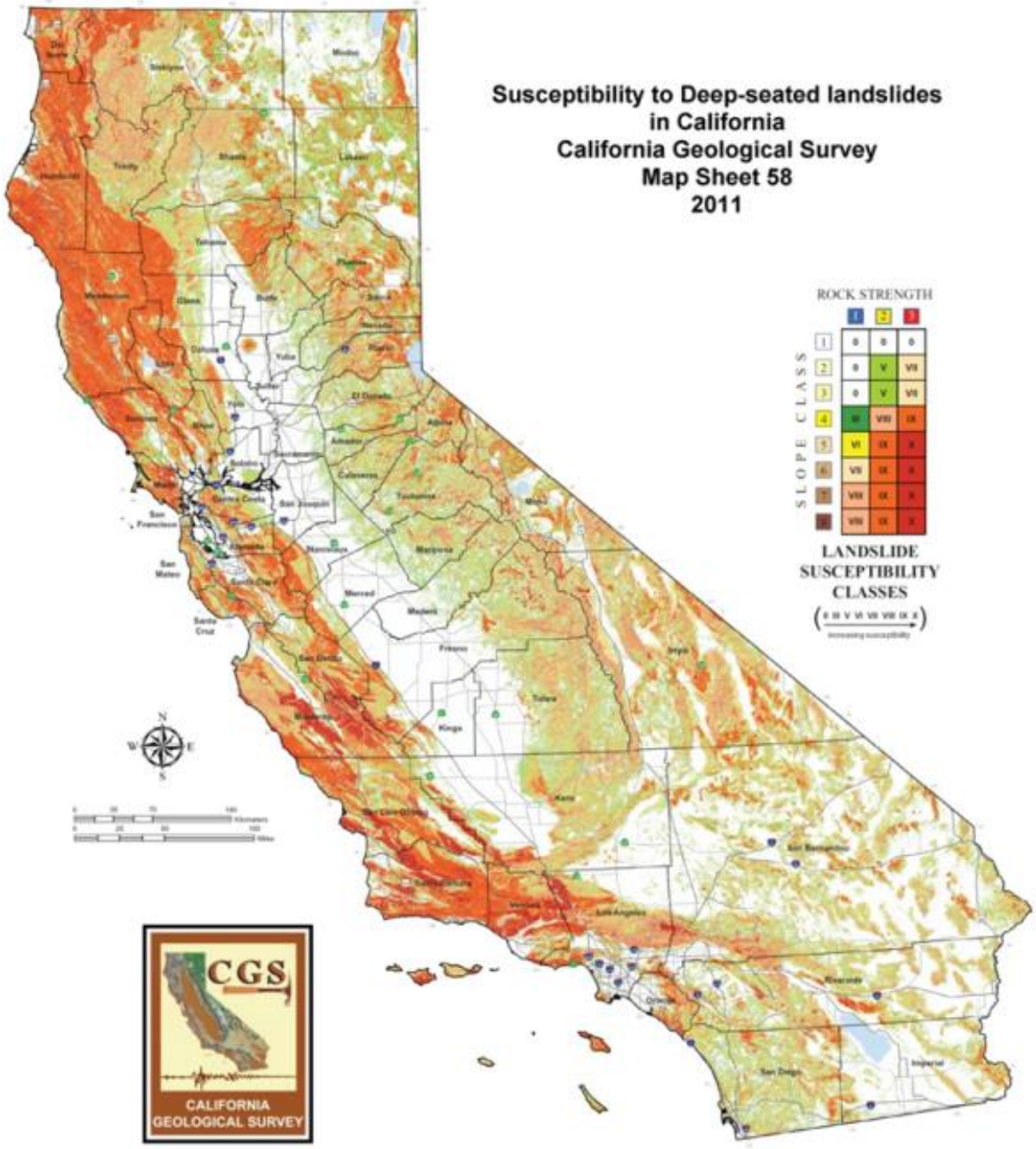
Figure 6.B: Landfalling Atmospheric Rivers from October 2016 to March 2017



Source: http://cw3e.ucsd.edu/how-many-atmospheric-rivers-have-hit-the-u-s-west-coast-during-the-remarkably-wet-water-year-2017/

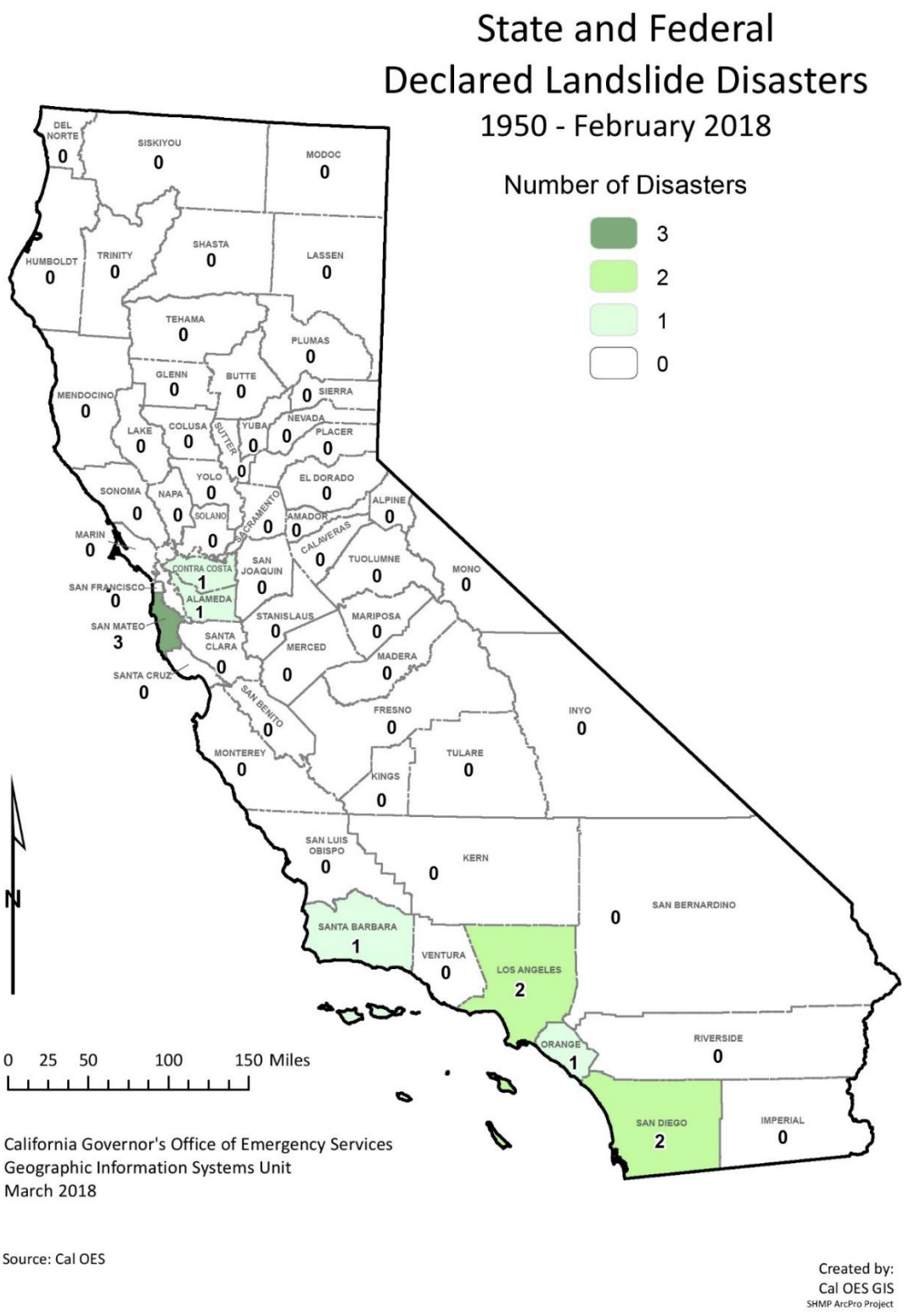
Figure 6.B summarizes the incidents of atmospheric rivers that made landfall along the west coast of the U.S from late 2016 through early 2017. While many of the strong and extreme atmospheric rivers landed north of California, several landings occurred within the state, bringing an increased risk of landslide occurrence.

Map 6.Z: Relative Susceptibility to Deep-Seated Landslides in California



General landslide susceptibility in California can be estimated from the distribution of weak rocks and steep slopes as shown in Map 6.Z. High and moderate landslide susceptibility, combined with high rainfall or high earthquake potential, leads to high landslide hazard in coastal California.

Map 6.AA: State and Federal Declared Landslide Disasters, 1950-February 2018



Map 6.AA shows state and federally declared landslide disasters by county from 1950 to February 2018. Note that despite frequent local occurrence of landslides, these events are rarely large enough to qualify for a disaster declaration. Additionally, large landslides and debris flows are frequently included under other disaster categories.

Earthquakes and Landslides

Although less frequent, the most devastating landslides worldwide have been triggered by earthquakes. Strong ground shaking can create the additional forces necessary to weaken slopes and cause those already distressed by gravity to fail. The greatest landslide disaster in history occurred in 1920 in central China, where a Magnitude 8.5 earthquake caused weak, wind-deposit slopes to collapse into a densely populated valley, killing an estimated 180,000 people.

Earthquake shaking can also rapidly weaken loose water-saturated sediments via liquefaction, which can greatly increase ground deformation and sliding, even on gentle slopes. This happened during the 1971 San Fernando Earthquake, when the soil beneath two earth-fill dams partially liquefied and shifted, causing partial collapse of both facilities. Those events resulted in over a half-billion dollars in damage and the temporary evacuation of 80,000 people below the dam.

Besides blocking the flow of streams and causing the potential for catastrophic flooding by sudden release of impounded waters, landslides can collapse into water bodies, causing very large, destructive tsunamis. In 1958, a Magnitude 8 earthquake collapsed a hillside into Lituya Bay, Alaska, causing a water splash wave that reached 1,720 feet up the mountain slope, stripping all vegetation. A massive landslide into the Vaoint Reservoir in Italy in 1963 caused a tremendous water splash wave that swept 800 feet over the top of the dam, causing a major flood that killed an estimated 2,600 people below. Grading during construction of reservoirs and alteration of the groundwater regime due to the impounded water can weaken the adjacent hillsides, which must be taken into consideration during design and construction.

Climate Change and Landslides

Landslides can result from intense rainfall and runoff events. Projected climate change-associated variance in rainfall events may result in more high-intensity events, which may increase landslide frequency (i.e., due to wetter wet periods and drier dry periods). While total average annual rainfall may decrease, rainfall is predicted to occur in fewer, more intense precipitation events. The combination of a generally drier climate in the future, which will increase the chance of drought and wildfires, and the occasional extreme downpour is likely to cause more mudslides and landslides.[135]

In addition, the increased wildfire occurrence also escalates the risk of landslide and debris flows in the period following a fire, when slopes lack vegetation to stabilize soils[136] and burned soil surfaces create more rainfall runoff. As climate change affects the length of the wildfire season, it is possible that a higher frequency of large fires may occur into late fall, when conditions remain dry, and then be followed immediately by intense rains early in the winter, as occurred with the Thomas Fire in December 2017 and subsequent Montecito and Carpinteria debris flows in January 2018.

6.2.3 ASSESSMENT OF LANDSLIDE VULNERABILITY AND POTENTIAL LOSSES

The impact of natural hazards on the built environment generally depends on exposure (proximity to the hazard and its severity) and the vulnerability of engineered structures (structure type, design, and age). The closer a structure is to a hazard event, the more damage that is likely to be sustained, while the larger a hazard event is, the greater its impact at a given distance. Brick buildings resist storm and fire damage better than wood construction; however, these buildings – particularly unreinforced masonry – are less resilient against earthquakes. The resistance a structure of a given type will have against natural hazards depends on the building code in effect at the time of construction and how closely its provisions are followed.

Codes improve with time, so newer construction generally performs better than older construction. While structures can be designed to resist the forces of gravity, wind, and earthquakes, it is not economically feasible to design structures to resist the large earth movements that can accompany large landslides. Landslide losses primarily result

[135] CNRA, 2009; California Climate Change Center, 2009
[136] California Department of Natural Resources. Safeguarding California: Implementation Action Plans. 2016. Sacramento: author, 279 p.

from hazard exposure (high population densities in mountainous terrain), however, rather than inferior structural design.

The two main types of structures that are vulnerable to landslides are buildings and utility/transportation lifelines. Table 6.K lists notable landslides and debris flows in California.

Typical Landslide damage to Homes Caused by Intense Ground Deformation of the Landslide Mass in Anaheim Hills, Orange County, 2005. (The slow movement of the slide allowed residents to evacuate.)



Buildings

Landslides directly damage engineered structures in two general ways: 1) disruption of structural foundations caused by differential movement and deformation of the ground upon which the structure sits, and 2) physical impact of debris moving downslope against structures located in the travel path. As a landslide breaks away from a slope and moves, it deforms the ground into an undulating, hummocky surface broken up by fissures and scarps.

When situated on top of a landslide, the deformation distresses structural foundations, and the structures themselves, by settlement, cracking, and tilting. This can occur slowly, over years, or rapidly within days or hours. Water-saturated, fast-moving debris flows (called “mudslides” by the media) can destroy everything in their path, collapsing walls and shifting structures off their foundations. The 2005 La Conchita Landslide in Ventura County traveled with such force that it destroyed 30 homes, scraping many off their foundations and piling them, one on top of another, three high.

Table 6.K: Notable Historic Landslides and Debris Flows in California

Location	Year	Impact[a]
Montecito	2018	Post-Thomas Fire debris flows. 129 homes destroyed, 307 homes damaged, 21 fatalities.*
Camarillo Springs	2014	Post-Springs Fire debris flows. 10 homes destroyed, 6 homes damaged.
La Canada	2009-2010	Post-Station Fire debris flows with early damage claims at $58 million and Los Angeles County cleanup costs at over $30 million (2009 dollars).
Pacifica	2007	Devil's Slide: bypass construction of $325 million (See: San Francisco Chronicle).
La Conchita	2005	30 homes destroyed, 10 fatalities.
Laguna Beach	2005	18 homes destroyed, 8 homes damaged. Slide repair cost: $21 million. Cost of damage: $35 million.
San Bernardino	2003	Post-Grand Prix/Old Fire debris flows on Christmas Day. 16 fatalities, 52 homes and 32 trailers damaged; more than $100 million in damages.
Mission Peak	1998	--
Laguna Niguel	1998	9 homes and 57 condominiums destroyed. $12 million awarded to homeowners in lawsuit; $16 million to stabilize slope[b]
Rio Nido	1998	37 homes destroyed. 140 residents evacuated[c]
Laguna Beach	1998	18 homes destroyed, damaged 300 others. Two fatalities.
El Dorado County Hwy 50	1997	Destroyed Highway 50; $32 million in repair and economic losses.[i]
La Conchita	1995/2005	6 homes destroyed.[e]
Anaheim Hills	1993	30 homes destroyed, 200 homes damaged. Cost: $12 million.
Bay Area	1982	Debris flows and landslides on private and public property Cost: $172 million[J]
Big Rock Mesa	1979/1983	13 homes destroyed. Cost: $114 million. Damage to Highway 1 cost: $1.26 billion[f]
Laguna Beach	1978	19 homes destroyed, 45 homes damaged. Cost: $62 million[g]
San Fernando	1971	Cost: $354 million
Saugus-Newhall	1971	Cost: $312 million
Palos Verdes	1956, intermittently	More than 100 homes severely damaged or destroyed. Cost: $34 million; $68 million in damage settlements[h]

Source: California Geological Survey, or as noted
[a]Dollar amounts are adjusted to 2006 dollars
[b] http://anaheim-landslide.com/laguna.htm
[c] http://www.sonoma.edu/geoloy/wright/rioslide.htm
[d] http://wrgis.wr.usgs.gov/wgmt/elnino/scampen/laguna/index/html
[e] http://www.geog.ucsb.edu/~jeff/projects/la_conchita/apcg2001_article/apcg2001_article.html
[f] http://www.ci.malibu.ca.us/download/index.cfm?fuseaction=download&cid=3144
[g] http://www.consrv.ca.gov/cgs/geologic_hazards/landslides/Bluebird%20Canyon%20Landslide%20Cover.pdf
[h] http://seis.natsci.csulb.edu/VIRTUAL_FIELD/Palos_Verdes/pvportuguese.htm
[i] http://www.conservation.ca.gov/cgs/rghm/landslides/cal_geology/Documents/1997%20hwy%2050%20cal%20geology.pdf
[J] USGS pp 1434; ftp://ftp.consrv.ca.gov/pub/dmg/pubs/cg/1982/35_07.pdf
**Based on preliminary incident data available February 2018*

The 2018 Montecito Debris Flow in Santa Barbara County Engulfs a Home Near San Ysidro Creek



Source: Jeremy Lancaster, California Geological Survey

Utilities and Transportation

In addition to buildings, utilities and transportation structures are vulnerable to the impact and ground deformation caused by slope failures. They present a particular vulnerability because of their geographic extent and susceptibility to physical distress. Lifelines are generally linear structures that, because of their geographic extent, have a greater chance of being affected by ground failure (hazard exposure).

Extension, bending, and compression caused by ground deformation can break lifelines. Failure of any component along the lifeline can result in failure to deliver service over a large region. Once broken, transmission of the commodity through the lifeline ceases, which can have catastrophic repercussions down the line: loss of power to critical facilities such as hospitals, impaired disposal of sewage, contamination of water supplies, disruption of all forms of transportation, release of flammable fuels, and so on. Therefore, the overall impact of lifeline failures, including secondary failure of systems that depend on lifelines, can be much greater than the impact of individual building failures.

The cost of damage to lifelines is a substantial part of the overall social impact. Studies have shown that Caltrans spends an average of $50 million per year repairing and mitigating landslide damage. Other lifeline operators (local governments and utilities) may spend a similar amount.

The economic impact of landslide damage to lifelines can be much greater than direct repair costs, but there are no estimates of the total indirect costs. In one illustrative example, the 49-year old Highway 1 Pfeiffer Canyon Bridge just south of Big Sur Station in Monterey County was demolished by Caltrans in March 2017 due to irreparable damage to the bridge columns caused by landslide movement under the bridge foundation as a result of heavy winter rains. The new bridge replacement, which Caltrans completed 2017, cost $24 million.

Another significant Big Sur landslide triggered by heavy winter and spring rains is the May 2017 Mud Creek Slide which buried a quarter mile section of scenic Highway 1 approximately 9 miles north of the San Luis Obispo-Monterey County line. Caltrans estimates that over 1 million tons of rock and dirt fell during the slide, which is actually a combination of five slides. The affected section of Highway 1 was covered by a layer of dirt and rock about 35 to 40 feet deep. The section of Highway 1 closed by the slide re-opened in July 2018.

Following the 1997 Mill Creek Slide on Highway 50, the CGS began development of highway corridor landslide maps to assist Caltrans. Development of these maps for various highway corridors continued for over a decade, and the maps are posted on the CGS website. To find out more about the history of the program or to view maps, visit: http://www.conservation.ca.gov/cgs/rghm/landslides.

In January 2018, the catastrophic Montecito post-fire debris flow discharged a volume of material so large that an approximate 10-mile portion of Highway 101 was closed for about two weeks while Caltrans and other state agencies worked to remove mud, boulders, trees, utility poles, and other debris. The debris flow was so powerful that mud and debris, including vehicles, were deposited onto beaches, necessitating the closure of eight Santa Barbara County beaches to protect public health. The debris flow also caused significant damage to utilities, including substantial damage to water mains and complete removal of utility poles. This utility damage left some Montecito residents and businesses without gas, power, and water services for close to two weeks.

Boulders Deposited in a Montecito Roadway During the Post-Fire Debris Flow, January 2018



Source: Mike Eliason/Santa Barbara County Fire Department

6.2.4 CURRENT LANDSLIDE HAZARD MITIGATION EFFORTS

Exposure to landslide hazards can be reduced by effective land use planning and hillside development practice. Like slope steepness and material strength, potential for water-saturated hillsides (or earthquake shaking) is a design parameter that should be considered when preparing a building site. Reducing landslide hazard is accomplished by either reducing gravity forces acting on a slope by grading to decrease steepness, or increasing slope resistance and restraint using structural systems and effective dewatering and drainage. If either approach is not economically viable for a particular project, avoiding the hazard by relocating the project to a safer site is the alternative. Landslides that affect existing structures can often be stabilized using engineering resistance and retention systems and effective dewatering that strengthen the slope and hold rock/soil mass in place.

Local Government Responsibilities

Managing landslide risk is primarily the responsibility of local governments where planning and building departments serve as lead agencies. Over 80 percent of California cities have landslide/mudslide ordinances, design standards, or guidelines for hillside development. California's Seismic Hazards Mapping Act designates landslide zones wherein cities and counties are required to condition construction permits upon adequate landslide site investigation and agreed-upon mitigation. These efforts have proven effective in reducing losses over the past decades, but not all jurisdictions that face potential landslide hazards have such instruments, nor has zoning of all landslide-prone areas been completed under the state program.

California Landslide Hazard Mapping

Since the 1970's, the California Geological Survey (CGS) has produced numerous maps that show landslide features and delineate potential slope-stability problem areas. Preparation of these maps has been episodic, often driven by landslide disasters and subsequent legislative mandates. Many CGS landslide maps and related products have been produced for local or state agencies in response to their specific needs.

California's Landslide Hazard Identification Act established the Landslide Hazard Identification Program (LHIP) in 1986 under the jurisdiction of the CGS, which prepared maps of landslide hazards and distributed them to local governments. Since the LHIP terminated by sunset law in 1995, some landslide hazard identification mapping is being conducted under the Seismic Hazards Mapping Act. However, there has been no state program to evaluate or map the types of landslides that cause the most casualties. Although the Alluvial Fan Task Force provided some guidance on where runout could affect developing areas in southern California, the need for a statewide assessment of debris flow potential on hillsides and alluvial fans is not being met.

Progress Summary 6.M: Landslide Hazard Mapping

Progress as of 2018: The California Geological Survey (CGS) has released maps of zones of requiring investigation for seismically induced landslides under the Seismic Hazards Mapping Act since 1997. In addition, the CGS has been producing maps of landslides since the 1970s.

The CGS is in the process of digitizing maps of landslides, and hundreds of these landslide inventory maps, covering much of coastal California, are now available on the CGS Landslide Inventory Viewer: http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=landslides.

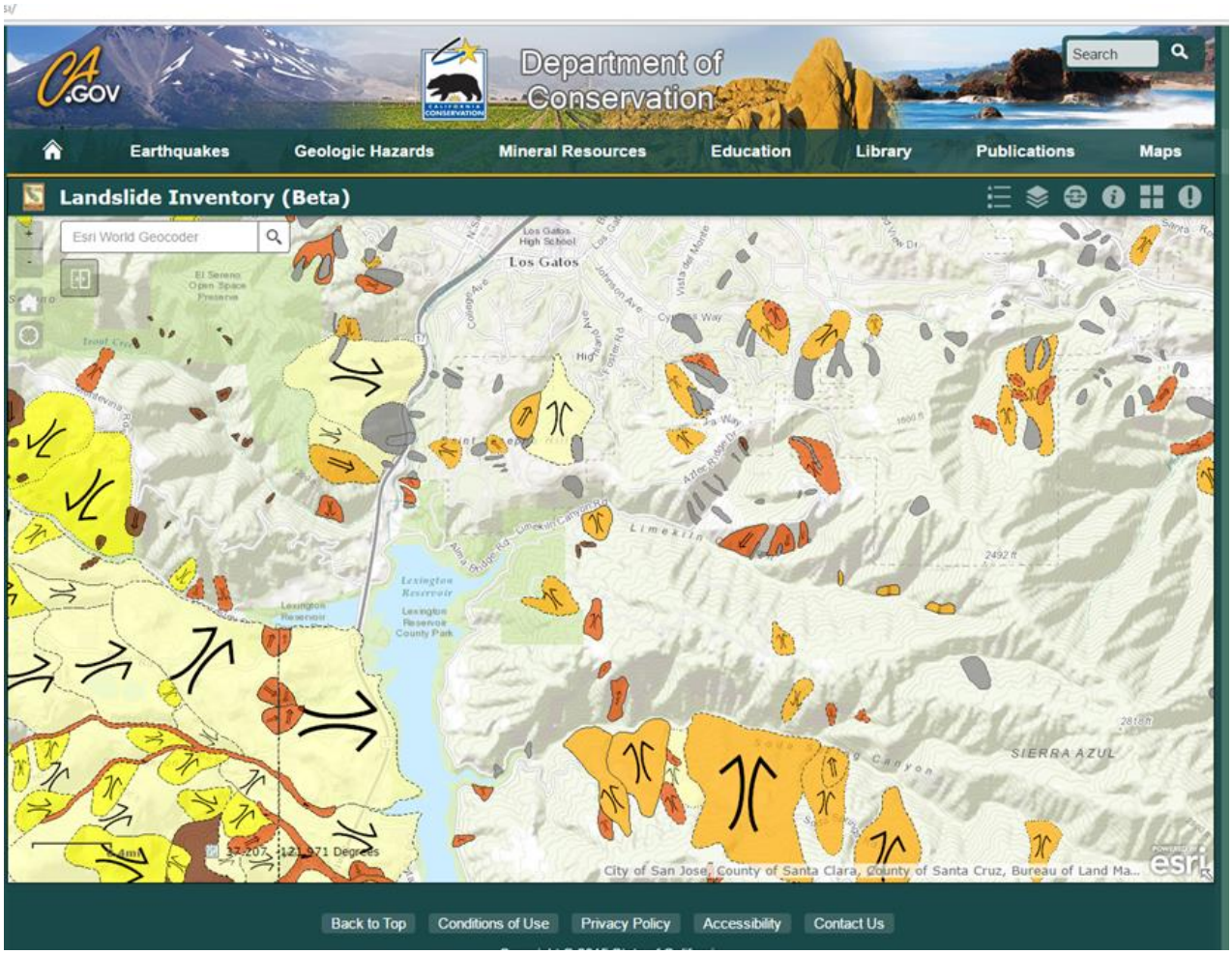
The map viewer index includes landslide maps produced over many years and for a variety of purposes. Mapping of landslides reflects the standards of the project and time the map was prepared. The amount of information recorded about each landslide has increased over time, so more information is available for more recently mapped landslides. Updates to the database are continuing, both to include more existing maps and to add current landslides as they occur. The Landslide Inventory Viewer is a work in progress and is being updated continuously as the CGS produces new maps, adds more information, and corrects existing maps.

The CGS prepares four main types of landslide maps:
1. Landslide-inventory maps
2. Landslide-hazard maps
3. Landslide-risk maps
4. Landslide-zone maps

For a more detailed discussion on the types of CGS landslide maps, current CGS mapping programs, and the history of CGS landslide mapping, visit: http://www.conservation.ca.gov/cgs/geologic_hazards/landslides/Pages/Index.aspx.

Maps showing the locations of existing landslides in a community are useful for land use decision-making because they target areas to be avoided or remediated before construction can safely proceed. The maps indicate not only the location, but also activity status and direction of slope movement to provide a better understanding of where landslides are most likely to be triggered, either by winter storms or earthquakes. Because of the value of landslide maps for hazard mitigation projects, many communities have prepared such maps as part of the safety elements of their general plans or for Local Hazard Mitigation Plans. Advanced knowledge of slope instability can help to assure that proper consideration will be included in grading plans and that safe foundations will be constructed.

Map 6.BB: California Geological Survey Landslide Inventory Viewer – Showing Los Gatos/Highway 17 Area



Source: CGS

Map 6.BB is an example of a landslide inventory map from CGS' landslide map viewer showing boundaries of existing landslides in a portion of the Los Gatos/Highway 17 area. Landslides mapped by CGS and other are shows as colored areas when data is available. The background yellow-red colors indicate areas of weak rocks and/or steep slopes leading to susceptibility to deep landslides. Darker red as background indicates higher susceptibility. Landslides are color-coded as Active or Historic Movement (brown), Dormant – Some Indication of Historic Movement (orange), and Dormant – Old, No Evidence of Historic Movement (yellow).Arrows show direction of landslide movement. When using the viewer online great detail can be viewed by zooming in.

Landslide Predictive Modeling and Preliminary Site Assessment

In response to recommendations made by the Alluvial Fan Task Force, the CGS collaborated with the California Department of Water Resources (DWR) to conduct a post-fire runoff assessment study culminating in a 2014 report entitled the "Assessment of Post-Fire Runoff Hazards for Pre-Fire Mitigation Planning – Southern California."[137] The study was funded by FEMA's Hazard Mitigation Grant Program.

The purpose of the study was to use regional-scale predictive models to assess potential effects of post-fire runoff from a pre-fire planning perspective. The study assessed watersheds under a range of possible rainfall and burn conditions, with the resulting data to be used by floodplain managers and emergency responders in developing mitigation actions and response plans. Regional model results provide information for use in hazard mitigation planning by highlighting watersheds prone to potentially hazardous post-fire runoff events and providing a range of results under different scenarios. This information allows floodplain managers and emergency responders to set priorities for hazard mitigation.

Regional modeling of burn areas around the state is being conducted by state and federal agencies that respond to post-fire hazards, to assess post-fire conditions for risk from debris flows that could affect vulnerable areas. A copy of the report can be downloaded at the following link:
ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sr/SR_234/CGS_SR234_Final_v1.pdf.

In 2015 CGS prepared a special publication guiding assessment of alluvial fan depositional environments to determine areas that may be impacted by alluvial fan flooding. The publication provides direction for regional planning including:

- Data requirements
- Mapping standards
- Clarification of terminology
- Information for preliminary design

For a copy of this report, contact CGS at: cgspubs@consrv.ca.gov.

For more information about USGS assessment of post-fire debris-flow hazards, visit the following webpage:
https://landslides.usgs.gov/hazards/postfire_debrisflow/index.php.

Watershed Emergency Response Team Post-Wildfire Debris Flow and Flood Assessments

Following selected wildfires, California, in coordination with federal agencies, deploys Watershed Emergency Response Teams (WERTs) to conduct post-fire assessments. The WERT assessments identify types and locations of threats to life-safety and property (i.e., collectively known as "values-at-risk" or VARs) from debris flows, flooding, rockfall, and erosion that are elevated due to wildfire. As part of the WERT assessment, the team develops preliminary emergency protection measures for the identified locations in a detailed report with maps, and communicate the findings to responsible emergency management agencies.

[137] CGS Special Report 234 and Alluvial Fan Flooding SR227

WERT post-fire assessments are generally limited to large wildfires that pose significant threat to lives and property from post-fire debris flows and flooding. While similar in some ways to U.S. Forest Service's Burned Area Emergency Response (BAER) Team assessments, the WERT assessments have less emphasis on natural and cultural resources and only recommend emergency measures for life-safety and property protection.

Most wildfires, including small fires, fires located mostly on federal lands, fires in areas with short gentle slopes or low landslide potential, and fires not in proximity to housing developments or other VARs, typically do not require a WERT assessment. (Note: fires greater than 500 acres on U.S. Forest Service lands trigger a separate BAER assessment.) WERT assessments are typically established based on the recommendation of the CAL FIRE director, unit chief, IMT incident commander, unit forester. A federal or state disaster declaration may also make WERT deployment more likely.

When making the determination to deploy the WERT for post-fire assessment work, the following key factors are considered:

- The presence of life-safety-related VARs (e.g., homes, businesses, other infrastructure) downslope and/or downstream of steep hillslopes and catchments burned at moderate to high soil burn severity.
- High likelihood of debris flows and flooding based on soil burn severity, topography, geology, and likely rainfall rates.
- Historical occurrence of debris flows and flooding during burned and/or unburned conditions.
- Presence of transportation networks (e.g., highways, rail lines), water supply systems, power generating plants and conveyance systems, campgrounds/resorts, and other high value sites expected to be at high risk due to post-fire debris flows and flooding.
- A high percentage of SRA included in the fire area.

WERT assessments are a collaborative effort between primary agencies and other additional agencies, which require interagency cooperation at the state, federal, and local level. Primary agencies include California Department of Forestry and Fire Protection (CAL FIRE), California Geological Survey (CGS), California Department of Water Resources (DWR), and U.S. Geological Survey (USGS). Additional agencies may include the Regional Water Quality Control Boards (RWQCBs), Natural Resources Conservation Service (NRCS), and local jurisdictions. CAL FIRE acts as the lead agency coordinating the WERT in cooperation with all contact agencies. Specialized personnel with qualifications in engineering geology, civil engineering, hydrology, GIS, forestry (including fire line safety), and water quality are required to rapidly identify life-safety hazards. Which specific agencies are involved in a WERT assessment and the size of the team typically depends on the size and complexity of the fire and post-fire threats. Team size can range from one to twenty individuals. CAL FIRE provides the funding for agency involvement through MOUs and other pending agreements.

When a WERT assessment is determined to be necessary, the process involves the following steps:

- Assemble an interdisciplinary team of engineering geologists, civil engineers, hydrologists, foresters, soil scientists, GIS specialists, and others, as required.
- Meet with county and/or city officials and others with local knowledge of potential high risk locations within or downstream of the fire area.
- Obtain the satellite-derived burned area reflectance classification (BARC) map indicating preliminary burn severity and field verify soil burn severity determinations shown on the map.
- Submit the field verified soil burn severity map to the U.S. Geological Survey (USGS), allowing their scientists to produce the debris flow model basin and segment probability map using a 15-minute rainfall intensity design storm event. USGS debris flow model results are presented in terms of combined hazard, reflecting both the probability of debris flows and the magnitude of potential debris volume.
- Conduct flood modeling and calculate debris volumes for specific watersheds located above identified VARs.
- Conduct surface erosion modeling before and after the fire.
- Compile all collected data and modeling results as GIS layers and load them on to tablets and smart phones for field use.
- Determine the location of potential VARs within and downstream of fire perimeter.

- Field check and record VAR locations digitally as points or polygons and develop preliminary emergency protection measures.
- Summarize VAR information in a detailed Excel table and GIS map format and compile a draft report documenting the physical setting, methods utilized, modeling results, general and specific observations, and general recommendations.
- Conduct a meeting with local emergency response agencies to present the draft report findings and answer questions regarding report information and recommendations.
- Following review of the draft report by senior CAL FIRE and CGS staff, the report is finalized and approved by CAL FIRE, posted on CAL FIRE's website, and distributed to local agencies and other contacts made during the field investigation.

The field assessment process typically takes between one and two weeks, with additional time required for draft report generation and agency approval. Following completion of the report, conducts a WERT closeout meeting with local governments to go over the findings of the WERT field assessment process and the identified VARs. Once the closeout meeting is completed, Cal OES assembles the Post-Fire Watershed Task Force. The Cal OES-led Post-Fire Watershed Task Force coordinates with local county offices of emergency services and other state and federal agencies to facilitate and support implementation of VAR emergency protection measures and mitigation projects.

Typical WERT recommended emergency protection measures include:

- Early warning systems—cell phone warnings using National Weather Service flash flood and post-fire debris flow "watch" and "warning" notifications for burned areas based on radar-derived forecasts
- Strom patrols—monitor road drainage infrastructure during strong storm events
- Structure protection/debris barrier—installation of k-rails, sandbags, silt fences, temporary culverts, straw bale check dams, muscle walls, etc., where appropriate
- Debris clearance—monitor and/or remove debris from debris basins, and from within channels subject to post-fire flooding
- Notification—post temporary signage in areas of potential hazard
- Closure of high risk areas—close areas such as campgrounds during strong storm events
- Emergency Action Plans—encourage local agencies to develop EAPs for very high risk VARs potentially impacting large numbers of people
- Improved agency communication--when appropriate encourage local flood control and public works departments to assist in communicating the high potential and high risk/consequences of post-fire watershed hazards to local emergency management agencies

Where wildfires include both federal and non-federal lands and an assessment is determined to be necessary, WERT and BAER teams work closely and collaboratively to share data and avoid redundant efforts. From 2015 to August 2018, WERT was deployed 16 times, including following the North Bay wildfires in 2017, the Thomas Fire in January 2018, and the Carr Fire and Holy Fire in the summer of 2018. Final WERT reports are posted on the CAL FIRE website.

In many cases, local jurisdictions may be able to obtain funding for some longer-term VAR emergency protection measures or mitigation projects from the FEMA Hazard Mitigation Assistance Program (HMA), either through a Hazard Mitigation Grant Program (HMGP) or Public Assistance (PA) grant. HMGP grants that prioritize shovel-ready wildfire/watershed mitigation projects or other post-wildfire mitigation activities or PA grants that prioritize immediate threat erosion control measures to address post-wildfire soil conditions may be applicable sources of funding for eligible VAR emergency protection measures and mitigation projects by local jurisdictions. Additionally, emergency management agency coordination with NRCS may be appropriate, since funding for post-fire recovery measures for exigent work may be available under NRCS's Emergency Watershed Protection (EWP) Program.

Flash Flood and Debris-Flow Demonstration Early Warning System

In Southern California, the USGS has identified the rainfall conditions required to trigger post-wildfire debris flows. Based on that data, the National Oceanic and Atmospheric Administration (NOAA) and the USGS have established a demonstration flash flood and debris-flow early warning system for recently burned areas covering eight counties in Southern California.

The early warning system uses the National Weather Service (NWS) Flash Flood Monitoring and Prediction (FFMP) system. The FFMP system identifies when both flash floods and debris flows are likely to occur based on comparisons between radar precipitation estimates and established rainfall intensity-duration threshold values.

When predicted rainfall rates exceed defined thresholds, the early warning system is triggered to send advisories, watches, and warnings to regional emergency management personal using the NWS Advanced Weather Information Processing System. This information can then be disseminated to local residents to give warning of potential of landslide risks or evacuation requirements.

This demonstration system improves on former warning systems that were based on local precipitation tracking and were not able to trigger alerts with sufficient lead time for evacuation.

For more information regarding the demonstration early warning system and participating Southern California counties, visit the program web page: https://landslides.usgs.gov/hazards/warningsys.php.

The following links provide information on early warning progress for the NOAA-USGS Flash Flood and Debris Flow Early Warning System: http://www.wrh.noaa.gov/lox/main.php?suite=hydrology&page=debris-flow_project and https://pubs.usgs.gov/fs/2005/3104/.

Best Practices Highlight 6.H: Devil's Slide Tunnel Project

Devil's Slide, located on the coast of California between the cities of Pacifica and Montara, is described by the California Department of Transportation (Caltrans) as "an unstable ocean-facing cliff highly prone to rock falls and slippage."[138] Since original construction of State Route 1 across the steep, geologically unstable cliff in the 1930s, ongoing landslides have caused safety problems as well as closures along this stretch of highway. Starting with a major landslide event in 1940 that destroyed much of the road, intermittent landslides occurring during winter storms have resulted in an ongoing periodic cycle of costly reconstruction and destruction.

In the late 1950s, a possible highway bypass route to Devil's Slide was identified but opposed by concerned groups due to potential environmental impacts. In the 1990s, a tunnel alternative was determined to be reasonable and feasible, leading to voter approval of the Devil's Slide Tunnel Initiative (Measure T) in 1996. This initiative amended the Local Coastal Plan to include the tunnel project as the only feasible highway bypass option for State Route 1 at Devil's Slide. Following completion of the environmental review process, ground breaking for construction of the tunnels occurred on May 6, 2005.

Boring of the tunnels started in September 2007 and was completed in 2011. The tunnel project consists of the following elements: 1) new realignment along State Route 1, 2) two parallel 4,000-foot-long tunnels, 3) two parallel 1,000-foot-long bridges at the north portal approach, 4) an operations and maintenance center south of the tunnels, and 5) public access features for hikers and bicyclists. As part of the project, Caltrans has handed over control of the bypassed portion of the road and 70 nearby acres to San Mateo County for use as a public park.

The tunnels, officially named the Tom Lantos Tunnels after late congressman Tom Lantos, opened to traffic in March 2013. The tunnels are the first to open in California in almost 50 years. By creating a bypass around the geologically unstable slide area, the tunnel project has mitigated safety problems and avoided costly future repairs and the risk of permanent failure of the State Route 1 roadway. More information about the tunnel project can be found at: http://www.dot.ca.gov/dist4/dslide/

Devil's Slide Tunnel Project Schematic by CalTrans



Source: California Department of Transportation website: http://www.dot.ca.gov/dist4/dslide/

[138] Devil's Slide Fact Sheet, California Department of Transportation

6.3 VOLCANO HAZARDS, VULNERABILITY, AND RISK ASSESSMENT

"California is the most geologically diverse state in the nation. We are known for our earthquakes, landslides, and flood hazards. But a nearly forgotten hazard is our volcanoes" John Parrish, State Geologist of California, February 9, 2012

Many of California's young volcanoes pose a threat to people and property. Volcanic eruptions occur in the state about as frequently as the largest San Andreas Fault Zone earthquakes; at least ten eruptions have occurred in California in the last 1,000 years and the likelihood of renewed volcanism in the state is on the order of 1 in a few 100 to 1 in a few thousand annually. A new effort to identify, prepare for, and mitigate volcanic hazards within California is underway. The California Governor's Office of Emergency Services (Cal OES), the United States Geological Survey California Volcano Observatory (USGS CalVO), and the California Geological Survey (CGS) are working in partnership to produce the first statewide assessment of California's exposure and vulnerability to future volcanic hazards.

6.3.1 IDENTIFYING AND PROFILING VOLCANO HAZARDS

A national report on volcanic threat published by the USGS in 2005 lists 15 young and potentially hazardous volcanic areas in California.[139] Volcanic threat rankings are derived from a combination of factors including age of the volcano, potential hazards (the destructive natural phenomena produced by a volcano), exposure (people and property at risk from the hazards), and current level of monitoring (real-time sensors in place to detect volcanic unrest). Threat rankings are periodically re-evaluated, and revised if necessary, as ongoing research provides new information on potential hazards or societal exposure.

As shown in Map 6.CC, California's Very High, High, and Moderate threat volcanoes include Medicine Lake Volcano, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Ubehebe Craters, Coso Volcanic Field and Salton Buttes. Seven other young volcanoes in California with lower threat ranking are identified in the 2005 report, including Brushy Butte, Twin Buttes, Tumble Buttes, and Silver Lake Volcanic Field, Eagle Lake Volcanic Field, Golden Trout Creek Volcanic Field, and Lavic Lake Volcanic Field.

Types of Volcano Hazards

A variety of hazard types accompany volcanic eruptions, as shown in Figure 6.C. *Explosive volcanic eruptions* blast lava fragments (*tephra)* and gas into the air with tremendous force from the volcanic *ven*t. The finest particles, called *volcanic ash*, billow upward, forming an eruption column that can attain stratospheric heights in minutes. Simultaneously, searing volcanic gas laden with ash and coarse chunks of *lava* may sweep down the flanks of the volcano as a *pyroclastic flow*, and *ballistics*, chunks of solid rock or partially molten lava, may come crashing down around the vent. Ash in the eruption cloud, carried by the prevailing winds, may remain suspended for hundreds of miles before settling to the ground.

During less energetic *effusive eruptions*, hot, fluid lava may gush out of the volcano as lava flows that can cover many miles in a single day. Alternatively, a sluggish plug of cooler, partially solidified lava may slowly push up through a crack during an effusive eruption, creating a *lava dome*. A growing lava dome may become so steep that it collapses, explosively releasing pyroclastic flows potentially as hazardous as those produced during explosive eruptions.

[139] http://pubs.usgs.gov/of/2005/1164/

Map 6.CC: Potentially Hazardous Volcanoes of California



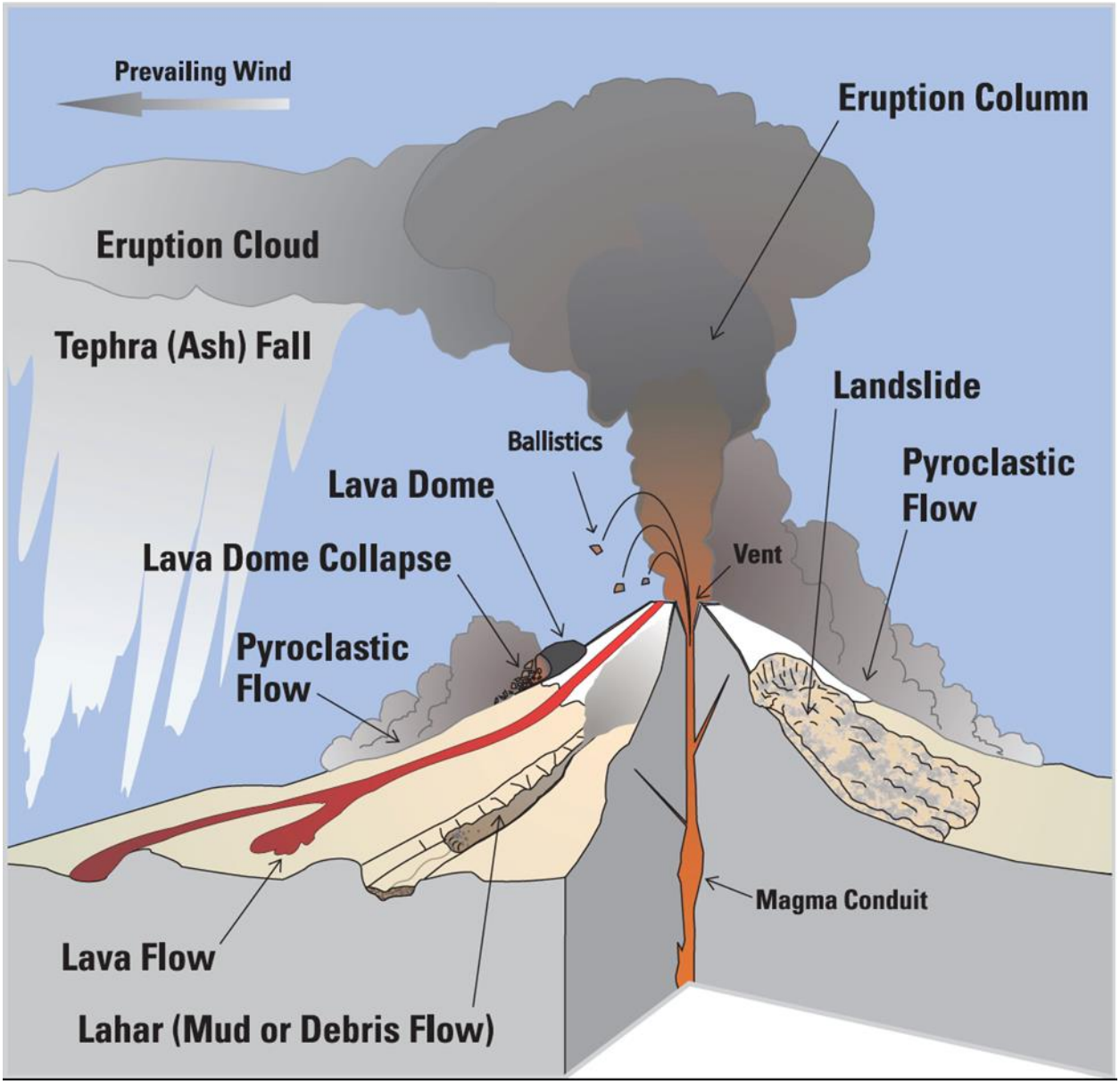
Source: U.S. Geologic Survey, Cal OES

Map 6.CC depicts California's young Low, Moderate, High, and Very High Threat volcanoes. See: https://pubs.usgs.gov/fs/2014/3120/downloads/fs2014-3120.pdf.

During and after an explosive or effusive eruption, loose volcanic debris on the flanks of the volcano can be mobilized by heavy rainfall or melting snow and ice, forming powerful floods of mud and rock (*lahars*) resembling rivers of wet concrete. These can rush down valleys and stream channels, destroying roads and bridges and carrying away entire buildings. Flooding can also occur due to melting of ice and snow by volcanic heat or by diversion of streams blocked by volcanic debris.

Low-energy effusive eruptions are destructive, but generally not life threatening. High-energy explosive eruptions are both destructive and life threatening. Volcanic areas can be hazardous even when the volcano is not erupting, with unstable ground, noxious gas emissions, intense heat, and steaming ground.

Figure 6.C: Volcano Hazard Components



Source: U.S. Geological Survey, Cal OES

Figure 6.C depicts the range of volcanic hazards that could accompany the next eruption in California. It is unlikely, however, that a single eruption would produce all hazards depicted. See: https://pubs.usgs.gov/fs/fs002-97/.

Eruption hazards are most severe within a few miles of the vent with life-threatening and/or highly destructive phenomenon evolving rapidly, often within seconds to minutes, leaving little time to mount evasive actions. Generally, hazard severity declines and the time available to issue warnings increases as distance from the vent increases.

Timely warnings reduce the risk of fatalities, but depending on hazard type, destruction and/or societal disruption can extend many tens of miles from the volcano. In addition, some hazards endure well beyond the timescale of the eruption. Post eruption hazards—rain remobilized lahars, re-suspended ash, and seeping volcanic gas—may disrupt human activities or cause annoyances for years, even decades after an eruption has stopped.

Table 6.L outlines the potential impact of particular types of hazards associated with California volcanoes.

Table 6.L: Characteristics and Potential Impacts of California Volcanic Hazards

Hazard Profile	Characteristics	Impact
Pyroclastic Flow	Sudden eruption of hot (400-1300°F), gas-pressurized flows of ash and lava fragments that rush outward from the volcano with great force at ground speeds greater than 50 miles per hour (mph). Pyroclastic flows typically follow valleys but can overtop ridges and travel 30 miles or more from the volcano.	Pyroclastic flows travel much too fast for people to outrun, and are thus a main cause of eruption-related fatalities. Flows knock down, shatter, bury, or carry away nearly all objects and structures. Extreme temperatures burn forests, crops, buildings, furnishings, and vehicles.
Lava Flow	Gradual inundation by lava from sustained low-level eruptions moving at speeds of less than 30 mph. Lava may pile up near the vent in thick mounds (lava dome), or move across the landscape for many kilometers as fluid rivers of molten rock.	Everything in the path of slow speed lava flows will be knocked down, buried, or burned. The flows generally travel slowly enough that people, possessions, and transportable infrastructure can be moved out of the way. The flows often ignite wildfires, and areas inundated by flows can be buried by 10 feet or more of hardened rock, making it impossible to rebuild or repair structures.
Lahars	Slurry-like floods of volcanic ash, rock, and water that look like wet concrete. Debris flows gain momentum during travel by eroding and entraining soil and loose rock debris from channels. Large debris flows may carry boulders 30 feet across and travel through valleys and stream channels at speeds of 20 to 40 mph. Debris flows can be hot, with temperatures close to boiling. They occur during an eruption due to melting snow or ice, or after an eruption due to re-mobilization of loose volcanic deposits during intense rainfall.	Most debris flows travel much too fast for people to outrun, and are thus a main cause of eruption-related fatalities. Debris flows can destroy buildings and bridges, and bury vast areas with deposits of mud and rock up to 160 feet thick as far as 65 miles from the volcano.

Hazard Profile	Characteristics	Impact
Ash Fall	Fine fragments of lava, sand size and smaller, deposited from drifting ash clouds. Impact zone may be many tens to a few hundreds of miles from the volcano.	Although generally non-lethal, fine ash fall is the most widespread and disruptive volcanic hazard. People exposed to fine ash commonly experience various eye, nose, and throat symptoms. Short-term exposures are not known to pose a significant health hazard. Long-term health effects have not been demonstrated conclusively. Ash deposited downwind of the volcano covers everything like a snowfall, but also infiltrates cracks and openings in machinery, buildings, and electronics. Falling ash can obscure sunlight, reducing visibility to zero. When wet, it can make paved surfaces slippery and impassable. Fine ash is abrasive, damaging surfaces and moving parts of machinery, vehicles, and aircraft. Life-threatening and costly damage can occur to aircraft that fly through fine ash clouds. Newly fallen volcanic ash may result in short-term physical and chemical changes in water quality. Close to the volcano, heavy ash fall may cause roofs to collapse, waste water systems to clog, and power systems to shut down. In agricultural areas, fine ash can damage crops, and sicken livestock. Re-suspension of ash by human activity and wind cause continuing disruption to daily life.
Ballistics	Ballistic ejection of coarse, hot fragments of lava from the volcanic vent. Impact zones are usually constrained to the flanks of the volcano. Fragments are usually softball size or smaller.	The impact of coarse air fall is limited to the immediate area of the volcanic vent. Structures may be damaged by accumulation of falling lava fragments or burnt by their high heat. Wildfires may be ignited.
Floods	Sudden melting of snow/ice by volcanic heat, and/or diversion of water by blocked drainages or breached embankments.	Impacts are similar those of non-volcanic floods, but the onset is usually sudden.

Source: Cal OES Earthquake, Tsunami, and Volcano

Past Eruptions and Present Day Volcanic Unrest

The most recent eruption in California occurred at Lassen Peak in Lassen Volcanic National Park about 100 years ago, from 1914 to 1917. Geophysical and geochemical monitoring conducted by the USGS CalVO reveals the presence of magma (molten rock) beneath seven of the eight California volcanoes ranked as Moderate, High, or Very High Threat. Low levels of volcanic seismicity, emissions of noxious volcanic gas, and/or ground deformation characterize the present status of Medicine Lake, Mount Shasta, Lassen Volcanic Center, Clear Lake Volcanic Field, Long Valley Volcanic Region, Coso Volcanic Field, and Salton Buttes.

Volcanic Activity in California's Past and Future: The Lassen Peak Example

Volcanic Profile: Lassen Volcanic Center (LVC) lies in Lassen Volcanic National Park about 55 miles east of the town of Redding. The park draws over 350,000 visitors each year with the spectacular volcanic landscapes created by the hundreds of eruptions occurring over its 825,000-year lifespan.

The last 25,000 years at LVC have been relatively quiet with three notable exceptions: the Chaos Crags eruption (1,100 years ago), the eruption of Cinder Cone (345 years ago), and the Lassen Peak eruption (1914 to 1917). The most recent eruption was confined to sporadic steam blasts until May 1915, when partially molten rock oozing from the Lassen Peak vent began building a precarious lava dome. The dome collapsed on May 19 of that year, sending a hot pyroclastic flow racing down the north flank of the volcano.

1915 Eruption of Lassen Peak as Seen from Red Bluff



Photo by R.E. Stinson courtesy of the National Park Service

Three days later, a vertical column of fine ash exploded from the vent reaching altitudes of 30,000 feet. A snapshot of the ash column taken from the town of Red Bluff some 40 miles west of the volcano is shown above (R.E. Stinson, courtesy of the National Park Service). Fine ash particles from the top of the column drifted downwind 200 miles to the east, as far as Winnemucca, Nevada. On both days, melting snow fueled lahars, flooding drainages 20 to 30 miles away.

Volcano Monitoring: Geophysical and geochemical studies show that a residual reservoir of partially crystallized magma is slowly cooling under the Lassen Volcanic Center. Heat from this reservoir emanates upward, driving a geothermal system at shallow depths, and, at the surface, the hot springs, steam vents, and boiling mud pots that attract park visitors.

Although the annual probability of renewed volcanism is small presently (about 1 chance in 7,150), LVC is still "alive" and future eruptions are inevitable. For this reason, a United States Geological Survey California Volcano Observatory (USGS CalVO) monitoring network of six seismometers and seven continuously recording Global

Positioning System (GPS) receivers is located within 10 miles of Lassen Peak. These sensors continuously transmit earthquake and ground deformation data to observatory scientists, and periodic geochemical and thermal surveys of volcanic gas vents and hot springs are ongoing.

Combined, earthquake, ground deformation, and gas sensors provide the data scientists need to recognize escalating unrest at LVC in time to warn civil authorities and the public before an eruption occurs. See https://pubs.usgs.gov/sir/2012/5176/a/index.html.

Future eruptions in California are inevitable, but fortunately, eruptions, unlike other natural hazards such as earthquakes or wildfires, are usually preceded by weeks to months of volcanic unrest manifesting as ground deformation, earthquakes, and/or gas emissions. By monitoring escalating unrest over days, weeks, or months, scientists can produce timely warnings of the impending hazards. Eruptions and continuing volcanic unrest can last longer than other types of natural disaster events taxing emergency response and recovery efforts.

Chart 6.B: Schematic Comparison of Natural Hazard Timelines

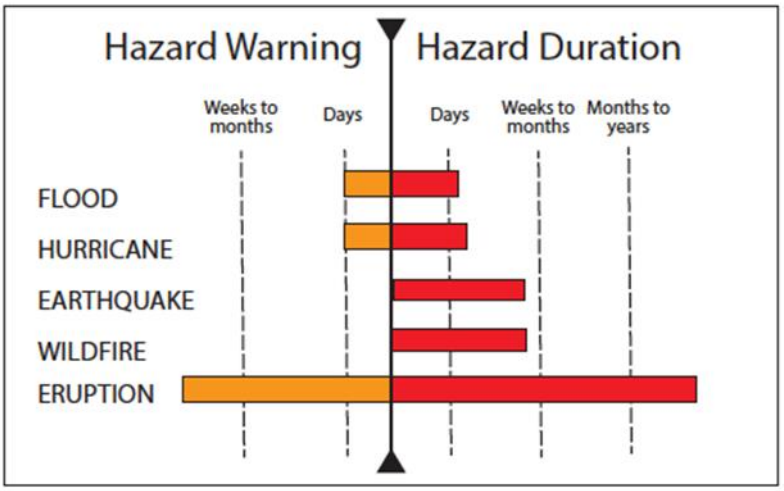


Chart 6.B compares the warning time and duration of various types of natural disasters. Volcanic eruptions are unique in having several days to months of precursory activity, but once initiated, the eruptive activity can persist months, even years before the all clear can be sounded.

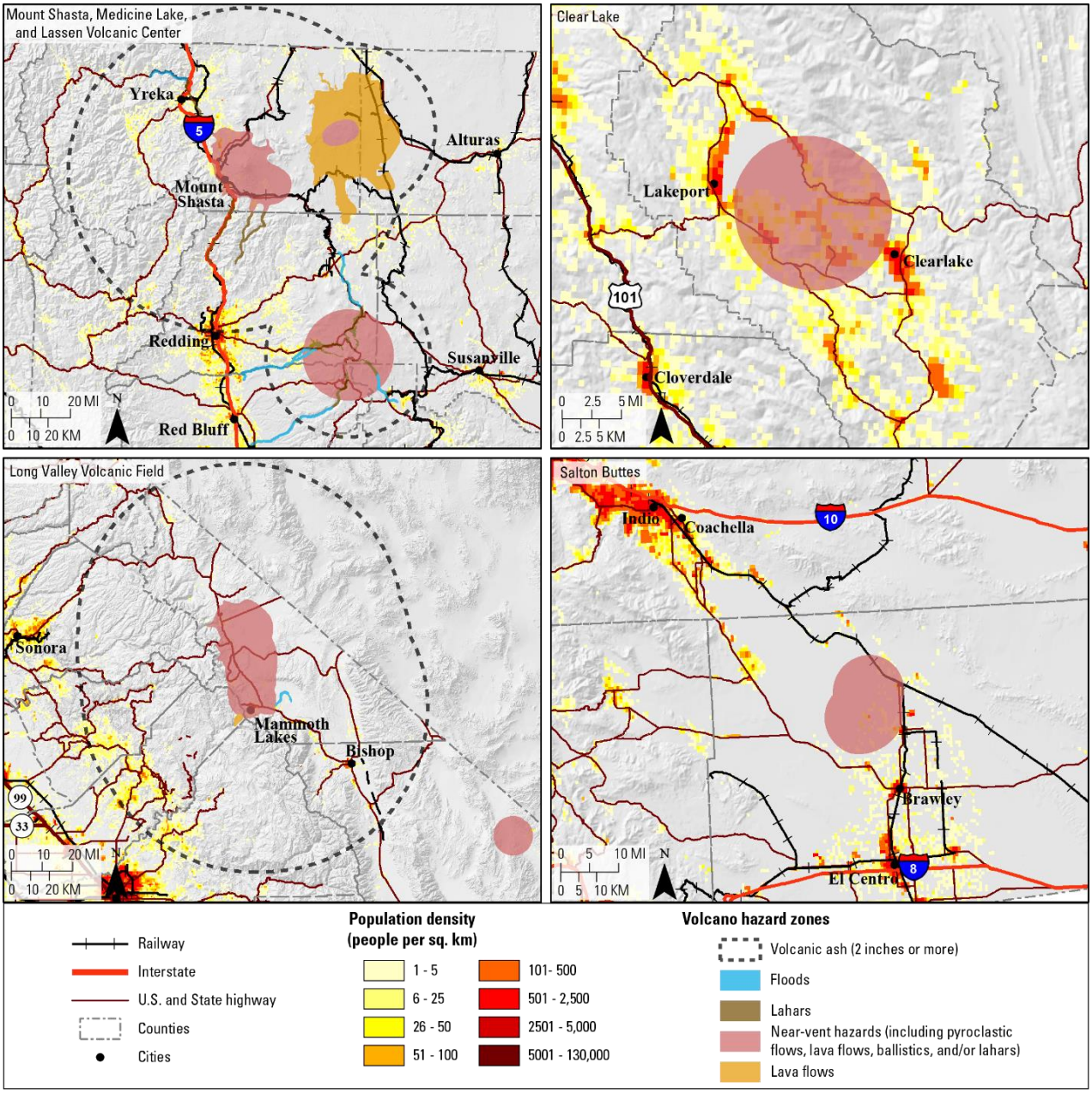
6.3.2 ASSESSMENT OF VOLCANO VULNERABILITY AND POTENTIAL LOSSES

Volcanic Hazard Zone Mapping

Geologists produce volcanic hazard zone maps to convey the types of hazards that may occur during a future eruption and to constrain the nature and area of impact. The type and severity of adverse impact depend on the eruption style (effusive or explosive), the volume of lava erupted, the location of the eruptive vent, the eruption duration, and local topography and hydrology.

Volcanic hazard zone maps are dynamic—as geologic research progresses, maps of vulnerable areas are updated and new maps are created. The USGS CalVO has published volcanic hazard zone maps for some, but not all, of California's Moderate, High, and Very High Threat volcanoes. Map 6.DD shows a simplified compilation of California's volcanic hazard zones. Significant field research is needed to augment hazard zone maps that are incomplete (Clear Lake Volcanic Field, Ubehebe Craters, and Salton Buttes) or non-existent (Coso Volcanic Field).

Map 6.DD: California Volcano Hazard Zones



Source: U.S. Geological Survey

Map 6.DD shows simplified hazard zones for California's most threatening volcanoes. The map is modified from the USGS reports available on the web at https://pubs.usgs.gov/bul/1847/, https://pubs.usgs.gov/sir/2012/5176/a/index.html, and https://pubs.usgs.gov/sir/2007/5174/a/sir2007-5174a_text.pdf

Map 6.EE shows state and county jurisdictions likely to be directly affected by a future eruption in California. The current zonation maps enclose 25,288 square miles, encompassing parts of 17 counties, all Cal OES Administrative Regions, and all but one of the State Mutual Aid Regions. About 62 percent of the land within hazard zones is privately owned; 36 percent is public land managed by the federal government; and state, city, tribal, and special districts collectively comprise 2 percent of the total.

Map 6.EE: Counties, Cal OES Administrative Regions, and Mutual Aid Administrative Regions Encompassed within Volcano Hazard Zones



Source: U.S. Geological Survey

Table 6.M shows a partial listing of vulnerable populations and Table 6.N shows a partial list of lifelines located within some of the volcanic hazard zones.

Table 6.M: Jurisdictions, Populations in Volcano Hazard Zones

Volcano	Counties within Hazard Zone	Cal OES Administrative Region	State Mutual Aid Region	Federal/State Management[1]	Daily Popaulation[2]
Medicine Lake	Modoc, Siskiyou, Shasta	Inland	III	USFS; NPS; BLM; USFW; CDPR	1,000
Mount Shasta	Siskiyou, Shasta	Inland	III	USFS; NPS; BLM; CDPR	100,000
Lassen Volcanic Center	Shasta, Lassen, Tehama, Plumas	Inland	III	USFS; NPS; BLM; CDPR	10,000
Clear Lake Volcanic Field	Lake	Coastal	II	CDPR	18,000
Long Valley Volcanic Region	Mono, Inyo, Tuolumne, Mariposa, Madera, Fresno	Inland	IV, V, VI	USFS; NPS; CDPR	63,000
Ubehebe Craters	Inyo	Inland	VI	NPS	0
Coso Volcanic Zone	Inyo	Inland	VI	DOD; BLM	not available
Salton Buttes	Imperial	Southern	VI	BLM; USFW	2,000

Source: California Governor's Office of Emergency Services (Cal OES), Earthquake, Tsunami, and Volcano Program

[1]Abbreviations: NPS National Park Service; USFS United States Forest Service; BLM United States Bureau of Land Management; USFW United States Fish and Wildlife Service; DOD United States Department of Defense; CDPR California Department of Parks and Recreation.

[2]Daily population from ORNL LandScan™ 2012 model rounded to the nearest 1,000. These data do not include intermittent populations visiting recreational areas within, or partially within, volcanic hazard zones, which include nine state parks, eight national forests, and six national parks. Usage statistics suggest over 20 million people visit these sites annually.

Table 6.N: Lifelines Located in Volcano Hazard Zones

Lifeline Utilities (water, power, transportation)
• Important hydroelectric power plants are located within ash fall hazard zones, including the Shasta Dam and Pit River facilities in Northern California.
• High voltage DC and AC transmission lines bringing power to California from hydroelectric plants in the Pacific Northwest pass through volcanic hazard zones.
• California's geothermal power plants are within or adjacent to volcano hazard zones, including the Geysers, Casa Diablo, Coso, and Salton Sea facilities.
• Interstate natural gas pipelines entering the state from the Malin Hub (OR) pass through the overlapping Shasta-Lassen-Medicine Lake hazard zones. This system supports residential customers and businesses from north of Redding to south of Bakersfield.
• Three key water projects in the State, the Central Valley Project, San Francisco's Hetch Hetchy Project, and the Los Angeles Aqueduct, have substantial assets in volcanic hazard zones.
• Over 2,500 miles of Interstate and state roads are in volcanic hazard zones, including a stretch of Interstate 5 in northern California over which tens of millions of vehicles travel annually.

Source: California Governor's Office of Emergency Services (Cal OES), Earthquake, Tsunami, and Volcano Program

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

6.3.3 CURRENT VOLCANO HAZARD MITIGATION EFFORTS

Overview

Robust volcano monitoring networks and effective warning schemes are essential to saving lives and reducing property losses. The USGS California Volcano Observatory headquartered in Menlo Park, California obtains and interprets data from real-time monitoring sensors installed on California's Very High, High, and Moderate Threat volcanoes, although network coverage is minimal at some locations. See monitoring capabilities and data at: http://volcanoes.usgs.gov/observatories/calvo/.

The sensor networks automatically and continually relay data to CalVO scientists for interpretation. Information is communicated to emergency response agencies and the public using alert level schemes for ground-based and airborne hazards (Tables 6.O and 6.P). A no-cost, email-based Volcano Notification Service (VNS) is available to agencies, businesses, and the public by registering online at: http://volcanoes.usgs.gov/vns/help.php.

VNS sends volcano status updates to subscribers, including notification of alert level changes, details of volcanic unrest, and eruption information. Figure 6.D illustrates the flow of information from monitoring networks to civil authorities and other stakeholders.

Table 6.O: Ground-Based Volcanic Hazard Alert Levels

Volcano Alert Levels Used by USGS Volcano Observatories

Alert Levels are intended to inform people on the ground about a volcano's status and are issued in conjunction with the Aviation Color Code. Notifications are issued for both increasing and decreasing volcanic activity and are accompanied by text with details (as known) about the nature of the unrest or eruption and about potential or current hazards and likely outcomes.

Term	Description
NORMAL	Volcano is in typical background, noneruptive state or, *after a change from a higher level,* volcanic activity has ceased and volcano has returned to noneruptive background state.
ADVISORY	Volcano is exhibiting signs of elevated unrest above known background level or, *after a change from a higher level,* volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
WATCH	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, **OR** eruption is underway but poses limited hazards.
WARNING	Hazardous eruption is imminent, underway, or suspected.

Table 6.P: Airborne Volcanic Hazards Alert Levels

Aviation Color Code Used by USGS Volcano Observatories

Color codes, which are in accordance with recommended International Civil Aviation Organization (ICAO) procedures, are intended to inform the aviation sector about a volcano's status and are issued in conjunction with an Alert Level. Notifications are issued for both increasing and decreasing volcanic activity and are accompanied by text with details (as known) about the nature of the unrest or eruption, especially in regard to ash-plume information and likely outcomes.

Color	Description
GREEN	Volcano is in typical background, noneruptive state or, *after a change from a higher level,* volcanic activity has ceased and volcano has returned to noneruptive background state.
YELLOW	Volcano is exhibiting signs of elevated unrest above known background level or, *after a change from a higher level,* volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
ORANGE	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, **OR** eruption is underway with no or minor volcanic-ash emissions [ash-plume height specified, if possible].
RED	Eruption is imminent with significant emission of volcanic ash into the atmosphere likely **OR** eruption is underway or suspected with significant emission of volcanic ash into the atmosphere [ash-plume height specified, if possible].

Volcano Hazard Vulnerability Assessment

Effective volcano monitoring, alerting, and pre-disaster planning are essential to reducing loss of life and property, but long-term mitigation efforts require knowledge of the proximity of people and assets to hazardous volcanoes. In California, identifying what and who is in harm's way is the critical next step in mitigation enhancement.

In cooperation with the California Geological Survey (CGS), and support from State of California Governor's Office of Emergency Services (Cal OES), the U.S. Geological Survey (USGS) California Volcano Observatory is working to provide broad perspective on the state's exposure and vulnerability to volcanic hazards by integrating existing volcanic hazard zones with geospatial data on at-risk populations, infrastructure, and resources.

The analysis, which is under review by state and federal stakeholders in 2018, focuses on five themes: 1) land cover, ownership, and jurisdictions; 2) ambient and intermittent populations; 3) lifeline utilities; 4) agriculture and forestry; and 5) community services and emergency facilities. This statewide information will form the basic framework needed to lead site- and vector-specific mitigation efforts. The report is to be published at the end of 2018 and will be available on the USGS and CGS websites.

Figure 6.D: Hazard Information Flow from USGS Monitoring Networks to Civil Authorities and Stakeholders

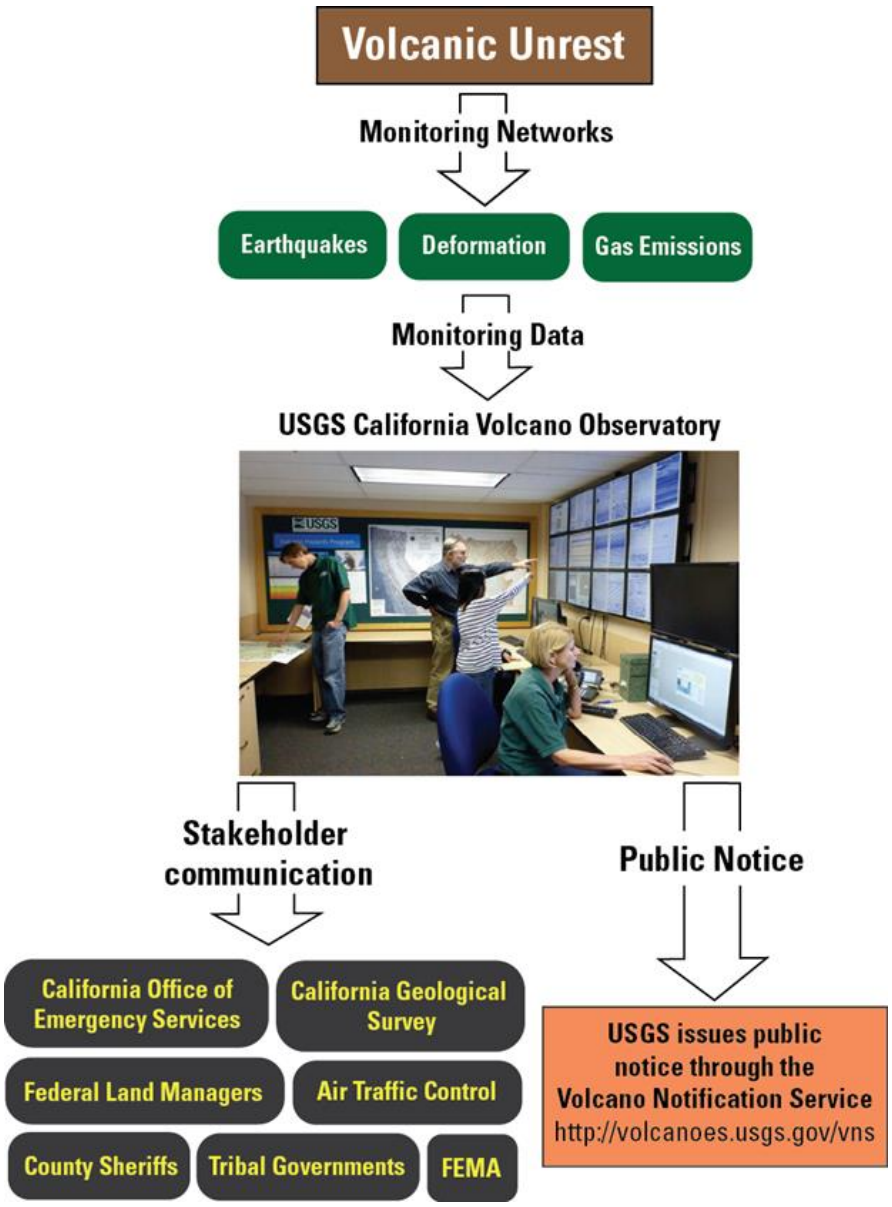


Figure 6.D shows how information flows from monitoring networks to observatory staff, where it is interpreted for stakeholder and public mitigation, planning, and response activities.

6.3.4 ADDITIONAL VOLCANO HAZARD MITIGATION OPPORTUNITIES

Providing a statewide analysis of California's exposure to volcanic hazards through the state volcano vulnerability assessment due to be completed in 2018 will prompt follow-up site- and sector-specific vulnerability analyses that will lead to greater awareness of the threat and improved hazard mitigation and response protocols.

CHAPTER 7 – FLOOD HAZARDS: RISKS AND MITIGATION

CHAPTER CONTENT

7.1 Riverine, Stream, and Alluvial Flood Hazards, Vulnerability and Risk Assessment
- 7.1.1 Identifying Riverine, Stream, and Alluvial Flood Hazards
- 7.1.2 Profiling Riverine, Stream, and Alluvial Flood Hazards
- 7.1.3 Assessment of State Flood Vulnerability and Potential Losses
- 7.1.4 Assessment of Local Flood Vulnerability and Potential Losses
- 7.1.5 Current Riverine, Stream, and Alluvial Flood Hazard Mitigation Efforts
- 7.1.6 Additional Flood Hazard Mitigation Opportunities

7.2 Sea-Level Rise, Coastal Flooding, and Erosion Hazards, Vulnerability and Risk Assessment
- 7.2.1 Identifying Sea-Level Rise, Coastal Flooding, and Erosion Hazards
- 7.2.2 Profiling Sea-Level Rise, Coastal Flooding, and Erosion Hazards
- 7.2.3 Assessment of Sea-Level Rise, Coastal Flooding, and Erosion Vulnerability and Potential Losses
- 7.2.4 Current Sea-Level Rise, Coastal Flooding, and Erosion Hazard Mitigation Efforts

7.3 Tsunami and Seiche Hazards, Vulnerability and Risk Assessment
- 7.3.1 Identifying Tsunami and Seiche Hazards
- 7.3.2 Profiling Tsunami Hazards
- 7.3.3 Assessment of State Tsunami Vulnerability and Potential Losses
- 7.3.4 Assessment of Local Tsunami Vulnerability and Potential Losses
- 7.3.5 Current Tsunami Hazard Mitigation Efforts
- 7.3.6 Additional Tsunami Hazard Mitigation Opportunities

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- 7.5.4 Current Dam Failure Hazard Mitigation Efforts
- 7.5.5 Additional Dam Failure Hazard Mitigation Opportunities

About Chapter 7

Chapter 7 assesses hazards and risks related to flooding. Flooding is considered one of the three primary hazards in California (along with earthquake and wildfire), as explained in *Section 1.2.3* of the 2018 SHMP (see that section for a discussion of the hazard classification system and information on the criteria used for hazard risk assessments). Flood hazards discussed in this chapter include riverine, stream, and alluvial flooding and coastal flooding, erosion, and sea level rise, all of which are influenced by climate and weather. Levee and dam failure are identified as secondary hazards, because they may be triggered by primary hazard events and also by flooding and inundation resulting from tsunamis.

California's geographic diversity represents a difficult challenge to planning for flood mitigation. California has a 1,100-mile-long coastline; prominent coastal and inland mountain ranges, including the Sierra Nevada; a large riverine Central Valley; the Sacramento and San Joaquin Delta; and extensive and highly varied deserts. These geographical factors combine to create various types of floods, specifically defined in the SHMP as:

- Riverine—flooding that occurs along river and stream channels and that can range from slow-rise gradual inundation to flash floods from high velocity flows.

- Alluvial fan—flows of shallow depths and high velocities often containing sediment and rocks along uncertain flow paths on the surface and at the toes of alluvial fans.
- Coastal—inundation of locations normally above high tide, often caused by storm surge occurring with high tide and exacerbated over time with climate change-induced sea-level rise. Increased coastal erosion can also result from these conditions.
- Engineered structure failure—flooding resulting from dam or levee failure.
- Tsunami—high-speed seismic ocean waves triggered by earthquakes and underwater landslides.

For more information on the criteria and template used for hazard risk assessments and a discussion of the hazard classification system, see *Chapter 1: Introduction, Section 1.2.3*.

7.1 RIVERINE, STREAM, AND ALLUVIAL FLOOD HAZARDS, VULNERABILITY AND RISK ASSESSMENT

Floods represent the second most destructive source of hazard, vulnerability, and risk, both in terms of recent state history and the probability of future destruction at greater magnitudes than previously recorded. In addition to causing tragic loss of life, flooding in California can have a serious impact on the state's economy and environmental resources. With California representing one of the world's largest economies, a major flood here will have an unprecedented impact on the national economy as well. When California floods:

- Critical infrastructure is damaged and could be out of service for long periods
- Vital services become isolated or are closed
- Jobs are lost or put at risk when businesses are dislocated or closed
- Water supplies and water quality are affected
- Vulnerable communities are displaced and/or personal property is lost
- Natural resources and public access are damaged or eliminated.

To manage flood risk, California has a complex system of flood infrastructure consisting of approximately 20,000 miles of levees, more than 1,500 dams and reservoirs (1,250 of which are under state jurisdiction), and more than 1,000 debris basins. Federal and state facilities in the Central Valley include approximately 1,600 miles of project levees, several bypasses and appurtenant weir and control structures, seven dams, and other associated facilities.

7.1.1 IDENTIFYING RIVERINE, STREAM, AND ALLUVIAL FLOOD HAZARDS

This section addresses floods as one of three primary hazards in the classification system introduced in *Chapter 1, Section 1.2.3* and includes information identifying the following dimensions of this hazard:

- Its location within the state (i.e., geographic area affected)
- Previous occurrences within the state
- The probability of future events (i.e., chances of recurrence)

Floods represent a significant concern for the State of California for several reasons. First, California has a chronic and destructive flooding history. Second, California has widespread flooding vulnerability as indicated by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) designations, which show flood hazard zones being common in populated areas. Third, most local governments that have FEMA-approved Local Hazard Mitigation Plans (LHMPs) have identified flooding as an important hazard.

7.1.2 PROFILING RIVERINE, STREAM, AND ALLUVIAL FLOOD HAZARDS

Every county in the state experiences floods, although the nature of these events varies due to the state's diverse climatology and geography. Disparate climatological patterns present challenges to flood mitigation planning in California. These patterns include:

- El Niño conditions
- La Niña conditions
- Desert monsoons
- Northwest coastal conditions
- Tropical storms
- Gulf of Alaska storms
- Atmospheric river patterns

Flooding, erosion, and debris flows can also occur in California in the months and years following large hot fires. High severity wildfires greatly reduce the amount of vegetation, which can reduce the amount of rainwater absorption, allowing excessive water runoff that often includes large amounts of debris. Structures located anywhere near a severe burn area are susceptible to flooding. Periods of high-intensity rainfall are of particular concern, but post-fire flooding can also occur during a normal rainy season. For more information, see: https://www.water.ca.gov/LegacyFiles/sfmp/resources/Computer_View_Highlight.pdf.

Hydrologic Regions

California's ten hydrologic regions present disparate flood mitigation planning challenges. The following is a brief description of the ten regions, shown in Map 7.A.

North Coast Hydrologic Region

The North Coast hydrologic region runs along the Pacific Coast from the California-Oregon border to the mouth of the Russian River. This region is sparsely populated, with the majority of settlement in the Humboldt Bay area. The area receives larger rain totals than any other region and has historically experienced some of the state's most spectacular and devastating flood events. Tsunamis also pose a very real threat, particularly to the community of Crescent City in Del Norte County.

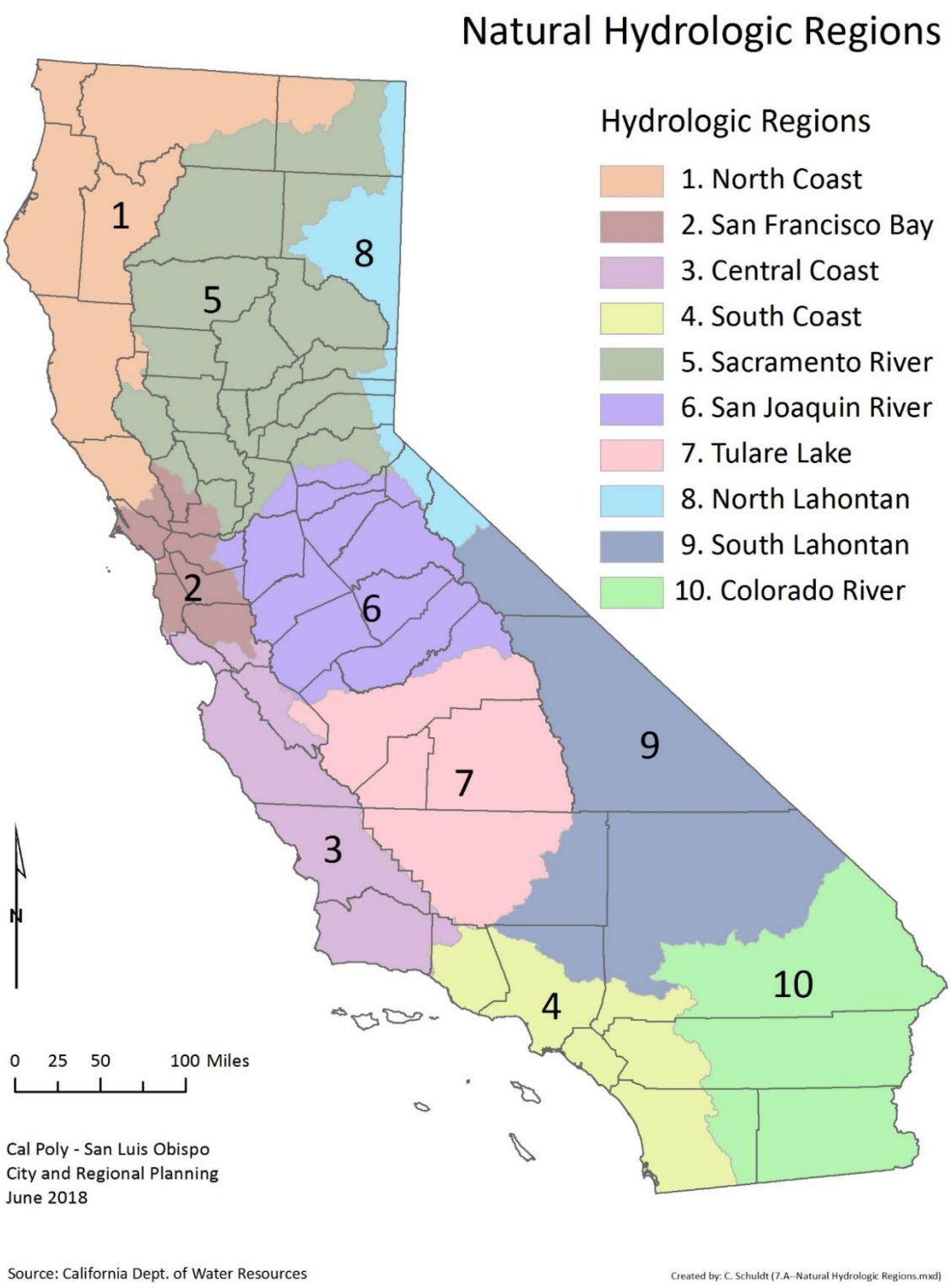
San Francisco Bay Hydrologic Region

The San Francisco Bay hydrologic region runs along the north central coast and encompasses most of the Bay Area counties. It reaches to just north of Ukiah in Mendocino County, south to the Coyote Creek watershed in Santa Clara County, and inland to just east of the Sacramento-San Joaquin Delta. The area around San Francisco Bay is heavily populated, and the entire region is marked by hills, river valleys such as those along the Russian River, and marshlands. The region is most vulnerable to classic stream flooding, landslides, and some urban flooding. Flooding along the coastal and bay shorelines can be severe when winter storms coincide with high tides. Sonoma County, most of which is located in this region, records the most National Flood Insurance Program (NFIP) repetitive losses of any area in California.

Central Coast Hydrologic Region

The Central Coast hydrologic region reaches from Año Nuevo Point in San Mateo County down the Pacific Coast to near the crest of the coast range in Santa Barbara County. The region is mountainous with very narrow strips of flat coastal plain. Generally, the mountain streams and rivers in this area run directly into the Pacific Ocean and lack significant delta areas. This region includes major agricultural areas and urban centers and is characterized by stream flooding and slides. This region is also at risk from tsunamis.

Map 7.A: Hydrologic Regions



South Coast Hydrologic Region

The South Coast hydrologic region extends north from the U.S.-Mexico border to the Tehachapi, San Bernardino, San Gabriel, and San Jacinto mountains. Nearly one-third of the area is coastal plain. This region contains major urban centers, including the counties of Los Angeles, Orange, and San Diego. Much of the flooding is sudden and severe, resulting in massive slides, debris flows, and mudflows. Typical of the flooding that occurs in this area are the 1969 winter storms that killed 47 people and resulted in $300 million in property damage. During these storms, an alluvial flood and debris flow on Deer Creek in San Bernardino County killed 11 people.

Sacramento River Hydrologic Region

The Sacramento River hydrologic region includes the northern half of the Central Valley. The Sacramento River drains through the Sacramento-San Joaquin Delta. The region is bounded by the Sierra-Nevada Mountains, Coast Range, Cascade Range, and Trinity Mountains. This is a major agricultural area, with the Sacramento metropolitan area comprising the largest concentration of population. Flooding in this region is predominantly caused by runoff from either major winter storm events or snowmelt. While massive dams and levee systems have significantly reduced this region's historic flood problems, residual risk remains a significant problem, especially for urbanizing areas within deep floodplains. The region is also vulnerable to flooding along small streams due to levee failures and in urban drain areas dependent upon pumping stations. This region includes portions of the Sacramento-San Joaquin Delta, which is vulnerable to levee failure (see *Section 7.4*).

San Joaquin River Hydrologic Region

The San Joaquin River hydrologic region encompasses the middle portion of the Central Valley. It is bounded by the Sierra Nevada Mountains and Coast Range and includes the Cosumnes, San Joaquin, and Kings River watersheds. The region also includes portions of the Sacramento-San Joaquin Delta. Although predominantly agricultural, this region has experienced increased urbanization in recent years and is subject to flooding from winter storm events and snowmelt. While many urban areas are protected by dams and levees, residual risk is significant, especially for urbanizing areas in deep floodplains.

Tulare Lake Hydrologic Region

The Tulare Lake hydrologic region comprises the extreme southern portion of the Central Valley. It bounded by the Sierra Nevada Mountains and the divide between the San Joaquin and Kings Rivers, the Coast Range, and the Tehachapi Mountains. The Kaweah, Tule, Kern, and Kings Rivers drain into the Tulare Lakebed. Through the late 1800s, Tulare Lake was of substantial size during wet periods, although its level fluctuated. A number of small reclamation districts were established in the area in the early 1900s and, over the years, built levees and reclaimed the more-than-200,000-acre lakebed for agriculture. Though now predominantly agricultural, this region contains the urban centers of Fresno, Bakersfield, Visalia, and Hanford. It is subject to flooding from winter storms and snow runoff.

North Lahontan Hydrologic Region

The North Lahontan hydrologic region lies in the extreme northeast portion of the state. It is bounded by the Sierra Nevada, Cascade, and Warner mountain ranges on the west and the Nevada border on the east and runs south to Bridgeport in Mono County. Lake Tahoe is located in the center of the region. All streams in the region terminate in lakes or playas because they have no outlet to the ocean. This region is sparsely settled with the exceptions of the communities around Lake Tahoe and in the City of Susanville. The region experiences flooding from winter rainstorms, snowmelt, and intense late spring and early fall thunderstorms.

South Lahontan Hydrologic Region

The South Lahontan hydrologic region is nestled between the Sierra Nevada, San Bernardino, and San Gabriel Mountains, the Nevada state line, Mono Lake Valley, and the northern Colorado Desert. Despite its generally dry conditions, this sparsely populated region experiences periodic winter storms and thunderstorms that often result in flash floods. Under storm conditions, the region's generally dry stream systems pose a significant threat. The Mojave River runs through three growing San Bernardino County communities: Hesperia, Victorville, and Barstow.

The desert community of Hesperia is located at the base of an alluvial fan that forms the headwaters for the Mojave River. This area experiences significant flood damage during both winter storms and summer monsoon events.

Colorado River Hydrologic Region

The dominant hydrologic features of this region are the Colorado River, which forms its eastern boundary, and the Salton Sea, which lies just shy of its western boundary. The region is marked by the San Bernardino and San Jacinto Mountains. The region is also bounded by the U.S.-Mexico border to the south and the South Lahontan region to the north. This is a mostly sparsely populated agricultural region that experiences irregular flooding. However, both common winter storm events and tropical flows from Mexico's Pacific Coast can bring massive rainstorms and flash floods. During the summer months, monsoonal flows come up over the mainland of Mexico.

Past Flood Disasters

From 1992 to February 2018, California has had 34 state-proclaimed flood emergencies and 15 federally declared flood disasters.

As shown in Table 7.A, since 1992, every county in California has been declared a federal disaster area at least once for a flooding event. The information in Table 7.A extends back to 1992 because that is the year that the California Governor's Office of Emergency Services (Cal OES) began tracking disaster recovery history information. The 1992 flood was the first federally declared flood disaster since Stafford Act implementation began in 1988.

Table 7.A: Federally Declared Flood Disasters in California, 1992-February 2018*

Disaster Number	Date	Scope (Number of Counties)	Number of Deaths	Damage in $
935-DR-CA	February 1992	6	5	$123.2 million
979-DR-CA	January 1993	25	20	$600 million
1044-DR-CA	January 1995	45	11	$741.4 million
1046-DR-CA	February 1995	57	17	$1.1 billion
1155-DR-CA	January 1997	48	8	$1.8 billion
1203-DR-CA	February 1998	40	17	$550 million
1498-DR-CA	June 2003	2	16	--[a]
1529-DR-CA	June 2004	1	0	$57 million
1577-DR-CA	February 2005	8	24	$573.1 million
1585-DR-CA	April 2005	7	0	$198.7 million
1628-DR-CA	February 2006	40	5	$327.8 million
1646-DR-CA	June 2006	16	1	$129.5 million
1884-DR-CA	March 2010	6	0	$50.6 million
4305-DR-CA	January 2017	22	**	$20.4 million
4308-DR-CA	February 2017	43	**	$260.5 million

Source: Cal OES Origins and Development - A Chronology 1917-2010; Cal OES After Action Reports; FEMA: California Disaster History, FEMA Disaster declarations for California, http://www.fema.gov/disasters/grid/state-tribal-government/77?field_disaster_type_term_tid_1=All

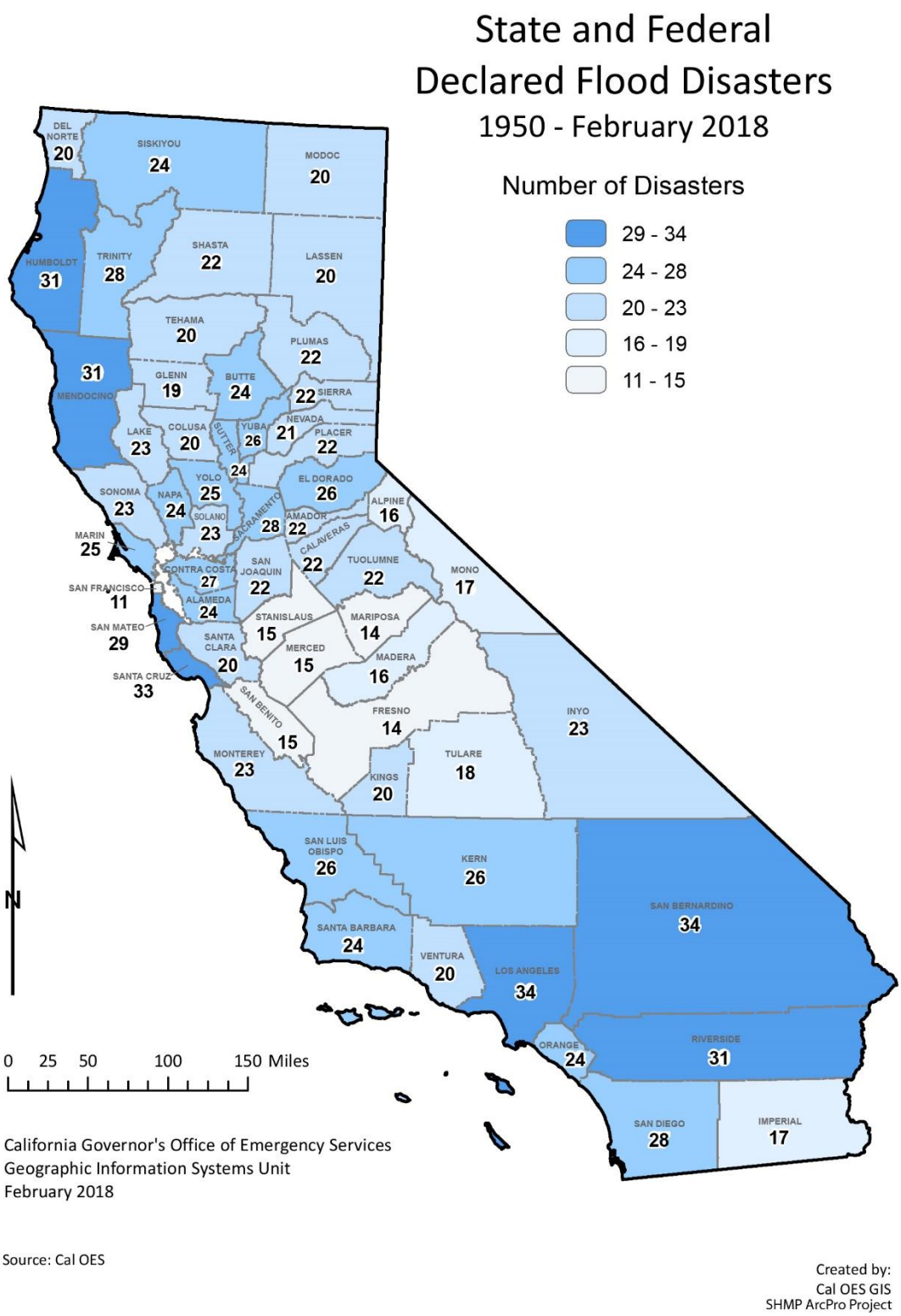
[a]DR-1428, 2003 Southern California Fires, caused the elimination of vegetation securing soils to the hillsides. In December 2003, mild flooding caused mudflows and landslides killing 16 people. The costs of the flood damages were not segregated from the fire damages.

**Disasters listed are only those designated by the Federal Emergency Management Agency (FEMA) as Flood Disasters (Storm Disasters are not included in this table).*

*** Figures pending*

Map 7.B shows the distribution of floods leading to disaster declarations from 1950 to February 2018. Some of the counties with 24 or more declared disasters during this period include Kern, Los Angeles, Riverside, San Bernardino, Orange, and San Diego in the southern portion of California; Contra Costa, Alameda, San Mateo, Marin, Napa, and Santa Cruz in the San Francisco Bay Area; Sacramento, Yolo, Sutter, El Dorado, and Yuba in the Sacramento/Sierra foothill area; and Humboldt, Trinity, Butte, and Mendocino in Northern California.

Map 7.B: State and Federal Declared Flood Disasters, 1950-February 2017



Probability of Flood Hazards

The standard references for establishing the location of flood hazards are the Flood Insurance Rate Map (FIRM) floodplains, part of a national insurance system maintained under the National Flood Insurance Program (NFIP), as described in *Chapter 1: Introduction, Section 1.4.1*. The FIRM designations not only identify the flood hazard zones for insurance and floodplain management purposes, but also provide a statement of probability of future occurrence. Map 7.C shows 1 percent chance (100-year) and 0.2 percent chance (500-year) flood zones designated by FEMA and 100-year, 200-year, and 500-year flood zones designated by the California Department of Water Resources (DWR).

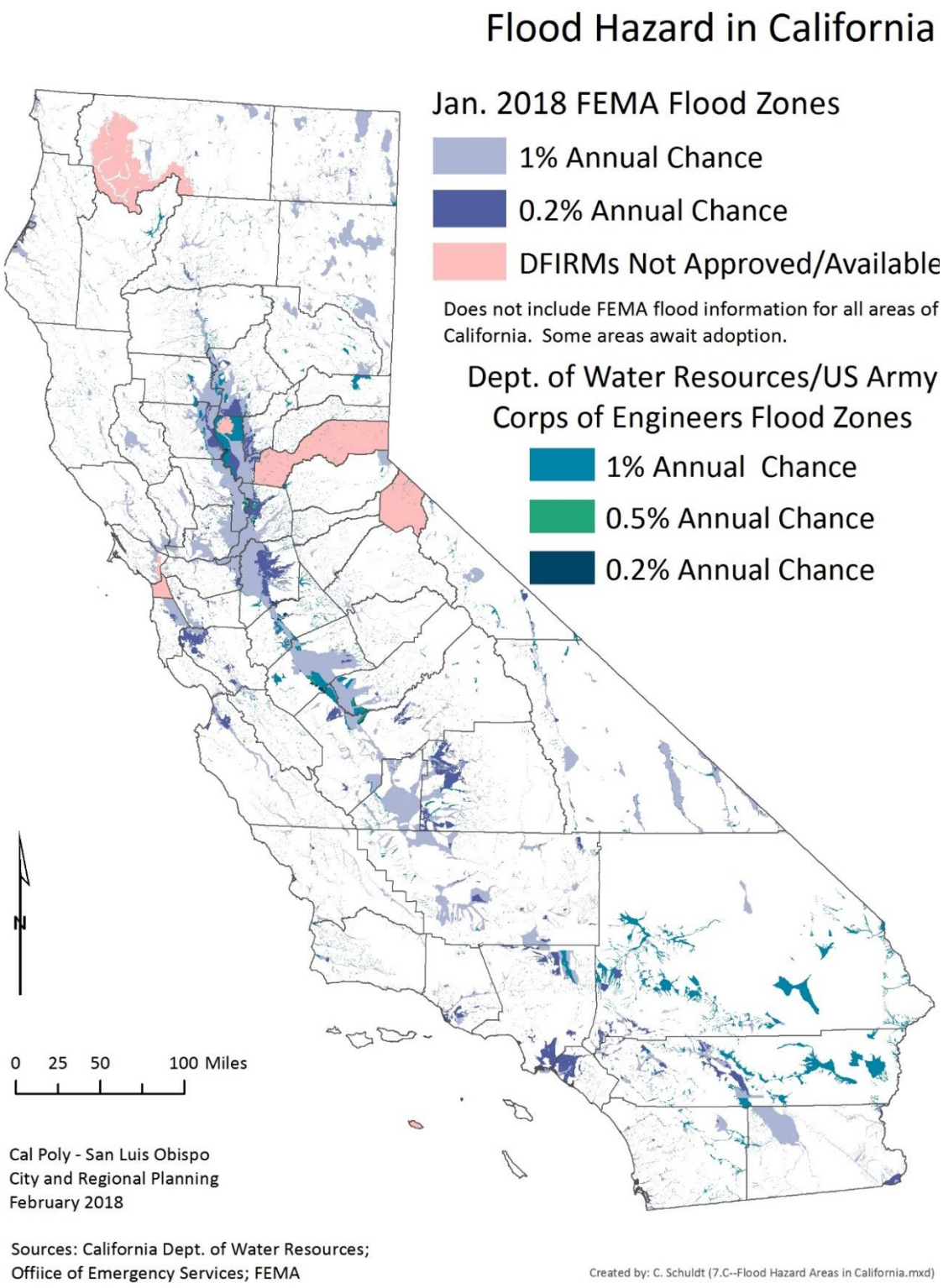
A 500-year flood has a 0.2 percent chance of occurring in any given year; a 100-year flood has a 1 percent chance, a 50-year flood has a 2 percent chance, and a 10-year flood has a 10 percent chance of occurrence. Although the recurrence interval represents the long-term average period between floods of specific magnitude, significant floods could occur at shorter intervals or even within the same year.

The FIRM designations typically identify components of the 500-year and 100-year floodplains. FEMA 100-year floodplains or areas with a 1 percent chance of a flood that size in any given year are shown in light lavender-blue in Map 7.C. High concentrations of 1 percent annual chance flood hazard areas are shown throughout the Central Valley, especially in the Sacramento-San Joaquin Delta region, as well as in selected other inland regions.

Analysis of Damage from Historic Flood Events

Damage data from California's historic flood events are useful for characterizing flood risk and identifying areas that probability-based assessments such as FIRM floodplains may miss. According to a study of population living in floodplains as of 1998, a majority of NFIP flood loss claims occur during flood events that do not rise to the level of a federal disaster declaration. Thus, the extent of flood disaster declarations alone is not a complete measure of vulnerability.

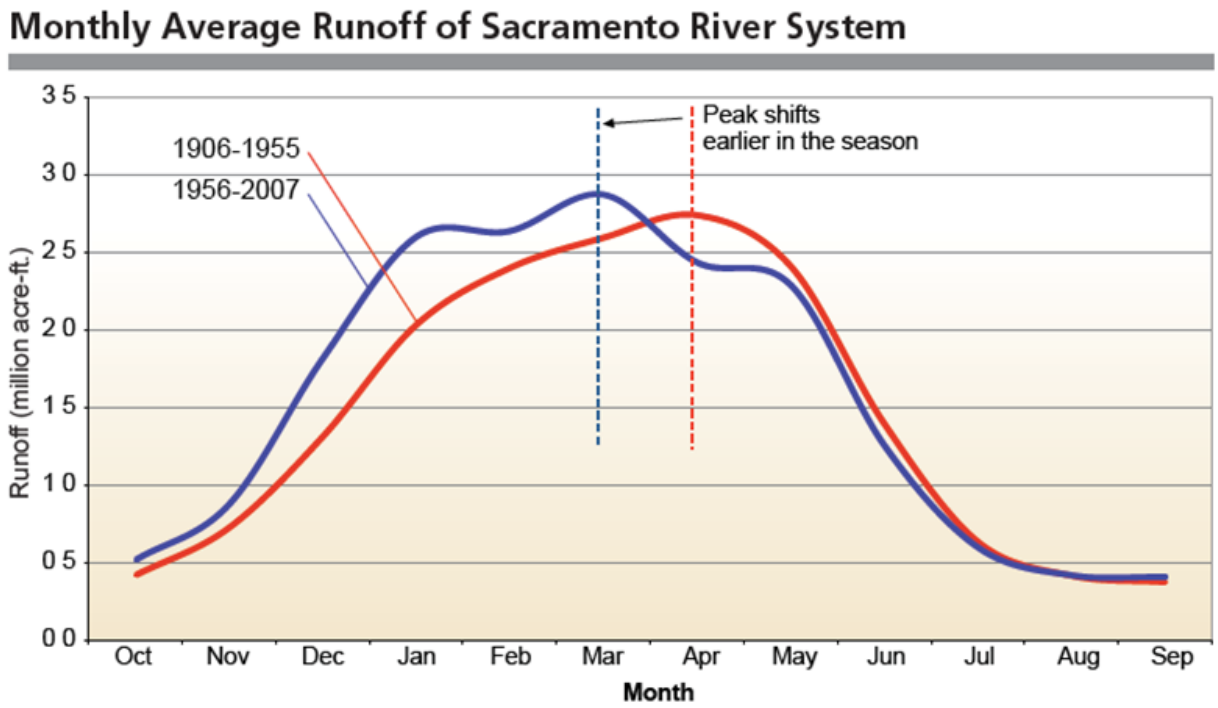
Map 7.C: Flood Hazard Areas in California



Climate Change and Flood Hazards

Climate change impacts have already been detected in temperature, precipitation, runoff, and snowpack records.[140] These changes have resulted in altered annual runoff patterns and the subsequent operation of reservoirs for flood protection. In addition, climate change not only alters annual average climate, it also increases variance.[141] As a result, regions projected to see an annual reduction in total precipitation, may experience an increase in the severity and frequency of flood events. The change of snowfall to rainfall may also contribute to an increased number and severity of flood events.

Figure 7.A: Monthly Average Runoff of Sacramento River System



Source: Department of Water Resources

An example of these effects is shown in Figure 7.A, which illustrates monthly average runoff in the Sacramento River system. The figure compares monthly average runoff for the period from 1956 to 2007 (blue line) and the period from 1906 to 1955 (red line), showing that the timing of peak runoff has shifted to earlier in the year.

Climate change impacts also interact in ways that can exacerbate the severity and frequency of flood events. For example, larger and more frequent wildfires brought on by climate change can reduce the ability of a landscape to retain rainfall, which can in turn lead to flooding and mudflows. Examples include the catastrophic mudflows that occurred in early 2018 in Santa Barbara County following heavy rainfall in an area where the 2017 Thomas Fire had denuded slopes of vegetation. In addition, sea level rise enlarges floodplains at the mouths of streams and rivers that empty into oceans and bays. Current projections indicate the following climate change trends that may affect flood hazards:

- *Precipitation:* Cal-Adapt mapping indicates a shift of precipitation events away from southern and inland hydrologic regions and toward central and northern regions.[142] However, the general decreases in annual

[140] California Department of Water Resources, California Climate Science and Data, 2015. Sacramento: author, 28 p. Retrieved on July 3,2017 from http://www.water.ca.gov/climatechange/docs/CA_Climate_Science_and_Data_Final_Release_June_2015.pdf
[141] Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller eds.), 2007. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.
[142] California Energy Commission. (2017). Cal-Adapt. Retrieved on 5/30/2017 from www.cal-adapt.org.

precipitation in southern and inland regions may not be accompanied by a reduction in flooding. The increase in climate variance may result in these regions experiencing heavier, more intense, episodic rainfall and flooding events due to transport of warmer, moisture-laden air from the ocean.[143]

- *Snowpack*: Snowpack in mountainous areas (northern and coastal mountains and the Sierra) is projected to be reduced and accompanied by earlier rainfall with subsequent runoff downstream, particularly in the Sacramento River and San Joaquin River watersheds that converge in the California Delta. These trends suggest the potential for increased incidence of intense flooding in the Central Valley and the San Francisco Bay region.
- *Sea-level rise:* The State of California Sea-Level Rise Guidance 2018 Update summarizes recent scientific findings regarding global sea level rise and presents projections for California that build on data collected from a network of 12 tide gauges located along the coast (see Table 7.F and Figure 7.G in *Section 7.2*). The guidance provides sea level rise projections by decade, based on greenhouse gas (GHG) emissions scenarios. These projections serve as the basis for ways to incorporate sea level rise data into planning. An extreme scenario was also included based on rapid ice melt on Antarctica, labeled as H++. The H++ rapid loss scenario projects extreme sea level rise with a 10.2-foot increase by 2100 and a 21.9-foot increase by 2150. This increase will not only result in coastal areas experiencing increased periods and levels of inundation, but also may increase the spatial extent of floodplains near the mouths of streams and rivers emptying into marine environments. For communities located on the coast that include waterways emptying into the ocean or other marine environments, the impact of sea level rise and high tide co-occurring with rainfall events must be evaluated. Sea level rise combined with high tides will increase the frequency and severity of flood events for areas adjoining places where coastal streams and rivers empty to the ocean.

Local projections of climate change impacts on flood hazards should be made in collaboration with local experts and should rely on DWR and other state guidance, such as the DWR Climate Change Handbook for Regional Water Planning and the California Adaptation Planning Guide.

7.1.3 ASSESSMENT OF STATE FLOOD VULNERABILITY AND POTENTIAL LOSSES

This section discusses statewide vulnerability of areas susceptible to flooding. It provides an overview of state vulnerability and potential losses to flood hazards and reviews progress with respect to Repetitive Loss Communities, as well as state-owned and -leased buildings. The assessment of state vulnerability to floods uses counties as the primary unit of analysis. Included are several methods available for assessing the areas of the state that are the most vulnerable to flood hazards:

- Geographic Information Systems (GIS) risk exposure modeling
- Analysis of population in Flood Insurance Rate Map (FIRM) floodplains
- Analysis of damage from historic flood events
- Analysis of Central Valley regional and basinwide flood risk, including urban areas, small communities, and rural areas

Collectively, the results of analyses can be used to establish current and future vulnerability and potential loss with measures of space and magnitude.

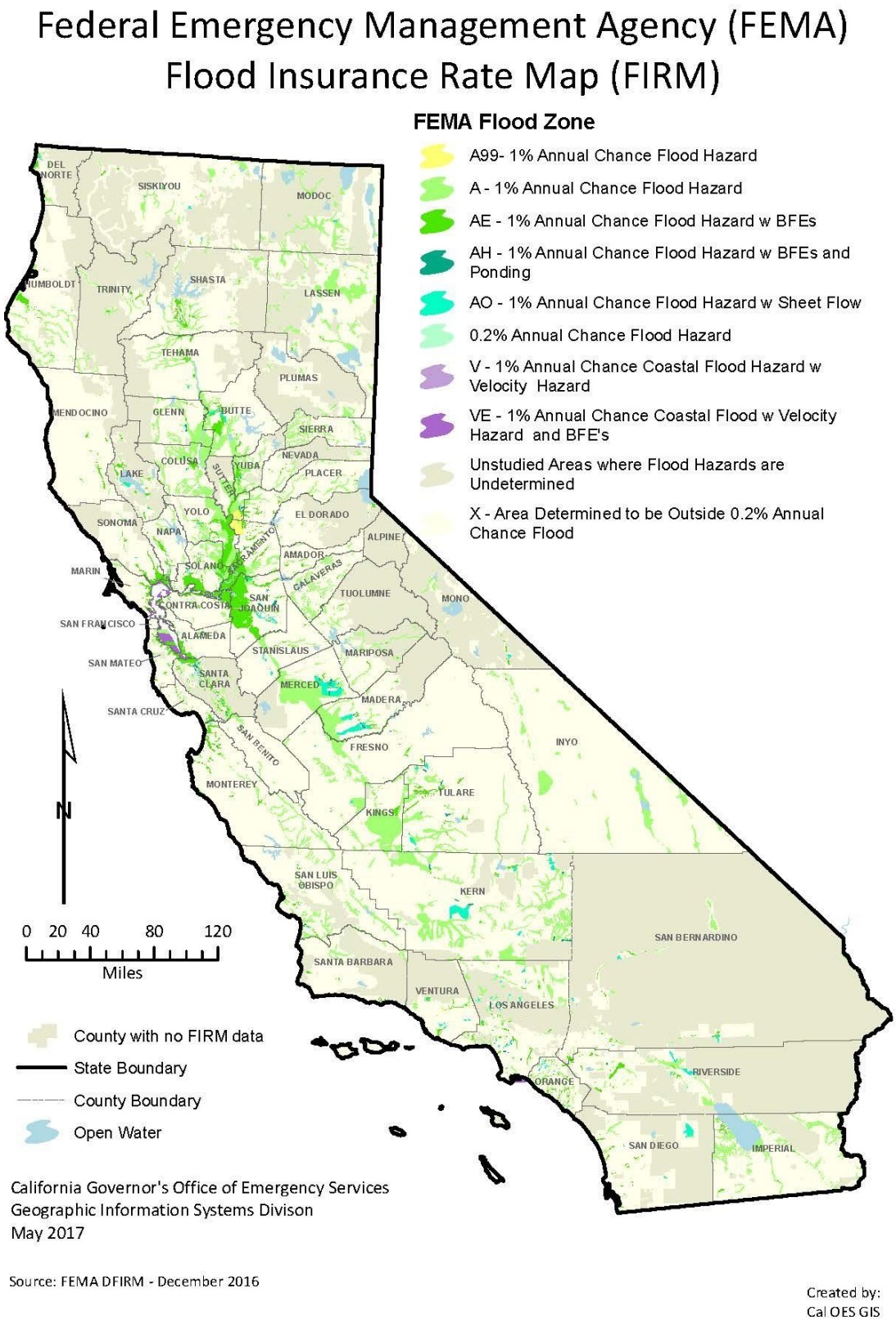
7.1.3.1 CALIFORNIA'S FLOOD EXPOSURE

Population in Flood Insurance Rate Map (FIRM) Floodplains

Flood zones are areas depicted on a Flood Rate Insurance Map (FIRM) and are defined by FEMA according to levels of risk. Zones with a 1 percent annual chance of flooding are part of the Special Flood Hazard Area (SFHA) and considered to have high risk. In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to the zones A, AE, A1-30, AH, AO, AR, A99, V, and VE or V1 through 30, as shown in Map 7.D and defined in Table 7.B.

[143] California Natural Resources Agency & California Emergency Management Agency. (2012). California Adaptation Planning Guide. Sacramento: author

Map 7.D: FEMA Flood Insurance Rate Map



For expanded definitions of the flood zones, visit the FEMA Flood Map Service Center web page: https://msc.fema.gov/portal.

It should be noted that FIRM do not provide full coverage of the state and contain inaccuracies due to changes in development and infrastructure since the original surveying. The federal government started regulatory floodplain mapping on a nationwide basis in the late 1960s. FEMA has mapped a portion of California but has substantial areas yet to map, subject to growth. Meanwhile, efforts have been under way to update some FIRMs in the state through FEMA's new Risk MAP (Mapping, Assessment, and Planning) Strategy.[144]

A Section of River Road in Modesto, Closed Due to January 2017 Floodwaters from the Tuolumne River



Source: California Department of Water Resources

According to an Analysis and Update of National Flood Hazard Layer Demographics and NFIP Policy and Claims Data report prepared for FEMA in 2012, 1,367,076 people and 506,165 housing units in California are within the Special Flood Hazard Area (SFHA).[145]

California's Flood Future: Mapping Flood Exposure

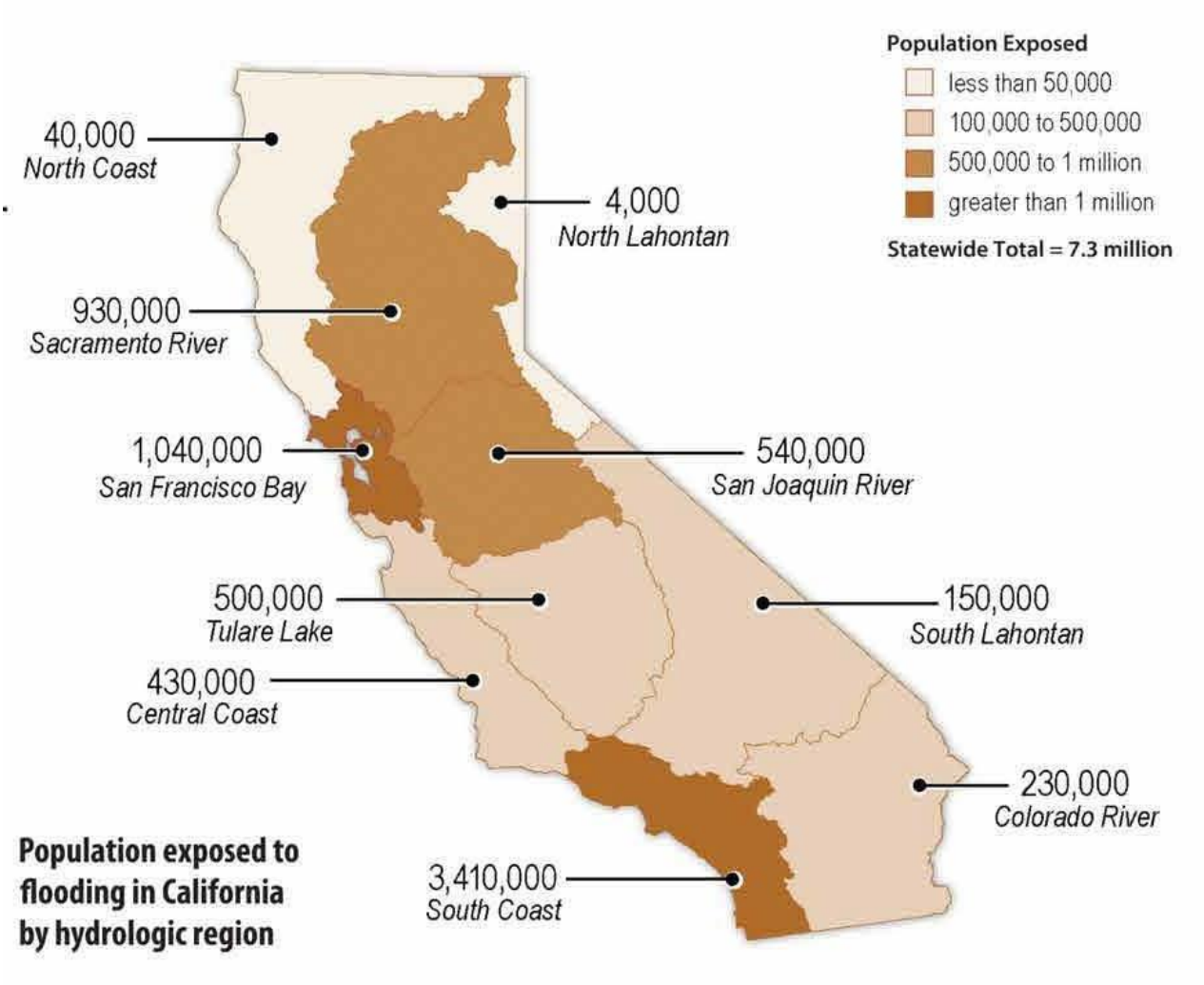
Maps 7.E and 7.F were produced as part of the California's Flood Future Report (discussed in more detail in *Section 7.1.5.2*). Map 7.E shows that one in every five Californians lives in a floodplain (500-year flood zone), and all counties have populations exposed to flooding.

As shown in Map 7.F, the statewide value of structures and contents at risk from a 500-year flood event is more than $575 billion, distributed over all regions. Los Angeles, Orange, and Santa Clara Counties lead the statistics with more than 500,000 persons, and structures and contents worth more than $70 billion, exposed to flooding.

[144] https://www.fema.gov/risk-mapping-assessment-and-planning-risk-map

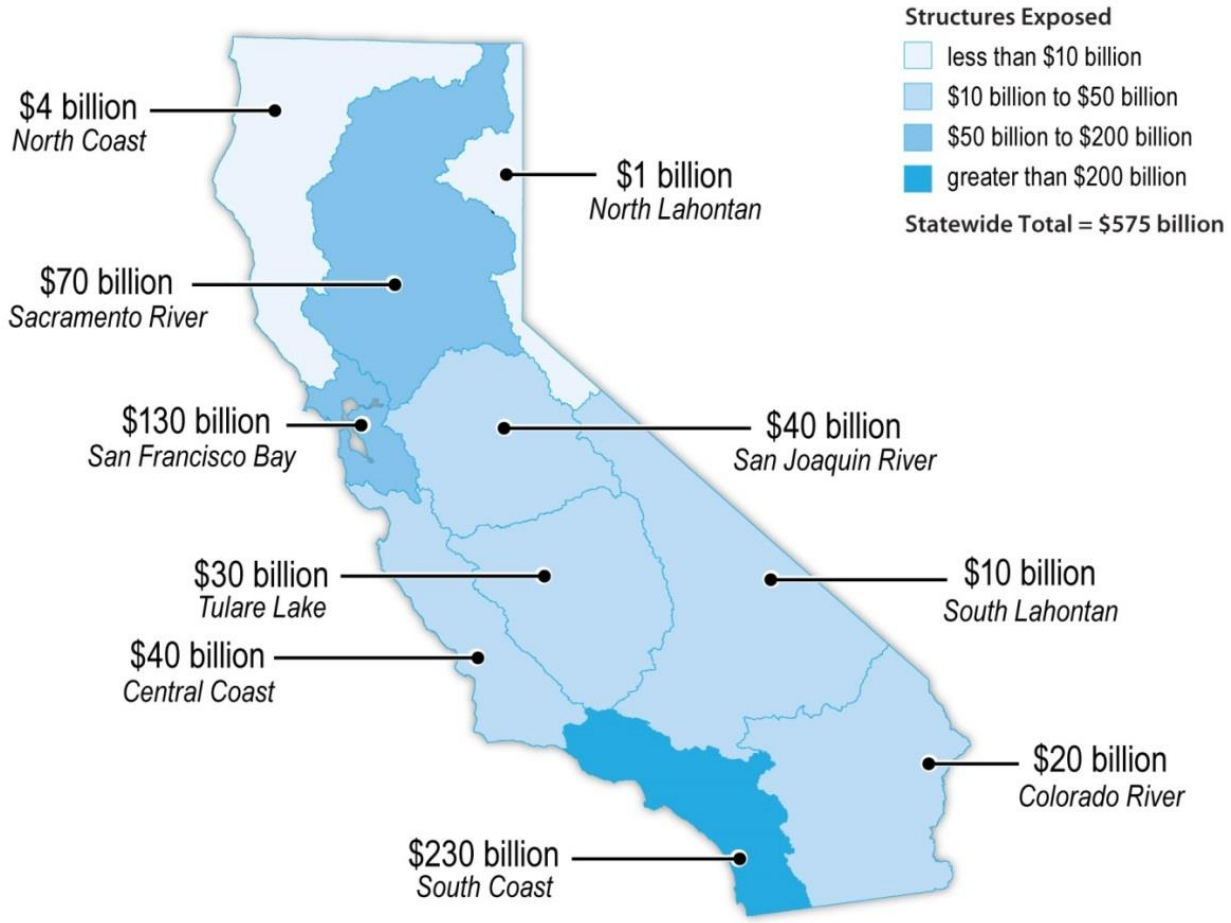
[145] Risk Assessment, Mapping, and Planning Partners (RAMPP), Project Report for Task Order#HSFEHQ-11-J-0002, Analysis and Update of National Flood Hazard Layer Demographics and NFIP Policy and Claims Data, Prepared for FEMA, October 2012.

Map 7.E: Population Exposed to 500-Year Flooding in California by Hydrologic Region



Source: California's Flood Future, http://www.water.ca.gov/sfmp/resources/Highlights_11x17_low_res.pdf

Map 7.F: Structures Exposed to 500-Year Flooding In California by Hydrologic Region



Source: California's Flood Future, http://www.water.ca.gov/sfmp/resources/Highlights_11x17_low_res.pdf

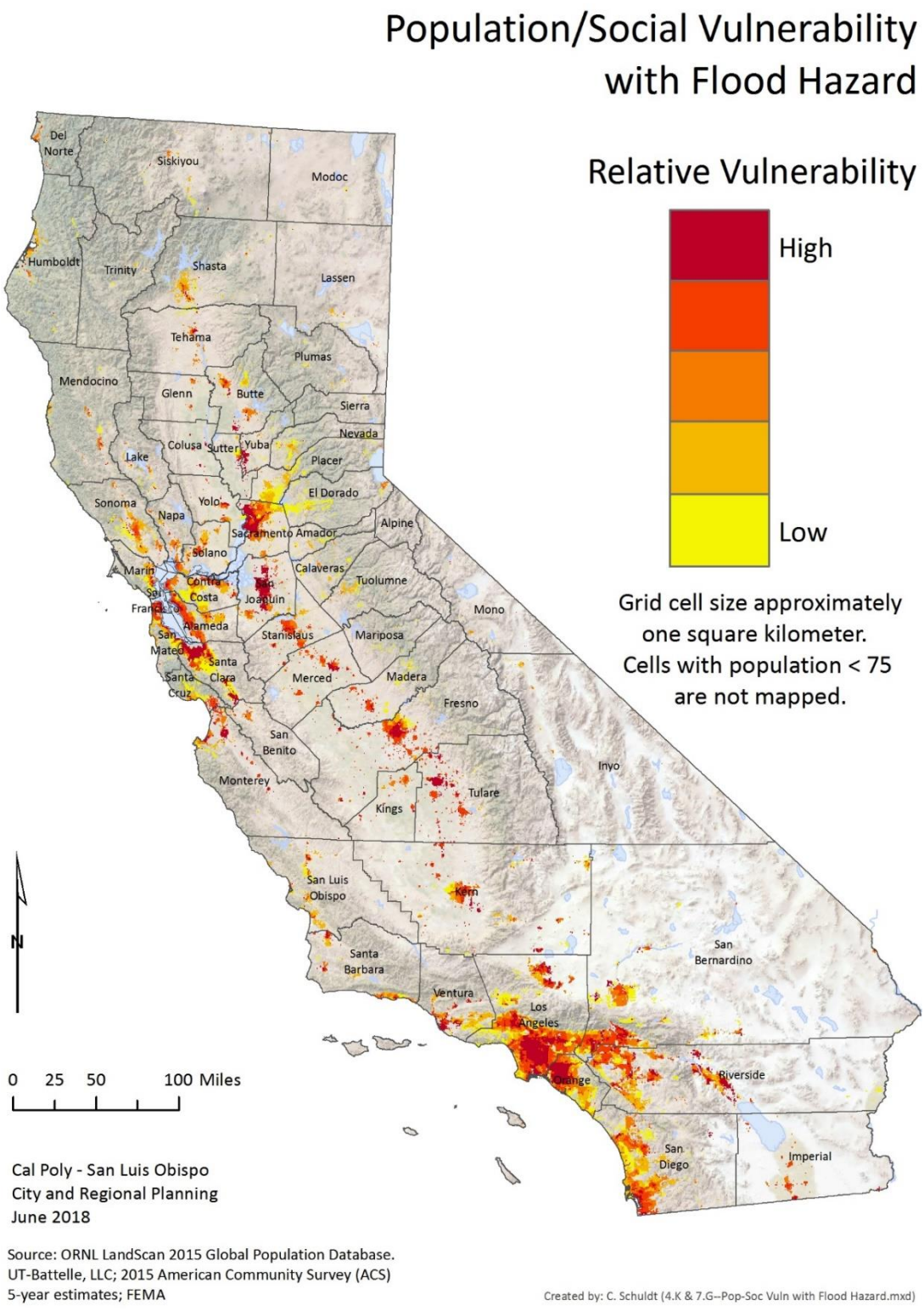
7.1.3.2 FLOOD VULNERABLE AREAS AND POPULATIONS

Flooding in California is widespread and the second most frequent disaster source. Since 1950, floods have accounted for the second highest combined losses and the largest number of deaths.

Like earthquake hazards, flooding disproportionately affects urban areas with high flood hazard potential, because these areas contain larger populations of people who are vulnerable to hazards. By comparison, uninhabited areas with high flood hazard potential are generally less vulnerable. Map 7.G shows high concentrations of socially vulnerable populations in the state's most heavily populated counties of Southern California, the Monterey Bay Area, and the San Francisco Bay Area. The color patterns shown on the map reflect the greater frequency of flooding, combined with greater social vulnerability, in portions of the Central Valley region.

Hurricane Katrina and other recent disaster events have brought to the public's attention the increased vulnerability of groups within the general population that may have fewer or differential access to resources, linguistic isolation, or less mobility than others, resulting in greater vulnerability to hazards events such as earthquakes. For an expanded discussion of social vulnerability, see *Section 4.4*.

Map 7.G: Flood Hazard and Social Vulnerability



Map 7.G shows high concentrations of population/social vulnerability (based on the index described in *Appendix N*) in areas at high risk of flood hazards within low-lying areas spread across the state. Most heavily affected counties are in the San Francisco Bay Area, the Central Valley area, and Southern California.

7.1.3.3 ESTIMATING FLOOD LOSSES TO STATE-OWNED AND LEASED BUILDINGS

Given the size and complexity of California's economy and infrastructure, the challenge of estimating potential dollar losses for state-owned facilities is substantial. As discussed in *Chapter 4*, there are over 20,000 state-owned structures in California, plus several thousand state-leased buildings, with lease terms varying in length. Table 7.B identifies a total risk exposure of $11.62 billion for buildings in areas potentially subject to the 100-year flood (Zone A).

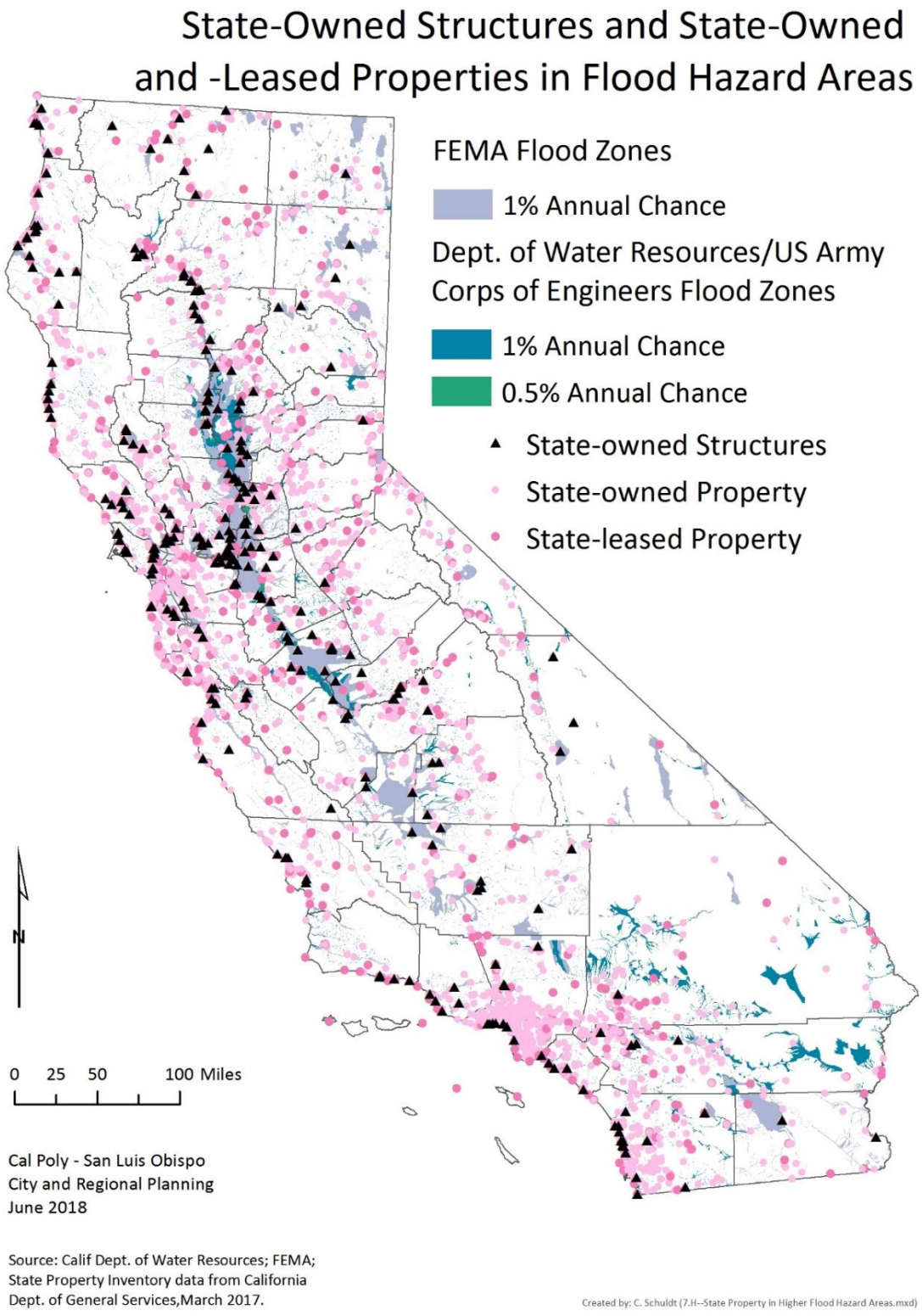
These figures tend to overstate potential losses from this hazard for two fundamental reasons: 1) flood events are centered within one region or another, and 2) only a very small portion of the building inventory within a region affected by heavy flooding would suffer substantial permanent damage.

Table 7.B: Potential Loss of State Facilities from Flood Hazards

	State Ownership Status	Number of Buildings	Square Feet	$ at Risk (billions)
FIRM 100 (Zone A)	Own	1,671	27,553,251	9.64
	Lease	433	5,657,268	1.98
	Total	**2,104**	**33,210,519**	**$11.62**
FIRM 500 (Zone X)	Own	609	5,665,724	1.98
	Lease	218	1,759,612	0.62
	Total	**827**	**7,425,336**	**2.60**
Overall Total Dollar Value at Risk				**$14.22**

Source: Department of General Services, California Governor's Office of Emergency Services (Cal OES)

Map 7.H: State-Owned Buildings in Higher Flood Hazard Areas



Map 7.H shows general locations of state-owned buildings in relation to the 1 percent Special Flood Hazard Area (SFHA) portion of the 100-year floodplain areas.

7.1.4 ASSESSMENT OF LOCAL FLOOD VULNERABILITY AND POTENTIAL LOSSES

This section addresses local flood hazard vulnerability and potential losses based on estimates provided in local risk assessments, comparing those with the state risk exposure findings presented in the GIS analysis in *Section 4.4.4* of *Chapter 4: Profiling California's Setting*.

7.1.4.1 SEVERE AND REPETITIVE FLOOD LOSS

Areas flooded in the past typically continue to be inundated repeatedly. The repetitive nature of flood damage is a cause for concern. FEMA, in coordination with the state, identifies California's top Severe Repetitive Loss (SRL) and Repetitive Loss (RL) counties. According to the University of California Davis Center for Watershed Sciences, in 2016 only 393 of the more than 30,000 RL properties are in California.[146] In 2017, RL counties in California accounted for nearly $30 million in total payments, representing 203 property losses throughout the state.

In 2017, the top 10 RL counties accounted for over 86 percent of total payments for RL counties in the state. Sonoma County is the top-ranking county in California, accounting for more than 48 percent of the total top 10 repetitive losses.

In order of losses, the top 10 Severe Repetitive Loss counties (based on grant funding amounts in 2017) are:

- Sonoma County
- Los Angeles County
- Lake County
- Marin County
- Napa County
- San Diego County
- Sacramento County
- Santa Cruz County
- Orange County
- Ventura County

In order of losses, the top 10 Repetitive Loss counties (based on grant funding amounts in 2017) are:

- Sonoma County
- Sacramento County
- Napa County
- Lake County
- Marin County
- Orange County
- Ventura County
- Santa Cruz County
- Solano County
- Monterey County

Appendices J and K provide details on 2017 losses and funding for the top 10 RL and SRL counties.

Severe and Repetitive Loss Reduction Goals

Goal 2 of the 2018 SHMP seeks to minimize damage to structures and properties. California places high priority on supporting this goal through an objective (2018 SHMP Goal 2, Objective 4) that the state and local jurisdictions use land use, design, and construction policies to facilitate reduction of severe and repetitive property losses.

[146] https://californiawaterblog.com/2016/12/14/california-flood-risk-and-the-national-flood-insurance-program/

Of the over 30,000 repetitive loss properties in the U.S., only about 1 percent are in California. However, California works to prioritize flood mitigation projects that will further reduce incidence of SRL and RL losses. California's 2013 Flood Future, developed by the California Department of Water Resources (DWR) and the U.S. Army Corps of Engineers (USACE), is a comprehensive review of statewide exposure to flood risk and includes specific tools, goals, and strategies to address barriers to improved flood management.

Additionally, Cal OES's State Hazard Mitigation Officer (SHMO) has appointed an SRL point-of-contact person who has created an account on Data Exchange, the Repetitive Loss Database. Cal OES contacts communities with SRL properties informing them of the availability of Flood Mitigation Assistance (FMA) grants and providing guidance regarding requirements. The state coordinates with the communities with the most Severe Repetitive Loss (SRL) properties to encourage them to develop and update their Local Hazard Mitigation Plans (LHMPs). The identified communities are given preference in the award of flood project grants (see *Appendices J and K*).

California is actively pursuing SRL projects to minimize future damages, as evidenced by funding issued up to December 31, 2017. As of that date, Sonoma and Los Angeles were the top SRL counties in California.

Potential Sources of Funding

In addition to receiving FMA, Pre-Disaster Mitigation (PDM), and Hazard Mitigation Grant Program (HMGP) funding, state agency flood hazard projects can be funded by local jurisdictions. County-financed flood control programs, such as Napa County's Living River project, are often funded by special funding mechanisms, such as voluntary local taxation forged through strong community coalitions. California also works to reduce flooding losses through the Community Rating System, building codes, education, and resiliency programs. The result of such efforts allow municipalities to pursue integration flood management projects specific to their local needs. Similar to Napa's efforts, Bay Area voters approved a parcel tax in 2016 to raise $500 million over the next 20 years, as a regional approach to funding sea level rise adaptation projects in the Bay Area.

The State Systemwide Investment Approach (SSIA) includes actions to improve flood protection in urban areas, small communities, and rural-agricultural areas as well as system-wide improvements, with an estimated cost of $14 to $17 billion over 25 years. Examples of a near-term system-wide action are the Yolo Bypass multi-benefit improvements that DWR is implementing. Examples of a near-term urban (regional) action are levee improvements to provide a 200-year level of protection to West Sacramento. Examples of near-term rural and small community (small-scale) actions include levee repairs and levee setbacks. The SSIA portfolio also includes investments in improved flood risk awareness, flood proofing, and land use planning. Map 7.J in *Section 7.1.5.2* shows the geographic scope of the Central Valley Flood Protection Plan (CVFPP).

Revised SSIA cost estimates now range from $17.4 to $21.3 billion, with estimated cost shares among project partners of local (8 percent), state (56 percent), and federal (36 percent). The 2017 Central Valley Flood Protection Plan (CVFPP) update includes policy and funding recommendations to support comprehensive flood management over 30 years. See *Section 7.1.5* for additional information about flood mitigation efforts.

Analysis of Effectiveness

In 2013 and 2014, Sonoma County was awarded over $5 million in two FMA grants to fund flood mitigation elevation projects. The 2013 FMA grant proposed to elevate 12 SRL homes and the 2014 FMA grant proposed to elevate 20 SRL homes. At the time of this writing, both projects are still underway, but Cal OES FMA grants specialists are coordinating with Sonoma County to determine if any preliminary information about project effectiveness is available. Sonoma County was also awarded an HMGP grant of over $660,000 to fund another flood mitigation elevation project in 2015. Work on this project is underway.

The City of Roseville in Sacramento County continues to address flood loss by obtaining PDM grant funding to acquire properties at risk of flooding. This is evidence of Roseville's commitment to addressing flood hazard and as a result of this commitment, the community holds a Community Rating System (CRS) ranking of 1. (For more discussion on the CRS, see *Section 7.1.5.8*.)

Cal OES also conducts assessments of the effectiveness of grant-funded projects through the State Mitigation Assessment Review Team (SMART) system. For more information on this system, see *Section 10.6*.

Prioritization of Funding to Address Repetitive Loss

For information about Cal OES' FMA and PDM program and funding prioritization, see *Section 10.4*. See *Appendix L* to review the PDM/FMA Project Grant NOI Consistency and Subapplication Review and Ranking Checklist with RL and SRL scoring criteria included.

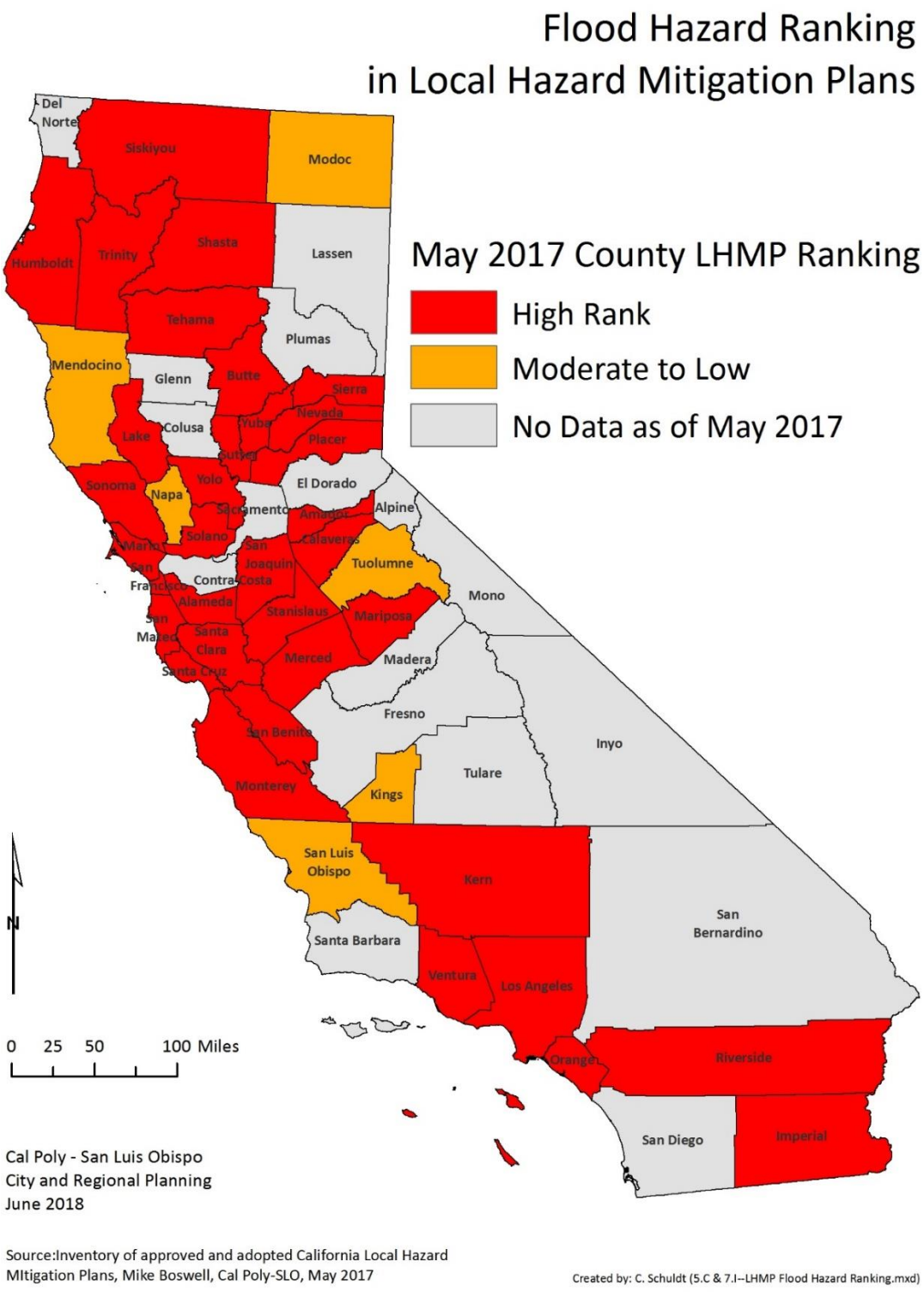
7.1.4.2 LOCAL HAZARD MITIGATION PLAN HAZARD RANKINGS

An important source of local perceptions regarding vulnerability to flood threats is found in the collection of FEMA-approved and adopted Local Hazard Mitigation Plans (LHMPs) adopted by cities, counties, and special districts as of May 2017. The most significant hazards reported in this review are earthquakes, floods, and wildfires—the three primary hazards also identified on a statewide basis by the 2018 SHMP. Including these three primary hazards, LHMPs identified over 25 distinct local hazards.

Map 7.I summarizes relative ratings of flood hazards in the May 2017 review of LHMPs. Displayed are predominant flood hazard rankings shown as high (red) and moderate to low (orange) given by at least 51 percent of the jurisdictions with LHMPs within each county. Counties shown in gray represent either jurisdictions not having a FEMA-approved and adopted LHMP, or counties where data are missing or problematic.

For a detailed evaluation of LHMPs approved as of May 2017, see *Chapter 5, California Local Hazard Mitigation Planning*.

Map 7.I: Flood Hazard Ranking in Local Hazard Mitigation Plans



As shown in Map 7.I, the 2018 LHMP review found that flood hazards are a predominant concern for most Southern California and San Francisco Bay Area counties with approved LHMPs, as well as for some Central Valley and eastern Sierra counties with approved LHMPs.

Implications for Local Loss Potential

Local hazard rankings are highly variable, responding to a wide variety of very specific local conditions. Each county has its own set of variables conditioning flood loss potential within its cities and unincorporated area. Descriptions of loss potential are very specific within individual LHMPs and are not consistently drawn up between plans, nor is there even coverage of all cities and unincorporated areas. Such variability will diminish as more cities and counties prepare LHMPs and greater standardization enables comparability of local data with statewide data.

Comparison with Statewide Vulnerability

Map 7.I reveals that most LHMPs reviewed in 2018 in Southern California, San Francisco Bay Area, and some Central Valley and eastern Sierra counties rated floods high in their hazard rankings. Overall, this finding is consistent with the patterns of flood hazards and the population/social vulnerability patterns identified in *Section 4.4.4* of the Statewide GIS Hazard Analysis presented in *Chapter 4: Profiling California's Setting*.

Robert's Island, San Joaquin County, 1996-97: A home that was required to meet Design Flood Elevation Level



Source: California Governor's Office of Emergency Services (Cal OES)

7.1.5 CURRENT RIVERINE, STREAM, AND ALLUVIAL FLOOD HAZARD MITIGATION EFFORTS

7.1.5.1 LEGISLATION

Following the devastation of Hurricane Katrina, California voters passed the Disaster Preparedness and Flood Prevention Bond Act (Proposition 1E) and the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act (Proposition 84) in November 2006, authorizing the sale of nearly $5 billion in state bonds for flood management improvements throughout the state, with $4.3 billion dedicated for repairs and improvements of flood projects in the Central Valley. Since passage of Propositions 84 and 1E, significant progress has been made in implementing levee improvements and reducing flood risk, especially in urban areas.

Furthermore, in late 2007, the California Legislature passed and the Governor signed five interrelated bills (flood legislation) aimed at addressing the problems of flood protection and liability and helping direct use of the bond funds. These were Senate Bills (SB) 5 and 17, and Assembly Bills (AB) 5, 70, and 156. A sixth bill passed in 2007, AB 162, requires additional consideration of flood risk in local land use planning throughout California.

These bills, effective January 1, 2008, collectively outline a comprehensive approach to improving flood management at the state and local levels. Major components of the 2007 legislation included the following:

- *State Planning Requirements*: The legislation required DWR and the Central Valley Flood Protection Board (CVFPB) to prepare, adopt, and collectively implement a Central Valley Flood Protection Plan (CVFPP) by 2012, then update that plan every five years. The plan must include 1) a description of existing flood risk and facilities within the State Plan of Flood Control (SPFC) area, 2) an evaluation of the improvements necessary to bring SPFC facilities up to current design standards, and 3) recommendations for improving the SPFC's performance that incorporate, wherever feasible, multiple benefits (such as to the ecosystem).

- *Local Planning Requirements*: The legislation required Central Valley cities and counties to 1) develop flood emergency response plans, and 2) amend general plans to conform to the data, policies, and implementation measures included in the CVFPP, including goals and policies intended to protect lives and property and reduce flood risk.

- *Higher Flood Protection Standards*: The legislation established 200-year flood event (a flood with a 1-in-200 or 0.5 percent chance of occurring in any year) as the minimum level of flood protection to be provided for new development in urban and urbanizing areas (i.e., areas with a population of 10,000 or more).

- *Local Zoning and Development Requirements*: The legislation required Central Valley cities and counties to amend their general plans and zoning ordinances to conform to the CVFPP, including prohibiting new development in urban areas not protected up to the 200-year flood standard. Cities and counties in the Central Valley will be required to make findings related to providing the appropriate level of flood protection or making adequate progress to achieve that protection.

- *State Mapping and Notification Requirements*: The legislation required DWR and the CVFPB to: 1) map flood risk areas in the Central Valley, 2) prepare levee flood protection zone maps, and 3) annually notify approximately 280,000 affected property owners that they live in a flood zone protected by a levee.

This flood legislation also links flood liability with local planning decisions. As of January 1, 2008, cities and counties now share flood liability with the state in the case of litigation over unreasonably approved new development in previously undeveloped areas. This requirement does not apply when the city or county has amended its general plan and zoning and otherwise makes land use decisions consistent with the CVFPP.

The State Housing Law Program of the California Department of Housing and Community Development (HCD) continuously refines the building standards to make sure they comply with new or changing laws and regulations

and develops statewide building standards for new construction of hotels, motels, lodging houses, apartments, dwellings, and buildings accessory thereto. The State Housing Law Program also develops the building standards necessary to provide accessibility in the design and construction of all housing other than publicly funded housing. The building standards are published in the California Code of Regulations, Title 24, known as the California Building Standards Code.

Progress Summary 7.A: Flood Laws

Progress as of 2018: Since 2007, multiple bills were passed by the state legislature to clarify certain aspects of the 2007 legislation relative to urban level of flood protection requirements in the Sacramento-San Joaquin Valley. These bills included Assembly Bill (AB) 1965 of 2000, Senate Bill (SB) 1070 of 2010, and SB 200 and SB 1278 and AB 1965 of 2012. AB 1965 amended the definition of adequate progress for urban level of flood protection applications and SB 1070 (2010) clarified the geographic boundaries of the Sacramento-San Joaquin Valley. SB 200 extended the state cost share for the Delta levee maintenance program to "up to 75 percent" of the costs in excess of $1,000 per levee mile.

SB 1278 (2012) and AB 1965 (2012) revised the definition of urban level of flood protection and modified the dates and timeframes for general plan amendments (July 2, 2015) and zoning ordinance updates (July 2, 2016) originally established in SB 5.

The California Department of Water Resources (DWR) has prepared three documents to inform the public and assist local governments with implementation of the legislative requirements:

DWR's 2007 California Flood Legislation Summary
This booklet provides the public with a better understanding of the roles and responsibilities of government agencies as they implement the requirements of this legislation. This booklet can be found at: http://www.water.ca.gov/legislation/2007-summary.pdf.

DWR's 2007 California Flood Legislation Companion Reference
This document is a companion to the 2007 Flood Legislation Summary that provides a listing of the code sections referenced in the flood legislation, including amendments and deletions. This booklet can be found at: http://www.water.ca.gov/legislation/2007-reference.pdf.

Local Land Use Planning: Handbook for Communities Implementing Flood Legislation - October 2010
This guidance handbook describes the new legislative requirements that affect city and county local planning responsibilities such as general plans, zoning ordinances, development agreements, tentative maps, and other actions. This handbook can be found at: http://www.water.ca.gov/floodmgmt/lrafmo/fmb/docs/Oct2010_DWR_Handbook_web.pdf.

For additional information regarding specific provisions of the aforementioned legislation, see *Annex 1, Guide to California Hazard Mitigation, Laws, Policies, and Institutions*.

7.1.5.2 FLOOD MANAGEMENT SYSTEM

Flood Management System Planning and Programs

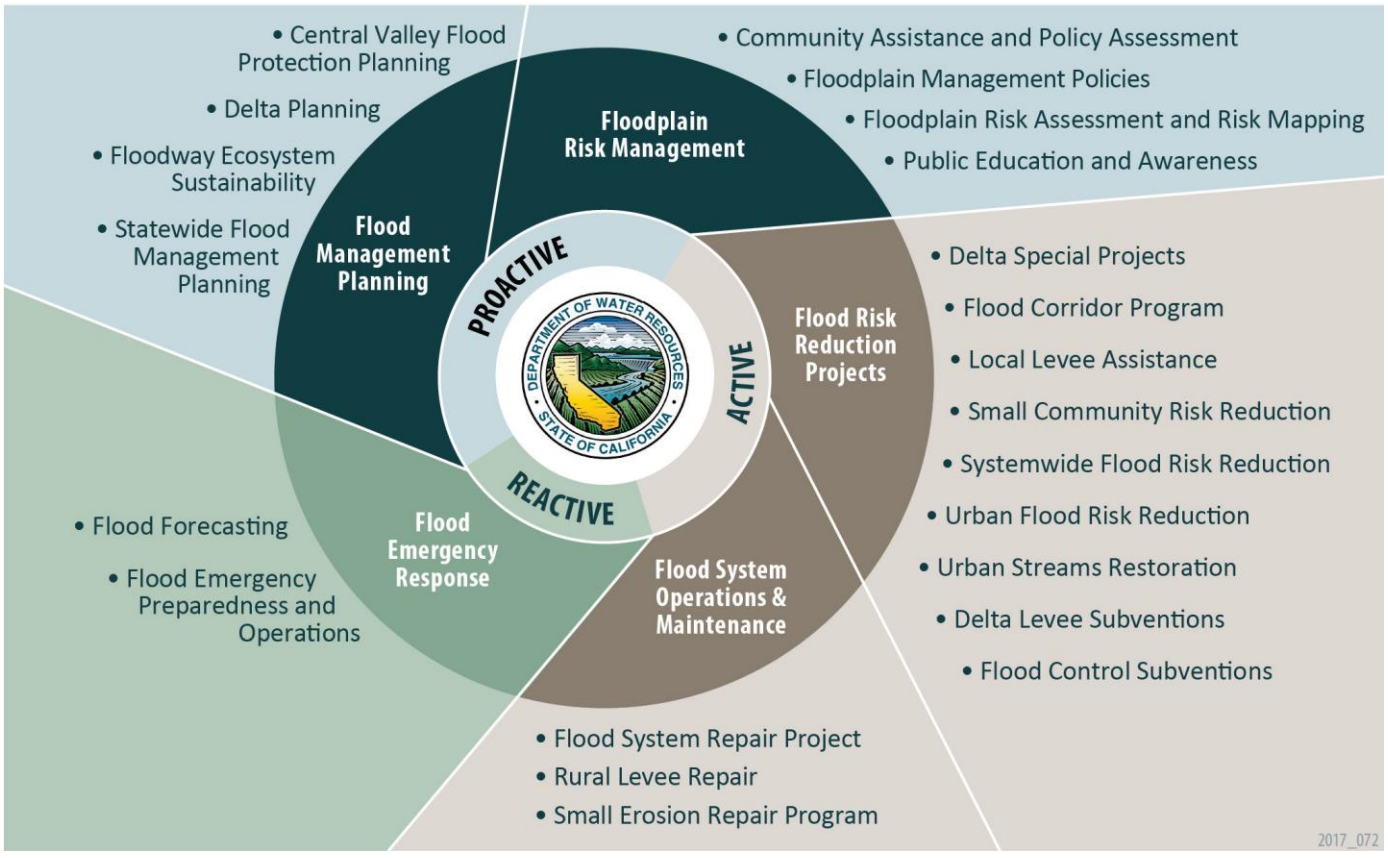
Since 2007, Propositions 1E and 84 have provided essential funding to improve flood management across the state and heighten awareness of California flood risks. Funding from these bond laws, leveraged by local and federal resources, has allowed DWR to initiate major programs to reduce flood risk in the state's communities

In addition, the funds have supported foundational work, including data collection, tools development, system evaluations, and engineering studies to identify problem areas and the improvements needed to enhance flood safety.

Progress Summary 7.B summarizes the various California flood management programs. Detailed information on accomplishments of those programs is provided in the text following the progress summary.

Figure 7.B provides a graphical representation of the inter-relationships among the flood management programs.

Figure 7.B: Inter-Relationships Among California's Flood Management Programs



Source: Central Valley Flood Protection Plan, 2017 Update.

Progress Summary 7.B: California's Flood Management Programs within the Flood Management System

Progress as of 2018: Ongoing progress in statewide floodplain management is reflected in the following significant program areas.

Flood Management Planning
These programs formulate strategies, plans, and investment priorities for implementing statewide and regional flood management projects. The two key programs are the Central Valley Flood Management Planning Program and the Statewide Flood Management Planning Program.

Floodplain Risk Management
These programs promote sound floodplain management to reduce flood risks by working closely with local agencies as well as federal agencies. Policies, guidance documents, and technical products—e.g., flood inundation models—are developed to assist communities with their strategies to manage floodplains. This area supports an additional element of successful floodplain risk management: educating the public about flood risks so people can plan, prepare, and take individual actions to reduce flood risks themselves, their families, and their property.

Flood Risk Reduction Projects
These programs coordinate with local and federal agencies to implement new flood projects; provide funding that enables local agencies to repair and improve levees and other flood management facilities statewide; provide advanced mitigation for the State Plan of Flood Control (SPFC) to aid project delivery; and enhances ecosystems associated with the flood system. A primary responsibility is to work closely with the U.S. Army Corps of Engineers (USACE), Central Valley Flood Protection Board (CVFPB), and local agencies to improve performance of SPFC facilities, as well as the Folsom Dam Joint Federal Project.

Flood System Operations and Maintenance
These programs focus on maintaining levees, pumping plants, bridges, channels, and hydraulic structures—e.g., weirs, outfall gates—to continue achieving the risk reduction benefits the SPFC was designed to provide. Local agencies carry out most of the SPFC by managing the levees and facilities for which they are responsible, while the state is required to operate and maintain those portions of the SPFC identified in California Water Code. Local agencies and the state work closely with the CVFPB, USACE, and environmental resource agencies to ensure that operation and maintenance activities promote public safety, environmental stewardship, and economic stability.

Flood Emergency Response
These programs prepare for and respond to flood threats in close coordination with local, state, and federal entities. Preparing for flood response requires continuous data collection, regular flood system inspections and evaluations, forecasts and information dissemination, annual training and exercises, preseason coordination, and replenishment of supplies and equipment.

Flood Management System: Flood Management Planning

As of 2017, work continues on two major planning efforts that will guide future state investments in both regional and statewide flood management planning activities: the Central Valley Flood Management Planning Program and the Statewide Flood Management Planning Program.

Central Valley Flood Management Planning Program

The Central Valley Flood Protection Plan (CVFPP) has guided the state's participation in managing flood risk in areas protected by the State Plan of Flood Control (SPFC) since the SPFC's adoption in 2012 pursuant to the Central Valley Flood Protection Act of 2008.

The primary goal of the CVFPP is to improve flood risk management, with supporting goals to improve operations and maintenance; promote ecosystem functions; improve institutional support, and promote multi-benefit projects.

The CVFPP is a strategic, long-range plan, and its five-year updates describe a programmatic vision for flood system improvements over time and across the Central Valley at different scales:

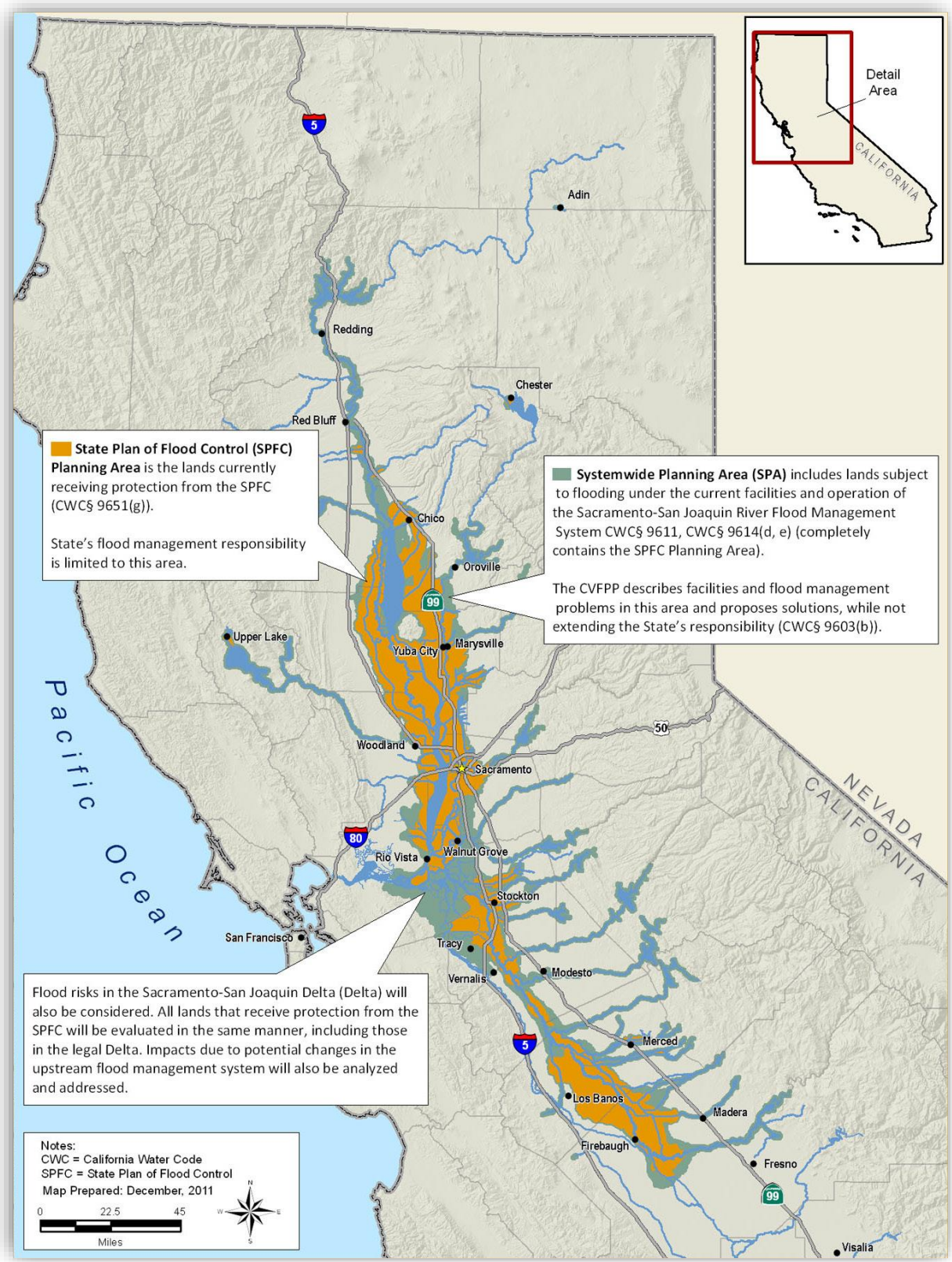
- *System-wide or large-scale:* This scale encompasses multiple regions and/or land use types up to the full extent of the flood management system in the Central Valley.
- *Regional or medium-scale:* This is the general scale of regions defined through regional flood management planning efforts according to delineation by hydrologic and administrative boundaries.
- *Small-scale:* This scale applies to local areas of limited geographic extent.

The 2012 CVFPP recommended a State Systemwide Investment Approach (SSIA), which included actions to improve flood protection in urban areas, small communities, and rural-agricultural areas as well as systemwide improvements with an estimated cost of $14 to $17 billion over 25 years. The 2012 CVFPP also recommended three major planning efforts to inform the 2017 CVFPP update:

- State-led Sacramento and San Joaquin basin-wide feasibility studies
- Six locally-led regional flood management planning studies (that involved more than 180 local entities)
- A conservation strategy

Map 7.J shows the geographic scope of the Central Valley Flood Protection Plan (CVFPP).

Map 7.J: Geographic Scope of Central Valley Flood Protection Plan



Progress Summary 7.C: Central Valley Flood Management

Progress as of 2018: Based on the results of these additional planning studies and other technical information, the 2017 Central Valley Flood Protection Plan (CVFPP) update developed a refined State Systemwide Investment Approach (SSIA) portfolio of recommended management actions that can be implemented over the near term (next 10 years) and longer term.

Examples of a near-term system-wide action are the Yolo Bypass multi-benefit improvements, which are being implemented by the California Department of Water Resources (DWR). Examples of a near-term urban (regional) action are levee improvements to provide a 200-year level of protection to West Sacramento. Examples of near-term rural and small community (small-scale) actions include levee repairs and levee setbacks. The portfolio also includes investments in improved flood risk awareness, flood proofing, and land use planning. Map 7.J shows the geographic scope of the CVFPP. Revised SSIA cost estimates now range from $17.4 to $21.3 billion, with estimated cost shares among project partners of local (8 percent), state (56 percent), and federal (36 percent). The 2017 CVFPP update includes policy and funding recommendations to support comprehensive flood management over 30 years.

Consistent with the state's climate change policies, the CVFPP has used a multi-phased approach to incorporate the latest science and data. For the 2017 CVFPP update, 2013 global climate models and 200 independent climate projections were used. Climate change is expected to contribute to an increase in the number of extreme weather events; generate more extreme floods, more seasonal rain, and less snow; raise sea levels; and increase stress on the flood management system. Results from these climate change analyses were incorporated into existing hydrologic and flood risk analyses.

More information on the CVFPP can be found at: https://water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan.

Progress Summary 7.D: Regional Flood Management Planning

Progress as of 2018: Following the Central Valley Flood Protection Board (CVFPB) adoption of the 2012 Central Valley Flood Protection Plan (CVFPP), the California Department of Water Resources (DWR) launched and funded a regionally led effort to help local agencies develop comprehensive plans that describe local flood management priorities, challenges, and potential funding mechanisms and define site-specific improvement needs.

Six Regional Flood Management Plans (RFMPs) were completed for regions in the Central Valley by 2015 and subsequently reviewed by DWR in support of the development of the 2017 update of the CVFPP. Each RFMP addressed operations, maintenance, repair, rehabilitation, and replacement; infrastructure performance; emergency management, governance; environmental compliance; regional priorities; and funding.

Together, the six RFMPs identified over 500 management actions totaling an approximate cost of $14 billion throughout the Central Valley. Despite being constrained to using existing information without new analyses or investigations, the RFMPs represent the most comprehensive thinking about local flood management challenges and opportunities and illustrate a breadth of potential flood management investments.

In addition to providing funding for the effort, DWR closely collaborated with the six regions during the development of the 2017 update of the CVFPP to reflect the contents of the RFMPs at a system-wide level. The RFMPs provided a platform for meaningful engagement and resulted in an unprecedented partnership and coordination among DWR and local and regional flood planning entities across the Sacramento River and San Joaquin River basins. DWR anticipates continuing partnership and coordination with the regions following CVFPB adoption of the 2017 CVFPP update.

For more information regarding regional flood management planning, visit: https://www.water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan.

Statewide Flood Management Planning Program

The purpose of the Statewide Flood Management Planning Program is to increase understanding of statewide flood risk, make recommendations for managing flood risk, and inform decision-makers about flood management policy and investments. In addition, the program coordinates with local, state, and federal agencies.

The Statewide Flood Management Planning Program has coordinated with the California Water Action Plan (2014 and 2016 updates), provided flood management and investment content for the California Water Plan Update 2013, coordinated and aligned content with the 2017 CVFPP update, and developed the "California's Flood Future: Recommendations for Managing the State's Flood Risk" report (2013). These documents underscore a deep commitment to the principles of Integrated Water Management (IWM).

Progress Summary 7.E: Statewide Flood Management

Progress as of 2018:

California Water Action Plan (CWAP)

In 2014, Governor Jerry Brown declared a drought emergency and issued the California Water Action Plan, which the 2017 Central Valley Flood Protection Plan (CVFPP) update and other California Department of Water Resources (DWR) programs must support. The California Water Action Plan was updated in 2016. The plan emphasizes operational and regulatory efficiency as well as sustainable and integrated funding opportunities. With regard to flood management specifically, the plan describes actions for increasing flood protection and the need for flood management projects to employ an integrated approach at a regional scale to achieve multiple benefits.

More information on the California Water Action Plan can be found at: http://resources.ca.gov/california_water_action_plan/.

California Water Plan Update (2013 CWP)

The 2013 California Water Plan Update focused on three themes: Integrated Water Management (IWM), government agency alignment, and investment in innovative and infrastructure. With regard to flood management specifically, the California Water Plan Update focuses on four general approaches: non-structural, restoration of natural floodplain functions, structural, and flood emergency management. More information on the California Water Plan Update can be found at: https://www.water.ca.gov/Programs/California-Water-Plan.

California's Flood Future: Recommendations for Managing the State's Flood Risk (California's Flood Future)

The 2013 "California's Flood Future" report provided the first comprehensive look at statewide exposure to flood risk and outlined seven recommendations for improved statewide flood risk management. Developed through a partnership between DWR and the U.S. Army Corps of Engineers (USACE), it included cooperation and information provided by more than 140 local agencies throughout California, as well as state and federal agencies. "California's Flood Future" found that more than seven million people and $580 billion in assets (crops, buildings, and public infrastructure) are exposed to flood hazards in California. It identified the immediate need for more than $50 billion to complete flood management improvements and projects statewide (including the needs identified by the 2012 CVFPP). Further, it estimated that significant additional funding—approximately $100 billion in additional capital improvements—is needed for flood management improvements and projects.

"California's Flood Future" concludes with seven recommendations for state and federal government assistance to reduce risk and consequences of flooding, provide flood risk information for policy-maker and public decisions, protect ecosystems, preserve floodplain functions, deliver multiple project benefits, improve flood management governance, identify statewide investment priorities, and provide sufficient and stable funding for flood management:

1. Conduct regional flood risk assessments to help local governments make informed decisions on land use, emergency response, ecosystem functions, and flood management projects. Strategies include identifying standard risk evaluation methods for each region, assisting local determination of risk reduction goals and acceptable residual risk, identifying opportunities to restore or maintain natural systems, and assisting local assessment of impacts of climate change and sea-level rise.

2. Increase public and policymaker awareness about flood risks to engender local, state, and federal government support for flood risk reduction actions, voter support for flood risk reduction funding, and resident support for flood preparedness efforts. For this effort state and federal government should provide consistent language and outreach program tools for increasing public awareness, provide online catalogued information about flood risk programs, grants, and related topics, promote the availability of this information, and share research data.
3. Increase support for flood emergency preparedness, response, and recovery programs to provide effective and comprehensive emergency preparedness, response, and recovery. State and federal strategy will be to provide funding and support for increased coordination, develop or improve Emergency Management Plans, conduct emergency exercises statewide, increase local participation in flood fight training, and identify data and forecasting needs.
4. Encourage land use planning practices that reduce the consequences of flooding to reduce risk to people, property, and economies in floodplains. Strategies include working with land use professionals to develop planning principles facilitating determination of flood risk, facilitating regular coordination at all levels, and linking flood project funding to use of best floodplain management practices.
5. Implement flood management from regional, system-wide, and statewide perspectives to provide multiple benefits through use of Integrated Water Management (IWM). The approach would be to identify regional flood planning areas consistent with watersheds, agency jurisdictions, and existing Integrated Regional Water Management Plan funding areas. (Integrated regional water management is the application of IWM principles on a regional basis.)
6. Increase collaboration among public agencies to foster innovative solutions, improve planning and permitting, develop high-value multiple-benefit projects, and prioritize investment needs. Strategies would be to establish regional working groups that focus on planning and implementing flood management projects, provide funding and credit for regional planning directed toward multiple-benefit or watershed-based projects, and develop a method of prioritizing and implementing flood management investments.
7. Establish sufficient and stable funding mechanisms to reduce flood risk, eliminate the backlog of identified but unfunded projects, and avoid much larger future costs for flood recovery. State and federal agencies should assess the applicability of potential funding sources, propose new funding options, develop a catalog to improve local access to information on state and federal funding sources, and increase funding for regionally based IWM flood management projects.

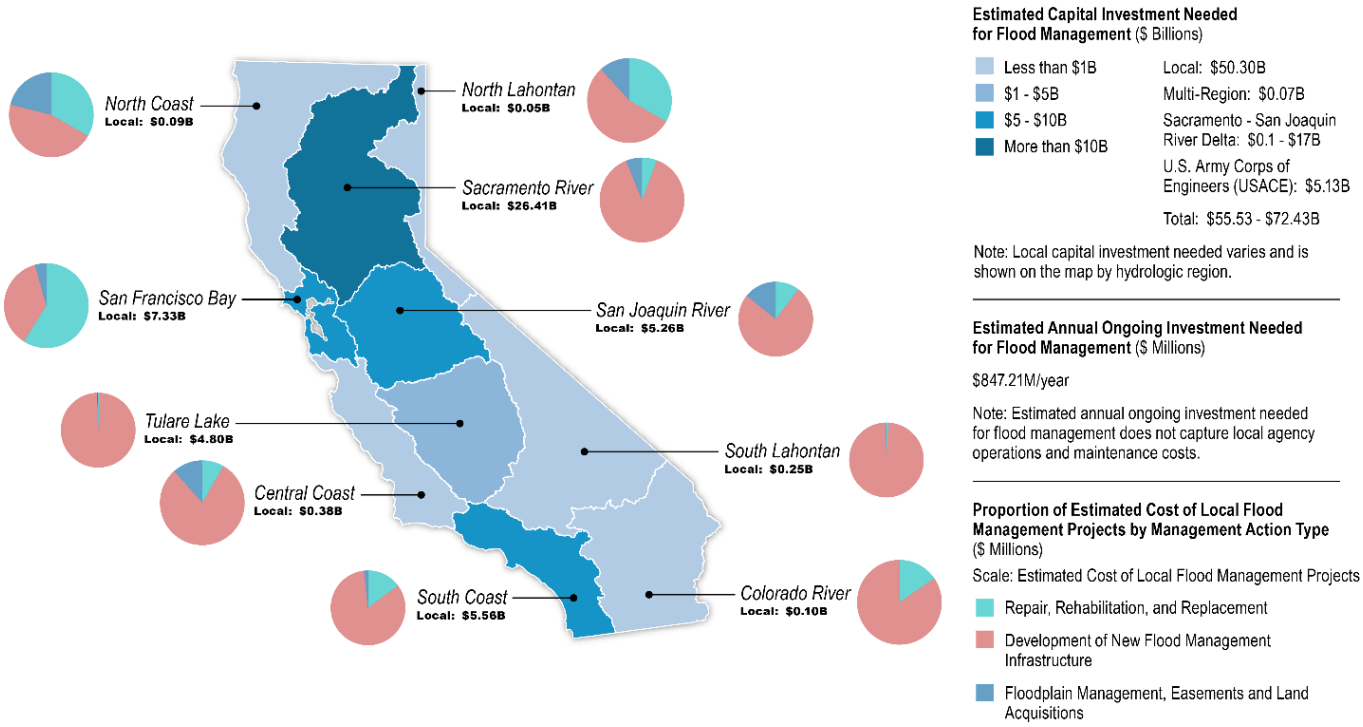
Building upon "California's Flood Future", DWR is developing a new report "Investing in California's Flood Future: An Outcome-Driven Approach to Flood Management." This new report will expand understanding related to all of the recommendations from "California's Flood Future", while describing the investment levels required to achieve the intended outcomes necessary to move the state's flood management system toward sustainability. Supporting documents for this new report will focus on establishing sufficient and stable funding mechanisms to reduce flood risk, and evaluating how public understanding of flood risk regulatory and environmental compliance processes, and agency alignment affect funding for flood management. "Investing in California's Flood Future" also outlines an outcome-driven approach for flood management.

As part of "Investing in California's Flood Future", more than 240 public agencies responsible for flood management in California were interviewed. This information gathering effort identified flood risk reduction opportunities for operations, maintenance, and capital improvements, including more than $72 billion for proposed capital flood risk reduction management actions and more than $845 million per year for ongoing flood risk reduction management action in California, as shown in Figure 7.C. Over the next decade, investments should focus on high-priority actions, such as:

- Institutional capacity, baseline operations, and routine maintenance
- Floodproofing, risk awareness, planning, studies, and mapping
- Maintenance, repair, rehabilitation, and replacement of existing infrastructure
- Development of new flood management infrastructure

More information on *California's Flood Future* can be found at: https://www.water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies.

Figure 7.C: Flood Risk Reduction Opportunities in California



Source: Investing in California's Flood Future: An Outcome-Driven Approach to Flood Management

Flood Management System: Floodplain Risk Management

Floodplain risk management programs, with the help of government partners, develop guidance and technical tools that promote sound floodplain management to reduce the risk of flooding and educate the public about flood risk. These activities occur at a regional or statewide scale.

Through FEMA's Community Assistance Program, DWR provides technical assistance to communities participating in the National Flood Insurance Program (NFIP). This technical assistance includes about 31 Community Action Visits per year to local communities, 12 workshops, and 3,000 to 4,000 hours of technical assistance to agencies and individuals. This assistance provides support for these communities in making wise land use decisions in floodplains, which reduces flood risk and preserves the beneficial uses of floodplains (e.g., groundwater recharge, native species habitat).

Additionally, in order to geographically identify population and assets at risk from flooding, DWR has invested in several floodplain mapping efforts, including in the Central Valley, at the coast, and in alluvial fans statewide. As a result, extensive mapping and hydraulic analyses have been provided for areas protected by the SPFC, high-resolution imagery has been developed for the California coastal shoreline, and maps characterizing the geologic conditions of California's alluvial fans are available.

Flood forecasts have greatly improved California's climate data collection and evaluation, and warning efforts. Information is shared and exchanged with local, state, and federal partners and the public through the California Data Exchange Center (CDEC).

Floodplain risk management projects and programs include the following:

- Local agencies and the USACE were actively involved in DWR's evaluation of 1,914 miles of levees in urban and non-urban communities, ensuring that all partner agencies agreed on evaluation criteria and findings.

- Levee evaluation processes, analyses, reports, and points of interest are available online at a single website (http://www.dwr-lep.com/auth) for partner agencies and the public, providing easier access to this information.

- The 200-year flood information maps released in 2013 help protect over 1 million Californians and provide the technical information that urban areas require to incorporate flood management into their general plans.

- The state's first-ever high-resolution imagery of 6,145 miles of California's coast provides a tool that can lead to consistent regulatory guidance for coastal communities. This imagery can streamline identifying sensitive ecological habitats as well as approximately $40 billion in assets along the coast.

- High-resolution maps of 35,000 square miles in 10 Southern California counties help identify potential flood risk for local communities.

- Preliminary 100-year flood hazard maps developed for alluvial fan areas in Riverside and Ventura Counties can be used by local agencies to help protect the public from the flashy and unpredictable flood flows typical of alluvial fans.

- Incoming atmospheric rivers can be tracked and the amount of moisture moving into the state quantified, so state, federal, and local agencies can inform the public about potentially destructive storms in advance of their arrival.

- Information exchanged through CDEC is essential for flood management operations and effective management of hydroelectric power generation, water supplies for irrigation, municipal and industrial uses, and environmental requirements.

- Forecasts produced by DWR are used by regulatory agencies and most water suppliers to set standards statewide, as well as to determine water allocations affecting most Californians.

Flood Management System: Flood Risk Reduction Projects

Flood risk reduction projects provide funding, direction, and oversight for repairing and improving flood management facilities to reduce flood risk, using both structural and nonstructural methods. Major activities include: planning, design, and overseeing construction of flood management projects sponsored by the Central Valley Flood Protection Board (CVFPB), local agencies, and the USACE for the SPFC, as well as locally led flood management projects statewide and in the Delta.

The program includes projects that provide advance environmental mitigation for the SPFC to aid project delivery and enhance ecosystems associated with the flood system. The following projects and programs further flood mitigation efforts through inter-agency, and state and local, collaborative efforts:

- *South Sacramento Streams:* This project increases flood protection from a 50-year level to greater than a 100-year level of protection for approximately 70,000 people and a billion dollar worth of infrastructure, including a wastewater treatment plant and transportation corridors. The project will provide financial relief to property owners paying high-cost flood insurance. Partners for this project include the USACE, DWR, Central Valley Flood Protection Board, Sacramento Area Flood Control Agency, City of Sacramento, and County of Sacramento. More information on this project can be found at: http://www.safca.org/Programs_SoSacStreams.html.

- *American River Watershed Project (includes Folsom Dam Joint Federal Project, American River Common Features, and Natomas Basin):* The new auxiliary spillways at Folsom Dam will improve the ability of the dam to manage large flood events by allowing more water to be safely released in advance of a major storm event, resulting in more storage capacity remaining in the reservoir to hold back peak inflow for later use. Fish and other species will benefit from more consistent flows. The project provides at least a 200-year level of protection for 350 square miles of the greater Sacramento area.

More information on this project can be found at: http://www.spk.usace.army.mil/Portals/12/documents/civil_works/CommonFeatures/ARCF_GRR_Final_EIS-EIR_Jan2016.pdf.

- *Urban Flood Risk Reduction:* The DWR Urban Flood Risk Reduction Program was created to address state investment priorities for urban areas. The program supports the implementation of regional flood damage reduction projects for urban areas in the Sacramento and San Joaquin Valleys protected by the State Plan of Flood Control (SPFC). All projects are designed to achieve protection from a 200-year flood. The program works with urban local agencies to plan, design, and construct flood risk reduction projects. Funding for these projects is provided through Proposition 1E. Projects supported by the program, as of late 2017, include the Sutter Butte Flood Control Agency, Sacramento Area Flood Control Agency, San Joaquin Area Flood Control Agency, West Sacramento Area Flood control Agency, Three Rivers Levee Improvement Authority, City of Lathrop, City of Woodland, and RDs 537, 785, and 827 (Lower Elkhorn Basin). Total funding for these projects is about $566 million.
  More information on Urban Flood Risk Reduction Program can be found at: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Urban-Flood-Risk-Reduction.

- *Yuba Feather Flood Protection:* The primary objective of this DWR program is to provide support to local agencies to reduce flooding and improve public safety. The program offers financial assistance to flood projects within the areas of the Yuba, Feather, and Bear Rivers, as well as Colusa Basin Drain. The program supports feasibility, design, and construction projects.

- *Flood Control Subventions:* This DWR program provides cost-share financial assistance to non-federal partners of federally authorized projects generally located outside of the Central Valley.
  More information on this program can be found at: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Control-Subventions-Program.

- *Urban Streams Restoration:* This DWR program provides grants to local communities for projects that reduce flooding and erosion and associated property damage; restore, enhance or protect the natural ecological values of streams; and promote community involvement, education, and stewardship.
  More information on this program can be found at: https://water.ca.gov/Programs/Integrated-Regional-Water-Management/Urban-Streams-Restoration-Program.

- *Small Communities Flood Risk Reduction Program:* Created as a result of the adoption of the 2012 Central Valley Flood Protection Plan (CVFPP), 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 (SPFC) facilities, as well as for legacy communities. The Program provides State funding assistance to small communities with 200 to 10,000 residents that are protected by the SPFC, as well as to Legacy communities.

- *Flood Corridor Program:* This DWR program provides cost-share grants to local agencies and non-profit organizations throughout the state for multi-benefit projects that reduce flood risk by restoring natural floodplains and reconnecting rivers and streams to their historic floodplains.

  The Flood Corridor Program includes three flood protection grant programs:
  - Flood Protection Corridor Program authorized and funded under Propositions 13 and 84
  - Floodway Corridor Program authorized and funded under Proposition 1E
  - Central Valley Nonstructural Grants Program authorized and funded under Proposition 1E

  Any local agency or non-profit organization with interest in flood management issues is eligible to sponsor projects under Flood Corridor Program that seek to acquire, restore, enhance, and protect real property for the purposes of flood control protection and agricultural land preservation and/or wildlife habitat protection. This includes California Native American Tribes that are registered as a non-profit organization or that partner with

a non-profit or local public agency. Sponsoring agencies or other organizations that meet the criteria can partner with other types of agencies and organizations, as necessary, to ensure diverse funding sources and necessary expertise on the project team.

Fundable activities under the Flood Corridor Program include:

- Non-structural flood damage reduction projects within flood corridors
- Acquiring real property or easements in a floodplain
- Acquiring and removing of structures from flood-prone areas
- Setting back existing flood control levees or strengthening or modifying existing levees in conjunction with levee setbacks
- Preserving or enhancing flood-compatible agricultural use of real property
- Preserving or enhancing wildlife values of real property through restoration of habitat compatible with seasonal flooding
- Repairing breaches in the flood control systems, water diversion facilities, or flood control facilities damaged by a project developed pursuant to Chapter 5, Article 2.5 of the Clean Water, Watershed Protection and Flood Protection Act of 2000
- Establishing a trust fund for up to 20 percent of the money paid for acquisitions to generate interest in maintaining the acquired lands
- Paying the costs associated with the administration of projects

Funding under this program is intended to be used for acquisition, restoration, enhancement, and protection of property while preserving agriculture and enhancing wildlife habitat in and near flood corridors. More information on this program can be found at: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Corridor-Program.

Flood Management System: Flood System Operations and Maintenance

This DWR program operates, maintains, and repairs specific levees, channels, weirs, gates, pumping plants, and bridges of SPFC facilities. Operation and maintenance of the SPFC is the joint responsibility of DWR and local maintaining agencies. The program is responsible for maintaining approximately 300 miles of SPFC levees and all Sacramento River SPFC channels. Local maintaining agencies are responsible for the remaining levees, as well as San Joaquin River SPFC channels. Flood system operations and maintenance projects and programs include:

- *Flood control facilities evaluation and rehabilitation:* This program evaluates, operates, maintains, and repairs SPFC facilities including 11 weirs, 5 gate structures, 13 pumping plants, and specific bridges associated with the SPFC.
- *Channel evaluation and rehabilitation:* This program operates, maintains, and repairs approximately 1,200 miles of SPFC channels. Specific activities include inspecting and evaluating channels and developing and using hydraulic models to identify areas within channels that require sediment or vegetation removal to maintain channel capacity and functionality.
- *Levee operations and maintenance components:* This program focuses on ongoing maintenance of specific levee structures in the SPFC to help ensure these levees will perform satisfactorily during high water events.

More information of these projects and programs can be found at: https://www.water.ca.gov/Programs/Flood-Management.

Flood Management System: Flood Emergency Response

This DWR program includes annual training; proactive preseason coordination with cooperating agencies; annual review; replenishment of supplies, thorough documentation; dedicated data collection and information dissemination; and continued efforts to improve all aspects of emergency response program performance. The program conducts functional exercises within DWR and joint exercises with local, state, and federal agencies and supports local preparedness efforts.

DWR's flood emergency response effort also provides information about the integrity of SPFC levees, channels, and structures through coordination and collaboration with local maintaining agencies and the Central Valley Flood Protection Board (CVFCB). This information improves DWR's ability to annually assess the integrity of the SPFC. The data provides valuable information for use by emergency responders and local levee maintaining agencies, as well as for flood system repair and enhancement.

The storm events of January and February 2017 caused widespread damage to a number of levees in the State Plan of Flood Control (SPFC). As described in the Central Valley Flood Protection Plan (CVFPP), local maintaining agencies and DWR, along with the U.S. Army Corps of Engineers (USACE), are responsible for maintaining the integrity of the SPFC levees, bypasses, and other facilities to continue to protect California's Central Valley. In 2017, DWR repaired 30 sites and the USACE repaired 22 sites. Additional sites are anticipated to be repaired in 2018.

Specific flood emergency response projects and programs include:

- *Hydro-climate data collection and precipitation runoff forecasting:* This program provides real-time data collection and dissemination through DWR's California Data Exchange Center (CDEC) and predicts the annual amount of runoff from Sierra snowpack that has direct implications for the state's water supply. Information collected by DWR and its partners and exchanged through CDEC is essential for flood management operations and effective management hydroelectric power generation, water supplies for irrigation, municipal and industrial uses, and environmental requirements. Forecasts produced by DWR are used by regulatory agencies and most water suppliers to set standards, as well as to determine water allocations affecting most of the population in California.

- *Real-time conditions status and warning:* This program inspects SPFC facilities to assess maintenance practices, assesses and documents the integrity and vulnerabilities of the SPFC, and provides a centralized database to store, process, and exchange real-time hydrologic information gathered by DWR inspectors and various partners throughout the state. CDEC also provides flood system conditions data and, historical information, and serves as the backbone for flood emergency response for local, state, and federal partners.

- *River forecasting and reservoir operations:* In collaboration with the National Weather Service (NWS) and the California-Nevada River Forecast Center, this program provides year-round daily forecasts of reservoir inflows, river flows, and water levels throughout California and much of Nevada. These forecasts are used by emergency responders to anticipate and prepare for flood conditions. During high water events, federal and state river forecasters work around the clock to monitor real-time changes in the larger rivers and estuaries of California's and Nevada.

  Through this program, DWR works to enhance early warning systems by improving lead time and filling-in data voids with regard to flood forecasts. In collaboration with NWS and the California Nevada River Forecast Center, this program is responsible for monitoring storms, preparing river and reservoir inflow forecasts, and issuing bulletins. Forecast-coordinated operations programs are being developed and enhanced for reservoirs in the San Joaquin and Sacramento River Basins. Coordinated operations give reservoir operators the ability to make smaller, controlled releases in advance of major storms, allowing for more water supply storage during the winter flood season. These activities help minimize the risk of exceeding river channel capacity and increase the warning times to communities along major California rivers and downstream of reservoirs.

- *Flood Emergency Response Grant Programs*: DWR offers three grants in the Flood Emergency Response Projects Grants Program. The Delta Emergency Communications Equipment Grants were awarded in 2012. The Flood Emergency Response Projects Statewide Grants (first round) were awarded in September 2013. Additional funding was made available for a second round of Statewide Grants, which were awarded in September 2015. More information on the flood grant programs can be found at: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Emergency-Response-Projects-Grants.

- *Flood Fighting:* The Department of Water Resources (DWR) and the U.S. Army Corps of Engineers (USACE) have been using specific flood fighting methods for many years. DWR provides training in flood fighting methods to local and regional agencies throughout the state, including the California Conservation Corps and California Department of Forestry and Fire Protection (CAL FIRE). While most of these methods are designed to be used to protect levees, others have been adapted to defending homes and other structures from floodwaters and debris flows. These measures are temporary, however, and cannot be expected to last for extended periods of time.

DWR has published two instructional documents on flood fighting methods.

- For levee-oriented methods, see the "Flood Fighting Methods" document at: http://www.water.ca.gov/floodmgmt/docs/flood_fight_methods.pdf. This document is also available in Spanish.

- For home- or structure-oriented methods, see "How to Fight Flooding At Home" at http://www.water.ca.gov/floodmgmt/docs/brochure_floodfightingathome.pdf. For specific mitigation ideas related to floods, see "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" January 2013, prepared by FEMA, available on the FEMA website: http://www.fema.gov/library/viewRecord.do?id=6938.

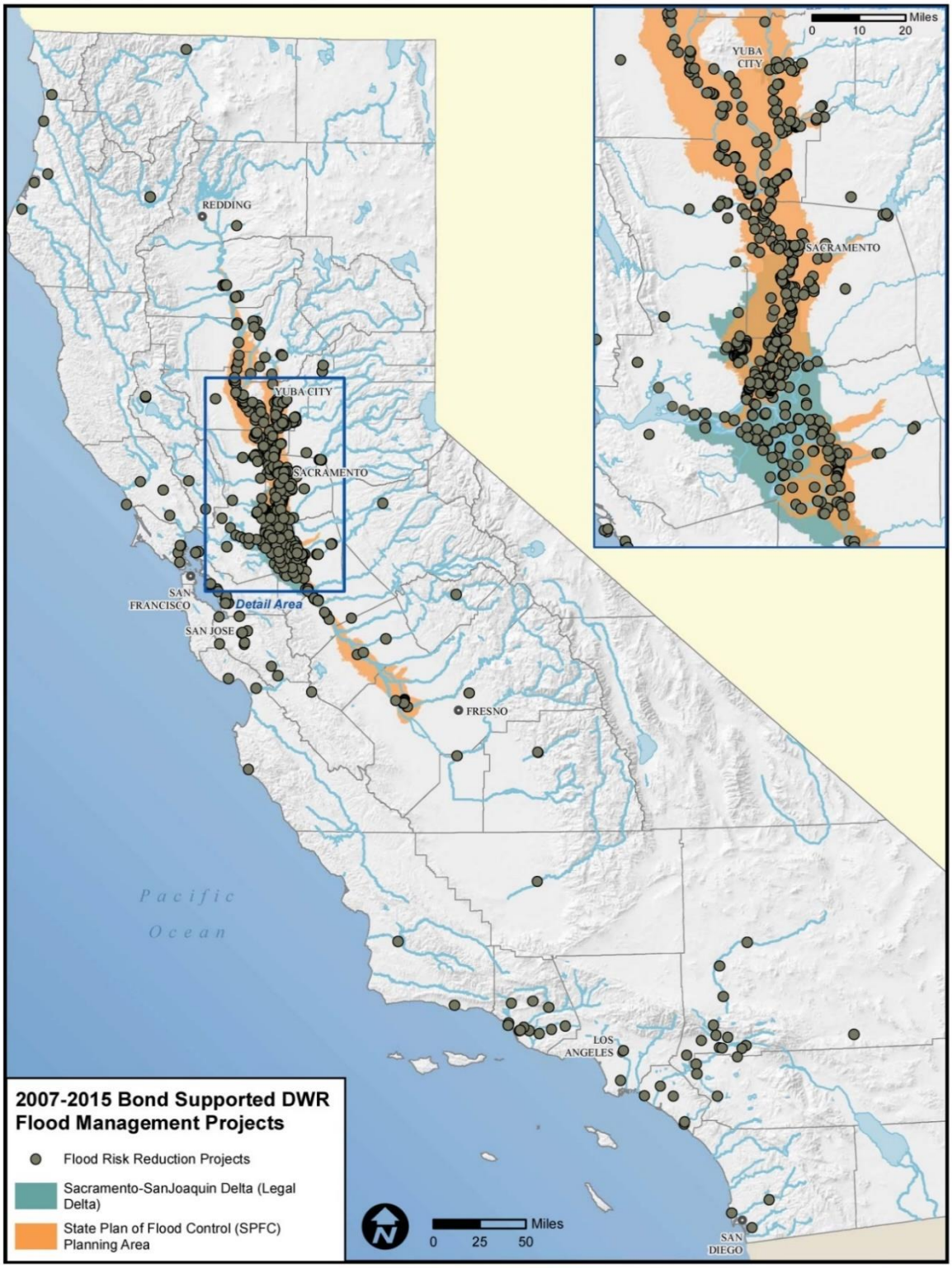
More information on these projects and programs can be found at: http://cdec.water.ca.gov.

DWR Flood Management Grant Programs

DWR administers 11 cost-sharing flood management grant programs. Benefits of DWR's grant programs in promoting flood mitigation progress include the following:

- With 12 projects completed or in progress and approximately 100 miles of levees repaired or improved to date, flood protection has increased to a 200-year level of protection for more than a half million Californians.
- Three transportation corridors (Interstate Highway 5, Interstate Highway 80, and California Highway 99) that are critical to California's economic wellbeing are now better protected from catastrophic flooding.
- Flood protection has significantly improved for Sacramento, which remains among the most at-risk cities in the country for "Katrina-like" flooding.
- With 38 projects completed or in progress and approximately 150 miles of levees repaired or improved, almost 300 square miles that include agricultural land and historic Delta communities have improved flood protection.
- Flood protection projects in the Delta that prevent saltwater intrusion into the State Water Project have helped safeguard the water supply for more than 28 million Californians.
- Flood protection has improved for approximately 100,000 Californians living in the Delta, along with native species habitat, and three key transportation corridors and utility infrastructure that cross the Delta.
- More than 27 million Californians benefit directly or indirectly from DWR grant funded projects—e.g., watershed sensor arrays that provide a broad range of data that allow local agencies to make better decisions earlier in potential flood emergencies.
- Local agencies can use the watershed sensor system to exchange information, improve emergency coordination, and communicate emergency information to the public.
- Almost 4 million people benefit directly from the interoperable communications equipment that was purchased and can be used for all emergencies, e.g. floods, fires, and earthquakes.
- Delta communities are better prepared through local flood management agencies receiving flood fight and Standardized Emergency Management System training and updated warning systems, as well as through emergency response plans.

Map 7.K: Projects of Central Valley Flood Protection Plan



Source: CA DWR, Bond and Legislative Suite Summary: Implementing Improved Flood Protection, Draft June 30, 2016

Map 7.K shows the location of DWR bond-supported flood management projects implemented from 2007 to 2015.

Investing in Flood Management

The January 2016 California Water Action Plan highlighted the continued need for broad and integrated solutions for addressing California's complex water management issues. The 2016 California Water Action Plan update provides additional guidance toward achieving sustainable flood and water management in California. It emphasizes collaboration and alignment across all levels of government, support for local and regional entities in addressing local and regional issues, and integrated-multi-benefit programs throughout the state.

Today aging built and natural flood management infrastructure, climate change with accompanying sea level rise, and growth in the floodplains create some of the pressures on the state-owned flood management system in the Central Valley and locally managed flood systems around the state. Consistent with the 2016 California Water Action Plan update, the next phase of flood management system improvement implementation will emphasize investment in:

- Expansion of the flood management system to ensure system resiliency, enabling the system to carry larger floods and manage increased runoff resulting from climate change
- Continued implementation of integrated multi-benefit projects and programs
- Increased level of protection for urban areas and small communities
- Conservation of forest and agricultural areas
- Improved operations and maintenance practices with streamlined regulatory permitting

Table 7.C summarizes flood management investments from 2007 to 2017.

Table 7.C: Flood Management Bond Expenditures by Program*

Flood Management Programs	Commitments and Expenditures, July 2006 through June 2016 ($ Millions)	Planned Investment, 2015-2017 ($ Millions)	Total Investment, 2007-2017
Flood Emergency Response	$123	$68	$191
Flood Systems Operations and Maintenance	$24	$17	$41
Flood Plain Risk Management	$116	$7	$123
Flood System Assessment, Engineering, Feasibility, and Permitting	$342	$53	$394
Flood Risk Reduction Projects			
System	$126	$251	$377
Urban	$1,170	$291	$1,461
Non-Urban	$110	$146	$256
Central Valley Total	**$2,011**	**$833**	**$2,843**
Elsewhere in the state	$754	$243	$998
Delta	$403	$116	$518
Non-Central Valley Total	**$1,157**	**$359**	**$1516**
STATEWIDE TOTAL	*$3,168*	*$1,192*	*$4,359*

**Reflects Propositions 1E and 84 only*
Source: DWR, Bond and Legislative Suite Summary: Implementing Improved Flood Protection

Flood Management Responsibilities and Infrastructure

Responsibilities for managing flood risk and responding to floods have evolved over time. In the early decades after the state's founding, flood management fell primarily to private entities. Local landowners would build levees—with varying strategies, materials, and methods—to direct and divert rivers, streams, and floodwaters. Major flood disasters in the late 1800s and early 1900s, however, spurred the state and federal governments to play greater

roles, including developing and implementing flood management policies and constructing public flood control infrastructure.

Local, state, and federal agency flood-related responsibilities, along with flood management infrastructure, are summarized below. In addition to these agency responsibilities, individual citizens also have a responsibility to plan, prepare, and take individual actions to reduce flood risks for themselves, their families, and their properties.

Local Flood Management Responsibilities

Cities, counties, and special districts (such as reclamation or flood control districts): conduct various activities including constructing, maintaining, and improving levees and flood management structures; developing land use polices; developing disaster mitigation and emergency response plans; leading emergency response and recovery efforts; and levying assessments on landowners to fund local flood management efforts.

State Agency Flood Management Responsibilities

The California Department of Water Resources (DWR) conducts flood forecasting, hydrology, and climatology studies; undertakes statewide flood management data collection and planning; inspects, oversees maintenance of, and in some cases constructs projects on State Plan of Flood Control (SPFC) levees; operates and maintains SPFC channels and other structures, as well as non-SPFC structures including dams; implements flood-related state grant programs; and helps coordinate emergency flood response operations.

The Central Valley Flood Protection Board (CVFPB) has the authority to decide whether appropriate standards are met for the construction, maintenance, and protection of SPFC facilities and floodways in the Central Valley.

The California Governor's Office of Emergency Services (Cal OES) assists counties in responding to floods and provides coordination, assistance, and funding for state-declared flood emergencies.

Federal Agency Flood Management Responsibilities

The U.S. Army Corps of Engineers (USACE) undertakes and authorizes changes to capital flood protection projects when authorized by Congress, generally in partnership with state and local agencies (including SPFC levees); periodically inspects federally constructed levees for compliance with federal standards; provides planning and assistance to state and local agencies, including during flood events; provides funding to repair eligible flood-damaged levees and structures under Public Law 84-99; provides emergency flood response when requested by the state; and establishes flood storage and release standards for certain reservoirs.

The Federal Emergency Management Agency (FEMA) operates the National Flood Insurance Program (NFIP), which includes developing flood hazard maps that define flood risk, establishing floodplain management standards, and offering federally backed insurance policies. FEMA also provides coordination, assistance, and funding for federally declared flood disasters.[147]

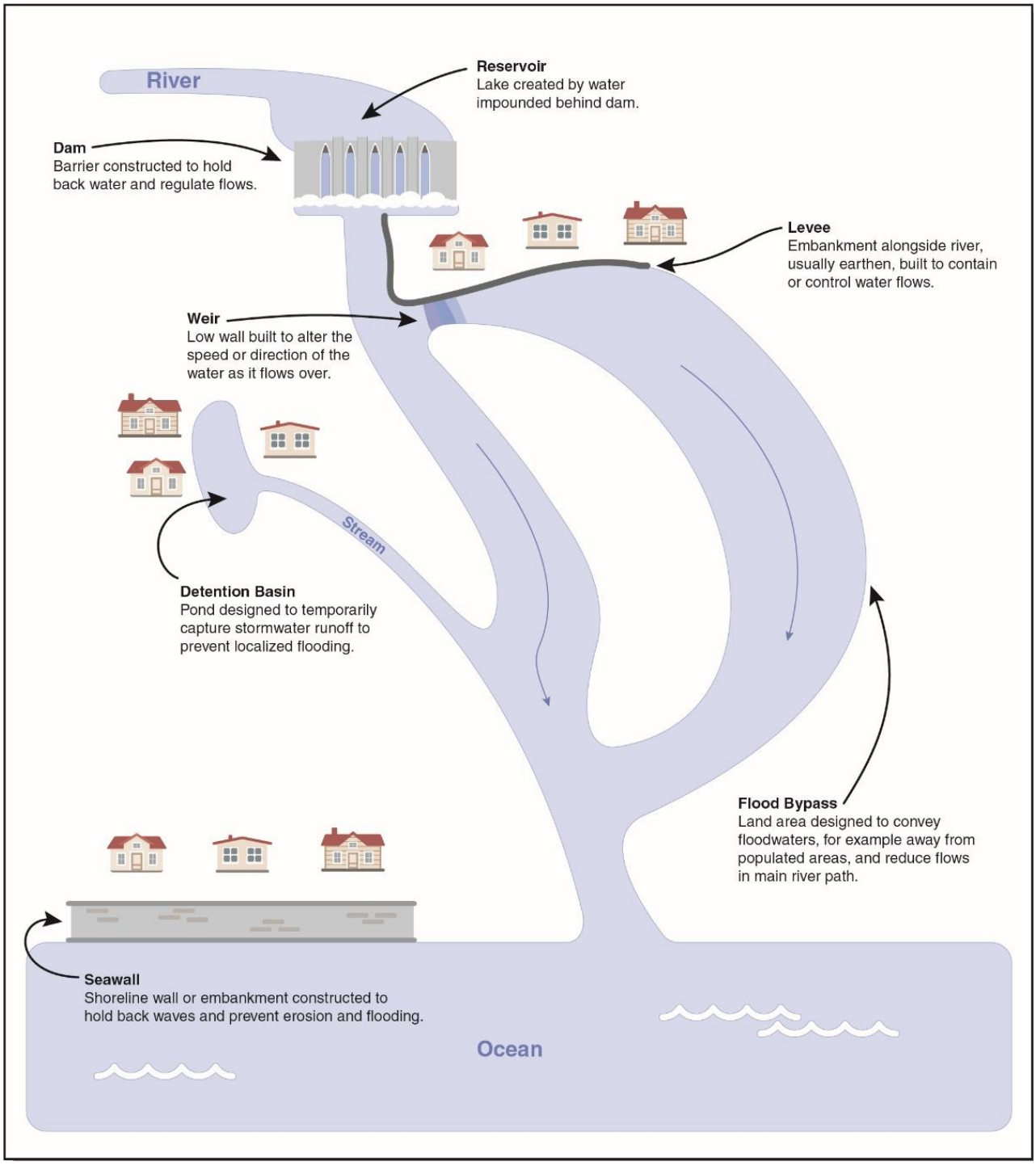
Flood Management Infrastructure

Local, state, and federal agencies have developed a variety of physical structures to convey and control water flows and floodwaters. Such structures include levees and floodwalls, channels, weirs, and culverts. Flood management infrastructure in the state includes more than 20,000 miles of levees and channels and more than 1,537 dams and reservoirs (with approximately 1,250 of these dams being under state jurisdiction). The SPFC includes about 1,600 miles of levees, five major weirs, 13 major drainage pumping plants, and seven bypasses that are used to divert water during periods of high flow. Additionally, flood management structures such as dams and reservoirs frequently are used for water supply purposes.

Figure 7.D provides a diagrammatical representation of various flood management structures and their inter-relationships. Map 7.L details the system of levees and bypasses within the State Plan of Flood Control (SPFC).

[147] Legislative Analyst Office Report "Managing Floods in California" (March 2017) http://lao.ca.gov/reports/2017/3571/managing-floods-032217.pdf

Figure 7.D: Key Flood Infrastructure Components

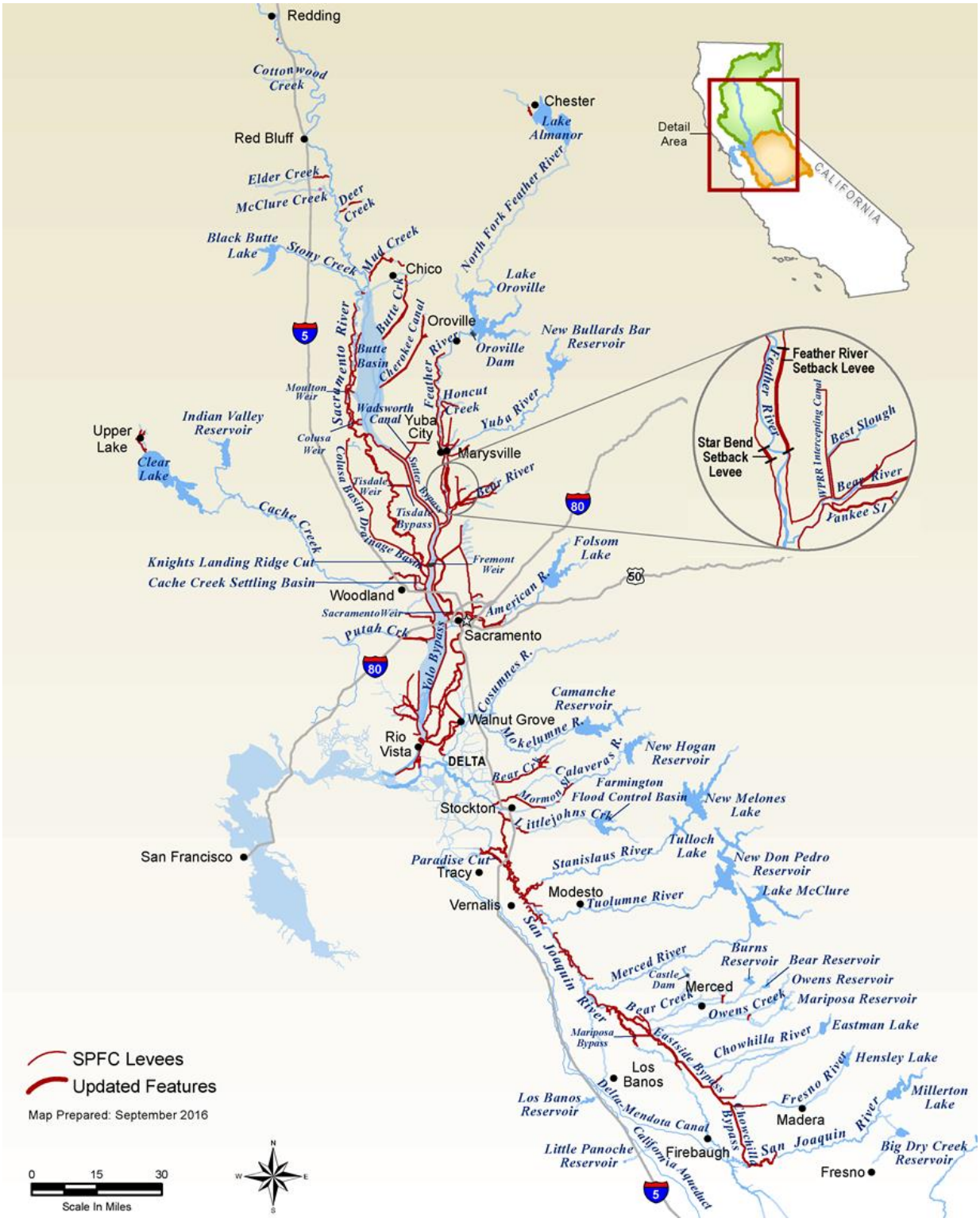


Source: California Legislative Analyst Office (http://lao.ca.gov/reports/2017/3571/managing-floods-032217.pdf)

Flood managers also use detention and retention basins, dams and reservoirs, and bypasses to collect or store water and thereby regulate flood flows. Seawalls and breakwaters are used to armor the shoreline against coastal flooding. Physical structures (e.g., levees and weirs) are also sometimes paired with non-structural approaches (e.g., wise use

of floodplains) for flood management. Additionally, flood management structures such as dams and reservoirs frequently are used for water supply purposes.

Map 7.L: State Plan of Flood Control Levees and Bypasses



Source: California Department of Water Resources

7.1.5.3 CALIFORNIA SILVER JACKETS PROGRAM

DWR continues engaging in various projects that help align federal, state, and local agencies' activities and strengthen flood mitigation efforts through communication and coordination, such as DWR's role co-leading the federally facilitated California Silver Jackets Team. The Silver Jackets Team focuses on reducing flood risk through non-structural measures and agency coordination. Goals of the Silver Jackets are to increase inter-agency cooperation in flood risk mitigation, promote flood hazard risk education and information sharing, identify and eliminate flood risk management barriers, and build on existing efforts for potential future actions. The Silver Jackets joint mission is the protection of life and property by building partnerships to work together to identify and plan for flood risk.

As a collaborative program, the California Silver Jackets program is led by the California Department of Water Resources (DWR) and empowered and supported by the U.S. Army Corps of Engineers (USACE). The program also includes the California Governor's Office of Emergency Services (Cal OES) and local California flood control/mitigation agencies.

Other federal participating agencies making up the Silver Jackets Team include FEMA, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Bureau of Reclamation, the Natural Resources Conservation Service (NRCS), and the U.S. Geological Survey (USGS).



Silver Jackets Team Charter Signing Ceremony, September 2016
Source: U.S. Army Corps of Engineers photo by Terri Rorke

In 2013, California became the 40th state to join Silver Jackets, and a formal team charter with about 15 agencies or umbrella (group) organizations was signed in September 2016. The ceremonial charter signing expanded team participation and served as a formal demonstration of the team's willingness to move forward.

The improved collaboration facilitated by the Silver Jackets will help to make project implementation easier and to enable local agencies to connect directly with state and federal agencies and provide "on-the-ground" information that improves the effectiveness of state and federal Projects. Silver Jackets Team outreach efforts such as California Flood Preparedness Week help to improve public understanding of flood risk around the state.

Current and future California Silver Jackets projects are non-structural, interagency projects that reduce flood risk and can be completed in 12 to 18 months. The following is a sampling of California Silver Jackets projects:

- *Flood Risk Education Project*. This project involved several agencies, organizations, and educators, including the U.S. Army Corps of Engineers (USACE), National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS), California Department of Water Resources (DWR), California Department of Education, Sacramento County Office of Education, Water Education Foundation/Project WET (Water Education for Teachers), and Green 360. This project increases awareness of flood risk, especially among children, to enable them to prepare for and take action in case of a flood emergency. Additionally, this project also improves USACE involvement in the science, technology, engineering, and math fields, as well as Common Core and Next Generation Science Standards. The products that emerged from this project include a Simulated Water Management Model. This interactive computer model promotes critical thinking through "simulation games" that can be played by middle and high school students. This project also resulted in a children's flood preparedness activity book for younger kids.

- *Watershed University*. Silver Jackets leads Watershed University, a free event for local communities that provides education and networking opportunities, with topics including water management, emergency management, flood risk reduction, and related fields. The California Watershed University enables communities to establish local flood risk awareness events and encourage citizens to take action. Prior to 2017, Watershed University was conducted using in-person two-day annual workshops, located in outlying areas such as Redding, Atwater, and West Sacramento. Since 2017, however, Watershed University has been conducted through monthly webinars with about 75 to 100 attendees per webinar, with a break during flood season. Participants can earn Continuing Education Credits for the Certified Floodplain Manager certification for attending. Past webinar topics include HMA grant information, Floodplain Management Plans, and an overview of "California's Epic Water Year 2017." One of the future webinars will focus on NOAA's E19 historical forecast point-impact information. For more information, see. http://water.ca.gov/watershed-university/.

- *California Flood Preparedness Week*. Since 2011, DWR through California Silver Jackets has organized a California Flood Preparedness Week during which several federal, state, and local government agencies in California join together to educate citizens about California's diverse flood types and encourage them to be aware, be prepared, and take action to reduce their flood risk. Every one of California's 58 counties has had at least one federally declared flood disaster in the past 20 years, and more than $575 billion in infrastructure and $7 billion in crops are exposed to flooding. Because flooding can happen at any time, the goals of this statewide effort are to increase public awareness of flooding and improve public safety for all Californians. In a related flood risk outreach effort, California Silver Jackets has developed a series of videos focused on riverine, coastal, and alluvial fan flooding and floods after wildfires. DWR also hosts a Flood Prepare California website that provides links to flood preparedness tools, weather resources, and flood risk videos: https://water.ca.gov/What-We-Do/Flood-Preparednes.

- *Conveying flood risk:* California participated in a FEMA four-year nationwide survey to ascertain the flood risk awareness of local officials and the public. While about two-thirds of local officials surveyed identified their community as being at risk of flooding, only about one-third of the public know of a community's flood risk. See: https://www.fema.gov/local-official-survey-findings-flood-risk.

- *FEMA-Led High Water Mark Initiative*. To improve the public's awareness of flood risk and encourage actions to reduce it, FEMA and seven other federal agencies developed the "Know Your Line: Be Flood Aware" initiative. The "Know Your Line" initiative helps communities showcase their local flooding history and motivate their residents to take action by posting high water mark signs in prominent places showing how high floodwaters have risen in the past. Communities are encouraged to hold a high-profile event to announce the initiative, followed by a wide range of supporting activities to remind residents of their flood risk over time and prompt them to take steps to reduce it. In California, the Cities of Sacramento and Roseville participated in the pilot program through California Silver Jackets. Other communities may use the information to expand this program to other cities. See: https://www.fema.gov/hwm-pilot-summary-cities-sacramento-and-roseville-ca.

- *Quick Response (QR) Code—Know Your Flood Risk*. This California Silver Jackets project was accomplished in partnership with USACE, DWR, and California State Parks, with a goal of increasing public and policymaker awareness of flood risk in California. The team produced an interactive, web-based tool using free, open-source software (ESRI Story Maps) and a flyer with a quick response (QR) code to send users to the digital product. The digital product is an interactive presentation that includes photos, maps, and videos designed to educate the audience on Sacramento's flood risk and history. The QR code can be scanned with a smart phone application so that users can go directly to the website without needing a link. Based on a pilot location, the Story Map was created to be geographically specific for Sacramento and surrounding areas. However, the content of the tool can be amended and targeted to other areas, with changes to text and graphics. DWR would like to expand this program to other cities. The ESRI story map can be viewed at: https://cespk.maps.arcgis.com/apps/MapJournal/index.html?appid=8e7c54b2d9cf4c3cb8de0a093d5509e3.

- *Levee Evaluation Study.* DWR and the USACE have embarked on a major study to evaluate the geotechnical adequacy of levees in California's Central Valley (Sacramento and San Joaquin River Flood Reduction Systems). The study provides communities with information about the status of levees and information about geotechnical characteristics, which influence floodplain and flood risk management decisions. Program benefits

include improved flood risk management decision-making and flood protection. Identifying and repairing deficient levees will reduce the potential of flooding and loss of life from flood events.

- *Regional Summaries of Local Hazard Mitigation Plans (LHMPs).* This project developed a database of identified projects from FEMA approved LHMPs from 16 counties, 63 cities, and 15 districts, which will identify flood risk reduction projects that align with federal and state priorities. By developing a database of projects identified by LHMPs, both federal and state agencies will be able to leverage the information in a summarized manner to help set project priorities, provide communities with grant information (other than HMA funding), and identify opportunities for collaboration. Updates to the database will occur as resources allow.
- *California Post-Wildfire Resources Guidebook and website*. This guidebook and website will increase public awareness of flood hazards that are present in areas affected by wildfire and will provide a "one stop" compendium of resources available from agencies responsible for hazard recognition and recovery. This is modeled after the New Mexico Silver Jackets effort.

For additional updated information about Silver Jackets programs, visit: http://silverjackets.nfrmp.us/State-Teams/California and http://water.ca.gov/SilverJackets.

7.1.5.4 OTHER FLOOD-RELATED PROJECTS AND PROGRAMS

Delta Working Group

The Delta Working Group was established in 2012 as a continuation of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force that was formed in response to Senate Bill 27, the Sacramento-San Joaquin Delta Emergency Preparedness Act of 2008.

The working group facilitates local, regional, state, and federal agency integration in addressing Delta flood issues, including coordination of preparedness and mitigation efforts. Working group participants include local maintaining agencies, Delta counties, Cal OES, the U.S. Army Corps of Engineers (USACE), the California Department of Water Resources (DWR), and others.

Alluvial Fan Task Force

In March 2007, DWR announced a partnership with the Water Resources Institute to coordinate the Alluvial Fan Task Force. The Director of DWR appointed 33 members to the task force including county supervisors, local flood managers, developers, land use/environmental groups and representatives of state and federal agencies.

Most recently the task force was charged with developing a model ordinance and local planning tools that would provide a framework to guide decisions regarding future land use on alluvial fans. Such guidance would be non-prescriptive and flexible allowing local governments to adapt it to local conditions and each development.

The model ordinance and local planning tools are aimed at ensuring public health, safety, and general welfare and minimizing public and private losses and damages that may result from the flood risks and related hazards posed by development located on alluvial fans while giving consideration to the beneficial floodplain area and other values that enhance the sustainability of watersheds.

Alluvial fans are created by the deposition of sediment moving from higher to lower elevations and they are common throughout Southern California. Alluvial fans tend to be popular places to build, but risks may be present including alluvial fan flooding, landslides, fires and other hazards that have long-ranging consequences for local governments.

In response to an Alluvial Fan Task Force recommendation, a study assessing post-fire runoff was conducted by the California Geological Survey (CGS) in collaboration with DWR, resulting in CGS Special Report 234 entitled "Assessment of Post-Fire Runoff Hazards for Pre-Fire Mitigation Planning – Southern California." This report is discussed in more detail in *Section 6.2.4* of the Landslide Hazard Risk Assessment.

To view the final reports and obtain additional information about the Alluvial Fan Task Force, visit: http://aftf.csusb.edu/.

Alluvial Fan Floodplain Evaluation and Delineation

The Alluvial Fan Floodplain Evaluation and Delineation (AFFED) project is one component of the California DWR FloodSAFE Initiative. As of late 2017, the AFFED project study area is limited to the 10 Southern California counties that participated in the Alluvial Fan Task Force. The AFFED project goals support the overall FloodSAFE goals. These include reducing flood risk to residents of California, their homes and property, the state's infrastructure, and public trust resources; developing a sustainable flood management system for the future; and reducing the adverse consequences of floods when they do occur.

To achieve these goals, the project will create preliminary maps of flood hazard boundaries for all alluvial fans within the 10-county study area. The mapping will rely on a methodology that includes the use of two-dimensional computer modeling techniques for the estimation of flooding extents.

Watershed Emergency Response Team

Post wildfire evaluation work on non-federal lands in California has been conducted by the California Department of Forestry and Fire Protection (CAL FIRE) in numerous ways over the past 60 years, beginning with Emergency Watershed Protection (EWP) assessments identify and mitigate hydrologic and geologic risk following wildfire. In 2007, CAL FIRE Watershed Protection Program staff developed a draft prioritization form for use in identification of fires that could present the highest risk to lives and property from post-fire hazards.

This approach was revisited in 2015, and has become the basis for the Watershed Emergency Response Team (WERT). WERTs are assembled with staff from primary agencies and other agencies and deployed to better coordinate local assistance to ensure a rapid response in identification of life safety and property downslope or downstream of burn areas at risk from post-fire flood or debris flows. For more information about WERT see *Section 6.2.4.*

Flooding at Discovery Park, Near Downtown Sacramento, During the January 2017 Winter Storms



Source: California Department of Water Resources

7.1.5.5 WATER MANAGEMENT AND ENVIRONMENTAL INITIATIVES

California Water Plan

The California Water Plan serves as the state's blueprint for integrated water management and sustainability. It details initiatives to ensure reliable water supplies and foundational actions for sustainable water use. It also provides an investment guide for the water community with an array of strategies to achieve multiple goals and benefits; integrates state government initiatives, objectives, and strategies; and incorporates consideration of uncertainties, risks, and resource sustainability into water and flood planning for the future.

The 2013 update was developed by DWR and other agencies through rigorous public involvement and state and federal agency coordination processes to build on the contents of the previous 2009 update. That update provided a strategic plan, a suite of resources management strategies, reports on California's hydrologic regions, and reference and technical guides and will introduce a number of key additional and enhancements in response to stakeholder recommendations and evolving decision-making information needs.

More information the California Water Plan and the in-progress 2018 California Water Plan update are available at: https://water.ca.gov/Programs/California-Water-Plan.

Delta Stewardship Council

The Delta Reform Act of 2009 created the Delta Stewardship Council (DSC), an independent state agency. The goals of the DSC are to provide a more reliable water supply for California and protect, restore, and enhance the Delta's ecosystem. These goals must be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. In 2012, the DSC developed a comprehensive management plan for the Delta (Delta Plan), which will include the Bay Delta Conservation Plan (BDCP) providing it is approved by state regulatory agencies and meets certain additional criteria. More information on the Delta Stewardship Council can be found at: http://deltacouncil.ca.gov/.

Bay Delta Conservation Plan/California WaterFix

The Bay Delta Conservation Plan (BDCP) is a 50-year, ecosystem-based plan designed to restore fish and wildlife species in the Delta in a way that also protects California's water supplies while minimizing impacts on Delta communities and farms. The BDCP is a multiyear collaboration effort among local water agencies, environmental and conservation organizations, state and federal agencies, and other interest groups. It serves as a natural community conservation plan (NCCP) under state law and a habitat conservation plan (HCP) under federal law which will support the issuance of permits from California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS).

The California Department of Water Resources (DWR), the Bureau of Reclamation, and those state and federal water contractors seeking to take authorizations for activities covered under the BDCP will have ultimate responsibility for compliance with the provisions of the BDCP and the associated regulatory authorizations. This group is referred to as the Authorized Entities and will work with the fish and wildlife agencies to implement the BDCP.

More information on the BDCP can be found at; http://baydeltaconservationplan.com/Home.aspx.

Progress Summary 7.F: Water Plans and the Delta

Progress as of 2018:

California Water Plan (2018 Update)

The 2018 California Water Plan update is in development, with ongoing Policy Advisory Committee and Tribal Advisory Committee meetings that are open to the public. The final 2018 update is planned for release in December 2018. A Tribal Water Summit held in April 2018 included topical material supporting the 2018 California Water Plan update. Tribal summits support integration of federal, state, and tribal mitigation planning.

More information on the progress of the California Water Plan update is available at: https://www.water.ca.gov/Programs/California-Water-Plan/Water-Plan-Updates.

Delta Stewardship Council

The Delta Stewardship Council (DSC) recently added a web page called the "Delta Plan Administrative Performance Measures Dashboard" that tracks implementation of programs recommended by the Delta Plan. The dashboard is sorted by agency, allowing the viewer to review progress for each agency. To view the Delta Plan Administrative Performance Measures Dashboard, go to: http://admin-measures-dashboard.deltacouncil.ca.gov/.

Bay Delta Conservation Plan/California WaterFix

The California WaterFix planning process began in 2006 when updates to the State Water Project (SWP) and coordinated operations of the Central Valley Project (CVP) were initially proposed as the Bay Delta Conservation Plan (BDCP). The BDCP envisioned updating the SWP by adding new points of diversion in the north Delta and complying with state and federal environmental regulatory processes through a 50- year habitat conservation plan.

In December 2013, the California Department of Water Resources (DWR), U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS) released the BDCP draft state and federal environmental regulatory documents.

In July 2015, DWR and the U.S. Bureau of Reclamation issued supplemental regulatory documents that included three additional alternatives that would update the SWP without the large-scale conservation efforts initially identified. These alternatives were proposed to achieve regulatory compliance through a different means that does not include the 50-year habitat conservation plan.

The lead agencies proposed that one of these new alternatives, known as California WaterFix (Alternative 4A), be identified as the preferred alternative in replacement of the previously identified alternative. In addition, the state proposed a separate program, California EcoRestore, to provide restoration efforts for species conservation independent of the SWP facility upgrades.

The California WaterFix Project consists of new water conveyance facilities with three new diversion points in the north Delta, tunnel conveyance and ancillary facilities, operational elements, and habitat restoration and other environmental commitments to mitigate construction- and operation-related impacts of the new conveyance facilities.

The BDCP final environmental review documents issued in December 2016 describe the alternatives, discuss potential environmental impacts, and identify mitigation measures that would help avoid or minimize impacts. They also provide responses to all substantive comments received during public review of the draft documents. In July 2017, DWR issued a Notice of Determination for the BDCP EIR, which identified Alternative 4a (California WaterFix) as the preferred alternative. Permitting efforts and full design work will occur through the end of 2018, with construction anticipated to begin in late 2018.

More information on this program can be found at: http://baydeltaconservationplan.com/FinalEIREIS.aspx. More information on the BDCP can also be found at: http://baydeltaconservationplan.com/default.aspx.

7.1.5.6 FLOOD HAZARDS MAPPING

Senate Bill (SB) 5 (2007) authorized the California Department of Water Resources (DWR) to develop the Best Available Maps displaying 100-year (1 percent annual chance) and 200-year (0.5 percent annual chance) floodplains for areas located within the Sacramento-San Joaquin Valley watershed. SB 5 (2007) requires that these maps contain the best available information on flood hazards and be provided to cities and counties in the Sacramento-San Joaquin Valley watershed. This effort was completed by DWR in 2008.

DWR has expanded the Best Available Maps to cover all counties in the state and to include 500-year floodplains. The 100- year (1 percent annual chance), 200- year (0.5 percent annual chance), and 500-year (0.2 percent annual chance) floodplains are displayed on a web viewer, found at http://gis.bam.water.ca.gov/bam/. The web viewer allows users to view a particular area and identify potential flood hazards.

Progress Summary 7.G: Senate Bill 1278—200-Year Floodplain Maps and General Plan Amendments

Progress as of 2018: As mandated by Senate Bill (SB) 1278 (2012), the California Department of Water Resources (DWR) developed and released 200-year informational floodplain maps for 10 urban communities within the Sacramento-San Joaquin Valley. The development of the maps met the legislative deadline of July 2, 2013. The maps provide information on the water surface elevation of flooding in urban areas in the event of failure of the State Plan of Flood Control (SPFC) facilities during a 200-year event.

The 10 urban communities are the following:

- Chico
- Yuba City and Marysville
- Woodland and Davis
- Merced
- Sacramento Metropolitan Area (Sacramento and West Sacramento)
- Stockton Metropolitan Area (Stockton and Lathrop)

SB 1278 (2012) also extended the date for cities and counties to amend their general plans and zoning ordinances to include certain floodplain information. The legislation required that general plans must be amended no later than July 2, 2015. The general plan amendments must include data and analysis contained in the 2012 Central Valley Flood Protection Plan (CVFPP), including the location of the facilities of the SPFC and locations of real property protected by those facilities. Additionally, general plans must include the locations of flood hazard zones mapped by the Federal Emergency Management Agency (FEMA) and flood hazard locations mapped by local flood agencies or flood districts. Cities and counties had an additional 12 months after their general plan amendments (or until July 2, 2016) to update their zoning ordinances to be consistent with the general plan amendments.

After these amendments (required to be completed no later than July 2, 2016), cities and counties will be required to make findings on whether they have achieved the level of flood protection stipulated in California Government Code Sections 65865.5, 65962, and 66474.5, or are making adequate progress using criteria developed by DWR. DWR has developed criteria in collaboration with cities, counties, other state entities, federal agencies, and associated professional organizations. For more information visit: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Urban-Flood-Risk-Reduction.

7.1.5.7 CODES AND STANDARDS

Progress has been made on the incorporation of standards for flood-resistant construction in the 2015 International Building Code and International Residential Code. Incorporation of standards for flood-resistant construction in these codes is a major step forward in implementing floodplain management at the local level.

For example, Section 1612.4 of the International Building Code states that the design and construction of buildings and structures located in flood hazard areas, including coastal high hazard areas and coastal A zones, shall be in accordance with Chapter 5 of ASCE/SEI 7-16, Minimum Design Loads for Buildings and Other Structures and with ASCE/SEI 24-14 Flood Resistant Design and Construction, which provides minimum requirements for flood-resistant design and construction of structures located in flood hazard areas.

The International Residential Code requires dwellings in floodways to be designed in accordance with ASCE 24-14 and includes an alternative that allows communities to require homes in any flood zone to be designed in accordance with ASCE 24-15. Highlights of ASCE 24-14 that complement the NFIP minimum requirements include provisions that address building performance; flood-damage resistant materials; utilities and service equipment and siting considerations.

The provisions of ASCE 24-14 are consistent with FEMA's NFIP performance requirements, and meet or exceed NFIP regulations. In comparison with NFIP requirements, ASCE 24: provides more specific requirements, incorporates the Coastal A Zone with foundation requirements; requires new construction and substantial improvement/damage construction to incorporate freeboard; and, requires dry floodproofing to include human intervention requirements.

For any FEMA-funded flood retrofitting project, complete compliance with ASCE 24 is preferred. Some requirements of ASCE 24 may be satisfied via a "deemed to comply" approach meeting the spirit of ASCE 24. Hazard Mitigation Assistance (HMA) funded elevation and dry floodproofing projects must comply with ASCE 24 regardless of whether they were "substantially damaged or they trigger substantial improvement." Additionally, any mitigation reconstruction projects proposed under HMA funding qualify as new construction and therefore must fully comply with ASCE 24.

7.1.5.8 PARTICIPATION IN NATIONAL FLOOD INSURANCE PROGRAM (NFIP)

U.S. Congress established the National Flood Insurance Program (NFIP) with the passage of the National Flood Insurance Act of 1968. The NFIP is a program administered by the Federal Emergency Management Agency (FEMA) enabling property owners in participating communities to purchase insurance as protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. In California, approximately 97 percent of California communities participate in the NFIP. For broader training, DWR provides statewide NFIP workshops annually.

California communities participate in the NFIP Community Rating System (CRS), which was implemented in 1990 as a voluntary program for recognizing and encouraging community floodplain management activities exceeding the minimum NFIP standards. Any community in full compliance with the minimum NFIP floodplain management requirements may apply to join the CRS. More information on DWR's management of California's NFIP and Community Rating System (CRS) can be found at: https://www.water.ca.gov/Programs/Flood-Management/Community-Resources/National-Flood-Insurance-Program.

As of 2017, there are 527 NFIP-participating communities throughout the state.[148] Also as of 2017, California had one of the largest NFIP policy counts in the nation, with over 238,000 NFIP flood insurance policies covering more than $68 billion of insured assets (not including other commercial coverage).[149] This policy count has increased by over 40,000 since 2013.[150] Table 7.D provides data on top 10 counties by number of NFIP policies. Coverage by county ranges from a low of 59 total policies to a high of over 53,000.

Table 7.D: Top 10 California Counties with NFIP Policies

	County	Number of National Flood Insurance Program (NFIP) Policies	Flood Insurance Rate Map (FIRM) Zone A Policies	Flood Insurance Rate Map (FIRM) Zone V Policies
1	Sacramento	53,859	23,384	0
2	Los Angeles	20,004	7,244	285
3	Orange	15,570	7,725	10
4	Santa Clara	15,508	12,883	0
5	San Diego	9,750	4,478	7
6	San Joaquin	8,263	1,755	0
7	Marin	8,262	4,726	107
8	Sutter	8,100	309	0
9	Tulare	7,472	3,592	0
10	Ventura	7,144	3,322	73

Source: Federal Emergency Management Agency, NFIP Insurance Report: California April 6, 2018

DWR provides the following services in support of the NFIP:

- Provides technical assistance, guidance, and NFIP training to local communities, other NFIP stakeholders, and federal and state agencies
- Acts as a resource for flood maps, technical data, and other general NFIP information
- Assists local floodplain administrators in maintaining community compliance and wise land use decision-making
- Supports the Community Rating System (CRS) and provides guidance and opportunities for communities to join and increase their participation
- Participates as an active partner in FEMA's Risk MAP Program
- Provides assistance to local communities and state agencies on FEMA grants
- Writes and edits white papers addressing floodplain management and other NFIP topics
- Provides assistance to the Cal OES and local communities on Local Hazard Mitigation Plans (LHMPs), general plans, and emergency management plans
- Pursues leadership roles and actively participates in national, state, and local floodplain management associations and organizations
- Coordinates with state and local agencies on flood management issues statewide
- Provides pre- and post-disaster support to federal, state, and local agencies and the general public[151]

Community Rating System Participation

The Community Rating System (CRS), part of the National Flood Insurance Program (NFIP), is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. This is done by providing flood insurance premium discounts to property owners in communities participating in the CRS program. Credit points are earned for a wide range of local floodplain management activities; the total number of points determines the amount of flood insurance premium discounts to policyholders.

[148] FEMA, 2017
[149] FEMA NFIP Policy and Claims Report, dated April 5, 2108
[150] FEMA Data Library, 2018
[151] Five-Year Floodplain Management Strategic Plan 2009-2013

Under CRS, communities that obtain a rating or 9 or better are awarded a premium discount ranging from 5 to 45 percent. For a CRS rating of 1, properties within the community receive a 45 percent discount on NFIP insurance premiums. Communities with a CRS rating of 5 are awarded a 25 percent discount. Under the CRS, flood insurance premium rates are discounted to reward community actions that meet the three goals of the CRS: 1) reduce flood damage to insurable property, 2) strengthen and support the insurance aspects of the NFIP and 3) encourage a comprehensive approach to floodplain management.

In California, eight communities have a CRS rating of 5 or better. Each built a floodplain management program tailored to its own particular hazards, character, and goals. Under these programs, each community carries out numerous and varied activities, many of which are credited by the CRS. The average discount in policyholder premiums varies according to a community's CRS rating, as described above, and the average amount of insurance coverage in place. According to FEMA, the "Best of the Best"[152] communities that hold the highest CRS ratings include two California communities: the City of Roseville and Sacramento County.

The City of Roseville in Placer County has the distinction of being the only community in the United States to achieve a CRS Class 1 rating, thus entitling policyholders to a 45 percent reduction in flood insurance premiums for properties located in Special Flood Hazard Area (SFHA). Floods in 1995 spurred Roseville to strengthen its floodplain management program. Today the city earns points for almost all CRS-creditable activities. The average premium discount for policies in the SFHA is $963.

Sacramento County, has steadily improved its rating since joining the CRS in 1992. Now a CRS Class 2 rating, the County's more significant activities are diligent public outreach on protecting waterways, purchasing flood insurance, and preparing for floods. The average premium discount in the SFHA is $395. The City of Sacramento has a CRS Class 5 rating, resulting in an NFIP discount of 25 percent.

As summarized in Table 7.E, in 2011, there were 173,922 NFIP flood insurance policies in CRS communities in California, representing a total of $124,209,085 in premiums paid by policyholders who realize $14,550,271 in savings from their communities' participation in the CRS. In 2017, the number of NFIP flood insurance policies increased by 65,029. Total premiums paid were reduced $34,617,217 from premiums paid in 2011, and savings resulting from CRS participation exceeded that of 2011. This is strong evidence of positive local-level flood management practices.

Table 7.E: Increases in Premium Savings Resulting from CRS Participation, Between 2011 and 2017

Year	National Flood Insurance Program (NFIP) Policies in Force	Total Premiums Paid by California Policyholders	Premium Savings as a Result of Community Rating System (CRS) Participation
2011	173,922	$124,209,085	$14,550,271
2017	238,951	$89,591,868	$14,749,350

Source: State CRS Summary: California, January 2012, https://water.ca.gov/LegacyFiles/floodmgmt/lrafmo/fmb/fas/nfip/crs/Links/doc/241_2012_California_State_Profile.pdf; FEMA Policy and Claim Statistics for Flood Insurance, https://www.fema.gov/policy-claim-statistics-flood-insurance

Of the top California Repetitive Loss (RL) and Severe Repetitive Loss (SRL) communities, the majority participate in the CRS program. The state encourages all RL and SRL communities to participate in the CRS program.

For a list of California communities participating in the CRS program, see "Table 3: Community Rating System Eligible Communities Effective October 1, 2016" in the following report: https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS_List_of_Communites_10_01_2016.pdf.

[152] https://www.fema.gov/media-library-data/1507029324530-082938e6607d4d9eba4004890dbad39c/NFIP_CRS_Fact_Sheet_2017_508OK.pdf

Federal Strategy for Mitigating Severe Repetitive Loss Properties

By creating the Severe Repetitive Loss (SRL) program, the Flood Insurance Reform Act of 2004 provided a new opportunity for state governments to mitigate the most flood-prone properties. On July 6, 2012, President Obama signed the Biggert-Waters Flood Insurance Reform Act of 2012. In response to outrage over the increase in flood insurance premiums resulting from the Biggert-Waters Act, the Homeowners Flood Insurance Affordability Act passed in 2014 with the intent of reducing the financial burden for policyholders. This 2014 legislation moved the SRL funding into the FMA program and created a combined National Flood Mitigation Fund. This resulted in administrative changes to how SRL projects are funded.

Approximately 9,000 insured properties have been identified with a high frequency of losses or a high value of claims. As these policies come up for renewal, they will be transferred to the National Flood Insurance Program (NFIP) Servicing Agent's Special Direct Facility. SRL properties with renewal dates of January 1, 2007 or later will be afforded coverage (new business or renewal) only through the Special Direct Facility.

For guidance on Severe Repetitive Loss properties, visit:
https://www.fema.gov/pdf/nfip/manual201205/content/20_srl.pdf.

For an overview of Homeowners Flood Insurance Affordability Act modifications to the Biggert-Waters Flood Insurance Reform Act, visit: https://www.fema.gov/media-library/assets/documents/93074.

Participation in FEMA's Risk MAP Program

FEMA works with federal, state, tribal, and local partners to identify and promote informed planning and development practices through the Risk Mapping, Assessment, and Planning (Risk MAP) program. Through the Risk MAP program, various NFIP maps are in the process of being updated. As a part of this effort, Risk MAP program staff are working with local jurisdictions around the state and federal and state agencies, such as Silver Jackets and the California Department of Water Resources (DWR), to determine local priorities for flood mitigation planning related to the map update efforts.

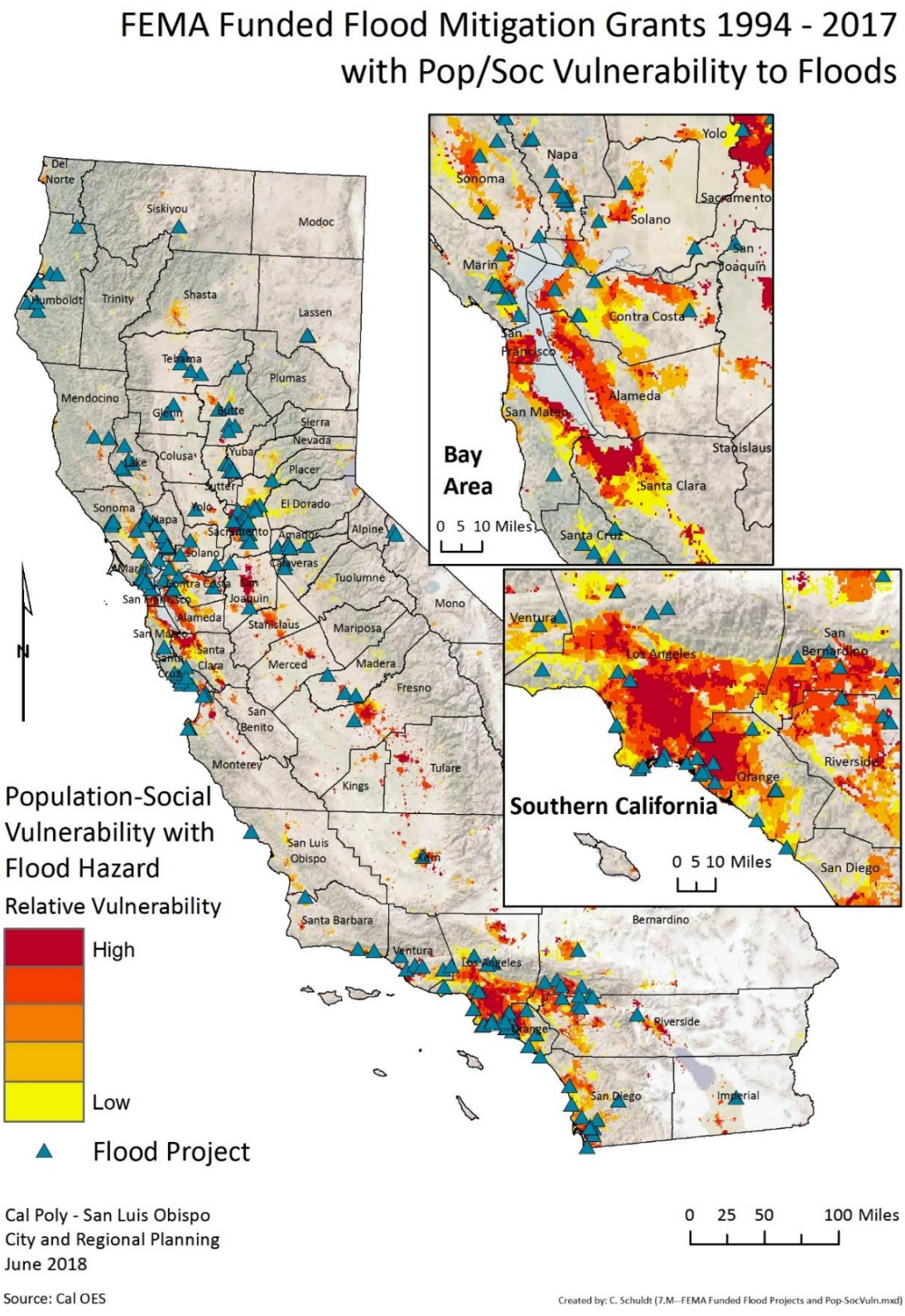
7.1.5.9 FEMA-FUNDED FLOOD HAZARD MITIGATION PROJECTS

The FEMA Flood Mitigation Assistance (FMA) program assists states and local communities in implementing flood hazard mitigation measures before a major disaster occurs. The program targets NFIP communities with numerous Repetitive Loss (RL) structures. The program offers two types of grants to local communities: planning grants and project grants. To be eligible for FMA grant funding, a community must have a FEMA-approved Floodplain Management Plan or a Local Hazard Mitigation Plan (LHMP), as long as the LHMP includes a flood assessment and mitigation strategy and has been FEMA-approved according to Section 201.4 or Section 201.5 of 44 Code of Federal Regulations (CFR). See *Chapter 10, Section 10.4.3* for more information regarding the FMA grant funding.

A community has two years to develop a Floodplain Management Plan and three years to complete a project with FMA funds. The FMA program only permits planning sub-applications that support the flood hazard portion of state, tribal, or local mitigation plans to meet the requirements outlined in 44 CFR Part 201 Mitigation Planning. Funds are only available to support communities participating in the National Flood Insurance Program (NFIP). The total planning grant funding made available in any fiscal year to any state, including all communities located in the state, cannot exceed $300,000. Project grant funding during any five-year period cannot exceed $10 million to any state or $3.3 million to any eligible community. States also receive technical assistance grants to administer the FMA program. The total assistance grants in any fiscal year during a five-year period cannot exceed $20 million.

Map 7.M shows the distribution of flood-related hazard mitigation projects in relation to vulnerable populations in high flood hazard areas. More projects are in the San Francisco Bay Area, Central Valley, and Northern California than in Southern California, coinciding with areas of higher population and social vulnerability to flood hazards.

Map 7.M: FEMA-Funded Flood Mitigation Projects and Population Vulnerability



Cal Poly - San Luis Obispo
City and Regional Planning
June 2018

Source: Cal OES

Created by: C. Schuldt (7.M--FEMA Funded Flood Projects and Pop-SocVuln.mxd)

7.1.5.10 LOCAL FLOOD MITIGATION SPENDING

According to California's Legislative Analyst's Office, as primary responsibility for managing flood risk rests with local governments, the majority of funding for flood management activities is generated and spent at the local level. DWR/USACE estimated that local funding for flood-related activities averaged $2 billion annually between 2000 and 2010.[153]

7.1.6 ADDITIONAL FLOOD HAZARD MITIGATION OPPORTUNITIES

7.1.6.1 FUTURE HAZARD MITIGATION ASSISTANCE GRANT FUNDING OPPORTUNITIES

This risk assessment describes several programs for which DWR would consider requesting future FEMA Hazard Mitigation Assistance (HMA) funding. These are either new programs that DWR is considering implementing or current successful programs that DWR would like to continue and/or expand. These potential HMA-funded programs include the following.

Central Valley Flood Management Planning

The Central Valley Flood Protection Plan (CVFPP) is California's strategic blueprint to improve flood risk management in areas of the Central Valley protected by the State Plan of Flood Control (SPFC) updated on a five-year planning cycle. The 2017 CVFPP update developed a refined State Systemwide Investment Approach (SSIA) that includes a portfolio of recommended management actions—both structural and non-structural—aimed at reducing flood risk. These refinements are summarized for areas of interest (system-wide, urban, rural, and small communities) and by management action category in Table 3-2 in Chapter 3 of the 2017 CVFPP update. Refinements to physical and operational elements of the SSIA are also provided in Chapter 3 (pages 3-5 through 3-7) of the 2017 CVFPP update. The actions are also justified by various supporting documents.[154]

System-Wide Actions – Bypasses, including Flood Structure Improvements

Yolo Bypass Multi-benefit Improvements

The Yolo Bypass expansion would increase the overall capacity of the Sacramento River flood management system to convey large flood events benefiting urban, small community, and rural-agricultural areas. The Yolo Bypass Multi-Benefit Improvements would also increase habitat acreage for sensitive species and expand opportunities for recreation and open space.

The expansion would increase system performance over current conditions to better withstand hydrologic uncertainty, climate change, sea level rise, and other stressors. In addition, operational changes have been developed to accompany the future bypass expansion. Once funding is available, the Yolo Bypass expansion is expected to take 15 to 20 years. The 2017 CVFPP update refinements are as follows:

- An approximately 1.5-mile expansion of the Fremont Weir and expansion of the Yolo Bypass in multiple locations with levee setbacks where feasible, including consideration of the use of the Sacramento Deep Water Ship Channel to convey flood flows
- An approximately 1,500-foot expansion of the Sacramento Weir and Bypass (including consideration of automation)
- Multi-benefit improvements to the Cache Creek Settling Basin for sediment management and sediment remediation

[153] http://lao.ca.gov/reports/2017/3571/managing-floods-032217.pdf
[154] http://cvfpb.ca.gov/cvfpp/

Paradise Cut Multi-benefit Improvements

The Paradise Cut Multi-Benefit Improvements would provide public safety benefits reducing stage and the probability of levee failure along the San Joaquin River. The Paradise Cut Multi-Benefit Improvements would also increase habitat acreage for sensitive species. In addition, operational changes have been developed to accompany the future bypass expansion. Key implementation actions, such as land acquisition, are expected over the next few years. The 2017 CVFPP update includes an approximately 1,000-foot-long weir and associated levee setbacks.

Feather River – Sutter Bypass Multi-benefit Improvements

The Feather River-Sutter Bypass Multi-Benefit Improvements are not expected to be implemented until 2030 or later, after the Yolo Bypass Multi-Benefit Improvements are complete. Nevertheless, a range of potential system-scale improvements are subject to further study in close coordination with local and regional partners. One consideration is upgrade and modification of the Colusa and Tisdale Weirs.

Butte Basin

To improve system-wide flood risk management, levee repair and infrastructure improvements for Butte Basin flood relief structures (rural) are being considered.

New Bullards Bar Dam

To improve system-wide flood risk management, a lower level outlet at New Bullards Bar Dam with capacity of approximately 20,000 cubic feet per second is being considered.

Rural Levee and Infrastructure Improvements

To improve system-wide flood risk management, completion of structural upgrades to identified rural infrastructure is being considered.

System-Wide Actions – Reservoir Storage and Operations

Overview

A range of reservoir flood storage and operations actions would significantly reduce flood risk near downstream urban areas. In addition, floodplain storage actions, pursued on a willing-seller basis and consistent with local land use plans, would reduce flood risk by providing transitory storage. There are also opportunities to reduce flood risk through groundwater banking from recharge and conjunctive use operations, particularly in the San Joaquin River Basin. The 2017 refinements are as follows:

- Study of potential changes to Calaveras River and Tuolumne River reservoir operations
- Continued state support for the Folsom Dam Raise
- Further study and refinement of reservoir and floodplain-related storage actions in the Calaveras and Tuolumne River watersheds
- Four transitory storage sites identified at Dos Rios, Three Amigos, Oroville Wildlife Area, and Conaway Ranch
- Multiple benefit opportunities (e.g., conjunctive use and groundwater recharge) identified at Madera Ranch and in western Madera County to reduce future subsidence and provide water supply benefits

DWR Forecast-Coordinated Operations

The DWR Forecast-Coordinated Operations program focuses on flood control reservoirs in the Central Valley to mitigate flood impacts downstream. Core partner agencies include DWR, the National Oceanic Atmospheric Administration (NOAA), and the U.S. Army Corps of Engineers (USACE). The core partners work with and coordinate with all reservoir operators to improve downstream flood protection without affecting the water supply of upstream reservoirs. This coordination is important to help reduce flood peaks and provide longer lead time for emergency responders. Information about reservoir operations and reports, as well as dam conditions, can be found at the California Data Exchange Center (CDEC) at: http://cdec.water.ca.gov/reservoir.html.

Urban Actions – Capital Improvements

Based on urban levee improvements in the preceding five years, remaining necessary urban improvements to achieve a 200-year level of protection are outlined by local, state, and federal agencies. The intent is to preserve urban development opportunities within specific boundaries without inducing broader urban development that increases aggregate economic and life safety risk. At present, the following urban areas are being considered: the City of Chico, Yuba City and the City of Marysville, the Sacramento metropolitan area, the Cities of Woodland and Davis, the City of Merced, and the Stockton metropolitan area. Other areas may be included in the future.

Rural Actions – Capital Improvements

Levee and Infrastructure Repairs: Site-specific rural-agricultural repairs are being considered, including potential levee repairs on the Eastside Bypass to replace capacity lost due to local subsidence.

Small Communities Actions – Capital Improvements

Levee and Infrastructure Repairs: Study and implementation of small community levee and infrastructure repairs to achieve protection from 100-year (1 percent annual chance) flood events are conducted through the Small Communities Flood Risk Reduction program. This program may include levee repairs and infrastructure improvements, levee setbacks, land acquisition, and habitat restoration.

Refinements to physical and operational elements in the State Systemwide Investment Approach (SSIA) call out residual risk management actions that are fundamental to the overall flood risk management approach in the CVFPP. They include emergency management (system-wide); routine maintenance (system-wide); risk awareness, floodproofing, and land use planning (urban, rural, and small communities); and land acquisitions and easements (rural).

Residual Risk Management

Emergency Management (System-Wide)

Enhanced emergency management would increase warning and mitigation times and would improve life safety and reduce property damages throughout the Central Valley. Specific activities planned for implementation to reduce the vulnerability of people and property in high risk areas are as follows:

- Improved all-weather roads on levee crowns for quick response to flood emergencies
- Continued maintenance of strategically located stockpiles of flood fight materials
- Enhanced flood information collection, forecasting, and notification
- Enhanced local flood emergency response planning with technical and financial assistance to local agencies to help develop local flood preparedness and response plans for communities, conduct local and regional flood exercises, and engage local responders to improve flood emergency readiness
- Improved rural post-flood recovery assistance program
- • Development and training of staff on the use of the Flood Emergency Management System for the state-federal joint flood operations center to manage, track, and report the flood emergency management and flood fight activities.

Routine Maintenance (systemwide)

A robust routine maintenance program underpins effective flood risk management. The 2017 CVFPP update acknowledges that funding for flood system maintenance over time has been insufficient and that significantly greater expenditures would be justifiable in the future. This justification comes from the "Flood System Long-Term Operations, Maintenance, Repair, Rehabilitation, and Replacement Cost Evaluation" Work Group effort. (For a summary of the effort, see Understanding the True Cost of OMRR&R box, 2017 CVFPP update, page 4-5.) Routine maintenance includes the following:

- Routine levee and channel maintenance, such as rodent control, vegetation control, encroachments and pipe maintenance, bank erosion and repair, and sediment removal

- Maintenance of minor structures, such as stop log or gated closure structures, pumping plants, monitoring and flood relief wells and piezometers, retaining walls and floodwalls, pipe penetrations, and encroachments
- Maintenance of

The state will carry out the following activities for SPFC facilities:

- Maintain all-weather levee crown roads for quick response to potential flood threats
- Assist local maintaining agencies in fixing sites requiring critical repairs in rural-agricultural areas
- Enhance inspection and maintenance of the levees and channels
- Ensure that sites identified as requiring maintenance actions during spring inspections are properly maintained and repaired by fall, prior to flood season
- Coordinate inspection and timely maintenance of the levees under jurisdictions of the local maintaining agencies
- Provide timely repair facilities that are the responsibility of the state and that are identified during an inspection as having deficiencies
- Develop strategies for long-term system management and maintenance, such as improving the efficiency of permitting routine maintenance activities and addressing legacy system issues such as encroachment and pipe penetrations

The state will also consider providing implementation grant funding to partner local agencies to ensure proper operation and maintenance of the SPFC

Risk Awareness, Floodproofing, and Land Use Planning (Urban, Rural, and Small Communities)

Risk Awareness

The 2017 CVFPP update includes a recommendation to promote activities that manage residual risk, such as public awareness campaigns and flood risk notifications. The goal of public awareness campaigns is to motivate people to take individual actions to protect themselves, such as developing personal evacuation plans, preparing supplies and provisions for a flood emergency, and insuring themselves against flood damages. Public awareness campaigns, flood risk notifications, and flood emergency preparedness and response programs offer opportunities to empower communities and individuals to take steps to further reduce residual risk. Awareness campaigns can also increase overall willingness to support flood system improvements.

Floodproofing

Non-structural flood risk management actions related to floodproofing reduce flood risk. They include:

- Raising and waterproofing structures and building berms
- Purchasing and relocating homes in floodplains

Land Use Planning and Floodplain Management

Other critical non-structural actions include land use and floodplain management. As stated in the 2012 CVFPP and reaffirmed in the 2017 CVFPP update, the state encourages policies and actions that avoid, to the extent feasible, creating new flood risks for people and property that are not presently at risk. Recommended future land use/floodplain management actions include the following:

- Establish a DWR Floodplain Management Strategic Implementation Plan to track what recommendations have been implemented from earlier endeavors (e.g., the 2002 California Floodplain Management Task Force) and propose a strategy for implementing the remaining recommendations
- Ensure state implementation of floodplain management actions by promoting internal efforts to facilitate implementation of measures prioritized in the update to the Floodplain Management Strategic Implementation Plan
- Evaluate the feasibility of a supplemental state insurance program
- Continue to work with the Agricultural Floodplain Ordinance Task Force
- Seek establishment of a post-disaster agricultural recovery program

- Seek support for a post-disaster habitat recovery program
- Partner with FEMA to increase investments in non-structural actions
- Track land use changes and flood management system improvements to assess whether life loss and property damage risks are increasing or decreasing

Land Acquisitions and Easements (Rural)

Agricultural and conservation easements are considered for their potential to reduce flood risk. These include potential flowage easements in the vicinity of the Eastside Bypass to replace capacity caused by local subsidence.

7.1.6.2 REGIONAL FLOOD MANAGEMENT PLANNING

As part of the 2017 CVFPP update, DWR launched and funded a regionally led effort to help local agencies develop comprehensive plans that describe local flood management priorities, challenges, potential funding mechanisms, and site-specific improvement needs. The site-specific improvement needs have been collected into a database of about 630 Regional Flood Management Plan (RFMP) projects in the Sacramento and San Joaquin River Basins. These projects include a wide variety of objectives, such as improving emergency response, constructing ring levees, repairing erosion, developing and maintaining all-weather levee crown roads, and improving reservoir operations. A subset of these projects was subsequently identified to inform the 2017 CVFPP update planning process. Local project HMA funding would be pursued by the responsible local agency pursuant to its Local Hazard Mitigation Plan (LHMP).

7.1.6.3 STATEWIDE FLOOD MANAGEMENT PLANNING

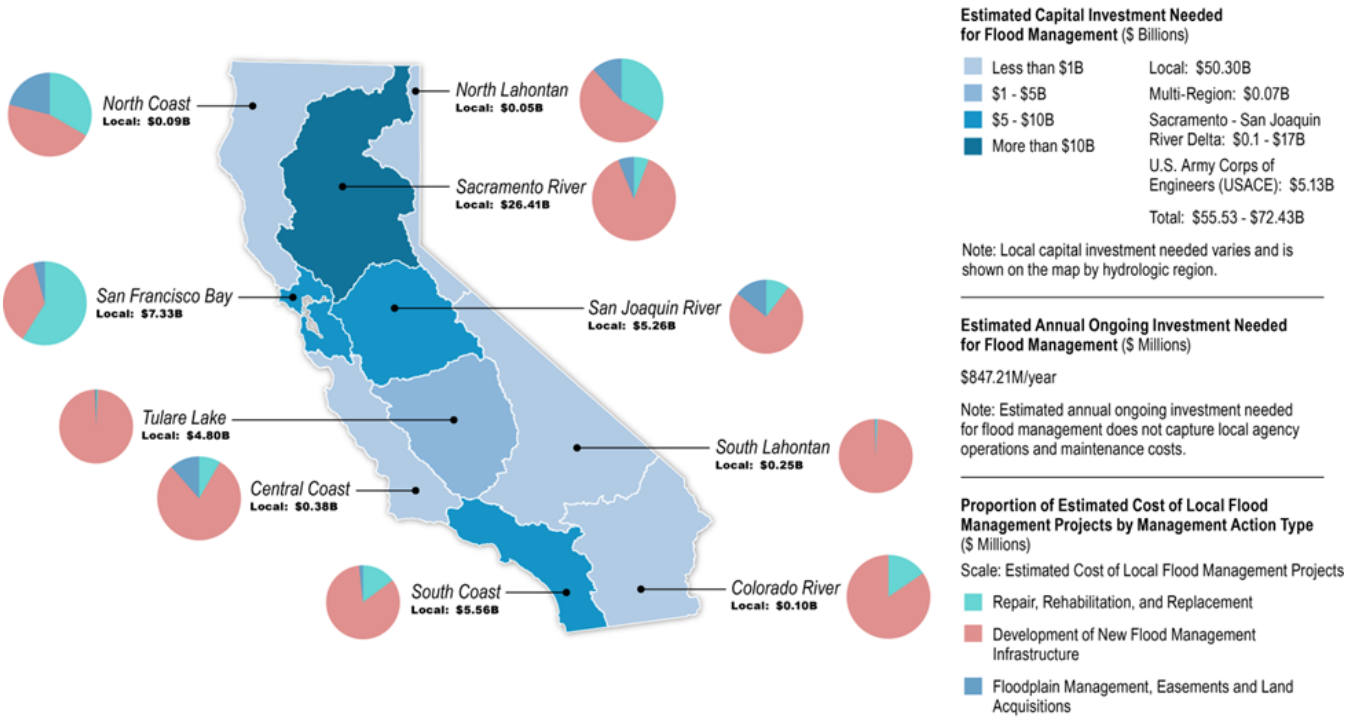
Building upon the "California's Flood Future" report, DWR is developing a new report titled "Investing in California's Flood Future: An Outcome-Driven Approach to Flood Management." This new report will expand understanding related to all of the recommendations from "California's Flood Future," while describing the investment levels required to achieve the intended outcomes necessary to move the state's flood management system toward sustainability.

As part of "Investing in California's Flood Future," more than 240 public agencies responsible for flood management in California were interviewed. This information gathering effort identified flood risk reduction opportunities for operations, maintenance, and capital improvements, including more than $72 billion for proposed capital flood risk reduction management projects and more than $845 million per year for ongoing flood risk reduction needs in California. Over the next decade, investments should focus on high-priority actions, such as:

- Institutional capacity, baseline operations, and routine maintenance
- Floodproofing, risk awareness, planning, studies, and mapping
- Maintenance, repair, rehabilitation, and replacement of existing built and natural infrastructure
- Development of new flood management infrastructure

Figure 7.E illustrates estimated flood management investment needs by hydrologic region and type of management action as identified by the "Investing in California's Flood Future" report. More information on the "California's Flood Future" report can be found at: https://www.water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies and https://www.water.ca.gov/Programs/Flood-Management.

Figure 7.E: Flood Risk Reduction Opportunities in California



Source: California's Flood Future: An Outcome-Driven Approach to Flood Management

7.1.6.4 OTHER FLOODPLAIN MANAGEMENT PROGRAMS

In the wake of the devastating effects of Hurricanes Harvey, Irma, and Maria in 2017, it is apparent that the nation must be better prepared for storms larger than those experienced in the past. This preparedness includes hazard mitigation planning beyond the NFIP Special Flood Hazard Areas (SFHAs). In addition to the ARkStorm scenario planning described above, other floodplain management programs that may be considered by DWR in the near future to broaden its flood hazard mitigation planning include the following:

- Update FEMA maps for State Plan of Flood Control (SPFC) protected areas
- Complete Central Valley Flood Evaluation Delineation (CVFED) goals of developing 100-year (1 percent annual chance), 200-year (0.5 percent annual chance), and 500-year (0.2 percent annual chance) maps
- Improve flood insurance coverage in levee protected areas
- Investigate a supplemental California flood insurance program for structures located outside SFHAs
- Develop a flood risk phone application that will inform people of their approximate flood risk by parcel
- Revisit building codes, especially concerning evacuation locations for schools and care facilities
- Update DWR's Awareness Floodplain Maps, which identify 100-year flood hazard areas not yet mapped by FEMA using approximate assessment procedures
- Update California hazard disclosure law to reflect state and federal flood maps, not just NFIP maps
- Work with communities to promote Integrated Community Resilience (ICR), which includes evacuation planning, accurate flood maps, improved warning systems, strong penetration of flood insurance, family emergency planning, vulnerable population identification, and school safety
- Incorporate dam safety into flood planning by modeling big releases due to large floods
- Integrate dam safety into local public safety agency emergency plans

An overall objective of the above programs is to put flood information in the hands of the people so that they can make better-informed decisions regarding their own flood hazard planning.

7.1.6.5 THE ARKSTORM SCENARIO

Cooperative planning efforts addressing severe storm events hold promise for future mitigation of potential catastrophic flooding and related impacts. Initiated by the USGS and other agencies, including Cal OES, a severe storm scenario has been developed in a manner similar to the 2008 Southern California ShakeOut Scenario.

The USGS Multi-Hazards Demonstration Project's second product, called ARkStorm, addresses massive U.S. West Coast storms analogous to those that devastated California in 1861-1862. Scientific studies of offshore deposits in Northern and Southern California indicate that storms of this magnitude and larger have occurred about as often as large earthquakes on the southern San Andreas Fault. Over the last decade, scientists have determined that the largest storms in California are the product of phenomena called atmospheric rivers, and so the Multi-Hazards Demonstration Project storm scenario is called the ARkStorm, for Atmospheric River 1,000 (a measure of the storm's size). Such storms are projected to become more frequent and intense as a result of climate change.


K Street, Sacramento, looking east, 1861-1862

For the ARkStorm scenario, experts designed a large, scientifically realistic meteorological event followed by an examination of the secondary hazards (e.g., landslides and flooding), physical damages to the built environment, and social and economic consequences. The hypothetical ARkStorm would be similar to the intense winter storms of 1861-1862 that left California's Central Valley impassible. Storms far larger than the ARkStorm, dubbed megastorms, have also hit California at least six times in the last two millennia.

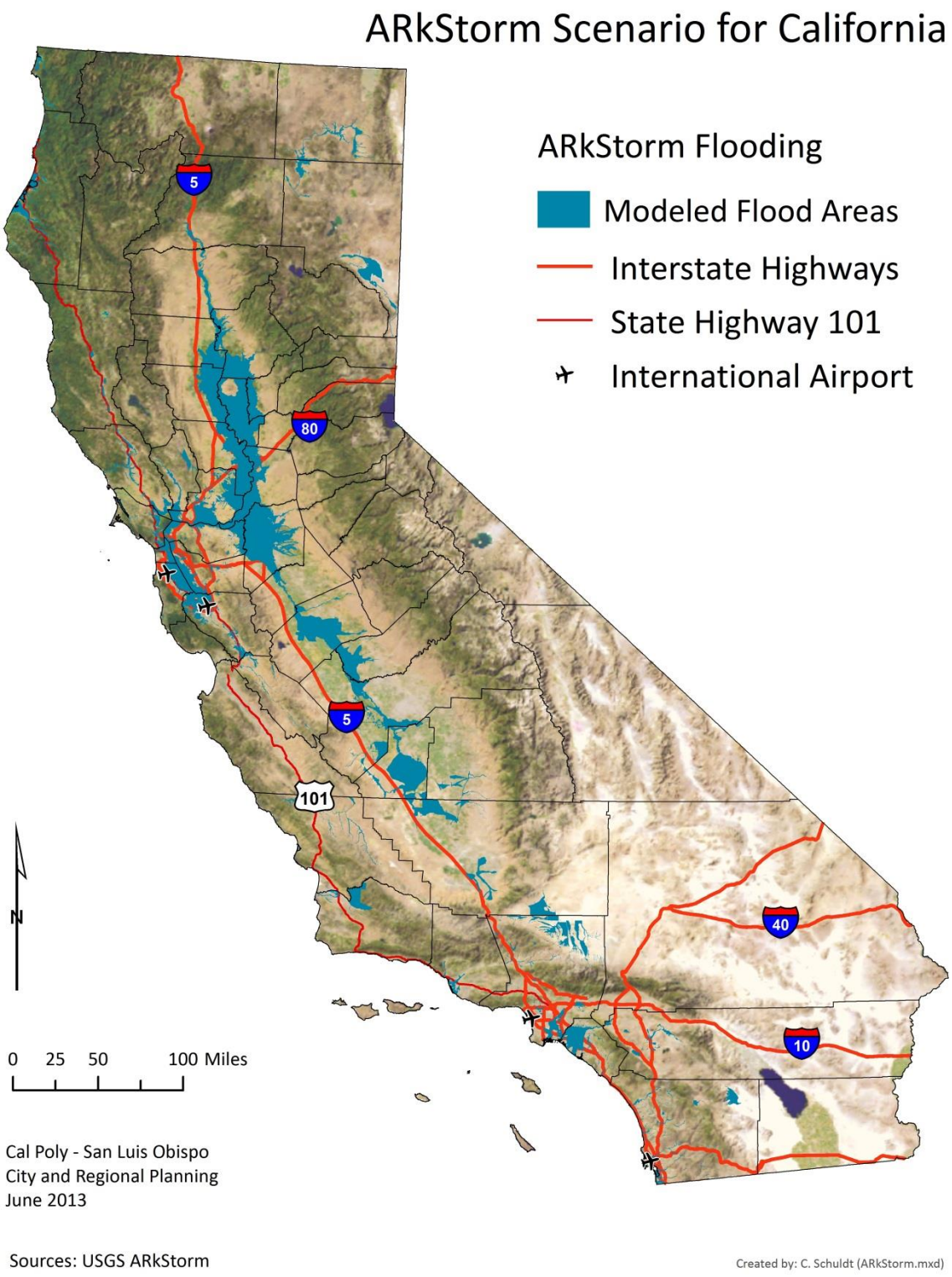
The ARkStorm produces precipitation in many places exceeding levels experienced on average every 500 to 1,000 years. Extensive flooding in many cases overwhelms the state's flood protection system, which is at best designed to resist 100-year (1 percent annual chance) and 200-year (0.5 percent annual chance) flows. (Many flood protection systems in the state were designed for smaller runoff events.) The Central Valley experiences widespread flooding. Serious flooding also occurs in Orange County, Los Angeles County, San Diego, the San Francisco Bay Area, and other coastal communities. In some places, winds reach hurricane speeds, as high as 125 miles per hour. Hundreds of landslides occur, damaging roads, highways, and homes. Property damage exceeds $300 billion, most of it from flooding. Agricultural losses and other costs to repair lifelines, dewater flooded islands, and repair damage from landslides bring the total direct property loss to nearly $400 billion, of which only $20 to $30 billion would be recoverable through public and commercial insurance. Power, water, sewer, and other lifelines experience damage that takes weeks or months to repair. Flooding evacuation could involve over one million residents in the inland region and Delta counties.

A storm of ARkStorm's magnitude has important implications: 1) it raises serious questions about the ability of existing national, state, and local disaster policy to handle an event of this magnitude; 2) it emphasizes the choice between paying now to mitigate, or paying a lot more later to recover; 3) innovative financing solutions are likely to be needed to avoid fiscal crisis and adequately fund response and recovery costs; 4) responders and government managers at all levels could be encouraged to conduct self-assessments and devise table-top exercises to exercise their ability to address a similar event; 5) the scenario can be a reference point for application of FEMA and Cal OES guidance connecting federal, state, and local natural hazards mapping and mitigation planning under the NFIP and Disaster Mitigation Act of 2000; and 6) common messages to educate the public about the risk of such an extreme event could be developed and consistently communicated to facilitate policy formulation and transformation.

The ARkStorm report was published in January 2011. To download the ARkStorm report, visit: http://pubs.usgs.gov/of/2010/1312/.

The ARkStorm scientific effort resulted in a plausible flood hazard scenario to be used as a planning and preparation tool by hazard mitigation and emergency response agencies to direct potential hazard mitigation and training efforts.

Map 7.N: Projected ARkStorm Flooding in California (Based on Modeled Scenario)



Map 7.N depicts an ARkStorm modeled scenario showing the potential for flooding in the Central Valley as the result of a large storm. *(Online or download viewers can zoom in for a closer view of the information on this map.)*

7.2 SEA-LEVEL RISE, COASTAL FLOODING, AND EROSION HAZARDS, VULNERABILITY AND RISK ASSESSMENT

7.2.1 IDENTIFYING SEA-LEVEL RISE, COASTAL FLOODING AND EROSION HAZARDS

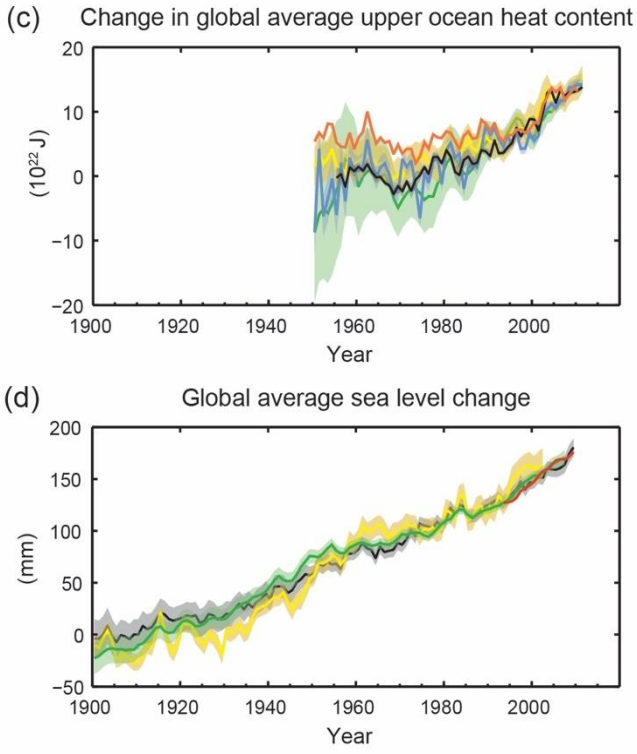
Coastal erosion is a natural geomorphic process. In California, coastal erosion can be accelerated or exacerbated through a combination of factors, including winter storms, tidal action, wind-generated high surf, wave action, and rising sea levels. High tides may coincide with heavy rain causing coastal flooding, coastal bluff erosion, and landslides, such as were experienced during the 1998 and 2016 El Nino storms.

As discussed in *Section 4.3*, climate change will result in sea-level rise and may increase the frequency of severe weather and winter storms. These changes will exacerbate existing coastal hazards, including flooding and erosion, and will have severe impacts along the California coast.[155]

It is important to distinguish between sea-level rise at the global scale and the regional/local scale and to identify the different contributing factors. Increases in global sea-level result from two primary causes: ocean thermal expansion (when water warms, it expands) and the melting of land-based ice, including mountain glaciers, ice caps, and the polar ice sheets of Greenland and Antarctica. Thus far, the largest contributor to sea-level rise is thermal expansion, but the rate of ice loss from both the Greenland and Antarctic ice sheets is accelerating.[156, 157] If the current rate of loss for the Greenland and Antarctic ice sheets continues, the contribution from the ice sheets will become the dominant source of sea-level rise.[158] As shown in Figure 7.F, changes in sea-level have been occurring for at least the last 100 years and are projected to continue. The rate of sea-level rise is increasing, meaning the amount of increase is higher in more recent decades than in preceding decade, and this trend is projected to continue.

While global mean sea-level is rising, it is relative sea-level—the local difference in elevation between the height of the sea surface and the height of the land surface at any particular location—that affects coastal communities and ecosystems at risk from coastal flooding. Future changes in relative sea-level will vary along the length of the California coastline.

Figure 7.F: Global Upper Ocean Heat Content and Sea-Level Change Since 1900



Source: IPCC: Climate Change 2013

[155] California Coastal Commission Staff Sea-level Rise Team. California Coastal Commission Sea-level Rise Policy Guidance. San Francisco: California Coastal Commission, 2015, 293 p.

[156] IPCC: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013, 1535 pp.

[157] Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017.

[158] Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017.

Generally, sea-level rise progressively worsens the impact of high tides and wind-driven waves associated with severe storms. Coupled with increased frequency, severity, and duration of high tide and storm events related to climate change, sea-level rise will exacerbate these extreme events along the coast. These events may expose the coast to severe flooding and erosion; damage to coastal structures, real estate, public access, and coastal habitats; and seawater intrusion into delta areas and coastal aquifers.[159] El Niño events exacerbate storms and coastal inundation above that already occurring due to sea-level rise and normal coastal weather and tidal patterns.[160]

California's land mass includes more than 1,100 miles of outer coast with features like bluffs, beaches, and wetlands, in addition to bay shorelines and the Delta. The San Francisco Bay shoreline alone is approximately 300 miles, not including the Delta. The coast also supports varying levels of development and land use, including recreational, agricultural, industrial, commercial, and residential uses. The continued rise in sea-level increases the risk of inundation in low coastal areas. Near-shore wave heights and wave energy will increase, intensifying the potential for storm damage, beach erosion, and bluff retreat. Under sea-level rise scenarios, development adjacent to shoreline areas will be at increased risk of damage from everyday tidal conditions as well as storm events.

Sea-level rise impacts on marine transportation include potential difficulties shipping into and out of the ports of Sacramento and Stockton, along with higher winter flows in the Sacramento River. Increased siltation from storm runoff would necessitate more frequent dredging of channels across California. Harbors could suffer wave damage, siltation, and other navigation and safety challenges. Sea-level rise will also create difficulties for ports and harbors by affecting cargo transfer capability as ships ride higher along docks and also by affecting transfer between roads or railways and docks (e.g., agriculture coming from Central Valley to be shipped out of the Port of Oakland).

Sea-level rise also impacts the environment. If beaches, wetlands, and other coastal habitats are unable to migrate inland, because of pace, sediment availability, or inland development as sea-levels rise, which is particularly likely in places where shoreline armoring or other development blocks natural migration, they can be lost to permanent inundation or degraded by salt water intrusion with resulting impacts related to land subsidence, loss of habitat for fish and wildlife, and loss of aesthetic, recreational, and commercial uses. Such loss would also mean the loss of important ecosystem services. For example, intact wetlands serve as a buffer to flooding events by increasing flood capacity, recharging groundwater, protecting water quality, and providing water supply reliability.

7.2.2 PROFILING SEA-LEVEL RISE, COASTAL FLOODING AND EROSION HAZARDS

The State of California Sea-Level Rise Guidance Document, initially adopted in 2010 and updated in 2013, provides guidance to state agencies for incorporating sea-level rise projections into planning, permitting, investment, and other decisions. The 2013 version of the guidance was based on the 2012 National Research Council report, which provided regionally specific scenario-based projections of sea-level rise across the West Coast. Since that time, there have been advances in the understanding of sea-level rise modeling (namely, improved methods for providing probabilities or likelihoods of local sea-level rise change) and the scientific understanding of potential ice loss from the Greenland and Antarctic ice sheets, warranting an update to the state's sea-level rise guidance to reflect the best available science. Additionally, increased policy and legislative directives and mandates focused on improving climate adaptation and resiliency in California at both the state and local level have necessitated an update to the guidance to help cities, counties, and state entities prepare for and adapt to sea-level rise.

In April 2017, at the request of the California Ocean Protection Council (OPC), a working group of the OPC's Science Advisory Team released a report entitled "Rising Seas in California: An Update on Sea-Level Science " that synthesizes the state of sea level rise science. The Rising Seas report provides the scientific foundation for the 2018 update to the state's sea-level rise guidance, led by the OPC in coordination with the California Natural Resources Agency (CNRA), the Governor's Office of Planning and Research (OPR), and the California Energy Commission (CEC). The State of California Sea-Level Rise Guidance 2018 Update was adopted by the OPC in March 2018. The updated 2018

[159] California Natural Resources Agency. 2009 California Climate Adaptation Strategy. Sacramento: author, 2009, 200 p. Retrieved on August 24, 2017 from http://resources.ca.gov/docs/climate/Statewide_Adaptation_Strategy.pdf.

[160] Barnard, P. L. et al. Extreme oceanographic forcing and coastal response due to the 2015–2016 El Nino. Nat. Commun. 8, 14365, 2017. Retrieved on August 28, 2017 from https://www.nature.com/articles/ncomms14365.pdf.

policy guidance provides direction on how to select appropriate sea-level rise projections based on geographic location, project lifespan, impacts, and adaptive capacity, as well as recommendations for planning and adaptation strategies to safeguard California's people, places, and natural environment.

The State of California Sea-Level Rise Guidance 2018 Update summarizes recent scientific findings regarding global sea-level rise and presents projections for California that build on data collected from a network of 12 tide gauges located along the coast, shown in Figure 7.G.

Figure 7.G: Locations of Tide Gauges Used as the Basis for Sea-Level Rise Projections



Source: State of California Sea-Level Rise Guidance 2018 Update; http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/

The guidance explains the rapid advancement of scientific understanding of sea-level rise and provides sea-level rise projections by decade, based on greenhouse gas (GHG) emissions scenarios (See Table 7.F). These projections serve as the basis for ways to incorporate sea-level rise data into planning. To complement the comprehensive probabilistic approach to projecting sea-level rise, an extreme scenario, labeled as H++, was also included based on rapid ice melt on Antarctica.

The H++ rapid loss scenario projects extreme sea-level rise with a 10.2-foot increase by 2100 and a 21.9-foot increase by 2150. The H++ rapid loss scenario is also detailed in the 2017 OPC report titled "Rising Seas in California: An Update on Sea-Level Rise Science."

Table 7.F: Projected Decadal Sea-Level Rise (in Feet) for San Francisco

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3 -	0.5	0.6	0.8	1.0
	2040	0.6	0.5 -	0.8	1.0	1.3	1.8
	2050	0.9	0.6 -	1.1	1.4	1.9	2.7
Low emissions	2060	1.0	0.6 -	1.3	1.6	2.4	
High emissions	2060	1.1	0.8 -	1.5	1.8	2.6	3.9
Low emissions	2070	1.1	0.8 -	1.5	1.9	3.1	
High emissions	2070	1.4	1.0 -	1.9	2.4	3.5	5.2
Low emissions	2080	1.3	0.9 -	1.8	2.3	3.9	
High emissions	2080	1.7	1.2 -	2.4	3.0	4.5	6.6
Low emissions	2090	1.4	1.0 -	2.1	2.8	4.7	
High emissions	2090	2.1	1.4 -	2.9	3.6	5.6	8.3
Low emissions	2100	1.6	1.0 -	2.4	3.2	5.7	
High emissions	2100	2.5	1.6 -	3.4	4.4	6.9	10.2
Low emissions	2110*	1.7	1.2 -	2.5	3.4	6.3	
High emissions	2110*	2.6	1.9 -	3.5	4.5	7.3	11.9
Low emissions	2120	1.9	1.2 -	2.8	3.9	7.4	
High emissions	2120	3	2.2 -	4.1	5.2	8.6	14.2
Low emissions	2130	2.1	1.3 -	3.1	4.4	8.5	
High emissions	2130	3.3	2.4 -	4.6	6.0	10.0	16.6
Low emissions	2140	2.2	1.3 -	3.4	4.9	9.7	
High emissions	2140	3.7	2.6 -	5.2	6.8	11.4	19.1
Low emissions	2150	2.4	1.3 -	3.8	5.5	11.0	
High emissions	2150	4.1	2.8 -	5.8	5.7	13.0	21.9

Source: State of California Sea-Level Rise Guidance 2018 Update; http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/

The State of California Sea-Level Rise Guidance 2018 Update also provides the probability that sea-level will meet or exceed particular heights for each decade from 2030 to 2150, as shown in Table 7.G. To further bolster the planning response to sea-level rise and complement the probability estimates in Table 7.G, efforts have been made to estimate the projected rate of sea-level rise.

Taken together, this information provides communities the ability to identify priorities for the most vulnerable locations and populations, keeping in mind that sea-level rise affects other coastal hazards such as erosion and flooding, as well as processes located a distance inland (see Tables 7.G and 7.H).

Tables 7.F, 7.G, and 7.H provide the sea-level rise data for San Francisco as an example of the sea-level rise projections provided in Appendix 3 of the State of California Sea-Level Rise Guidance 2018 Update for the remaining 11 tide gauge locations along the California Coast. Under these projections from the State of California Sea-Level Rise Guidance 2018 Update, California can expect to lose hundreds of feet of shoreline along its entire coastline over the next century.

Table 7.G: Probability that Sea-Level Rise Will Meet or Exceed a Particular Height (in Feet) in San Francisco

SAN FRANCISCO - High emissions (RCP 8.5)

	Probability that sea-level rise will meet or exceed... (excludes H++)									
	1 FT.	2 FT.	3 FT.	4 FT.	5 FT.	6 FT.	7 FT.	8 FT.	9 FT.	10 FT.
2030	0.1%									
2040	3.3%									
2050	31%	0.4%								
2060	65%	3%	0.2%	0.1%						
2070	84%	13%	1.2%	0.2%	0.1%					
2080	93%	34%	5%	0.9%	0.3%	0.1%	0.1%			
2090	96%	55%	14%	3%	0.9%	0.3%	0.2%	0.1%	0.1%	
2100	96%	70%	28%	8%	3%	1%	0.5%	0.3%	0.2%	0.1%
2150	100%	96%	79%	52%	28%	15%	8%	4%	3%	2%

SAN FRANCISCO - Low emissions (RCP 2.6)

	Probability that sea-level rise will meet or exceed... (excludes H++)									
	1 FT.	2 FT.	3 FT.	4 FT.	5 FT.	6 FT.	7 FT.	8 FT.	9 FT.	10 FT.
2060	43%	1.4%	0.2%							
2070	62%	4%	0.6%	0.2%	0%					
2080	74%	11%	2%	0.4%	0.2%	0.1%				
2090	80%	20%	3%	1.0%	0.4%	0.2%	0.1%	0.1%		
2100	84%	31%	7%	2%	0.8%	0.4%	0.2%	0.1%	0.1%	
2150	93%	62%	31%	14%	7%	4%	2%	2%	1%	1%

Source: State of California Sea-Level Rise Guidance 2018 Update; http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/

Table 7.H: Projected Average Rate of Sea-Level Rise (millimeters/year) for San Francisco

	Probabilistic Projections (mm/yr) (based on Kopp et al. 2014)				H++ scenario (Sweet et al. 2017) *Single scenario
	MEDIAN	LIKELY RANGE	1-IN-20 CHANCE	1-IN-200 CHANCE	
	50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...	5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
		Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions 2030-2050	6.7	4.5 - 9.3	12	17	26
Low emissions 2060-2080	5.3	3.1 - 8.2	12	22	
High emissions 2060-2080	9.5	6.4 - 13	17	28	42
Low emissions 2080-2100	5.2	2.3 - 9.1	14	28	
High emissions 2080-2100	11	6.0 - 16	22	37	55

Source: State of California Sea-Level Rise Guidance 2018 Update; http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/

In the context of rapidly evolving science, communities developing strategies to address sea-level rise impacts should choose sea-level rise projections based on best available science at the time, and in alignment with recommendations from California's sea-level rise guidance. California's key sea-level rise guidance documents, as of July 2018, include:

- The Ocean Projection Council's State of California Sea-Level Rise Guidance 2018 Update and 2017 Rising Seas in California: Update on Sea-Level Rise Science: http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/

- The California Coastal Commission's Sea-Level Rise Policy Guidance (*2018 update pending*): https://www.coastal.ca.gov/climate/slrguidance.html

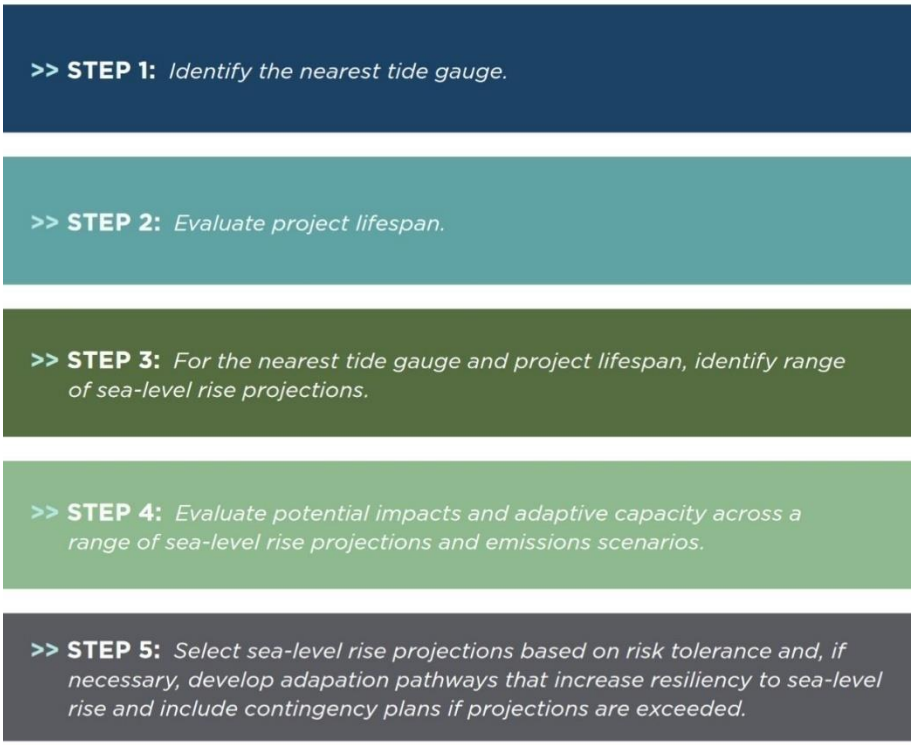
The 2015 California Coastal Commission Sea Level Rise Policy Guidance also provides a background on sea level rise science, recommendations for addressing sea level rise in Local Coastal Programs (LCPs) and Coastal Development Permits, and information on adaptation options. In particular, the California Coastal Commission (CCC) guidance recommends using best available science to determine appropriate sea level rise projections for the planning horizon; identifying the physical impacts associated with sea level rise, including changes in erosion and flooding; assessing impacts on coastal resources and development; and identifying and implementing adaptation options to minimize risks.

The CCC is in the process of updating its 2015 guidance to incorporate the newest science and will align its projections with the State of California Sea-Level Rise Guidance 2018 Update, which includes the best available science from the 2017 "Rising Seas in California: An Update on Sea-Level Science" report. The 2018 Draft Science Update of the 2015 California Coastal Commission Sea Level Rise Policy Guidance is available for review and public comment closes in early September 2018.

An important component of the State of California Sea-Level Rise Guidance 2018 Update, which can assist communities in determining the sea level rise scenario most applicable to their sea level rise planning and adaptation efforts, is the step-wise approach outlined in the section entitled "Guidance on How to Select Sea-Level Rise Projections," starting on page 21 of the document.

The step-wise approach provides a decision framework that can be used to guide the selection of applicable sea level rise projections and develop adaptation pathways. Decisions about which sea-level rise projections to select—and the necessary adaptation pathways and contingency plans to ensure resilience—will be based on factors including location, lifespan of the given project or asset, sea level rise exposure and associated impacts, adaptive capacity, and risk tolerance/aversion. Figure 7.H illustrates the step-wise approach.

Figure 7.H: Step-Wise Approach to Selecting Sea-Level Rise Projections



Source: State of California Sea-Level Rise Guidance 2018 Update; http://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/

The State of California Sea-Level Rise Guidance 2018 Update expands on each step in detail, providing considerations and justifications for potential scenario selections, as well as a risk decision framework outline (in Appendix 4; built on the work of the Governor's Office of Planning and Research [OPR] in response to Executive Order B-30-15) to assist state, tribal, and local government decision-makers' evaluation efforts. The framework should be used to guide selection of appropriate sea level rise projections and, if necessary, develop adaptation pathways that increase resiliency to sea level rise and include contingency plans if projections are exceeded or prematurely reached.

7.2.3 ASSESSMENT OF SEA-LEVEL RISE, COASTAL FLOODING, AND EROSION VULNERABILITY AND POTENTIAL LOSS

Sea level rise threatens many aspects of the coastal economy, as well as California's broader economy, including coastal-related tourism, beach and ocean recreational activities, transfer of goods and services through ports and transportation networks, coastal agriculture, and commercial fishing and aquaculture facilities.[161]

Statewide Assessment

In addition to potential losses in revenue, Heberger et al. (2009) estimate that $100 billion worth of property is at risk of flooding during a 100-year coastal flood with 4.6 feet (1.4 meters) of sea level rise (the amount projected to occur by the year 2100 in their Pacific Institute study). This at-risk property inventory includes seven wastewater treatment plants, commercial fishery facilities, marine terminals, coastal Highway 1, 14 power plants, residential areas, and other important development and infrastructure. Sea level rise also poses environmental justice and social equity challenges. This is particularly true for communities that may be dependent on at-risk industries, are already suffering from economic hardship, or have limited capacity to adapt, including lower-income, linguistically isolated, elderly, and other vulnerable populations.

The potential impacts of sea level rise are substantial. Areas vulnerable to inundation in 2100 have a population of about 475,000 and property values estimated at approximately $100 billion.[162] According to the Pacific Institute study, critical infrastructure now threatened by increased risk of inundation includes:

- 140 schools
- 34 police and fire stations
- 55 health care facilities
- 330 hazardous waste facilities and sites
- 3,500 miles of roads and highways and 280 miles of railways
- 30 coastal power plants, with a combined capacity of 10,000 megawatts
- 28 wastewater treatment plants (including both treatment plants along the open ocean coastline and along bay coastlines)
- San Francisco and Oakland International Airports

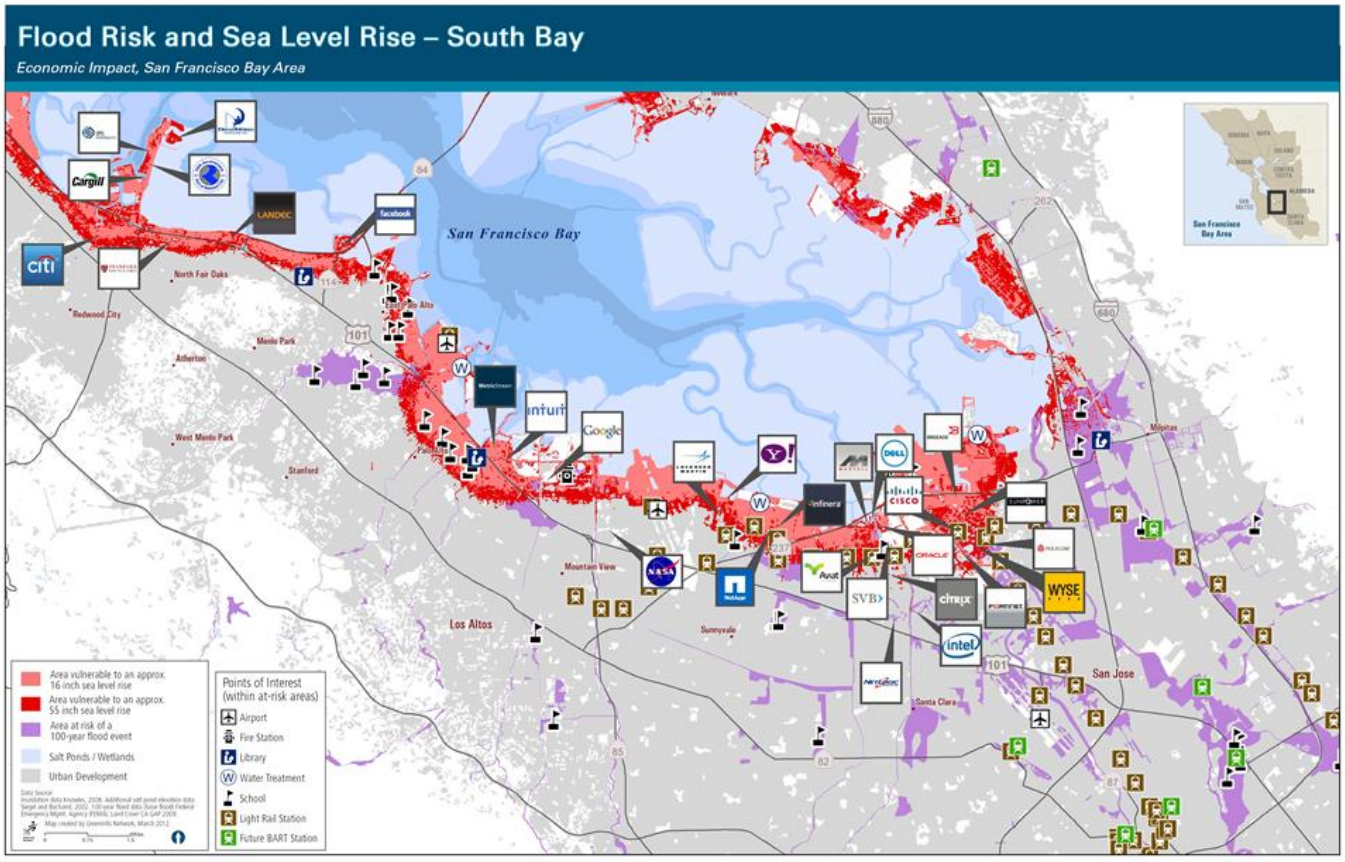
The study estimates that $100 billion worth of property (in year 2000 dollars) is at risk from a 100-year flood event with a 4.6-foot (1.4-meter) sea level rise and no adaptation. The study also notes that two-thirds of the vulnerable property is in the San Francisco Bay Area. Most of the bayfront north, east, and south of San Francisco and Oakland, including both San Francisco and Oakland International Airports, will require some form of adaptive action, such as sea walls, elevated and low-impact development, or managed retreat through acquisition and wetlands restoration. In addition, the occupants of these coastal areas include many businesses that would experience both physical damage and economic disruption due to the rising sea levels. See Map 7.O, which was prepared as part of the South San Francisco Bay Shoreline Project, showing locations of businesses in Santa Clara County vulnerable to sea-level rise.

While the Pacific Institute study is no longer a new assessment, it still offers a reasonable statewide view of sea-level rise vulnerability. What is new since the 2009 publication is the development of many local and regional assessments of sea-level rise vulnerability by jurisdictions, agencies, and organizations, which lend more region-specific detail to sea-level rise vulnerability analysis and support subsequent development of local or regional adaptation plans.

[161] https://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf

[162] Gleick, P. The Cost of Adaptation to Sea-level Rise along the California Coast and in the San Francisco Bay. California Climate Change Center, October 2008, pp. 42-47

Map 7.O: Businesses Vulnerable to Sea-Level Rise in the San Francisco South Bay



Source: THE SOUTH SAN FRANCISCO BAY SHORELINE STUDY AND PROJECT; summarized by Richardson 2016, http://www.lhc.ca.gov/sites/lhc.ca.gov/files/Reports/239/WrittenTestimony/RichardsonOct2016.pdf

Local and Regional Assessments

Since the 2009 Pacific Institute study, most sea-level rise assessments have been either focused at a regional or jurisdictional level and are prepared with greater detail and depth of analysis than is typically found in a statewide assessment. These area-specific vulnerability assessments review local hazards and climate exposure and assess what may be affected as a necessary first step in developing local mitigation and adaptation actions. This local/regional focus allows a jurisdiction or group of jurisdictions to evaluate the results and implications of the assessment; educate the public about sea level rise hazards and vulnerability in their communities; identify possible adaptation strategies; incorporate information and actions into climate adaptation, land use and hazard mitigation plans; and build solutions into other ongoing programs.

Many coastal communities vulnerable to sea level arise along the length of California have undertaken site and sector specific analyses of the potential impacts of sea-level rise to their communities, infrastructure, critical facilities, economies, environments, and social vulnerabilities. Some recent examples include (from north to south):

- *Humboldt Bay Shoreline Inventory, Mapping, and Sea Level Rise Vulnerability Assessment*: The Humboldt Bay Shoreline Inventory, Mapping, and Sea Level Rise Vulnerability Assessment (2013) inventoried and mapped existing shoreline conditions on Humboldt Bay; assessed existing shoreline vulnerability to breaching or overtopping under current tidal and climatic conditions; assessed existing shoreline vulnerability to sea-level rise; and, identified land uses and infrastructure that could be affected if the existing shoreline fails to retain the tides. The assessment was performed for six separate hydrologic units and for ten types of shoreline structures

within each of those hydrologic units. The study results may be found at: http://scc.ca.gov/projects/north-coast/ and http://scc.ca.gov/webmaster/ftp/pdf/humboldt-bay-shoreline.pdf.

- *Marin Bay Waterfront Adaptation and Vulnerability Evaluation*: The Marin Bay Waterfront Adaptation and Vulnerability Evaluation (BayWAVE) (2017) presents potential consequences of sea-level rise for a variety of assets, including parcels and buildings, transportation networks, utilities, working lands, natural resources, recreational assets, emergency services, and cultural resources for 8 municipalities and 19 unincorporated jurisdictions within the County. Additionally, asset profiles include economic, environmental, equity, and management considerations related to sea-level rise vulnerability. For additional details regarding BayWAVE, go to: https://www.marincounty.org/main/marin-sea-level-rise/baywave/vulnerability-assessment.

- *San Francisco Sea Level Rise Action Plan*: The San Francisco Sea Level Rise Action Plan (2016) outlines a comprehensive path toward building a sea-level rise adaptation and implementation plan. An ongoing phase in the process is completing the sea-level rise vulnerability assessment. Asset categories are being continuously added and, when completed, will provide the basis for asset prioritization to guide adaptation strategies. To view the action plan, visit: http://sf-planning.org/sea-level-rise-action-plan.

- *County of San Mateo Sea Level Rise Vulnerability Assessment*: The County of San Mateo's Sea Level Rise Vulnerability Assessment (Sea Change SMC) (2018) documents potential impacts to 15 cities and the unincorporated portions of San Mateo County based on three different sea-level rise scenarios and one erosion scenario. This risk-based vulnerability assessment uses best available existing data. Vulnerability profiles were developed for 29 assets. The vulnerability assessment report serves as the first step of the Sea Change SMC Initiative. For additional information about the vulnerability assessment and Sea Change SMC, see Best Practices Highlight 7.A and visit: http://seachangesmc.com/.

- *County of Santa Barbara Sea Level Rise & Coastal Hazards Vulnerability Assessment*: The County of Santa Barbara's Sea Level Rise & Coastal Hazards Vulnerability Assessment (2017) addressed two separate zones of the unincorporated coastline (North County and South County). Risk and exposure to coastal erosion, coastal flooding, and tidal inundation of assets within the unincorporated areas of the County were modeled. The vulnerability assessment evaluated the impact of up to 5 feet of sea-level rise by the year 2100 and additional impacts associated with large wave storm events. County assets were divided into eight sectors: hazardous materials and minerals, roads and public transportation, land use, public facilities, public access and recreation, environmentally sensitive habitats, and wastewater and water supply. The document also includes an extensive discussion of the current planning landscape for context. The Assessment can be found at: http://longrange.sbcountyplanning.org/programs/Coastal%20Resiliency%20Project/coastalresiliency.php.

- *City of Los Angeles Sea Level Rise Vulnerability Study*: The City of Los Angeles Sea Level Rise Vulnerability Study (2013) provides an assessment of the potential vulnerabilities the City may face due to rising sea levels. It draws attention to potentially vulnerable City assets, possible building-related economic losses, and indicators of social vulnerability to begin to identify the most vulnerable communities in the City. A regional stakeholder working group was established early in the process to provide critical input to the study as well as suggestions on how to: 1) move forward in adaptation planning, 2) expand the study in future iterations, and 3) communicate the findings to wider audiences.
  The full report may be found at: http://www.adaptationclearinghouse.org/resources/sea-level-rise-vulnerability-study-for-the-city-of-los-angeles-california.html.

- *San Diego County Economic Vulnerability to Sea Level Rise*: The San Diego County Economic Vulnerability to Sea Level Rise (2018) report, published by the San Diego Regional Climate Collaborative, seeks to identify whether important parts of the economic base of the region (the industries which sell outside the region) are vulnerable and where adaptation strategies may be needed to sustain commercial and industrial activity. The analysis uses six different scenarios combining sea-level rise and storm intensity. Results indicate that commercial and industrial properties in San Diego County face significant risks to their economic well-being from sea-level rise-related flooding. The largest industries in terms of vulnerabilities include tourism and recreation, shipbuilding, and professional and technical services, each of which is an important part of the economic base of the County.

For additional details, go to: https://www.sdclimatecollaborative.org/single-post/2018/04/02/San-Diego-Regional-Climate-Collaborative-Publishes-Regional-Economic-Vulnerability-to-Sea-Level-Rise-Report.

The above examples provide a sampling of the various approaches individual communities have taken to assess their vulnerability to sea level rise. It should be noted that in most cases, conducting the vulnerability assessment is an incremental process which begins with collecting existing data and is supplemented over time with additional categories and more detailed analysis. Many of the jurisdictions described above, along with many other vulnerable coastal communities, continue to enhance their assessment and adaptation efforts.

Recent funding support for some of these efforts has been provided through the California Coastal Commission Local Assistance Grant Program which placed an emphasis on sea-level rise and climate change in both the 2016-2017 and 2017-2018 funding cycles (see Progress Summary 7.J). The California Department of Transportation (Caltrans) also supports enhancing transportation related vulnerability assessments to inform adaptation planning through the SB 1 Adaptation Planning Grant program (three funding cycles, ending in 2019). For more information about SB 1, see http://www.dot.ca.gov/hq/tpp/grant_files/FY_18-19/7.FY18-19_AP_AwardList.pdf.

Best Practices Highlight 7.A: San Mateo County's Sea Change Program and Sea Level Rise Vulnerability Assessment

San Mateo County faces a somewhat unique risk in that it is exposed to sea-level rise along its western Pacific Ocean coastline as well as its eastern shoreline which fronts the southern portion of the San Francisco Bay. In December 2013, the County held a conference that focused on addressing the challenges facing the County from the threat of sea-level rise. The conference identified the need for more specific information about the impact of sea-level rise on San Mateo County communities. Further action was taken in 2015 when the County established the Office of Sustainability and launched the "Sea Change SMC" initiative. The first two tasks for Sea Change SMC included initiating a community engagement process to build support for cross-jurisdictional collaboration and commencement of the San Mateo County Sea Level Rise Vulnerability Assessment. The primary goals of the vulnerability assessment were to:

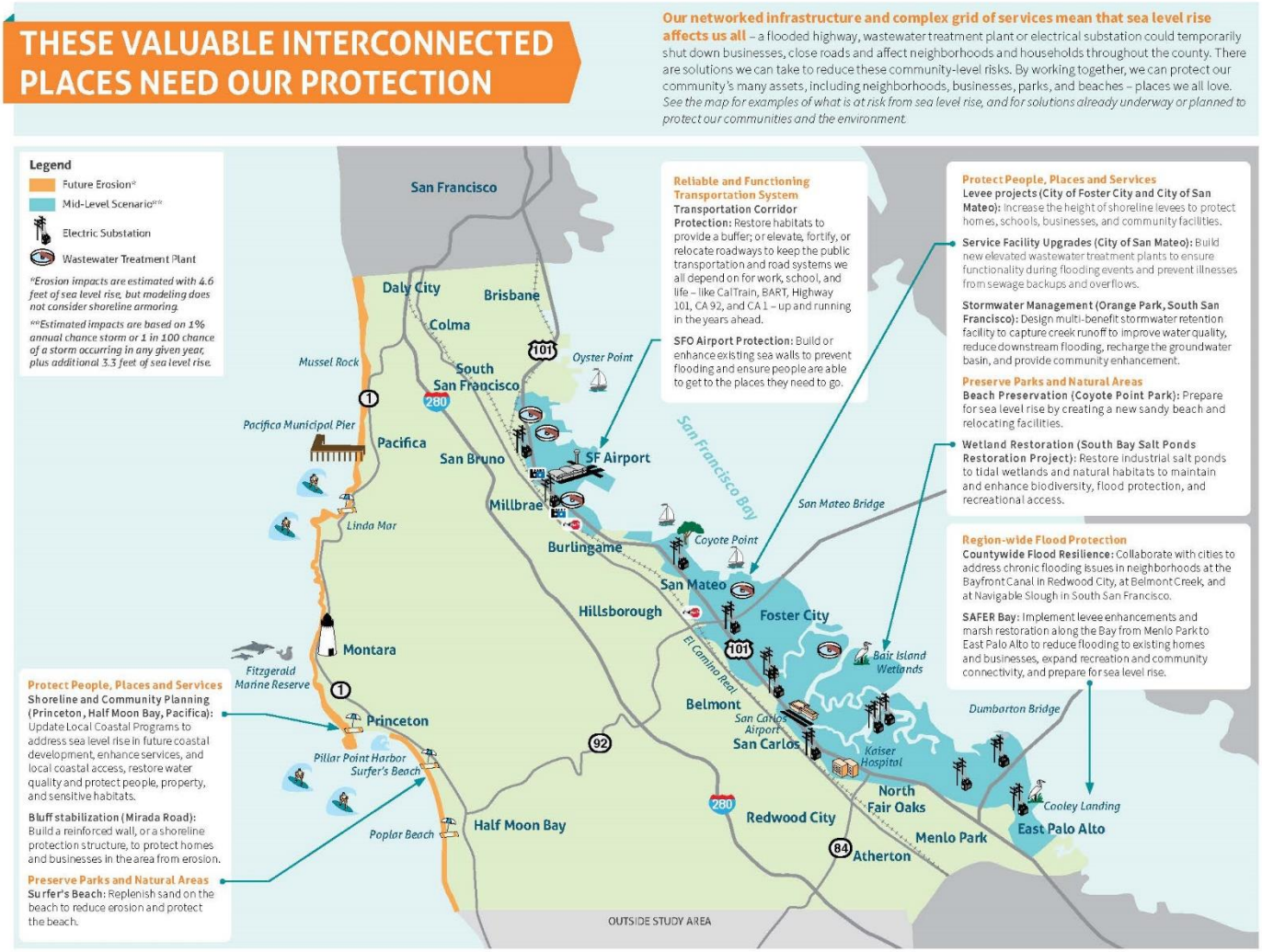
- Assess the overall vulnerability of the County to the impacts from sea-level rise, including permanent inundation, temporary flooding, erosion, and saltwater intrusion
- Identify potential consequences of hazards associated with sea-level rise, if no actions are taken
- Provide useful information to lead to actionable outcomes and lay the foundation for future, more detailed analyses to be conducted by the County or its cities
- Create an awareness of the need to prioritize nature-based solutions and to reduce impacts to socially vulnerable communities
- Build a collaborative network throughout the County on which to plan future efforts assess vulnerability, identify impacts of flooding and erosion on people, places, and critical infrastructure, and provide a menu of protective solutions

The assessment used existing data projecting sea level rise hazards to understand the geographic extent to which the County could be exposed to inundation and erosion. Three sea-level rise scenarios and one scenario for coastal erosion were developed based on best available scientific data.

Key steps in the vulnerability assessment process included: producing maps and inventories of built and natural assets exposed, as well as an assessment of communities in areas at risk from current and future inundation; analyzing short and long-term impacts of sea-level rise, storm related impacts and the potential long-term implications of inaction; developing 30 Asset Vulnerability Profiles (AVPs) for a representative set of assets across geography and asset categories; preparing a menu of adaptation options; engaging multiple stakeholders to discuss the challenges associated with sea-level rise; and, preparing a roadmap for future efforts to increase resiliency through suggested adaptation strategies.

The assessment report identifies built and natural assets vulnerable to sea-level rise, explores public health and risks from cascading impacts, and discusses what these factors mean for policy and planning purposes. The report findings highlight that many of the assets have cross-cutting vulnerabilities and may have more than one point of exposure to sea level rise. Additionally, issues such as "governance vulnerability" resulting from the complexity of multiple governing agencies and asset ownership, and the potential for increased social vulnerability as a result of sea level rise are discussed. Specific details of the vulnerability assessment methodology, results, and community process, and next steps in the sea level adaptation planning process may be found at: http://seachangesmc.com/vulnerability-assessment/.

Figure 7.I: Graphic from San Mateo County's Sea Level Rise Vulnerability Assessment



Source: County of San Mateo Sea Level Rise Vulnerability Assessment, http://seachangesmc.com/wp-content/uploads/2018/03/SLR_VA_Highlights_v12_web-spread.pdf

Key Resources and Guidance for Sea-Level Rise Vulnerability Assessments and Adaptation Planning

Sea level projections are the basis for assessing vulnerability to sea level rise and planning adaptation strategies. The ability for communities to visualize the local assets threatened by sea level rise is critical for developing adaptation strategies.

Many federal and state agencies and other organizations have developed support resources for local, regional, and tribal jurisdictions. Table 7.I includes a listing of best available sea level rise resources and guidance as of July 2018, including interactive mapping tools intended to aid communities in assessing and planning for sea level rise impacts. This table includes many of the SLR resources available as of August 2018, but is not an exhaustive list. Other resources may be available, or be developed in the future, that are valuable assessing or planning for SLR.

Table 7.I: Sea-Level Rise Resources and Guidance

Sea Level Rise Resource/Guidance	Description
Guidance and General Resources	
Ocean Protection Council (OPC) State of California Sea-Level Rise Guidance 2018 Update	OPC's updated 2018 guidance recommends how to include sea-level rise projections in decisions and recommends strategies for risk evaluation and adaptation. The 2018 guidance should be consulted for the most current sea-level rise projections. http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf
OPC 2017 Rising Seas in California: Update on Sea-Level Rise Science	This report synthesizes the state of sea level rise science and provides the scientific foundation for the 2018 update to the State of California's sea level rise guidance. http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf
California Coastal Commission Sea-Level Rise Policy Guidance	This document is an overview of sea-level rise science and recommended methodology for addressing SLR in planning and regulatory actions. It is intended to serve as a multi-purpose resource for a variety of audiences and includes a high level of detail on many subjects. Supplemental sea-level rise guidance materials can be found on the Coastal Commission website. https://www.coastal.ca.gov/climate/slrguidance.html
Governor's Office of Planning and Research (OPR) Integrated Climate Adaptation and Resiliency Program (ICARP) Adaptation Clearinghouse: Ocean and Coast Topic Area	The Adaptation Clearinghouse serves a centralized source of information to guide planning and implementation of adaptation projects. For the clearinghouse start page, visit: http://opr.ca.gov/clearinghouse/adaptation/ The Clearinghouse's "Ocean and Coast" topic area provides a comprehensive listing of resource information, including sea-level rise planning documents, adaptation plans, policies, guidance, science and research, case studies, and funding sources. For the ocean and coast topic page of the clearinghouse, visit: https://resilientca.org/topics/ocean-and-coast/
OPC Sea-Level Rise Planning Database	Assembly Bill 2516 (2014) requires OPC to develop and maintain a sea-level rise Planning Database biannual surveys of sea-level rise planning information to catalog California's efforts to prepare for rising seas. OPC is working with OPR to provide the resources listed in the databased through the Adaptation Clearinghouse Ocean and Coast Topic area. http://www.opc.ca.gov/planning-for-sea-level-rise-database/

Sea Level Rise Resource/Guidance	Description
National Oceanic and Atmospheric Administration (NOAA) Digital Coast	Portal to local, state, and federal data, tools, and training for resilience and other coastal issues. NOAA developed the website in partnership with stakeholders who are the website's primary users. These contributing partners include federal, state, local, and regional governments, and non-governmental, academic, and private sector organizations. https://coast.noaa.gov/digitalcoast/
Adapting to Rising Tides Portfolio	The San Francisco Bay Conservation Development Commission (BCDC) Adapting to Rising Tides (ART) program offers planning guidance, engagement and planning tools for conducting a community adaptation planning process, and resources addressing sea-level rise, specific to counties in the San Francisco Bay Area. http://www.adaptingtorisingtides.org/
California State Coastal Conservancy	The Coastal Conservancy's Climate Ready Program is helping natural resources and human communities along California's coast and San Francisco Bay adapt to the impacts of climate change, such as rising sea levels, beach and bluff erosion, extreme weather events, flooding, increasing temperatures, changing rainfall patterns, decreasing water supplies, and increasing fire risk. http://scc.ca.gov/climate-change/
California State Coastal Conservancy /The Nature Conservancy	The Nature Conservancy in California and the California State Coastal Conservancy collaborated to produce the first statewide, comprehensive assessment of the vulnerability of California's coastal habitats, imperiled species, and conservation lands to sea level rise. http://coastalresilience.org/project/conservation-assessment/
California State Lands Commission	The California State Lands Commission works to facilitate sea-level rise preparedness with an emphasis on protecting California's public trust lands and the public's right to access and enjoyment of these lands. The Commission partners with the California legislature and federal, state, and local agencies on efforts to mitigate the impacts of sea-level rise on the lands and natural resources entrusted to its care. http://www.slc.ca.gov/Programs/Sea_Level_Rise.html
Coastal Plan Alignment Compass	Developed through a multi-agency partnership, The Compass focuses on California coastal communities, which are responsible for developing a suite of local plans that include local coastal programs, local hazard mitigation plans, and general plans. https://resilientca.org/topics/plan-alignment/
California Natural Resources Agency	The California Natural Resources Agency leads and coordinates the administration's climate adaptation policy and its natural resources climate policy. http://resources.ca.gov/climate/
California Climate Change Portal	The State of California hosts this web page offering sea level rise resources for local governments. http://www.climatechange.ca.gov/adaptation/local_government/sea_level_rise.html
OPR General Plan Guidelines	OPR updated General Plan Guidelines provide guidance to local governments on how to incorporate climate change into general plans. http://opr.ca.gov/planning/general-plan/
Sea-Level Rise Mapping Tools	
Cal-Adapt Climate Change Mapping Tools	This tool offers state climate data for multiple hazard and is interactive with the General Plan Guidelines Data Mapping Tool (see description below). Mapping data includes water depth based on various sea-level rise scenarios. http://cal-adapt.org/tools/slr-calflod-3d/

Sea Level Rise Resource/Guidance	Description
NOAA Office for Coastal Management Sea Level Rise Viewer	This web mapping tool assisting in visualizing community-level impacts from coastal flooding or sea-level rise (up to 6 feet above average high tides). It also provides photo simulations of how future flooding might affect local landmarks, as well as data related to water depth, connectivity, flood frequency, socio-economic vulnerability, wetland loss and migration, and mapping confidence. https://coast.noaa.gov/slr/
Sea the Future: Sea Level Rise and Coastal Flood Web Tools Comparison Matrix	This matrix compares sea-level rise visualization tools to apply to local questions. The matrix was created to provide the planning and coastal management communities with an expandable chart to compare the functions and methods of publicly available sea level rise and coastal flood web tools. The matrix was originally developed as part of California's "Lifting the Fog" workshop, which sought to provide guidance to end users interested in using modeled sea level rise projections in coastal planning. http://sealevel.climatecentral.org/matrix/
CoSMos	The Coastal Storm Modeling System (CoSMoS) is a dynamic modeling approach that has been developed by the United States Geological Survey in order to allow more detailed predictions of coastal flooding due to both future sea-level rise and storms integrated with long-term coastal evolution (i.e., beach changes and cliff/bluff retreat) over large geographic areas. https://walrus.wr.usgs.gov/coastal_processes/cosmos/index.html
Hazard Exposure Reporting and Analytics: HERA	Developed by USGS, HERA can be used in conjunction with CoSMoS to evaluate sea-level rise impacts on demographics, economics, land cover, and infrastructure. HERA provides mapping results in chart and table formats. https://www.usgs.gov/apps/hera/
Our Coast Our Future (OCOF), Online Viewer for the CoSMoS Tool	Our Coast, Our Future (OCOF) is a collaborative, user-driven project focused on providing coastal California resource managers and land use planners with locally relevant, online maps and tools to help understand, visualize, and anticipate vulnerabilities to sea-level rise and storms. http://data.pointblue.org/apps/ocof/cms/
The Nature Conservancy Coastal Resilience California	This tool visualizes sea-level rise to identify vulnerabilities along the California coast, compares economic impacts of nature-based adaptation approaches, and identifies potential mitigation pathways for coastal habitats. http://maps.coastalresilience.org/california/
Surging Seas Risk Finder	This tool provides local information on se-level rise and coastal flooding down to the neighborhood level. http://sealevel.climatecentral.org/
General Plan Guidelines Data Mapping Tool	This tool maps various data sets (including sea-level rise projections) that may be useful to local, regional, and tribal planners. Data are grouped by general plan category and by common themes. http://opr.ca.gov/planning/general-plan/data-mapping-tool.html
State of California Geoportal	Many of the state's hazards mapping tools, along with many other Geographic Information Systems (GIS) tools are accessible on the State of California Geoportal website. http://portal.gis.ca.gov/geoportal/catalog/main/home.page

Additionally, some agencies such as California State Lands Commission have also developed internal resources regarding sea-level rise. For example, the California State Lands Commission's Sea-Level Rise Viewer is a web-mapping application developed to assist staff in sea-level rise planning and lease area review.

For other mitigation and adaptation planning resources see Tables 5.J and 5.K in *Section 5.3.2*.

7.2.4 CURRENT SEA-LEVEL RISE, COASTAL FLOODING, AND EROSION HAZARD MITIGATION EFFORTS

Mitigating the impacts of sea-level rise requires action at all levels of government. A global effort is needed to reduce greenhouse gas (GHG) emissions that are leading to climate change, but GHG emission reduction will not be able to blunt sea-level rise in the near term. In addition, GHG emissions remain in the atmosphere for periods ranging from decades to centuries. As a result, ocean waters will continue to warm and the polar ice caps and continental glaciers will continue to melt even as GHG emission reduction programs occur.

Since sea-levels will continue rising, communities must implement a variety of adaptation strategies to reduce impacts from sea-level rise. Appropriate land use planning and regulation are needed at the federal, state, and local levels. Many statewide guidance documents provide information related to adaptation options. For example, the Coastal Commission's draft Residential Adaptation Policy Guidance document discusses climate adaptation for residential development to help communities with residential land use planning.[163]

Often, the first step in developing mitigation strategies is assessing vulnerability, because it is through the vulnerability assessment that areas in need of mitigation are identified. In some cases, specific assessment methods are used to inform mitigation actions and are classified as part of the mitigation strategy. Thus, some sea-level rise vulnerability assessment efforts being undertaken by state agencies, considered to be precursors to development of priority mitigation and adaptation actions, are included in this section.

Adaptation Efforts by State Agencies

In California, multiple agencies are pursuing efforts to address sea-level rise and development decisions affecting coastal areas are regulated at state, regional, and local levels. While not a regulatory agency, the Ocean Protection Council (OPC) is responsible for updating the State of California's sea-level rise guidance document to ensure that state and local planning, permitting and investment decisions are based on the best available science and are protective of vulnerable communities, infrastructure, and coastal habitats. This guidance is integrated into regulatory and funding decisions of the state's coastal management agencies. The California Coastal Commission regulates development to ensure protection of coastal resources and calls for preparation of Local Coastal Programs (LCPs), which carry out state Coastal Act policies (subject to review and approval by the Coastal Commission). Similarly, the Bay Conservation and Development Commission (BCDC) prepares and implements plans that determine development along San Francisco Bay.

The State Department of Parks and Recreation has jurisdiction over more than 300 miles of California coastline and implements a Coastal Erosion Policy to avoid construction of new structures or coastal facilities in areas subject to ocean wave erosion, sea cliff retreat, and unstable cliffs.

The California State Lands Commission regulates the construction of marine oil terminals (Chapter 31F Marine Oil Terminals, Title 24 Part 2, California Building Code). It regulates the construction of liquid natural gas (LNG) marine terminals through a building code in pre-draft stage and will oversee the construction of oil platforms on state lands. In addition, California State Lands Commission oversees public trust lands. As sea levels rise, the public trust boundary will move inland, affecting areas of development not currently serving public trust interests (e.g. private residential development). Community responses to sea-level rise and hazards will be affected by how the California State Lands Commission addresses public trust lands over time.

While several state agencies are in the process of evaluating and responding to potential effects of sea-level rise, four agencies have substantial focus on the issue. The Ocean Protection Council (OPC), California Coastal Commission, and San Francisco Bay Conservation and Development Commission (BCDC) are actively engaged in an ongoing evaluation of sea-level rise and related hazards such as erosion and coastal flooding. In addition, the

[163] California Coastal Commission. Draft Residential Adaptation Policy Guidance. 2017. Retrieved on August 30, 2017 from https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/residential/

California Department of Transportation (Caltrans) has responsibility for extensive transportation infrastructure potentially at risk and has been assessing the vulnerability of these transportation systems.

Continued efforts are also underway to facilitate coordinated understanding of the latest science regarding climate impacts on oceans. These efforts help to integrate adaptation work between federal, state, regional, and local jurisdictions.

Fourth Climate Change Assessment

The Fourth Climate Change Assessment is the first inter-agency effort to implement a substantial portion of the Climate Change Research Plan that was released in 2015. The California Natural Resources Agency, in collaboration with the Governor's Office of Planning and Research (OPR), the California Energy Commission (CEC), and the Climate Action Team (CAT) Research Working Group, has developed a proposed portfolio of projects for California's Fourth Climate Change Assessment.

Among the portfolio of projects being undertaken in the fourth Climate Change Assessment are several that address coastal issues, sea-level rise, and ocean ecosystems, including:

- Assessing and Communicating the Impacts of Climate Change on the California Coast
- Identification of Natural Infrastructure Options for Adapting to Sea-Level Rise
- California Mussels as Bio-Indicators of the Ecological Consequences of Global Change: Temperature, Ocean Acidification, and Hypoxia
- Multi-Scale Infrastructure Interactions with Intermittent Disruptions: Coastal Flood Protection Infrastructure, Transportation, and Government Networks
- Strategies for Adapting to Long-Term Sea-Level Rise in the San Francisco Bay Area

Final reports for the projects listed above are planned for release in August 2018.

Best Practices Highlight 7.A: Natural Infrastructure for Adapting to Sea Level Rise

In November 2017, the Fourth Climate Change Assessment in coordination with other federal and state agencies published "Case Studies of Natural Shoreline Infrastructure in Coastal California: A Component of Identification of Natural Infrastructure Options for Adapting to Sea Level Rise." The report features five case studies of projects along the state's coastline that address adaption to sea level rise through green and/or natural shoreline infrastructure methods. Natural shoreline infrastructure is an alternative to engineered structures that is more likely to preserve the benefits of coastal ecosystems while also maintaining coastal access.

A Technical Advisory Committee was charged with selecting a set of projects to highlight as case studies of natural shoreline infrastructure, and was composed of 34 representatives from local, state, and federal government agencies, non-governmental organizations, and environmental consulting firms.

For each featured case study, a summary is provided along with a list of "Key Lessons for Success" that can be used by other coastal jurisdictions. The case studies were designed to be useful examples for coastal planners, local governments, and others working on solutions and making decisions regarding climate-related coastal hazards.

To download the report, visit: http://coastalresilience.org/wp-content/uploads/2017/11/tnc_Natural-Shoreline-Case-Study_hi.pdf.

Safeguarding California Plan: 2018 Update

In the 2018 update to the Safeguarding California Plan strategies are organized into 10 sectors with five for social systems and the built environment and five for natural and managed resource systems and an additional sector, new to the 2018 update, for "Parks, Recreation, and California Culture."[164] The "Parks, Recreation, and California Culture" sector is categorized under both systems, as it deals with social systems, the built environment, and natural resources. Climate justice recommendations, also new to the 2018 update, are included in all policy sectors. (For more information on the Safeguarding California Plan: 2018 Update, see *Section 4.3.6.4*).

Within the natural and managed resource systems grouping is the "Ocean and Coast" Sector. For this sector, recommendations with associated next steps and ongoing actions are listed. These recommendations (and their associated steps and actions) address sea-level rise and adaptation. For more information, visit the California Natural Resources Agency website: http://resources.ca.gov/climate/safeguarding/.

California Coastal Commission: Planning and Regulatory Process

There are a number of ways the California Coastal Commission addresses sea-level rise in its planning and regulatory process. The potential impacts of sea-level rise fall directly within the Coastal Commission's planning and regulatory responsibilities under the Coastal Act, which mandates the protection of public access and recreational opportunities, coastal habitats, and sensitive resources, and requires the minimization of coastal hazards for all coastal development.

The Coastal Commission implements these policies through the review and certification of Local Coastal Programs (LCPs) (which allow local governments to implement the Coastal Act at the local level) and through direct review of certain projects (either through an appeal of a local agency decision or review of projects located in areas of the Coastal Commission's retained jurisdiction). Since its inception, the Coastal Commission and local governments have addressed coastal hazards that will be exacerbated by sea-level rise through actions such as requiring hazard and site stability analyses, ensuring that development is setback or otherwise designed to avoid or minimize hazards, and requiring that any measures taken to address hazards will minimize impacts on coastal habitats.

The Coastal Commission is working to implement the state's sea level rise policy guidance through a number of avenues. These includes outreach and training for Coastal Commission staff, local governments, and other interested parties; and coordination with state and federal agencies such as NOAA, FEMA, USGS, Caltrans, the California State Lands Commission, OPC, and others. Notably, the Coastal Commission has emphasized (and devoted significant funding to) working with local governments to update their LCPs to better address sea level rise.

The impacts of sea level rise will be felt at the local level, and therefore local responses are a critical component of effective management of these impacts. To that end, the Coastal Commission (leveraging funding from both OPC and the State Coastal Conservancy) developed a grant program that funds local jurisdictions to update LCPs with the goal of updating or developing policies to ensure that adaptation occurs in a way that protects both coastal resources and public safety and allows for sustainable economic growth. To date, over 30 local governments have received grants to complete vulnerability assessments, technical studies, and adaptation plans, and to develop updated land use and adaptation policies that better address sea level rise.

[164] California Natural Resources Agency. (2017). Draft Report Safeguarding California Plan: 2017 Update. Sacramento: author, 183 p., p. 4.

Progress Summary 7.H: California Coastal Commission Sea-Level Rise Policy Guidance

Progress as of 2018: In August 2015, the Coastal Commission adopted the "California Coastal Commission Sea-level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits" document. It provides background on sea level rise science, recommendations for addressing sea level rise in Local Coastal Programs (LCPs) and Coastal Development Permits, information on adaptation options, and a discussion of the legal context of adaptation planning. Communities should check the Coastal Commission website for updates to the guidance as science evolves.

The 2015 document provides six steps for addressing sea level rise in LCPs and other plans:

1. Determine the range of sea level rise projections relevant to the LCP planning area
2. Identify potential physical sea level rise impacts in the LCP planning area
3. Assess potential risks from sea-level rise to coastal resources and development
4. Identify LCP adaptation strategies to minimize risks
5. Draft an updated or new LCP for certification by the Coastal Commission
6. Implement the LCP and monitor and revise as needed.

Sea level rise and the changing climate present management challenges of a new magnitude, with the potential to significantly threaten many coastal resources. As sea levels rise, beaches, wetlands, and other coastal habitats will be drowned and eventually lost if they are backed by fixed development and unable to naturally migrate inland over time. This constraint, commonly referred to as "coastal squeeze," also affects public access and recreation and presents a significant environmental justice issue if private residents adjacent to the shoreline continue to enjoy shoreline access while the general public access is blocked.

The "coastal squeeze" phenomenon requires the implementation of adaptation strategies like beach nourishment and managed retreat to ensure the continued protection of coastal resources as mandated by the Coastal Act. To better address these challenges, the Coastal Commission developed its Sea Level Rise Policy Guidance, which was unanimously approved in August 2015. This document provides a set of guiding principles and recommendations for how to address sea level rise within the context of the Coastal Act. It provides step-by-step processes for how to develop or update LCPs to respond to sea level rise and how to address sea level rise in Coastal Development Permit applications.

The guidance also includes information of sea level rise science, a library of adaptation strategies, and background on the legal context of adaptation planning. In 2018, the Coastal Commission released a draft science update to the Sea Level Rise Policy Guidance intended to better align the CCC guidance with the Ocean Projection Council's State of California Sea-Level Rise Guidance 2018 Update and 2017 Rising Seas in California: Update on Sea-Level Rise Science documents.

Visit the California Coastal Commission website to download the Sea Level Rise Policy Guidance document: https://www.coastal.ca.gov/climate/slrguidance.html.

Progress Summary 7.I: Local Coastal Resources Grant Program

Progress as of 2018: The California Coastal Commission's Local Coastal Program/Local Assistance Grant Program provides funds to support local governments in completing or updating Local Coastal Programs (LCPs) consistent with the California Coastal Act, with special emphasis on planning for sea level rise and climate change.

Four rounds of LCP local assistance grants have been awarded. To date, $5 million has been awarded to 34 different local governments to complete a variety of vulnerability assessments, technical studies, and adaptation plans, to conduct public outreach, and to develop or update LCP policies to better address sea level rise. In the fourth round of grant funding, a total of $546,685 of California State Coastal Conservancy funds were awarded to jurisdictions working on sea level rise and climate change planning. The fifth round of grant funding is planned to be awarded in the fall of 2018.

More information on the Coastal Commission grant program, including links to completed grant deliverables from local jurisdictions, can be found at: https://www.coastal.ca.gov/lcp/grants/.

More information on the Coastal Commission's continued sea level rise work can be found on the Coastal Commission's sea level rise [165] and LCP local assistance grant program web page: https://www.coastal.ca.gov/lcp/grants/.

Caltrans – Sea Level Rise Assessment and Adaptation Planning, Permitting, Highway Design

In February 2009, Caltrans prepared a report titled "Vulnerability of Transportation Systems to Sea-level Rise: A Preliminary Assessment," which concluded that a 4.58-foot (1.40-meter) rise in sea level would have substantial impacts on various transportation systems, including flooding of tunnels and airport runways, washouts of coastal highways and rail lines, and submersion of dock and port facilities. These would have strategic security implications, as well as transportation and economic implications.

By 2100, sea level rise could put at risk about 350 miles of major state highways located along coastal, delta, and interior waterways. Freight transportation that involves ports, rail lines, local streets, highways, and pipelines also faces the potential for major disruption. The impacts of sea level rise could endanger an estimated 3,500 miles of roads and 280 miles of railways that would be vulnerable to a 100-year flood event in 2100.

Building on the initial evaluation in 2009, Caltrans released "Guidance on Incorporating Sea-level Rise" in 2011. The 2012 Caltrans Director's Policy 30 bolstered these efforts by mandating the consideration and integration of climate change into departmental decisions and activities. In 2013, "Caltrans Activities to Address Climate Change" was released.[166] This document summarizes GHG reduction as well as adaptation needs and strategies for California's transportation system.

Caltrans' initial vulnerability assessment and adaptation studies are detailed in the 2014 "District 1 Climate Change Vulnerability Assessment and Pilot Studies FHWA Climate Resilience Pilot Final Reports."[167] This study effort created a process for vulnerability evaluation of Caltrans assets and a means to assess adaptation strategies. Vulnerability assessment and pilot study efforts are planned for the remaining districts within the next year, with District 4 expected to release a draft report in 2017.

The climate change impacts studied include sea level rise, storm surge, precipitation change, high temperatures, and wildfires. The vulnerability assessment studies complete four steps:

- Project future climate scenarios (2050, 2070, 2100)

[165] https://www.coastal.ca.gov/climate/slrguidance.html
[166] Caltrans. Caltrans Activities to Address Climate Change, 2013. Retrieved on 8/25/17 from http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/documents/Caltrans_ClimateChangeRprt-Final_April_2013.pdf.
[167] Caltrans. (2014). District 1 Climate Change Vulnerability Assessment and Pilot Studies. Retrieved on 8/25/17 from http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/documents/ccps.pdf.

- Quantify and map impacts of climate change stressors
- Identify transportation assets as risk (roads, bridges, culverts)
- Develop strategies and guidance to address vulnerable assets in Caltrans planning programming, and project development

Senate Bill 1, the Road Repair and Accountability Act of 2017, includes accounting for projected climate change impacts such as sea level rise as a condition for projects receiving funds. The bill also establishes a funding program to support climate adaptation planning. For more information on Senate Bill 1, see *Section 4.3.6.2* or visit: http://www.dot.ca.gov/hq/tpp/grant_files/FY_18-19/7.FY18-19_AP_AwardList.pdf.

Best Practices Highlight 7.B: Caltrans Incorporating Sea-level Rise into Corridor Planning for State Route 37

State Route 37 (SR 37) constitutes a major regional east-west vehicular transportation corridor in the northern San Francisco Bay Area. Caltrans selected this corridor for a case study to understand adaptive transportation planning in the face of sea-level rise. The case study, initiated in 2014, was designed to implement a four-stage process:

- Involve stakeholders in a multi-way discussion of future scenarios
- Model potential risks to SR 37 and associated shoreline
- Develop conceptual diagrams, costs, and visualizations of adaptive structures
- Share text resources, data, and project findings through a web-system

The results of the case study were released in 2016 as the State Route 37 Integrated Traffic, Infrastructure, and Sea-level Rise Analysis report, also known as the SR 37 Stewardship Study. The University of California, Davis, in partnership with Caltrans District 4, conducted the study in conjunction with key stakeholders including congestion management agencies from Napa, Solano, Sonoma, and Marin Counties; the Metropolitan Transportation Commission; North Bay county resource conservation districts; state and federal resource and permitting agencies; the Sonoma Ecology Center; the Sonoma Land Trust; and numerous others.

The study provided crucial information on the expected impacts of sea-level rise on State Route 37 and developed high-level cost estimates for three potential highway reconstruction options to mitigate the impacts of sea-level rise, while also addressing environmental considerations. The results of the study will help shape long-range planning for State Route 37 by informing the updates of the Transportation Concept Report. District 4 will also use this study as the foundation for future decision-making in potential follow-up studies, including a hydraulic study and a transit opportunities assessment. The full report and technical appendices may be accessed at: http://scta.ca.gov/wp-content/uploads/2018/02/SR-37-Corridor-Plan-with-appendix.pdf.

The State Route 37 Integrated Traffic, Infrastructure, and Sea Level Rise Analysis study, as well as other preceding research efforts provided a basis for an additional regionally based sea-level rise planning effort. The SR 37 Transportation and Sea Level Rise Corridor Improvement Plan was released in June 2018. Also a collaborative effort between Caltrans, the Metropolitan Transportation Commission, and the four North Bay Transportation Authorities, this corridor plan encompasses three broad goals:

- Integrate transportation, ecosystem, and sea-level rise adaptation into one design
- Improve mobility across all modes and maintain public access
- Increase corridor resiliency to storm surges and sea-level rise

The most critical issues for the study corridor are recurrent traffic congestion, vulnerability to flooding (including sea-level rise), and potential impacts of sea-level rise on highly sensitive environmental resources adjacent to the corridor. The corridor plan developed and evaluated three potential strategies to maintain Highway 37 in the context of the existing corridor and identified adaptive mitigation strategies to address the key corridor issues and develop resiliency to sea-level rise. An Implementation Plan is also included which outlines specific projects to be completed in the near-, mid-, and long-term. Further details may be found at: http://scta.ca.gov/wp-content/uploads/2018/02/SR-37-Corridor-Plan-with-appendix.pdf.

Department of Water Resources

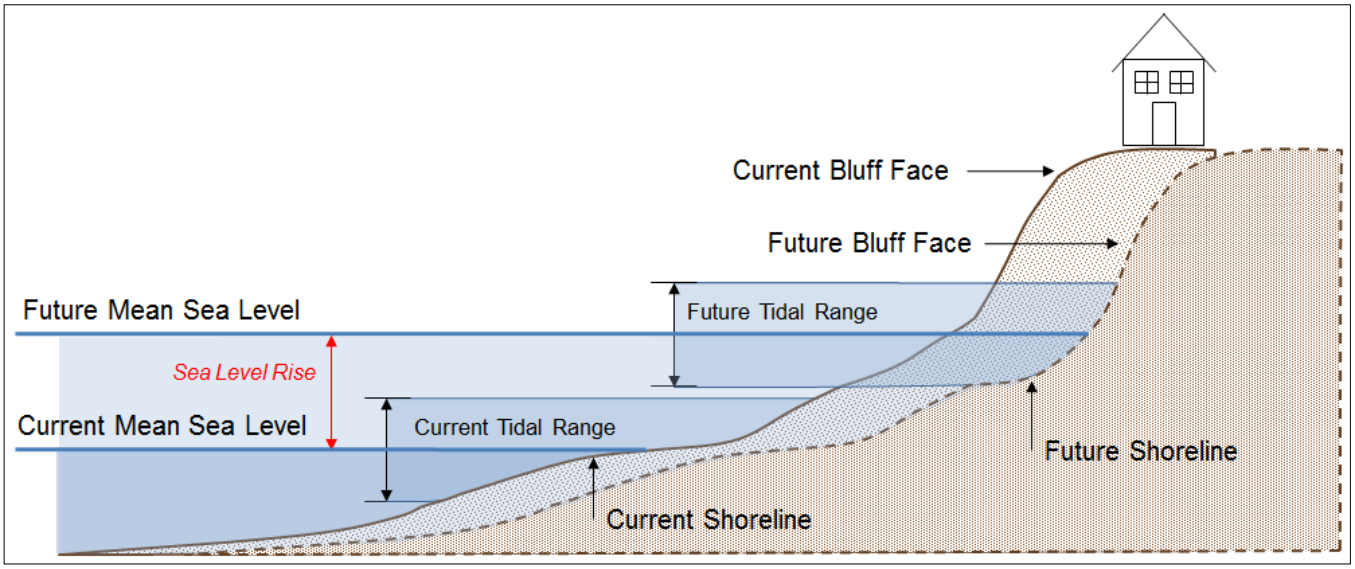
The California Department of Water Resources (DWR) produced the California Quick Guide in 2007 with a focus on "existing condition" flood hazards. In October 2016, DWR published an appendix to the Quick Guide titled "The National Flood Insurance Program in California Quick Guide Coastal Appendix: Planning for Sea-Level Rise" to provide information to floodplain managers, planners, and community leaders who need to understand the effects of future sea level rise in order to enhance their communities' mitigation plans and take action to better protect their citizens. The appendix provides information and resources on regulatory and non-regulatory FEMA mapping efforts, general approaches for mapping sea level rise in coastal areas, and guidance to communities on how to plan for sea level rise.

Figure 7.J illustrates information provided in DWR's Quick Guide. To download the California Quick Guide Coastal Appendix document, visit: http://water.ca.gov/floodmgmt/lrafmo/fmb/docs/QGCoastalAppendix_FINALDRAFT_2016dec02.pdf.

For more information about California's climate change adaptation initiatives, see *Section 4.3.6*.

(Note: DWR's Quick Guide information has not yet been updated to incorporate the sea level rise projections from the 2017 "Rising Seas in California: An Update on Sea-Level Science" report and the State of California Sea-Level Rise Guidance 2018 Update, which are considered the best available science for sea level rise projections in California, as of 2018.)

Figure 7.J: Sea-level Rise Planning Guidance



Source: California Department of Water Resources, The National Flood Insurance Program in California: Quick Guide Coastal Appendix: Planning for Sea-level Rise, October 2016.

Adapting to Rising Tides: Addressing Vulnerability to Sea-level Rise in San Francisco Bay

The Bay Conservation and Development Commission (BCDC) focuses on sea level rise in San Francisco Bay and development within the first 100 feet of the waterfront. The document titled "Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline" was released in 2011. Building on this effort, BCDC supports the Adapting to Rising Tides (ART) program. This program offers includes guidance, examples, and many other resources to support regional and local efforts (see Figure 7.K).

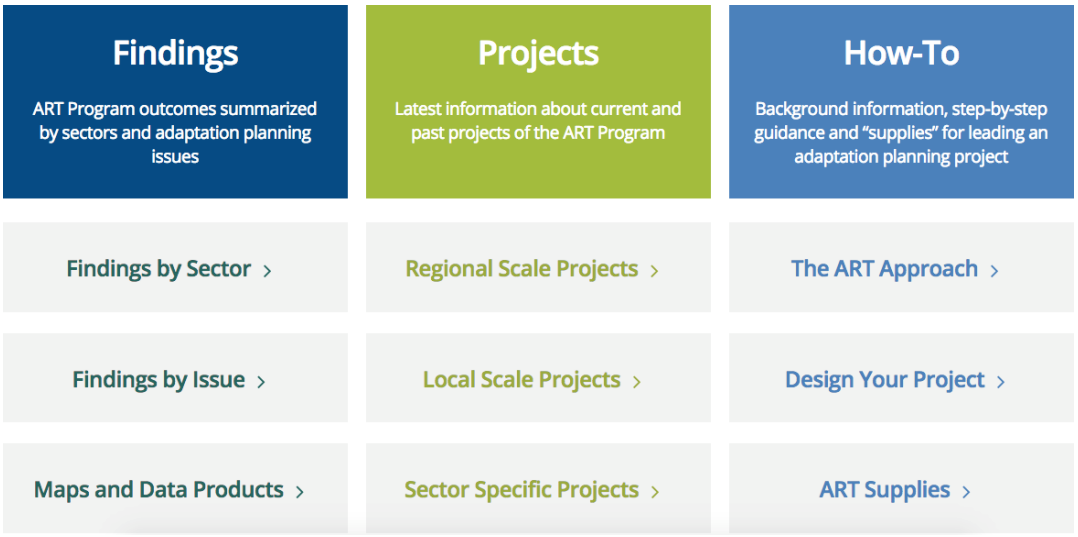
Progress Summary 7.J: San Francisco Bay Conservation and Development Commission

Progress as of 2018: The San Francisco Bay Conservation and Development Commission (BCDC) has been working to support local and regional sea level rise adaptation efforts with guidance, improved science, and educational programs. Since 2010, these efforts have been housed within the Adapting to Rising Tides (ART) program.[168]

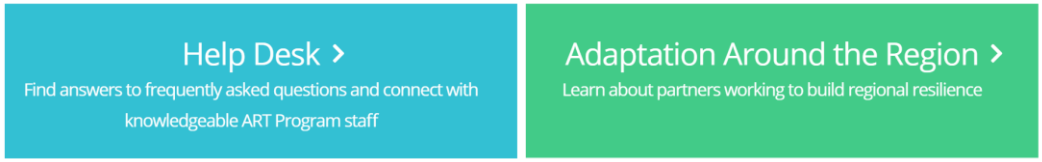
BCDC's efforts continue to expand in scope, detail, complexity, and setting. These efforts (including several implemented projects) will continue to foster adaptation efforts in the Bay Area.

For more information about BCDC's Adapting to Rising Tides (ART) program, visit: www.adaptingtorisingtides.org/.

Figure 7.K: Bay Conservation and Development Commission (BCDC) Adapting to Rising Tides Program – Resource Organization



Source: www.adaptingtorisingtides.org



Source: www.adaptingtorisingtides.org

Two valuable aspects of the ART program are the "Help Desk" and "Adaptation Around the Region" features. For more information about these features, visit: www.adaptingtorisingtides.org.

[168] San Francisco Bay Conservation and Development Commission (BCDC). 2017. Adapting to Rising Tides. Retrieved on 8/28/17 from http://www.adaptingtorisingtides.org/

Local and Regional Adaptation Planning and Efforts

Many local and regional jurisdictions have pursued sea level rise planning and adaptation efforts. The following best practices highlight planning efforts and projects completed since 2013 can be used as examples by other jurisdictions.

Best Practices Highlight 7.C: The Adapting to Rising Tides Project: Collaborative Adaptation Planning on the Shoreline of Alameda County

The Adapting to Rising Tides (ART) project is a collaborative planning effort led by San Francisco Bay Conservation and Development Commission (BCDC) and the National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management. The ART program seeks to answer two key questions:

1) How will climate change impacts of sea level rise and storm events affect the future of Bay Area communities, infrastructure, ecosystems, and economy?
2) What strategies can we pursue, both locally and regionally, to reduce and manage these risks?

For its pilot project, the ART team worked with an active and engaged group of local, county, regional, state, and federal agency staff to evaluate the vulnerability and risk of a portion of the Alameda County shoreline from Emeryville to Union City. The first step in this process was an impacts assessment that identified local climate impacts associated with sea level rise and storm events, and characterized the existing conditions of community land use, transportation, utility, and shoreline assets in the project area (the ART sub-region). The impacts assessment set the stage for a comprehensive evaluation of vulnerability based on exposure and sensitivity to sea level rise and storm events, and the capacity to accommodate or adjust to these impacts. With input from the working group and other experts, the project also broadly evaluated the social equity, economic, environmental, and governance consequences of sea level rise and storm event impacts.

Based on the assessment of vulnerability and risk, the ART project developed a suite of adaptation responses to mitigate the risk of future sea level rise and storm events by improving the resilience of community land use, transportation, utility, and shoreline assets at the sub-regional scale. With the working group, the project is evaluating the sub-regional adaptation responses, which include a number of possible actions that can be taken together or individually by interested stakeholders to strategically address identified vulnerabilities. The adaptation response also included options for local, regional, and statewide implementation, including the processes, partners, and triggers for initiation.

In addition to developing adaptation responses at the sub-regional scale, the ART project is evaluating the issues of inter-related vulnerabilities and risks, including infrastructure inter-dependencies, which need to be addressed at scales smaller than the sub-region. These efforts will help the region better understand the potential mitigation options to address cross-cutting, the multi-hazard risk that the shoreline will face in light of sea level rise, existing coastal hazards, and other future pressures. While the documents for Alameda County were completed in January 2014, the ART staff continue to work with asset managers within the project area on more focused assessment and adaptation planning.

The initial ART program has expanded into BCDC's "ART Portfolio" program, which includes a range of ongoing local- and regional-scale projects and sector-specific projects, such as ART Bay Area, the Contra Costa County ART Project, the Capitol Corridor Passenger Rail project, and many others.

To learn more, see: http://www.adaptingtorisingtides.org/project/art-subregional-project/.

Best Practices Highlight 7.D: Sea-Level Rise Adaptation in the San Francisco Bay Area – Mission Creek Sea-level Rise Adaptation Study

San Francisco is one of many coastal cities threatened by the impacts of sea level rise. The lowest-lying part of the city is the eastern waterfront surrounding Mission Creek Canal and Mission Bay. Projections for San Francisco Bay presented in the State of California Sea-Level Rise Guidance 2018 Update anticipate a 2.4- to 3.4-foot increase in tide levels by 2100 (based on low to high emissions scenarios in the likely range), which could flood neighborhoods, historic bridges, and other critical infrastructure.

To address the hazards posed by rising sea level in Mission Creek, several City and County of San Francisco agencies conducted a $200,000 adaption study in collaboration with experts from the Netherlands, San Francisco Bay Area Planning and Urban Research Association (SPUR), San Francisco Bay Conservation and Development Commission (BCDC), and other stakeholders. The report preparation effort sets an example of collaborative efforts among agencies and private sector partners. The Mission Creek Sea Level Rise Adaptation Study provides a set of multi-purpose design alternatives to promote a more resilient waterfront community around Mission Creek Canal and Mission Bay. The purpose of the study was to generate a range of solutions through an imaginative and collaborative process, rather than a list of policy recommendations commensurate with a "preferred" alternative. The rationale behind this method is to ensure that the discussion of sea level rise adaptation includes all possibilities and perspectives.

The process resulted in seven possible adaptation strategies, three for the creek and four for the bay shoreline, and separate adaptation concepts for the historic piers in the area. The alternatives include protecting the perimeter shoreline, providing tidal control, damming or leveeing the creek as a barrier against the greater San Francisco Bay, providing a multi-purpose levee, elevating streets, and creating a new waterfront. Priorities for the development of these alternatives included the integration of flood protection into the urban fabric for an attractive and economically viable city, natural ecosystem and habitat development, and future adaptability. The report can be downloaded from the SPUR website at the following link: http://www.spur.org/sites/default/files/publications_pdfs/Mission_Creek_Sea_Level_Rise_Adaptation_Study.pdf.

Best Practices Highlight 7.E: City of Del Mar Sea-level Rise Adaptation Plan

The City of Del Mar, located in San Diego County, has committed to actively planning for sea level rise to protect its coastal resources. With grant funding from the California Ocean Protection Council, California State Coastal Conservancy and California Coastal Commission, in addition to its own supplemental funding, the City committed to prepare a vulnerability and risk assessment of local hazards (sea level rise, storm-surge, and coastal flooding), a long-term sea level rise Adaptation Plan, and Local Coastal Program (LCP) amendment with new land use policies and implementing regulations.

Del Mar's City Council approved the Adaptation Plan in May 2018 and is scheduled to adopt the plan in September 2018. The plan recognizes the threat of sea level rise to city resources and its role in worsening storm surge and coastal flooding and erosion. Of significance is the City's coordinated planning effort with the goal of integrating the Adaptation Plan into the LCP via an LCP amendment. This effort serves as an example of successful integration of adaptation and hazard mitigation planning with general planning. Figure 7.L, taken from the Adaptation Plan, shows the steps used by the City of Del Mar to evaluate, select, and plan for adaptation options.

The guiding principles for developing, evaluating, and analyzing adaptation measures in the plan include the following:

- Limit the risk of extreme coastal and river flooding to less than 5 percent
- Maintain a walkable beach for recreational use and economic benefit
- Maintain horizontal coastal access and vertical water access points to North and South Beach
- Maintain San Dieguito Lagoon wetland habitat functions

The plan combines accommodation, protection, and retreat approaches to sea level rise adaptation with triggers for various strategies in the plan. The plan evaluates "acceptable risk," which it defines as a risk with a less than 5 percent chance of occurring. Five particular areas affected by sea level rise were identified:

- Vulnerable City assets and public resources throughout the City
- San Dieguito Lagoon wetland (River Valley and Del Mar Fairgrounds)
- San Dieguito River flooding (North Beach, River Valley, and Del Mar Fairgrounds)
- Erosion of bluffs and adjacent beaches (South Bluffs, Powerhouse Park, and North Bluffs)
- Erosion and flooding for North Beach (15th Street north to the San Dieguito Lagoon mouth)

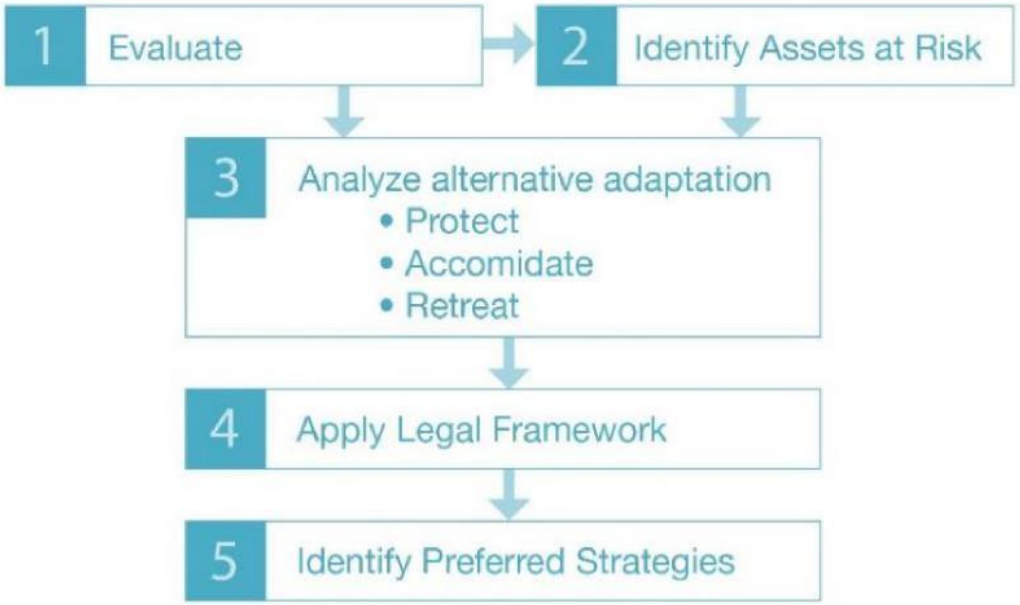
In addition to the five areas mentioned above, three areas were listed as having high priority for sea level rise adaptation needs. Adaptation measures include relocating the City's fire station and public works yard and flood proofing a sewer lift station.

For each of the five areas listed above, vulnerability was assessed and a phased set of adaptation strategies were identified, with triggers (e.g., sea level or beach width) for when each strategy should be pursued. Each measure is described with both benefits and constraints identified. For example, North Beach adaptation measures include the following:

- Beach and dune nourishment
- Raise/improve sea walls and revetments
- Sand retention measures
- Raise structures
- Relocate public infrastructure

More information about the City of Del Mar's Adaptation Plan and LCP Amendment can be found at: http://www.delmar.ca.us/498/Sea-Level-Rise-Local-Coastal-Program-Ame.

Figure 7.L: Del Mar's Process for Evaluating, Selecting, and Sea Level Rise Adaptation Options



Source: City of Del Mar. Approved City of Del Mar Sea-level Rise Adaptation Plan, May 2018. Retrieved on July 23, 2018 from http://www.delmar.ca.us/498/Sea-Level-Rise-Local-Coastal-Program-Ame

7.3 TSUNAMI AND SEICHE HAZARDS, VULNERABILITY AND RISK ASSESSMENT

Although tsunamis and seiches are rare events, the consequences can be high. They can quickly put the lives of millions of coastal residents, businesses, and visitors in jeopardy. The impacts on people and property in the wake of the 2004 Indian Ocean tsunami (230,000 fatalities in 14 countries) and 2011 Japan tsunami (18,000 fatalities in Japan alone; costliest modern natural disaster at $235 billion) emphasize the need to improve tsunami preparedness, mitigation, and recovery planning efforts in California.

A recent study indicated that a large tsunami event originating from the Aleutian Islands could cause coastal flooding that would result in extensive damage and lead to years of recovery, costing the state billions of dollars. However, this study also found that 80 to 90 percent of the damage could be prevented with detailed response, mitigation, land use, and recovery planning efforts. This is the type of work coordinated through the California Tsunami Program, among all levels of government, led by the California Governor's Office of Emergency Services (Cal OES) and the California Geological Survey (CGS).

7.3.1 IDENTIFYING TSUNAMI AND SEICHE HAZARDS

Tsunami

A tsunami is a wave triggered by any form of land displacement along the edge or bottom of an ocean or lake. Land displacement can be in the form of submarine landslides or submarine dip-slip faults. These types of faults cause ruptures that result in seafloor uplift or down-drop. This mass movement translates to a tsunami or gravity wave within the overlying water at the surface. A good general description for understanding tsunamis can be found in Chen and Scawthorn (2003).

Tsunamis travel radially outward from the area of initiation. The size of a tsunami is proportional to the mass that moved to generate the tsunami. As a tsunami approaches the shore and the depth of the water column decreases, the energy in the wave pushes the wave crest above the water surface resulting in a larger wave height. Wave run-up is the elevation above mean sea level on dry land that a tsunami reaches. Run-up is what causes inundation of coastal areas that are below the run-up height.

There are two types of source regions for tsunamis—resulting in local and distant source tsunamis as viewed from the affected shoreline. Local tsunamis are typically more threatening because they afford at-risk populations only a few minutes to find safety. California is vulnerable to, and must consider, both types. Identifying tsunami hazards requires 1) evaluating the potential for submarine mass movement both locally and at great ocean distances, and 2) identifying coastal regions within the direct or indirect path of a potential tsunami wave that are below the run-up height.

Tsunamis can travel at speeds of over 600 miles per hour in the open ocean and can grow to over 50 feet in height when they approach a shallow shoreline, potentially causing severe damage to coastal development. Tsunami hazards that affect both harbors and communities include coastal flooding, seiches (standing waves in an enclosed or partially enclosed body of water), strong damaging currents, extreme water-level fluctuations, eddies (circular currents), and sedimentation/scour. Once coastal areas become flooded and/or damaged, additional subsequent, tsunami-induced hazards can include free-floating debris and environmental contamination from spills.

Seiche

Although less common, seiches can also affect coastal and lake shorelines. A seiche is caused by resonances in a body of water that has been disturbed by wind, atmospheric pressure variations, seismic activity, or even tsunamis. The vertical harmonic motion produces an impulse that travels the length of the water basin and reflects off the other end or sides. These reflected waves can then interfere with each other and create amplified standing waves. Seiches can occur in large bays or lakes as well as large, odd-shaped harbors. Natural basins like Lake Tahoe or man-made basins like the Ports of Los Angeles and Long Beach can be locations where seiches occur in California.

Although seiche activity can be captured by numerical tsunami models, little work has been performed exclusively on seiches in the state.

7.3.2 PROFILING TSUNAMI HAZARDS

Numerous studies have documented historical tsunamis recorded along California's coast. In 1700, an earthquake estimated at Magnitude 9.0 ruptured along the Cascadia Subduction Zone, which stretches from along the coasts of British Columbia, Washington, and Oregon to offshore of California north of Cape Mendocino. Though there were no local written accounts, scientists originally recognized the event from geological evidence and oral histories from the Native American people in the area. This information was eventually cross-referenced with Japanese documents that described an "orphan" tsunami that was not accompanied by a large earthquake in Japan. The exact date and time of this earthquake are known because of a combination of tsunami deposit evidence, carbon-14 and tree-ring dating, tsunami modeling, and historical Japanese records.

The Cascadia Subduction Zone is the most significant local tsunami source for the California coast north of Cape Mendocino. Geological evidence indicates that large Cascadia earthquakes and associated tsunamis have occurred at least 19 times over the past 10,000 years, with event recurrence varying from 200 years to more than a thousand years over that 10,000-year period.

The California Seismic Safety Commission report, the Tsunami Threat to California Findings and Recommendations on Tsunami Hazards Risks, published in December 2005, indicates that over 80 tsunamis have been observed or recorded along the coast of California in the past 150 years. The report includes findings that tsunamis generated either locally or from events elsewhere in the Pacific Basin pose a significant threat to life and property in California, and that tsunamis present a substantial risk to the economy of the state and nation primarily through the impact on ports.

The National Centers for Environmental Information (NCEI) provides a database cataloging all tsunami occurrences. The database can be used to evaluate past tsunami events at a particular site. As shown in Table 7.J, there have been eight tsunamis known to have caused damage to ports and harbors or coastal inundation in California since 1946. In 1964, a tsunami caused by a Magnitude 9.2 earthquake offshore from Alaska resulted in 13 deaths in California and destroyed portions of downtown Crescent City. More recently, a 2006 tsunami (originating in the Kuril Islands region north of Japan) caused approximately $20 million in damage to Crescent City harbor. A 2010 tsunami (originating offshore from Chile) caused millions of dollars in damage to ports and harbors in the state.

Table 7.J: Summary of Tsunami Damage Along the California Coast Since 1946

Date	Event	Magnitude	Cost of Damage [a]	Deaths
March 11, 2011	Offshore Japan Earthquake	9.0	$100 million	1
February 27, 2010	Offshore Chile Earthquake	8.8	$3 million	0
November 15, 2006	Kuril Islands Region Earthquake	8.3	$20 million	0
March 28, 1964	Offshore Alaska Earthquake	9.2	$20 million	13
May 22, 1960	Chile Earthquake	9.5	$1 million	2
March 9, 1957	Aleutian Islands Earthquake	8.6	<$1 million	0
November 4, 1952	Kamchatka Earthquake	9.0	<$1 million	0
April 1, 1946	Aleutian Islands Earthquake	8.8	<$1 million	2

Source: California Geological Survey
a: "Cost of Damage" represents reported damage at the time of the tsunami; not all damage may be accounted for in early events.

A tsunami in 2011 (caused by a Magnitude 9.0 earthquake offshore of Japan) killed one person at the mouth of the Klamath River and caused up to $100 million of damage to 27 ports, harbors, and marinas throughout the State.[169] The most damage occurred in Crescent City, Santa Cruz and Moss Landing harbors and a federal disaster was declared in Del Norte, Santa Cruz, and Monterey Counties. Both Crescent City and Santa Cruz harbors sustained

[169] Wilson et al., 2012

damage to all docks, and oil spills and water/sediment contamination that resulted from sunk or damaged boats. Because recovery efforts in these two harbors took several years to complete, both harbors incurred business/economic losses that have been difficult to recapture.

Post -Tsunami Damage to Crescent City Harbor, March 2011



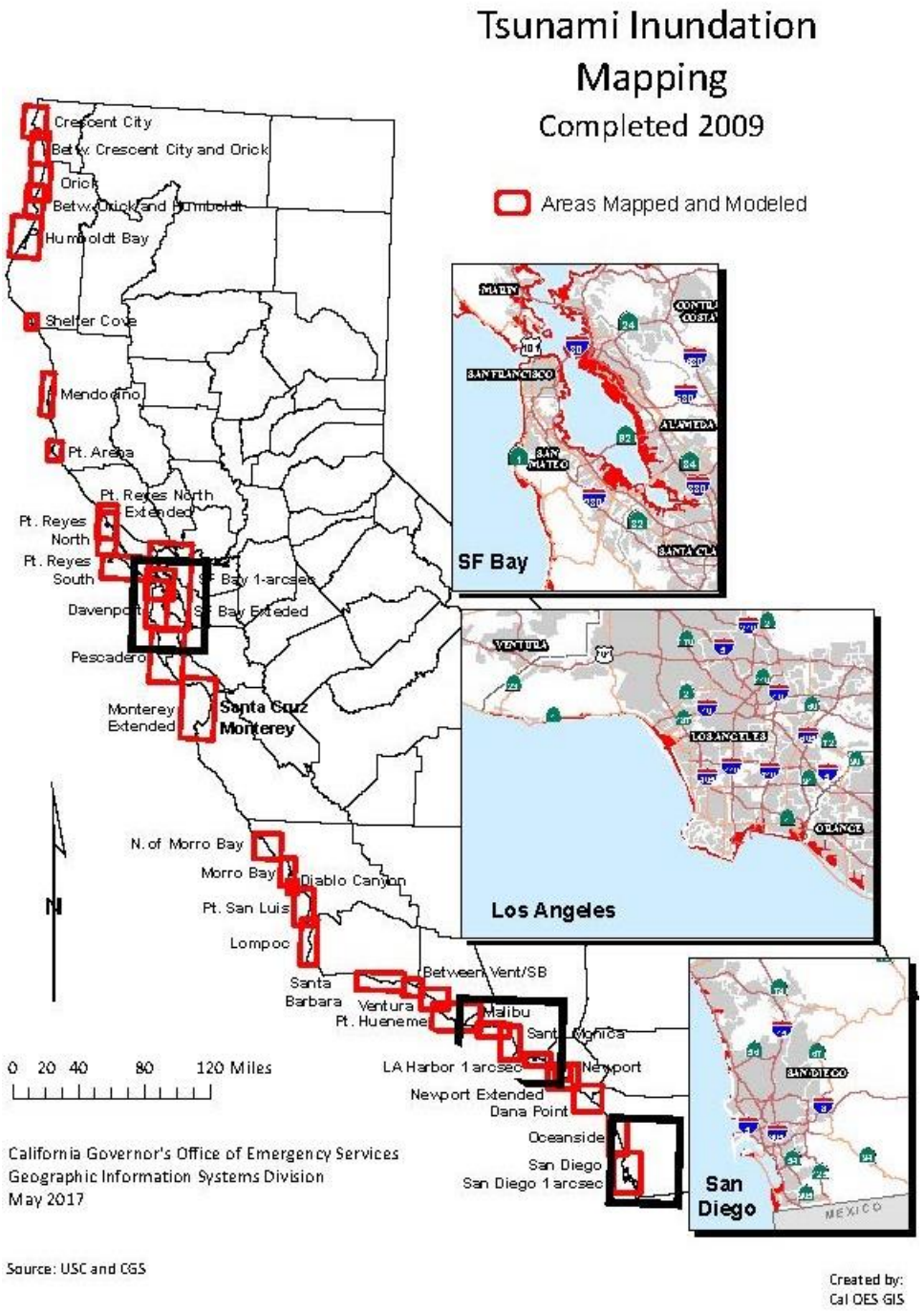
In 2009, the California Tsunami Program, along with the Tsunami Research Center at the University of Southern California (USC) completed statewide tsunami inundation maps appropriate for evacuation planning (see Maps 7.P and 7.Q). These maps were a composite of numerical tsunami inundation model runs from a suite of large, realistic tsunami sources both local and distant.

Projections of tsunami flooding varied by source and location along the coast but, in general, maximum tsunami flood elevations varied from 25 to 50 feet along the coast north of Cape Mendocino, from 15 to 30 feet along the coast from Cape Mendocino to Point Conception, from 3 to 12 feet within the San Francisco Bay, and from 5 to 15 feet south of Point Conception[170]. As previously mentioned, the Cascadia Subduction Zone provides the largest tsunami hazard for the area north of Cape Mendocino because it could generate large tsunami surges onshore within minutes after an earthquake. The most significant tsunami source region for the entire state from a distant-source event would be from the subduction zone off the coast of the eastern Aleutian Islands.

As was evident during the 2010 and 2011 Japan tsunami, California's ports, and harbors are also prone to damage from strong tsunami currents. The 2010 version of the Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS), codified as the 2010 California Code of Regulations Title 24, Part 2, California Building Code, Chapter 31F Marine Oil Terminals, became effective in 2011. It includes a study by Borrero et al. (2006) that provides maximum credible tsunami water levels and current speeds for marine oil terminals in the San Francisco Bay Area.

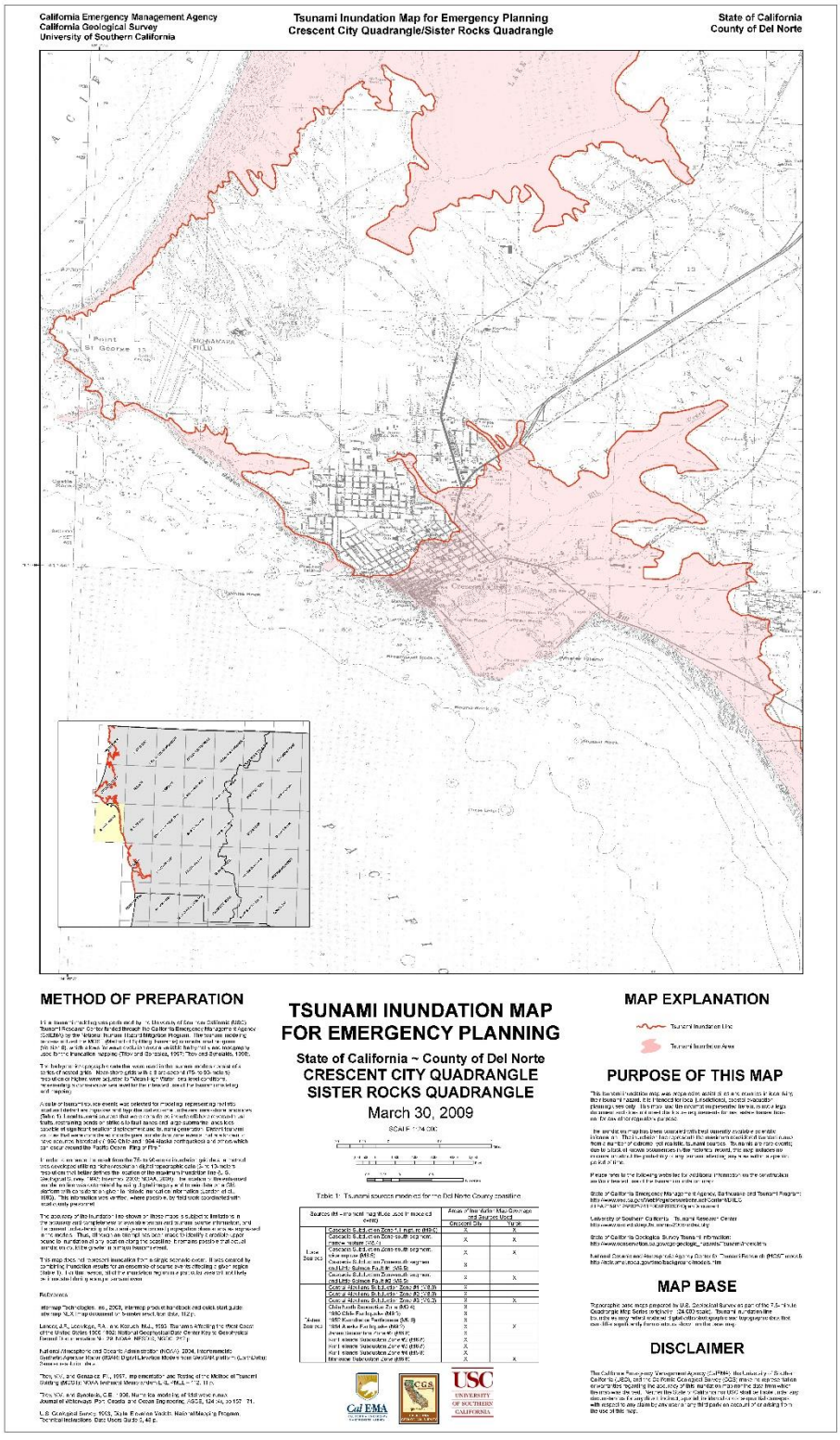
[170] Wilson et al., 2008; Uslu, 2008; Barberopoulou et al., 2009

Map 7.P: Tsunami Inundation Mapping Completed, 2009



Map 7.P provides a generalized statewide index to local areas covered by California Geological Survey (CGS) tsunami modeling and mapping. CGS, in cooperation with Cal OES and the Tsunami Research Center at the University of Southern California (USC), has undertaken modeling of tsunami hazards to produce statewide tsunami inundation maps. These local maps are developed for all populated areas at risk to tsunamis in California and represent a combination of the maximum considered tsunamis for each area.

Map 7.Q: Tsunami Inundation Map – Crescent City



Map 7.Q shows a local area tsunami inundation map prepared by the CGS. For more detailed information on areas within the future tsunami run-up areas, see: http://www.conservation.ca.gov/cgs/geohazards/tsunami/maps.

Progress Summary 7.K: Understanding Tsunami Probability

Progress as of 2018: There have been a number of new studies and strategies that have continued to improve the understanding of tsunami hazards in California through the coordinated research and resultant work of various government, university, and private partners. This work directly benefits tsunami preparedness, mitigation, and policy development in California.

Historical/Pre-Historical Tsunamis. A statewide assessment for geological evidence of tsunamis was conducted, including a reconnaissance of 20 coastal marshlands through site visits and coring of shallow surface sediments to determine if evidence for past tsunamis existed.[171]

Conclusive evidence of tsunami deposits was not found at most of the sites evaluated. Geologic evidence consistent with tsunami inundation was found at two locations: three marshes in the Crescent City area for the 1700 and 1964 tsunamis, and Pillar Point Marsh near Half Moon Bay from the 1946 Aleutian Islands event. Potential tsunami deposits were also evaluated at the Carpinteria Salt Marsh Reserve in Santa Barbara County.

The state also worked with Humboldt State University to complete a tsunami deposit database cataloging data from the statewide study and other studies, especially past studies which have found tsunami deposits in Northern California from pre-historic Cascadia events.[172] Although tsunami deposit information is useful for studying the area of flooding and the recurrence of past tsunamis, it should be noted that the absence of evidence of tsunami deposits is not indicative that large inundating tsunamis have not occurred. Rather that the conditions may not have been ideal for creating and preserving tsunami deposits, for instance, extensive coastal development leaving little undisturbed area for preserving tsunami records at the coast.

Probabilistic Tsunami Hazard Analysis (PTHA). The State Tsunami Program is working with other scientists to complete new tsunami hazard maps based on a probabilistic analysis.[173] These maps, some of which will be completed by the end of 2018, will be available for various land-use and mitigation applications, discussed in more detail in *Section 7.3.5: Current Tsunami Hazard Mitigation Efforts* below.

The PTHA maps identify areas of expected flooding for various risk levels, including 100-, 200-, 475-, 975-, 2,475-, and 3,000-year average return periods. Because the probabilistic approach includes uncertainties in the sources, modeling, and mapping, projected flooding from the higher return periods (2,475 year average return period and over) where uncertainties can be high is more extensive. Initial evaluation of the PTHA products indicate that the 2009 state inundation maps are similar in their flood potential to the 975-to-3,000 year range of return periods in different parts of the state.

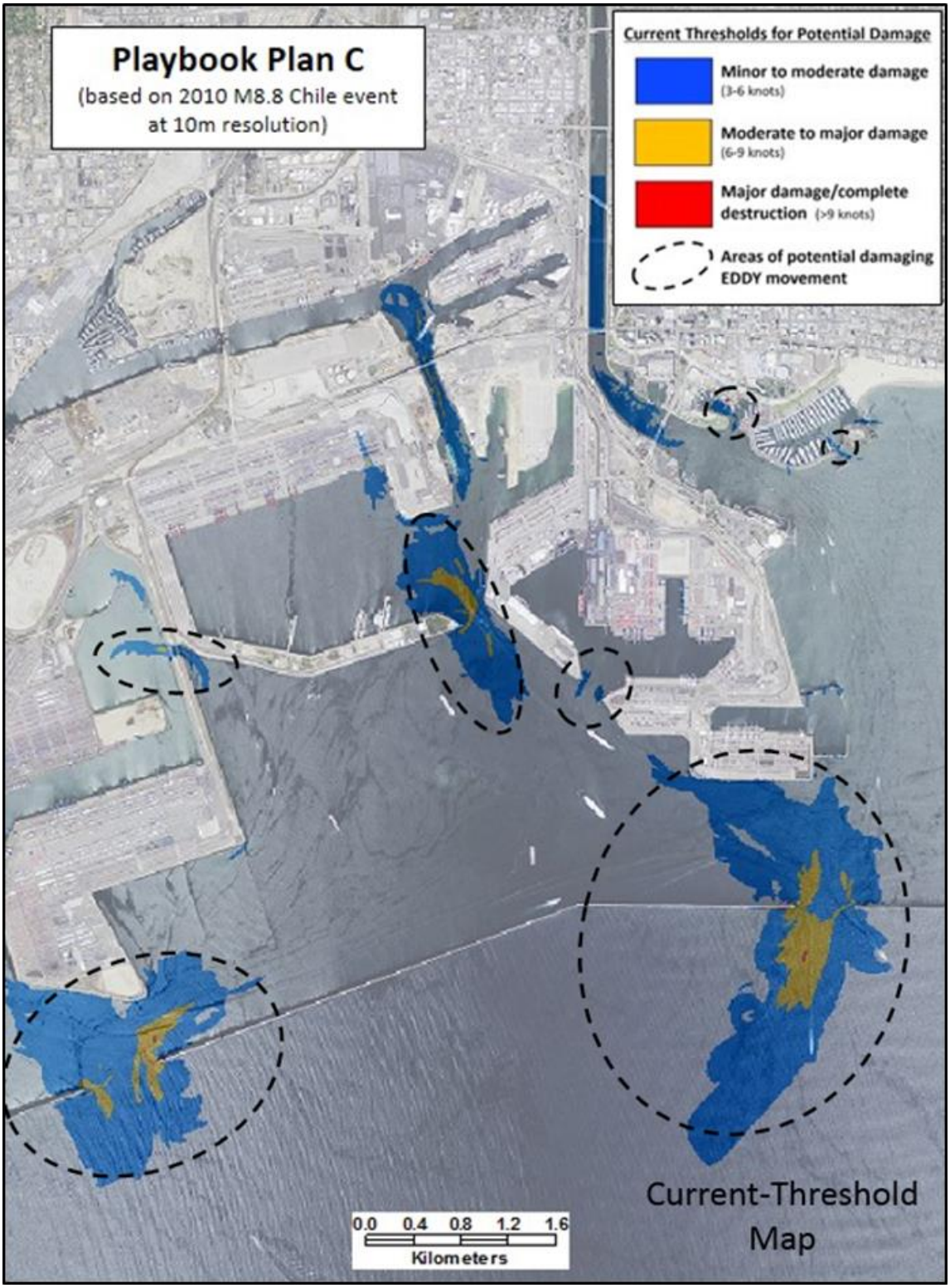
Maritime Hazards. With regard to strong currents, more recent studies by the California Governor's Office of Emergency Services (Cal OES), California Geological Survey (CGS), and the University of Southern California (USC) focus on the impacts of currents within harbors statewide.[174] Thirty-three Maritime Tsunami Response Playbooks have been developed covering over 70 ports, harbors, and marinas to provide harbor officials with information about where strong currents and damage could occur during various distant-source tsunami scenarios.

Map 7.R is the Maritime Tsunami Playbook Current-Threshold map for the Port of Long Beach.

The results of this project indicate that all open coast and most Bay Area harbors are prone to damage from tsunamis of various sizes and source locations.

[171] Wilson et al., 2014
[172] Hemphill-Haley et al., in press
[173] California Probabilistic Tsunami Hazard Analysis Work Group, 2015; Thio, in press
[174] Wilson et al., 2016

Map 7.R: Example Maritime Tsunami Playbook Current-Threshold Map for the Port of Long Beach



Source: California Geological Survey. Refer to CGS Special Report 241 for more information

7.3.3 ASSESSMENT OF STATE TSUNAMI VULNERABILITY AND POTENTIAL LOSSES

Spurred by the catastrophic tsunami in Sumatra,[175] and Japan,[176] the tools to perform vulnerability assessments are now available and being used to assess the California coast. The USGS has completed a vulnerability analysis based on the current state tsunami inundation maps. The study titled "Community Exposure to Tsunami Hazards in California" provides first responders, state and local emergency planners and other stakeholders, with valuable, new information about the people who live in, work in, and visit each of the 20 counties, 94 incorporated cities and 83 unincorporated communities located in a tsunami inundation zone.[177] The study found that the 2009 state tsunami inundation zone contains 267,347 residents, 15,335 businesses, and 168,565 employees. In addition, millions of non-residents also visit areas within the tsunami inundation zone during the summer months.

In January 2012, the Multi-Hazards Demonstration Project evolved into an ongoing project known as Science Application for Risk Reduction (SAFRR) that has a similar mission and national purview. Under SAFRR's coordination auspices, the USGS, Cal OES, CGS, and other entities teamed to develop a Pacific Basin Tsunami Scenario (Ross et al., 2013). This scenario modeled physical tsunami characteristics of inundation, currents, and scour to estimate the impacts of damage and resultant, necessary restoration of the built environment. This also included environmental, social, and economic impacts that would result from a large, hypothetical, but plausible distant source tsunami affecting the west coast of the United States, Alaska, and Hawaii.

Like previously studied disaster scenarios, the SAFRR Pacific Basin Tsunami Scenario sought to apply science to explain and understand the impacts of natural disasters, in this case, tsunamis. Some of the findings of the California statewide analysis included the following:

- The largest economic impacts on the state pertain to damage and incapacitation of the ports and harbors, and damages to coastal properties, resulting in billions of dollars in losses.
- One third of the boats could be damaged or sunk, and two thirds of the docks damaged or destroyed.
- 8,500 residents who live in the scenario inundation zone would likely need shelter because of damage to their homes.
- Although tsunami travel time could take four to six hours, timely, completed evacuations would be a challenge for certain areas with limited access and dependent-care populations.

For more information on SAFRR, visit: https://www2.usgs.gov/natural_hazards/safrr/projects/tsunamiscenario.asp.

As previously discussed, by early 2018 the State Tsunami Program expects to have completed maps that will use a PTHA for California.[178] These maps will be used for numerous applications including identifying potential tsunami hazard "zones of required investigation" under the Seismic Hazards Mapping Act and will assist state and local agencies in making land use planning decisions. They will also help regional and state planners understand the flood potential from tsunamis representing different risk levels.

7.3.4 ASSESSMENT OF LOCAL TSUNAMI VULNERABILITY AND POTENTIAL LOSSES

Community exposure to tsunamis in California varies considerably—some communities may experience great losses that reflect only a small part of their community and others may experience relatively small losses that devastate them.

Among the 94 incorporated communities and 83 unincorporated areas of the 20 coastal counties, the communities of Alameda, Oakland, Long Beach, Los Angeles, Huntington Beach, and San Diego have the highest number of people and businesses in the tsunami inundation zone. The communities of Belvedere, Alameda, Crescent City, Emeryville, Seal Beach, and Sausalito have the highest percentages of people and businesses in this zone. On the basis of a

[175] Iwan et al., 2006
[176] Wilson et al, 2012
[177] Wood et al., 2013
[178] Thio, in press

composite index, the cities of Alameda, Belvedere, Crescent City, Emeryville, Oakland, and Long Beach have the highest combinations of the number and percentage of people and businesses in tsunami-prone areas.

The communities that are most vulnerable to injury and life safety issues exist within Del Norte and Humboldt counties due their close proximity to the Cascadia Subduction Zone. To download the Community Exposure to Tsunami Hazards in California report visit the USGS website: http://pubs.usgs.gov/sir/2012/5222/.

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans (LHMPs) and Local Coastal Programs (LCPs) that help guide planning for coastal communities under the California Coastal Act.

Progress Summary 7.L: Assessing Tsunami Hazards and Potential Losses

Progress as of 2018: New products and tools are available or are being produced that can help assess community-level, regional, and statewide vulnerability and potential losses. Using these products and tools together will result in the most comprehensive vulnerability and loss potential analysis possible.

HAZUS Tsunami Module. FEMA has developed a new tsunami loss estimation module for HAZUS using existing numerical model results for tsunami inundation, flow depth, velocity, and force. This HAZUS module allows new capability for estimation of casualties, economic losses, structural functionality, and site-specific analysis, content losses, casualties, infrastructure damage, and evacuation time, and a range of losses based on safe zones and community preparedness levels. It performs independent (non-repetitive) calculation of the earthquake and tsunami results. This is a huge step forward as there was previously no method to systematically compute losses from tsunamis. With the production of new probabilistic tsunami analysis maps, the use of the tsunami HAZUS module will improve the state's ability to compare tsunami casualties and physical and economic impacts to those of other hazards, including earthquakes.

PTHA Maps and Products. As previously discussed, the State Tsunami Program is completing a set of Probabilistic Tsunami Hazard Analysis (PTHA) maps representing risk levels from 100-year to 3000-year average return periods. Analysis using these probabilistically based products will allow for a more common platform for comparison to other seismic and flood probabilistic analyses.

Tsunami Loads in Building Design. The American Society of Civil Engineers Subcommittee 7-16 on tsunami load forces has completed analysis and design standards that have been adopted by the International Building Code. These standards address structural response to tsunami wave loading, tsunami wave-loading forces for design purposes, non-structural element response to wave loading, and dynamic effects of tsunami wave travel throughout a built environment. If adopted by the state during the next building code cycle (2019), these tsunami design load standards will be applied to critical and essential buildings (Risk Category 4 and 3) and may apply to some other high-occupancy structures (Risk Category 2).

Maritime and Pier Mitigation Plans. The State Tsunami Program is working with engineers at the University of Southern California (USC) and the California State Lands Commission to complete Harbor and Pier Improvement Reports for all at-risk harbors and piers. These products are based on deterministic (scenario-based) and probabilistic (recurrence interval based) methods and provide site-specific harbor and pier improvements and engineering recommendations as well as a cost-benefit assessment for each mitigation activity based on new tsunami damage potential analyses and evaluation of other potential hazards from storms, high tides, and sea-level rise. The partners will also help harbor and pier officials obtain Federal Emergency Management Agency (FEMA) and California Governor's Office of Emergency Services (Cal OES) pre-disaster hazard mitigation funds and/or other grants and loans to help make the recommended improvements.

Tsunami Evacuation and Maritime Response "Playbooks". Instead of an all-or-nothing approach to evacuation and response, Playbooks provide communities and harbor officials with tsunami-specific maps and guidance about what areas to evacuate or avoid during distant source events.[179] Using a sports analogy, the Playbook approach provides the best coastal defensive "play" (or plan) against a tsunami of a particular size and source origin location.

Reducing the number of people and businesses that have to evacuate can reduce costs of business closures and vulnerability of evacuees to other hazards during evacuation (e.g., large storms or earthquake hazards during local events). For example, Wood et al (2016) indicated that using the Playbook approach instead of the worst-case evacuation zones during a large distant source tsunami scenario, with enough lead time to implement this approach, could result in 1) 178,646 fewer residents and 159,271 fewer employees having to evacuate; and 2) a $122 million reduction in business disruptions statewide. See Map 7.R for an example Playbook Map.

Tsunami Evacuation Time Analyses: The State Tsunami Program has partnered with the U.S. Geological Survey (USGS) to evaluate pedestrian and car-based tsunami evacuation times. Area-specific studies have been completed for Balboa Island in Newport Beach[180] and the City of Alameda.[181] Playbook scenario and full evacuation lines were evaluated in these studies. The results of these studies have helped the above communities determine the best evacuation routes and modes of transportation to use during future tsunami events. By early 2018, a statewide analysis of evacuation times will be completed using the new probabilistic tsunami hazard maps. This information can help identify the most vulnerable population centers for both local- and distant-source tsunamis.

Tsunami Recovery Guidance: The State Tsunami Program is developing recovery guidance for communities.[182] Integrating a recovery planning strategy can help identify where the most vulnerable populations and community assets are located. For example, it took Crescent City Harbor years to fully recover from the combined damage from the 2006 and 2011 tsunamis. Although the harbor is improved and fully functional, a large number of fishing fleet vessels have found homeports elsewhere because of the delays in harbor recovery. To reduce this problem after future tsunamis, the harbor installed larger piles and deflection docks in order to reduce impacts and recovery times.

[179] Lynett et al., 2014; Wilson and Miller, 2014; Wilson et al., 2016)
[180] Henry et al., 2016
[181] Peters et al., 2016
[182] Johnson et al., in press

Map 7.S: Example Harbor Cleat Failure Potential Analysis in the Draft Harbor Improvement Report for Oceanside Harbor



Zone	Case ID				
	Alaska	Cascadia	Chile 2010	Chile North	Japan 2011
1	Moderate	Moderate	Moderate	Moderate	Moderate
2	Moderate	Low	Low	Low	Low
3	Moderate	Low	Low	Low	Low
4	Moderate	Low	Moderate	Moderate	Low
5	Moderate	Low	Moderate	Moderate	Moderate
6	Moderate	Low	Low	Moderate	Low
7	Low	Low	Low	Low	Low
8	Low	Low	Low	Low	Low
9	Low	Low	Low	Low	Low

Source: University of Southern California

7.3.5 CURRENT TSUNAMI HAZARD MITIGATION EFFORTS

State Tsunami Program Coordination with Federal Programs

Most tsunami hazard preparedness and mitigation planning efforts are conducted through the State Tsunami Program and its Steering Committee comprised of representatives from the 20 coastal and Bay Area counties and the four coastal-region National Weather Service (NWS) offices. Based on the analysis of recent events, the California Tsunami Program is enhancing existing products and developing new products that will improve tsunami preparedness and mitigation. These planning efforts and products help 1) the maritime community better understand tsunami hazards within their harbors and determine if and where mitigation activities should be implemented; 2) emergency managers not only prepare for significant tsunami events, but develop evacuation plans for relatively small ''Warning'' level events where extensive evacuation is not required, and 3) land-use planners and building designers better understand the probabilities of tsunami hazard and the effects over the lifetime of construction and development.

The state program cooperates with NOAA and other states within the National Tsunami Hazard Mitigation Program (NTHMP) through federal grants, and FEMA Region IX through a Co-operative Technical Partnership to fund preparedness and mitigation planning efforts. The primary structural and financial support for the NTHMP comes from the 2017 Tsunami Warning, Education, and Research Act. The State Tsunami Program relies exclusively on federal funding sources, which at times are limited or in jeopardy due to real and potential federal budget cut decisions.

A report issued by the California Seismic Safety Commission in 2005 states that "tsunamis, generated either locally or from events elsewhere in the Pacific Basin, pose a significant threat to life and property in California" and points out that losses from tsunamis can be reduced in four ways: 1) engineering standards creating more damage-resistant buildings and port structures, 2) public education training Californians to recognize tsunami alerts and providing instruction on what to do, 3) warning systems alerting a population to a tsunami coming from a distant source, and 4) effective evacuation planning.

More recently, the California Tsunami Policy Work Group (2014) completed a report titled "California's Tsunami Risk: A Call for Action," providing direction to the state tsunami program and other state and federal partners through 47 recommendations. The 2013 version of the state hazard mitigation plan (SHMP) recognized that the California Tsunami Policy Work Group would be completing this document to "…help guide, develop, and improve future tsunami preparedness and mitigation activities…," which the state program is actively working to initiate. The 47 recommendations cover the following broader topics:

- Comprehensively assess tsunami hazard likelihood and severity
- Improve our understanding of tsunami risk and ways to reduce it
- Establish a framework to more effectively communicate tsunami warnings
- Capitalize on national efforts to reduce tsunami risk
- Condition development in areas exposed to tsunami hazards
- Implement tsunami resilient building codes
- Consider tsunami hazards in land-use decisions
- Enhance multi-jurisdictional planning for tsunami hazard
- Increase the effectiveness of tsunami hazard warnings
- Address regional preparedness, response, and recovery issues
- Prepare the maritime sector for tsunami hazards

Tsunamis cannot be prevented, but early warning and evacuation can dramatically reduce their threat to human safety. Modern warning networks can sense tsunamis hundreds, or even thousands, of miles from their location of impact and issue warnings to potentially threatened communities. For example, NOAA's Tsunami Program operates the National Tsunami Warning Center (NTWC) in Palmer, Alaska, which monitors seismographs and deep-ocean

buoys and provides tsunami alerts to coastal communities in California. Cal OES and CGS work with the NTWC and the coastal National Weather Service (NWS) offices to provide real-time tsunami information to the communities through the State and Regional Emergency Operations Centers. Such warning systems, coupled with well-designed evacuation plans and a public educated about how to respond, can remove people from harm's way.

Federal and state programs continue to educate local emergency response agencies and the public. As discussed in previous sections, the State Tsunami Program completed a statewide set of tsunami inundation maps in 2009 for use in evacuation planning. These maps, made with the assistance of the Tsunami Research Center at the University of Southern California, are available to the public through the CGS tsunami web page at www.tsunami.ca.gov and Cal OES MyPlan and MyHazards web pages at http://myplan.calema.ca.gov/ and http://myhazards.calema.ca.gov/.

Local Jurisdiction Efforts

Municipalities are undertaking their own planning efforts specifically directed toward this hazard. For example, Tsunami Safety Plans and related brochures have been prepared for communities in Humboldt County with the assistance of the Redwood Coast Tsunami Working Group. For more information, visit: http://www.humboldt.edu/rctwg/. Many other communities are taking an active role in tsunami preparedness and response activities, such as: holding community education and preparedness events, installing tsunami hazard and evacuation signs, and running tsunami tabletop exercises and evacuation drills. The state is also helping to support this work and encouraging other coastal regions of the state to develop similar types of tsunami work groups and enhance their preparedness events.

Other State Tsunami Program Efforts

Other tsunami hazard mitigation activities of the State Tsunami Program include: 1) offering guidelines for local emergency managers to use for reviewing geotechnical and utility-disruption hazards as they relate to evacuation from a local tsunami event; 2) assisting coastal communities to become TsunamiReady®, a federal designation indicating that the community has fully prepared to respond to a tsunami emergency; 3) conducting tsunami workshops and exercises with local communities; and 4) providing communities with educational materials they can use for their outreach activities.

Maritime communities in California were challenged and affected first and foremost during the 2010 and 2011 tsunamis. Although millions of dollars were lost during these two events, the eyewitness accounts and video information collected after each event provided an excellent resource for improving tsunami hazard analysis in harbors and bays. Through the aforementioned partnership developed between the state and FEMA, observed strong tsunami currents and damage were used to validate and calibrate numerical tsunami model currents to produce in-harbor hazard maps included in Maritime Response Playbooks.[183] These products identify offshore safety zones for potential boat evacuation when a tsunami "Warning" is issued for a distant source event.

As previously discussed, Harbor Improvement Reports are also being created to provide harbor-specific mitigation measures that can be directly integrated into Local Hazard Mitigation Plans (LHMPs). The State Tsunami Program has developed educational information for boaters and harbormasters alike, including a new brochure for boaters with tsunami education information and advice on what to do and what not to do during a tsunami. Ultimately, harbor-specific guidance has been created to help maritime communities better prepare for, respond to, and recover from future tsunamis.

As also noted previously, a majority (80 to 90 percent) of the losses from future large tsunami events can be reduced by implementing effective response, mitigation, and recovery strategies. One of the key tools required to make these efforts successful are the regulatory zone maps prepared by the GS. "Zones of required investigation" have been and are being prepared for surface fault rupture, soil liquefaction, and earthquake-induced landslide hazards in California.

183

Evacuation Drill for King Salmon, Humboldt County, 2012



Source: Rick Wilson, California Geologic Survey

Although hazard maps are typically associated with only with hazard identification, these regulatory maps constitute mitigation through their requirement for site-specific investigation of relevant hazards at development sites, and mitigation plans approved by the lead agency before permits are issued. CGS has used federal funding and external partners to advance the science behind tsunami hazard mapping to the point where the State Geologist determined that regulatory zones for tsunami hazards can now be prepared, as stipulated in the 1990 Seismic Hazard Mapping Act.

Progress Summary 7.M: Probabilistic Tsunami Hazard Analysis Mapping Linkage to Mitigation Activities

Progress as of 2018: In addition to being used for the Seismic Hazard Mapping Act, Probabilistic Tsunami Hazard Analysis (PTHA) products are being produced for other mitigation activities to protect coastal residents and infrastructure in California. The California Geological Survey (CGS) is working with a number of organizations to help them incorporate the PTHA products into their response, mitigation, and construction planning:

C*alifornia Building Standards Commission (CBSC):* A new section in the California Building Code addressing tsunami loads on critical and essential facilities is set to be included in the 2019 update of the code. The original Tsunami Design Zone maps created for this update by the American Society of Civil Engineering are not of a suitable detail and quality for making design and construction decisions. For example, these existing maps show tsunami flooding traveling too far inland and overflowing river levees and other structures where they should not. The PTHA maps produced by the CGS will be of much higher quality and accuracy. The CGS plans to work with the CBSC to replace the existing maps with the new, more accurate maps when they become available.

As previously mentioned, if adopted by the state during the next building cycle, these tsunami design load standards will be applied to critical and essential buildings (Risk Category 4 and 3) and may apply to some other high-occupancy structures (Risk Category 2). PTHA maps representing 2475-year average return periods will apply to Risk Category 4 structures, whereas the 2,475-year average return period minus 3 feet of flow depth will apply for Risk Category 3 and possibly Risk Category 2 structures.

California Governor's Office of Emergency Services (Cal OES): The CGS has been a long-time partner of Cal OES through the State Tsunami Program and its Steering Committee. Cal OES plans to use the PTHA maps for a number of projects when they become available:

1. Cal OES and the CGS will use the PTHA maps to verify and update the accuracy of the 2009 tsunami inundation maps for evacuation planning, most likely replacing the 2009 maps with the new maps.
2. Cal OES will use the PTHA maps in developing vertical evacuation structures in several coastal communities to protect vulnerable populations that have no safe, high ground immediately available for evacuation before a local-source tsunami arrives.
3. The PTHA maps and the related products (hazard potential maps; sediment/debris model results; etc.) will help Cal OES and the Federal Emergency Management Agency (FEMA) work with harbors and ports to obtain local hazard mitigation funding to implement mitigation measures in the most hazardous parts of the harbors.
4. PTHA maps will be used to set the foundation of local and state tsunami recovery planning guidance being developed by Cal OES and the CGS.

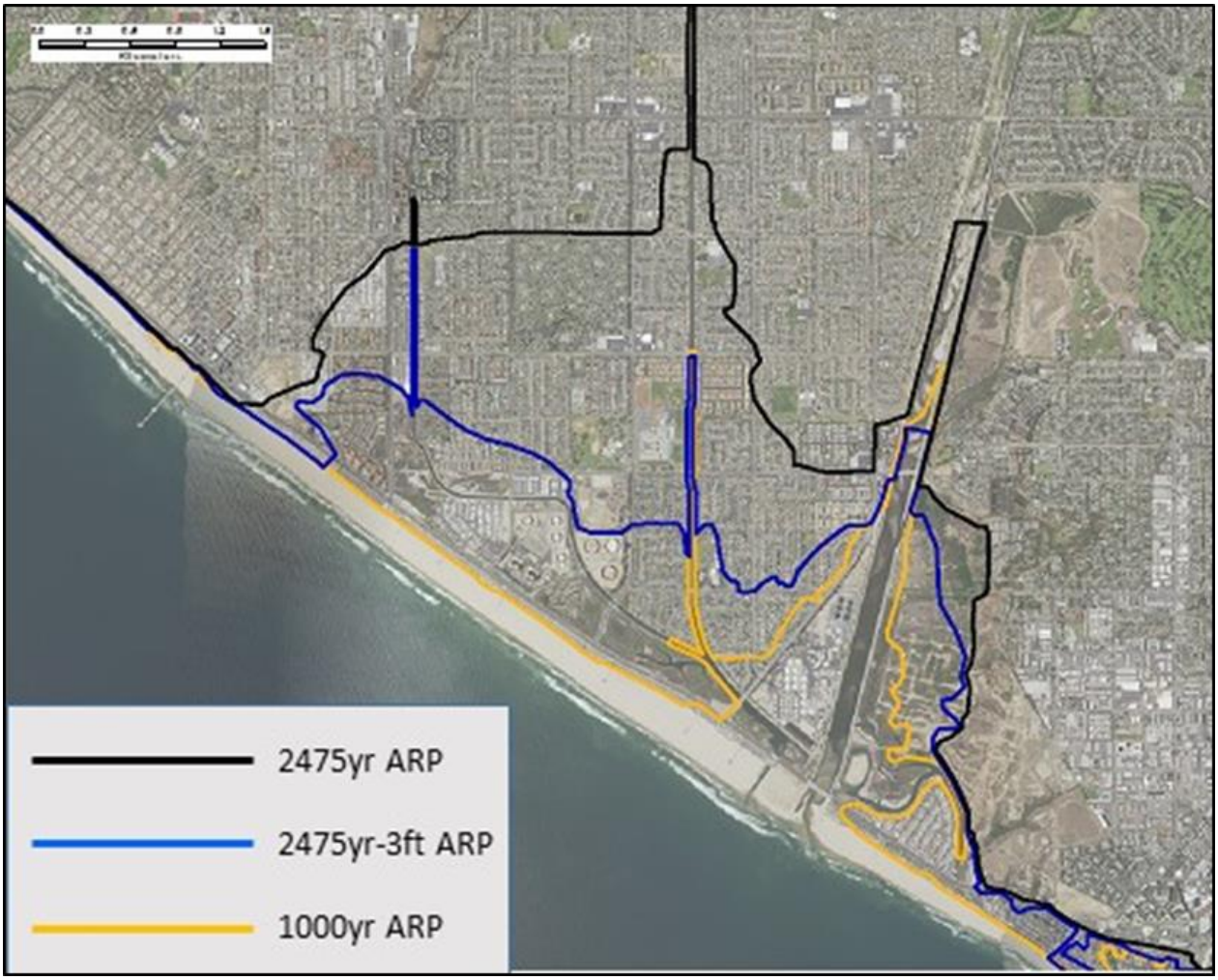
California Coastal Commission (CCC): At present, the California Coastal Commission uses the 2009 tsunami inundation maps for evacuation planning for Local Coastal Programs (LCP). As previously stated, the 2009 maps are based on deterministic scenarios and the State Geologist has determined that these maps are not appropriate for making land use decisions. The PTHA maps will provide the Coastal Commission with a more appropriate set of maps for community-level land use planning through LCPs.

FEMA: There are a number of programs within FEMA which plan to utilize the results from the PTHA products:

1. PTHA maps will be created and included in FEMA's RiskMAP program, which provides flood hazards maps to the public outside of the existing Flood Insurance Rate Map (FIRM) program.
2. PTHA maps will be compared to existing FEMA FIood Insurance Rate Maps to determine if and how they should be merged into the existing FIRMs that restrict new development in flood prone areas.

At present, the California Coastal Commission uses the 2009 tsunami inundation maps for evacuation planning for Local Coastal Programs (LCP). As previously stated, the 2009 maps are based on deterministic scenarios and the State Geologist has determined that these maps are not appropriate for making land use decisions. The PTHA maps will provide the Coastal Commission with a more appropriate set of maps for community-level land use planning through LCPs.

Map 7.T: Draft PTHA Inundation Lines for a Portion of Huntington Beach



Note: Lines represent Probabilistic Tsunami Hazard Analysis (PTHA) risk levels of 2,475-year and 1,000-year average return periods (ARPs), as well as the 2,475-year ARP minus 3 feet of flow depth.
Source: California Geological Survey

Caltrans: At present, Caltrans does not consider tsunami loads in their analysis of their highways and bridges. The PTHA maps and related products will be used in the retrofitting of existing bridges and highways and the design and construction of future bridges and highways. This will produce a more resilient infrastructure during tsunamis.

Harbors/Ports/Piers: The PTHA maps and related products covering a range of risk levels will be integrated into Harbor and Pier Improvement Reports that cover recommended mitigation activities of maritime and pier facilities and related infrastructure.

Local Communities: The PTHA maps which cover a range of risk levels can be used for improving land-use plan decision-making through Local Coastal Plans and risk-reduction measures through the Local Hazard Mitigation Plans.

Life and property loss from tsunamis and seiches can also be reduced by limiting development along low-lying coasts and designing structures to allow swift water to flow around, through or underneath without causing collapse.

In 2011, FEMA released the National Disaster Recovery Framework—the first statement of national recovery policy—which specifically identifies an approach for multi-level government coordination and local empowerment and partnership in planning and managing disaster recovery. It also emphasizes the importance of recovery planning, both before and after disasters, focuses on community outcomes, and defines measures of recovery success. The State of California has followed suit and is in developing the California Disaster Recovery Framework that defines the roles and responsibilities of state-level agencies and partners in supporting community recovery.

Based on the immediate and long-term tsunami recovery issued faced by Japan and even California's harbors, the State Tsunami Program and its partners are developing a community-level tsunami recovery guidance document. This guide is being developed to assist staff and local officials of California coastal cities and counties, particularly those with a significant level of risk, to initiate planning for community recovery following a tsunami disaster. Community recovery following a major disaster is a complex process that can take years and even decades to complete. Local governments have an important leadership role in community recovery because of their ability to mobilize resources and technical assistance from state, federal, and non-governmental partners, and to support and even catalyze the actions of residents, businesses, and other affected organizations.

7.3.6 ADDITIONAL TSUNAMI HAZARD MITIGATION OPPORTUNITIES

The State Tsunami Program and its federal and community partners are working together to mitigate the impacts of tsunami hazards. The primary goal for coastal California is to identify which regions are vulnerable to tsunami hazards and to prepare those communities accordingly.

Probabilistically based tsunami hazard maps allow for a rational risk-based approach to hazard and mitigation decisions. Other products, such as evacuation and maritime response Playbooks, Harbor and Pier Improvement Reports, and recovery guidance, will greatly assist local harbors and communities enhance their real-time and long-term hazard mitigation activities. Addressing multiple hazards at once, such as tsunami, storms, tides, and sea level rise, will augment the effectiveness of mitigation activities for communities in the future. This newly available, vetted information must be comprehensively integrated into community resilience documents like Local Coastal Programs (LCPs), Local Hazard Mitigation Plans (LHMPs), and related planning efforts.

Considering the advances in tsunami hazard mitigation and planning, there are a number of enhanced mitigation activities to consider for the future work:

- Develop and enhance existing educational materials to increase public knowledge of potential tsunami risk in their community and ways to reduce this impact.
- Continue to address the recommendations outlined in the California Tsunami Policy Work Group report.
- Assist federal, state, and local entities in the application of new PTHA products.
- Develop an overarching tsunami planning guidance document that incorporates the use of new PTHA maps, maritime and pier mitigation reports, evacuation time analyses, and the recovery guidance.
- Work with harbor districts and community planners to integrate new products into their LCPs, LHMPs, and related land use planning documents.
- Assist harbor and community officials with applying for and obtaining hazard mitigation funds and loans to implement risk-reduction strategies.
- Use the tsunami HAZUS tsunami module to evaluate local, regional, and statewide impacts of the PTHA results and significant scenario events.
- Improve numerical tsunami modeling for evaluating tsunami currents and forces within the onshore built environment.
- Work with harbor districts and community planners to improve community preparedness and response activities, such as using the "blue-line" project to identify the extent of tsunami flooding on roads.

- Develop guidance for communities to evaluate the use of existing buildings for vertical evacuation during local tsunami events.
- Complete and update Tsunami Evacuation Playbooks for all communities statewide, and continue to evaluate and enhance the real-time response recommendation process using the FASTER flood prediction approach.
- Enhance and maintain the coastal web-camera network, and improve the ability to use this network in real time during future tsunami events.
- Develop tsunami response guidance for large vessels, such as tankers, container ships, and cruise ships.
- Improve evaluation, planning, and implementation of tsunami hazard mitigation efforts as they related to non-tsunami hazards, such as extreme storm and tidal events, coastal erosion and sedimentation, and sea level rise.
- Evaluate the tsunami and seiche risk within large, deep-water lakes and reservoirs like Lake Tahoe and Clear Lake, and work with communities around those lakes to develop tsunami planning strategies.
- Continue to participate in and work through the National Tsunami Hazard Mitigation Program (NTHMP) to develop national guidance and standards to ensure consistent, accurate, and cost-effective products and planning efforts across state lines.

7.4 LEVEE FAILURE AND SAFETY, VULNERABILITY AND RISK ASSESSMENT

7.4.1 IDENTIFYING LEVEE HAZARDS

Millions of people and billions of dollars of assets in California are protected by levees. Levees in California protect land from peak flood levels and/or protect land that is below sea-level. The first type of levee is intended to withstand peak flood levels that are caused by intense rainfall or rapid snow melt within the watershed. Examples are the levees along the Russian River or the Sacramento River near Sacramento. The second type of levee is intended to withstand nominal water levels on a continuous basis as well as peak flood levels. Examples are the levees throughout Sacramento-San Joaquin Delta.

The San Francisco Bay-San Joaquin-Sacramento Delta region (a.k.a. "the Delta" or "the Bay-Delta") contains levees critical for delivering irrigation water to 3 million acres and drinking water to over 23 million people. A failure in one of the Delta levees in 1972 interrupted the state and federal water supply systems and required approximately 500,000 acre-feet of fresh water to restore export water to acceptable quality.[184] Recent studies indicate the levees in the Delta are susceptible to damage from close or more distant seismic events.

History of Levees in California

The construction of levees in California's Central Valley started in the 1850s to protect or claim floodplains including islands in the Delta, for agricultural purposes. In many cases, soil was either scraped from adjacent land or dredged from adjacent channels and placed onto existing natural levees. Central Valley and Delta soils allow for one of the most agriculturally productive regions in the world and a significant economic benefit for California. The soil was rich for growing crops as a result of river-deposited silts or river-nourished backwater peats in these locations, but these types of soils generally make poor foundation material for levees.

During the same time period, hydraulic mining occurred in the mountains at the headwaters of the rivers that feed the Delta and huge amounts of sediment were flushed downstream raising riverbeds and causing increased flooding. To prevent buildup of this sediment, levees were built and/or heightened to increase flows through the low-lying areas to aid in moving the sediment pulses through the Delta.

The levees have been augmented since then to produce the current system. After several devastating floods the U.S. Army Corps of Engineers (USACE) started modifying and constructing levees as early as the early 1900s using sediment from adjacent rivers and channels. Levees were also constructed by others in the 1900s in areas subject to coastal influences, such as in San Francisco and San Pablo Bays. Until about the 1940s to 1950s, most levees were not engineered and frequently failed.

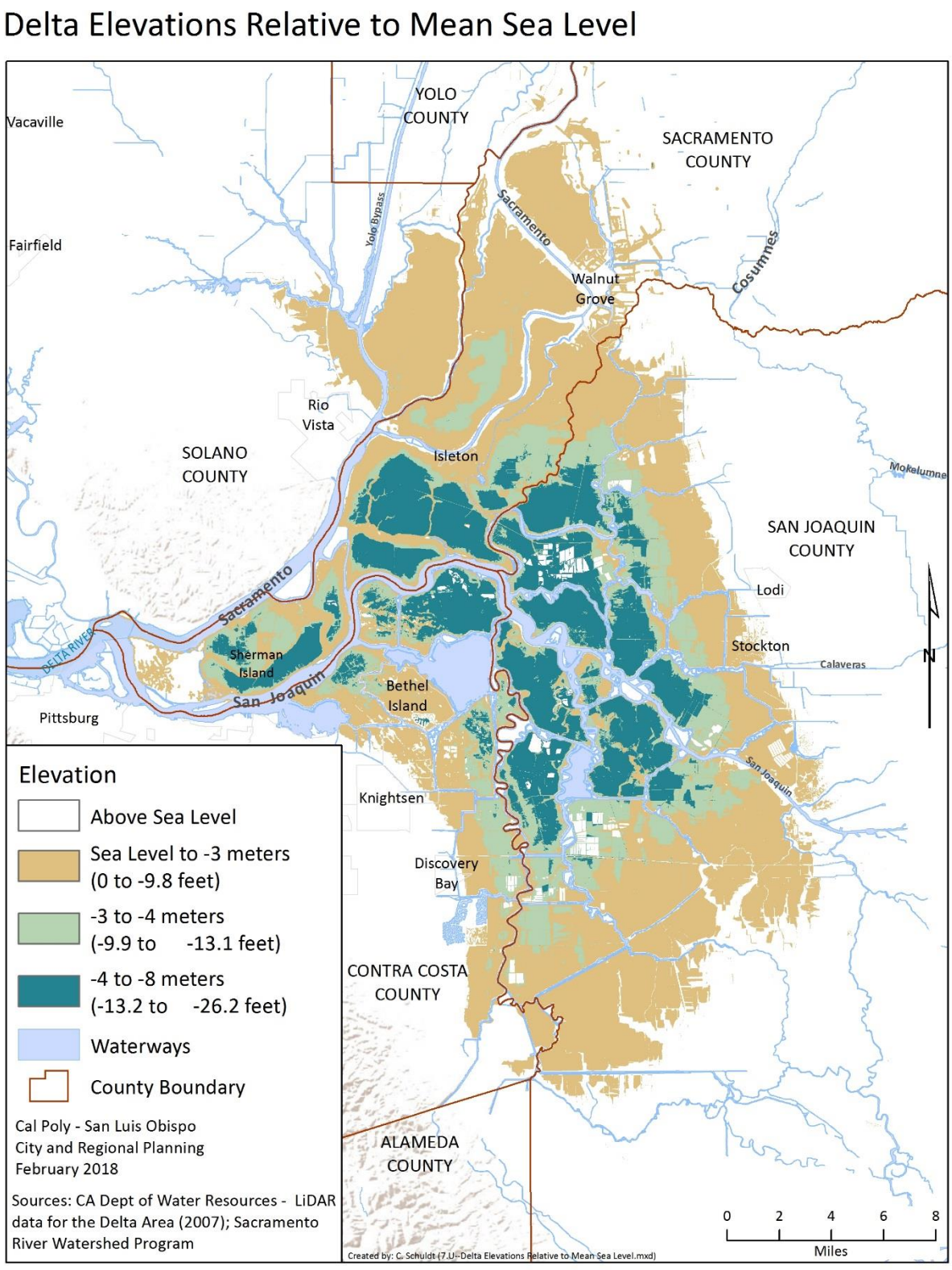
Increasing Risk and Consequences

Some of the areas protected by these levees were originally intended to have land use compatible with agriculture but have subsequently become urban. Some of the levees in California have been augmented in recent years but many remain as originally constructed or have deteriorated. Changes in climate affecting hydrologic patterns in California, as well as sea-level rise, are bringing additional loading to levees.

With the reclaimed floodplains not being replenished with new sediment and the drying out of some of the boggy areas, the land protected by the levees began to drop in elevation via subsidence and wind erosion of topsoil. Land behind the levees will continue to drop in elevation with the addition of potential sea-level rise exacerbating the situation.

[184] Senate Hearings on the 1972 Levee Failure at Brannan- Andrus Islands

Map 7.U: Delta Elevations Relative to Mean Sea-Level



Map 7.U shows the general configuration of levees and waterways in the Delta area. Most levees in California are in the Bay-Delta and, for the most part, protect land that is at or below sea-level. As can be seen in Map 7.U, there

are vast areas in the Delta that are already below sea-level. In California, levees protect farmland, ranchland, rural residential areas, urban residential areas, and infrastructure such as roads, highways, and waterways or canals. The Bay-Delta is a complex system in which there are three rivers bring in fresh water and tidal fluctuations cycle in salt water or brackish water.

Water projects carry fresh water to millions of citizens in Central and Southern California. Approximately 60 percent of the water supply of the San Francisco Bay Area is also extracted from or passes through the Delta. In addition to facing risks to its water system from Delta levee failures, the Bay Area also has numerous substandard levees protecting both low-lying and below-sea-level urban areas and infrastructure, including the Oakland International Airport.

Levee Stability

The stability of levees is a function of several variables. Three main loading functions related to levee failure are water level changes, ground shaking, and static loading.[185] Water level changes can be due to peak flood levels or rapid drawdown; both are known to adversely affect the stability of levees. Other hydrostatic influences known to affect levee stability are constant load, cyclical influx of seawater from bay (tidal changes), and reverse flows in some areas. Ground shaking is a function of earthquakes in and around the levees but can occur up to 100 kilometers or more away and still affect levee performance. Static loading represents the nominal loading conditions that regularly exist, but documented levee failures have occurred with no adverse conditions other than static loading. The Jones Tract failure in 2004 is an example of a failure without adverse conditions. The type of foundation the levee is constructed upon (such as peat or alluvium) or the composition of the levee itself (such as loose sand) will influence a levee's performance during a seismic event or under certain static loading conditions. Many levees in the Delta are designed nominally to 100-year design flood levels.

Levee Failure Mechanisms

Six main failure mechanisms are a function of the three loading functions. The six mechanisms are bearing failure, sliding failure, slump or spreading failure, seepage failure, erosion failure, and overtopping, which may be described as follows[186]:

1. A bearing failure in levees is typically deep-seated and can be induced by seismic ground shaking or a loss of soil shear strength. Failure can be triggered by a seismic event that either causes a loss of soil strength or produces destabilizing inertial loading conditions.

2. A sliding failure may occur if the foundation soil has a weak or brittle zone resulting in a preferred failure plane. Both seismic-induced inertial loading and high water levels can cause sliding failures.

3. Slumping and spreading can be generated by two loading conditions. Cyclic loading from earthquakes may generate increased pore pressures and reduced soil strength, leading to volumetric and/or deviatoric strains in the foundation. The same results can also occur due to increased pore pressures from high water levels and increased seepage.

4. Seepage is one of the most common failure mechanisms in levees. Levees are built in fluvial depositional environments, and it is common to find levees with an existing sandy layer beneath the foundation. The sandy layer can be a conduit for flow underneath the levee, resulting in critical conditions at the landside toe of the levee. This can lead to erosion of the foundation during high water or a consistent weakening of the foundation over a long period of time, both eventually leading to failure. Biogenic agents can also lead to destabilizing seepage. These can include rodent holes, tree roots, or other biological activity that create conduits for seepage. Some of the materials used in the construction of levees historically are also susceptible to through seepage. This through seepage can also result in a failure.

[185] Moss and Eller, 2007
[186] Moss and Eller, 2007

5. High-velocity flows can erode material from the outboard or waterside of the levee, which may lead to instability and failure. Erosion can occur at once or over time as a function of the storm cycle and the scale of the peak storms.

6. The failure mechanism of overtopping occurs when high water exceeds the elevation of the levee crest. The water energy is then concentrated at the landside toe of the levee, leading to soil erosion and decreased levee stability. Once overtopping starts, the erosion can quickly lead to a large failure. Some areas in California have experienced land subsidence due to groundwater depletion or other reasons. Land subsidence can cause overtopping to occur in areas that have not had overtopping risk in the past.

Re-Engineering the Levees

Federal, state, and local agencies have been endeavoring to re-engineer the older levees and to build new levees to increasing design standards. One of the biggest issues of the existing levee system, particularly in the Bay-Delta, is the quality of the foundation material on which the levees are founded, as well as the material composition of the levees themselves. Two seismic concerns related to California levees are liquefaction potential of sandy levees and levees founded on granular or sandy soils, and cyclic failure and post-cyclic deformations of levees founded on peaty organic soils. Some non-seismic concerns related to California levees are ensuring sufficient levee height to withstand peak flows, armoring levees against toe or face erosion, preventing detrimental seepage through and beneath levees, and mitigating against degradation of levee integrity due to biological agents or time-based strength degradation of levee materials.

One of the important lessons learned from the New Orleans levee failures[187] was that levees can be designed and built to appropriate standards, but the juncture where two levees abut or join or where a levee abuts or joins a floodwall must also be designed and built to the same standards to avoid failure. A number of failures in and around New Orleans can be attributed to this juncture or interface between different levees built at different times using different designs or under different jurisdictions. Regardless of how well built each levee was, the interface or connection was sub-standard and failure occurred at that location. In engineering terms, levees are considered a series system, a chain of connected engineered components. Levee hazard mitigation must be conducted on a system-wide basis, and a levee system, as with any series system, is only as strong as the weakest “link” in the chain.

7.4.2 PROFILING LEVEE HAZARDS

In parts of California, both the chances and the consequences of flooding are ranked the highest in the nation. Many of the levees in California are intended to protect against a storm that as a 1 percent chance of occurring in any year. Some areas have an even lower level of protection. For perspective, the levee system protecting the city of New Orleans was intended to protect against a storm that has a 0.4 percent of occurring in any year (a 250-year level of protection) but failed in 2005 due to Hurricane Katrina.

A list of significant levee failures in the Bay-Delta from 1900 to the present is shown in Table 7.K. This list documents the spatial and temporal variability of levee failure but does not attribute the failures to a particular loading function or failure mechanism.

[187] Seed, et al., 2006

Table 7.K: San Francisco Bay-San Joaquin-Sacramento Delta Levee Failures, 1900-2017

Delta Island/Tract	Total Acres Flooded	Year Flooded
Andrus Island	7,200	1902, 1907, 1909, 1972
Bacon Island	5,546	1938
Bethel Island	3,400	1907, 1908, 1909, 1911, 1972, 1981, 1983
Big Break	2,200	1927
Bishop Tract	2,100	1904
Bouldin Tract	5,600	1904, 1907, 1908, 1909, 1972
Brack Tract	2,500	1904
Bradford Island	2,000	1950, 1983
Brannan Island	7,500	1902, 1904, 1907, 1909, 1972
Byron Tract	6,100	1907
Canal Ranch Tract	500	1958, 1986
Clifton Court Tract	3,100	1901, 1907
Coney Island	900	1907
Dead Horse Island	200	1950, 1955, 1958, 1980, 1986, 1997
Donlon Island	3,000	1937
Edgerly Island	150	1983
Empire Tract	3,500	1950, 1955
Fabian Tract	6,200	1901, 1906
Fay Island	100	1983
Franks Tract	3,300	1907, 1936, 1938
Glanville Tract	--	1986, 1997
Grand Island	--	1955
Grizzly Island	8,000	1983
Holland Tract	4,100	1980
Ida Island	100	1950, 1955
Jersey Island	3,400	1900, 1904, 1907, 1909, 1981, 1983
Little Franks Tract	350	1981, 1982, 1983
Little Mandeville Island	22	1980
Lower Jones Tract	5,700	1907, 1980
Lower Roberts Island	10,300	1906
Lower Sherman Island	3,200	1907, 1925
Mandeville Island	5,000	1938
McCormack Williamson Tract	1,500	1938, 1950, 1955, 1958, 1986, 1997, 2017
McDonald Island	5,800	1982
Medford Island	1,100	1936, 1983
Middle Roberts Island	500	1938
Mildred Island	900	1965, 1969, 1983
New Hope Tract	2,000	1900, 1904, 1907, 1928, 1950, 1986
Palm Tract	2,300	1907
Pescadero	3,000	1938, 1950
Prospect Island	1,100	1980, 1981, 1982, 1983, 1986
Quimby Island	700	1936, 1938, 1950, 1955, 1986
RD 1007	3,000	1925
RD 17	4,500	1901, 1911, 1950
Rhode Island	100	1938
Ryer Island	11,600	1904, 1907
Sargent Barnhart Tract	1,100	1904, 1907
Sherman Island	10,000	1904, 1906, 1909, 1937, 1969

Delta Island/Tract	Total Acres Flooded	Year Flooded
Shima	2,394	1983
Shin Kee Tract	700	1938, 1958, 1965, 1986
Staten Island	8,700	1904, 1907
Stewart Tract	3,900	1938, 1950, 1997
Terminous Tract	5,000	1907, 1958
Twitchell Island	3,400	1906, 1907, 1909
Tyler Island	8,700	1904, 1907, 1986
Union Island	2,400	1906
Upper Jones Tract	5,700	1906, 1980, 2004
Upper Roberts Island	500	1938
Van Sickle	--	1983, 2017
Venice Island	3,000	1904, 1906, 1907, 1909, 1932, 1938, 1950, 1982
Victoria Island	7,000	1901, 1907
Webb Tract	5,200	1950, 1980

Source: California Department of Water Resources (DWR), 2006 and 2017; DWR Public Affairs Chief Ted Thomas, personal communication, 2006; U.S. Army Corps of Engineers (USACE), 2006

Additionally, there have been other levee failures along the Sacramento and San Joaquin rivers during flood events. Some notable floods include 1950, 1955, 1983, 1986, and 1997 events. During these events Yuba City, Marysville, Linda/Olivehurst, Nicolaus, Manteca, and other areas were flooded.

Climate Change and Levees

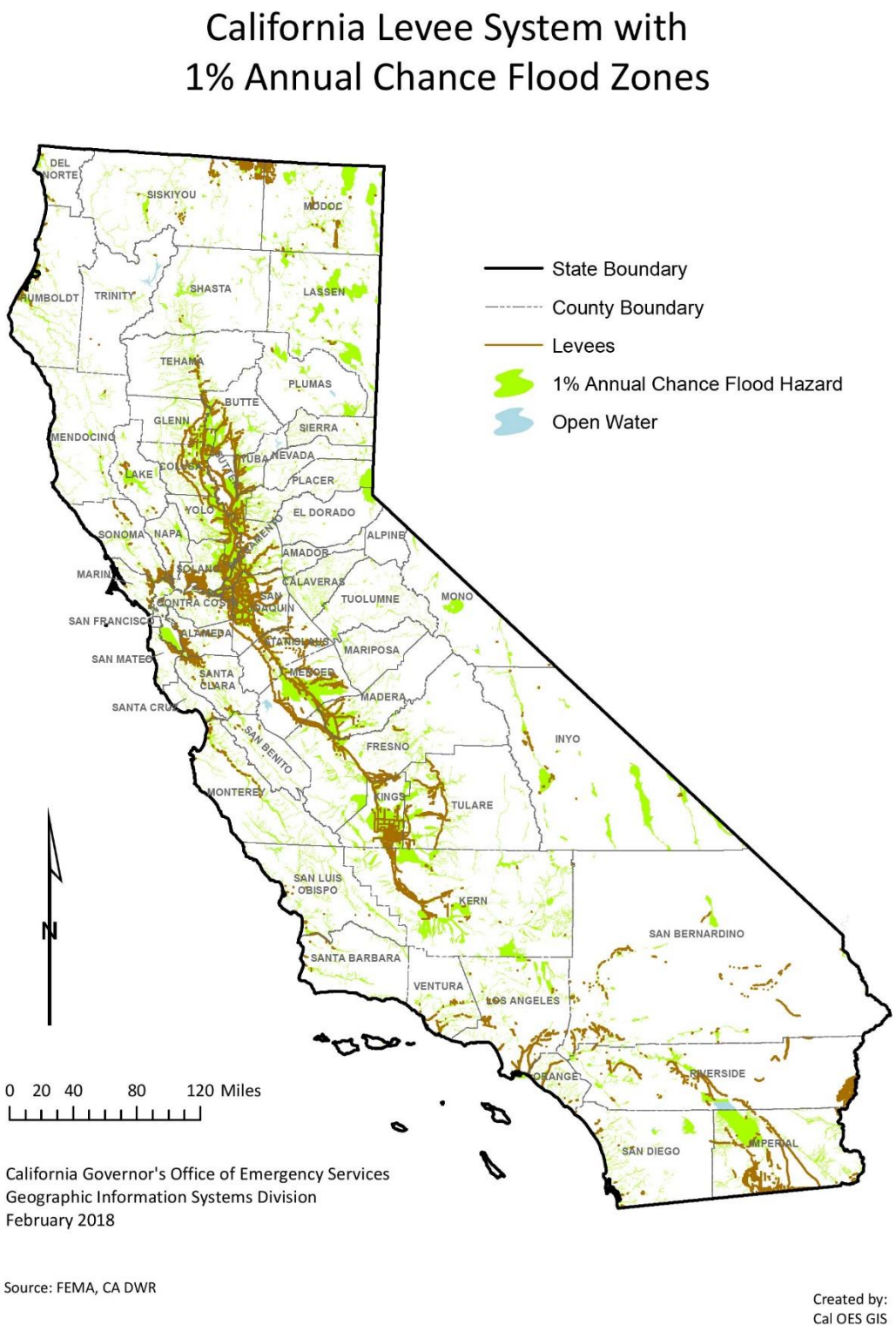
Climate change in California is expected to increase the risk of flooding significantly. Increased flood frequency and magnitude are predicted consequences of climate change.

The Sierra Nevada mountain range is the largest reservoir in the state and a key part of California's flood control system. The Sierra Nevada holds water through the winter months in the form of snow, which is then released to the Central Valley as snow melt during the warm months of the year. As annual temperature increase more of the precipitation that would have fallen into the mountains as snow may fall instead as rain, increasing winter flows in the rivers downstream into the Delta system.

As sea-levels rise, flood stages in the Sacramento-San Joaquin Delta of the San Francisco Bay estuary may also rise, putting increasing pressure on Delta levees. This threat may be particularly significant because recent estimates indicate that the additional force exerted upon the levees is equivalent to the square of the water level rise. Estimates using historical observations and climate model projections suggest that extreme high water levels in the Bay and Delta will increase markedly if sea-level rises above its historical rate. These extremes are most likely to occur during storm events, leading to more severe damage from waves and floods. As water levels in the Delta increase, water levels upstream in the Sacramento and San Joaquin Rivers will also increase, putting additional pressure on levees located there.[188]

[188] DWR, 2006; California Climate Change Center, 2006

Map 7.V: California Levee System with 1 Percent Annual Chance Flood Zones



Map 7.V shows the pattern of levees in relation to National Flood Insurance Program (NFIP) 1 percent annual chance flood hazard floodplains in California illustrating the potential for flooding resulting from levee failure. The greatest concentration of levees is in the Central Valley area. Lesser concentrations are found in the San Francisco Bay Area and Southern California.

7.4.3 ASSESSMENT OF LEVEE FAILURE VULNERABILITY AND POTENTIAL LOSSES

The list of levee failures in Table 7.J also documents the consequences of the levee failures in terms of area of land flooded per failure. The consequences of failure are critical for profiling the hazard and developing a rational risk-based assessment. Ultimately, the consequences are in terms of dollar figures associated with crop loss, building destruction, life loss, or saltwater intrusion that brings to a halt the pumping of fresh water to Central and Southern California as well as potential for environmental losses.

The Delta is subject to high water conditions during storm events but also to near-field seismic events. The California Water Policy Council and Federal Ecosystem Directorate (CALFED's "Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees" report of April 2000 concluded that 3 to 10 failures are likely to occur on critical Delta levees during an earthquake with a 1 percent chance of occurring in any year (100-year level of protection). These failures would likely stop the export of Delta water until water quality is restored. Approximately 60 percent of the water supply of the San Francisco Bay Area is extracted from or passes through the Delta. The intrusion of saltwater would force the State of California and Bureau of Reclamation to stop pumping and would endanger the water supply for 3 million acres of irrigated land and over 23 million people. A levee failure would result in an encroachment of brackish or seawater into the Delta. The presence of the saltwater would also have a significant impact on local agriculture and salt-sensitive native species.

The Delta also has many fuel storage facilities and oil and gas pipelines as well as electrical transmission lines and transportation infrastructure across the region. During a seismic event, these lines may fail and cause large-scale spills that would also inhibit the export of Delta water and severely affect one of the nation's largest natural salt water habitats. Levee failure resulting in flooding of a Delta island with infrastructure risks could introduce hazardous material into the water ad impede evacuation routes, and could also affect energy supplies in regions beyond the Delta.

In San Francisco and San Pablo Bays levees protect infrastructure as well as urban areas. The Oakland International Airport is an example of infrastructure protected by levees.

Progress Summary 7.N: Earthquake, High Water, and Levee Failure: Cascading Hazards

Progress as of 2018:
Draft Workshop Report – Earthquakes and High Water as Levee Hazards in the Sacramento-San Joaquin Delta
In July 2016, the Delta Independent Science Board organized a workshop at the University of California (UC) Davis to review and evaluate earthquakes and high water as hazards to Delta levees. The results of this workshop were published in a 24-page workshop report. The workshop highlighted findings that mostly postdated hazard assessments in the Delta Risk Management Strategy.

The workshop participants discussed earthquakes and high water as two of the greatest risks to levees. Specifically:

- The levee failure mechanism resulting from earthquake deemed most likely was liquefaction of sand within levee fills, if ground motions are sufficient.
- Present-day Delta water levels were shown to rise over time with riverine floods, winds surge, and tides, along with sea levels within the estuary. As a result of climate change, floods and winds in the Delta are projected to become more severe. Combinations of higher tides, wind-driven surges, and high river discharge create a significant high-water threat to levees.

The Draft Workshop Report – Earthquakes and High Water as Levee Hazards in the Sacramento-San Joaquin Delta can be downloaded from the Delta Council website at:
http://deltacouncil.ca.gov/sites/default/files/2016/08/2016-07-31-levee-workshop-full-report.pdf.

7.4.4 CURRENT LEVEE FAILURE HAZARD MITIGATION EFFORTS

State Flood Management Initiatives

California voters have approved billions of dollars in bonds over the years to finance various critical infrastructure improvements and retrofit projects. A November 2006 bond election resulted in provision of $4.9 billion of levee repair and improvement funding. The 2006 levee bond election led to formation of the California Department of Water Resources (DWR) Delta Risk Management Strategy (DRMS) program and to initiation of a comprehensive flood mitigation program in the Central Valley. In June 2011 the final Phase 2 Risk Reduction report was issued building on the knowledge gained from the DRMS Phase 1 assessment evaluating scenarios to reduce risk to the state economy. For more information on the DRMS program and to review the Phase 2 report visit: https://www.water.ca.gov/Programs/Flood-Management/Delta-Conveyance-And-Flood-Protection.

Levee Evaluation and Repair

Overview

DWR is undertaking unprecedented efforts to evaluate and upgrade aging and deteriorating levees along the Sacramento River and San Joaquin River valleys and the Delta. Funding for the levee evaluation efforts was provided through the two large flood control bonds, Propositions 84, and 1E, approved by California voters in November 2006. To expedite efforts to protect these communities, levee evaluations were conducted in a fast-track manner over an eight-year period.

To date, nearly 250 levee repair sites have been identified, with more than 100 of the most critical sites having already been repaired. Repairs to others are either in progress or scheduled to be completed in the near future, and still more repair sites are in the process of being identified, planned, and ranked.

Levee Repairs on Tyler Island in February 2017



Source: California Department of Water Resources

Urban Levee Evaluations Geotechnical Evaluation Report

The Geotechnical Evaluation Report is comprised of two volumes that present cumulative geotechnical evaluation results for the studied area. Volume 1, Existing Conditions, reports Urban Levee Evaluations ULE Project analysis results for existing levee conditions and identifies levee reaches and segments that do not meet the design and/or 200-year flood protection criteria (0.5 percent chance of failure in any given year). Volume 2, Remedial Alternatives, reports ULE Project conceptual remedial alternatives and associated costs for those reaches and segments that do not meet criteria based on the results of the Geotechnical Evaluation Report Volume 1. Volume 2 also evaluates the study area levees for seismic vulnerability but does not include conceptual remedial alternatives or associated costs.

Progress Summary 7.O: Levee Hazard Mitigation: Evaluation and Repair

Progress as of 2018: The California Department of Water Resources (DWR) Levee Evaluations Program included the Urban Levee Evaluations (ULE) Project and the Non-Urban Levee Evaluations (NULE) Project. The program evaluated current levels of performance for State Plan of Flood Control (SPFC) levees and associated non-SPFC levees. (If these non-SPFC levees fail, areas protected by the SPFC would flood.)

The ULE Project addressed approximately 470 miles of State-Federal Project Levees and appurtenant non-State-Federal Project levees located in the Central Valley protecting populations of 10,000 people or more. The NULE project addressed the remaining State-Federal Project and non-State-Federal Project levees protecting populations of fewer than 10,000 people. The ULE and NULE Projects were completed in April 2015. Information, analysis, cost estimate tools, and levee performance models developed by the program are being used in local, state, and federal areas of the Central Valley protected by the SPFC. More information on these programs can be found at: http://www.dwr-lep.com.

Urban Levee Evaluations (ULE) Project

The ULE Project evaluated levees that protect areas with more than 10,000 people. The ULE Project evaluated urban State-Federal Project levees, including appurtenant non-project levees, to determine if they meet defined geotechnical criteria and, if appropriate, identify remedial measure(s) to meet those criteria. The goals of the ULE Project included the following:

- Support the Central Valley Flood Protection Plan (CVFPP), federal and local flood management projects, local Federal Emergency Management Agency (FEMA) certification efforts, and the legislative mandate of urban 200-year flood protection by 2025
- Support federal and local flood management programs by providing geotechnical data, analysis, and remedial alternatives to local, state, and federal stakeholders
- Improve geotechnical information exchange methods between state, local, and federal flood management agencies
- Identify critical levee repairs

Non-Urban Levee Evaluation (NULE) Project

The NULE Project is part of DWR's Levee Evaluations program established through FloodSAFE with the primary purpose to evaluate non-urban/State-Federal Project levees and appurtenant non-State-Federal Project levees that protect fewer than 10,000 people. The NULE Project determined whether the non-urban levees meet defined geotechnical criteria and, if appropriate, identified remedial measure(s) to meet those criteria. The goals of the NULE Project include the following:

- Support the CVFPP and Central Valley Flood Evaluation Delineation (CVFED) projects
- Support federal and local flood management programs by providing geotechnical data, analysis, and conceptual remedial alternatives and their costs to local, state, and federal agencies
- Improve geotechnical information exchange methods among state, local, and federal flood management agencies.
- Identify locations where critical levee repairs may be needed.

Two phases have been developed to meet the NULE Project goals:

NULE Phase 1 – Geotechnical Assessment Report (GAR)

The Phase 1 assessments consisted of non-intrusive studies and preparation of the Geotechnical Assessment Report (GAR). Over 1,200 miles of non-urban State-Federal Project levees and over 300 miles of appurtenant non-urban non-State-Federal Project Levees were included in Phase 1 of the Geotechnical Assessment Report. The report contained a compilation of existing data about the levees, levee systems, and historical levee performance. The compiled data were reviewed for levee construction information, subsurface information, and past performance descriptions. Each levee segment was assigned a hazard category. Tools and methodology were developed to consistently assess levee segments based on systematic, consistent, repeatable analysis that correlated geotechnical data with levee performance history. Conceptual remedial alternatives and associated cost estimates were prepared and are presented in a Remedial Alternatives and Cost Estimate Report.

NULE Phase 2 – Geotechnical Overview Report

Phase 2 assessments build on Phase 1 results in DWR selected study areas, which generally consist of levees protecting populations greater than 1000 people. Phase 2 consisted of targeted field explorations, laboratory testing, and analyses to identify levees not meeting criteria established for the NULE Project. The fieldwork and laboratory testing will be summarized in the Geotechnical Data Reports. The analysis of existing conditions and remedial alternatives will be summarized in the Geotechnical Overview Reports. The Geotechnical Overview Report will be divided into two volumes, with Volume 1 describing existing conditions includes the study area overview, methodology, and analysis results. Volume 2 contains remedial alternatives for levees that do not meet criteria, and includes analyses of remedial alternatives and conceptual cost estimates.

All of the above-mentioned reports are completed. The GER and GOR reports were completed on April 30, 2015. DWR has made these reports available electronically. They can be found at http://www.dwr-lep.com.

Urban/Non-Urban Levee Evaluations Cost Analysis Tool

This tool is helping flood managers develop accurate estimates for levee repairs. The tool provides the previously unknown factor in the cost analysis of levee repairs: an analysis of levee conditions for 1,914 miles of levees (1,548 miles of SPFC levees and 366 miles of non-SPFC levees) while also accounting for hard construction costs and soft costs like design. The tool is being used by DWR's Central Valley Flood Management Planning Office, the U.S. Army Corps of Engineers, and local levee maintaining agencies.

Progress Summary 7.P: Delta Levees Program

Progress as of 2018: The Delta Levees Program includes the Special Flood Control Projects Program, the Delta Levees Maintenance Subventions Program, and the Delta Ecosystem Enhancement Section. The Delta Levees Program addresses approximately 1,100 miles of levees. Originally, the program was authorized to address flooding on the eight Western Delta Islands and in the towns of Thornton and Walnut Grove. In 1996, the program was expanded to include the entire Delta and portions of the Suisun Marsh. The Delta levees addressed by the program protect more than 10,000 people.

The Special Flood Control Projects Program provides funding to local agencies in the Sacramento-San Joaquin Delta for levee maintenance and improvement and for habitat mitigation and enhancement. The Delta Levees Maintenance Subventions Program is a cost-share program that provides technical and financial assistance to local levee-maintaining agencies in the Delta for the maintenance and rehabilitation of non-project and eligible project levees. Each year, 70 local agencies enter into agreements for the reimbursement of the eligible incurred costs. The Delta Ecosystem Enhancement Section operates as the environmental arm of the Delta Levees Program and has a primary role in providing environmental oversight for reclamation district projects funded by the program. The primary objective of these projects is to provide habitat and ecosystem benefits for native species. For more information, visit: **https://www.water.ca.gov/Programs/Flood-Management/Delta-Conveyance-And-Flood-Protection**.

DWR's Delta Levees Program helps support the work of more than 70 local agencies that maintain, rehabilitate, or improve levees at risk from flooding, tidal stresses, and sea level rise, among other threats, in the Sacramento-San Joaquin Delta. During 2015 and 2016, additional partnerships were established with local agencies that represent individual Delta islands, making it possible to continue reducing flood risk in the Delta. Additionally, 2016 saw the completion of significant levee projects on New Hope Tract, Bouldin Island, Bacon Island, and elsewhere in the Delta. This work contributes toward a major milestone in a $38 million effort that began in 2011 to raise all Delta levees to an interim Hazard Mitigation Plan standard.

Delta Stewardship Council and the Delta Levees Investment Strategy

The Delta Reform Act of 2009 called on the Delta Stewardship Council to lead a multi-agency effort to update priorities for state investments in the Delta levee system to reduce the likelihood and consequences of levee failures and to protect people, property, and state interests, while advancing the coequal goals of improving water supply reliability, restoring the Delta ecosystem, and protecting and enhancing the values of the Delta as an evolving place.

The Delta Stewardship Council was created in legislation to achieve the state-mandated coequal goals for the Delta. In response, the Council has launched the Delta Levees Investment Strategy (DLIS), which will combine risk analysis, economics, engineering, and decision-making techniques to identify funding priorities and assemble a comprehensive investment strategy for the Delta levees.

Beginning in 2014, the development of the DLIS has been underway through collaboration among state agencies, local reclamation districts, Delta landowners and businesses, and other stakeholders. A final draft version (amended by the Council) was released on March 23, 2017. A Memorandum of Understanding for implementation of the DLIS was drafted in June 2017.

Implementation of the DLIS aligns with 2018 SHMP Goal 2*: Minimize damage to structures and property, as well as interruption of essential services and activities* and Goal 3*: Protect the environment.*[189]

More information can be found at http://deltacouncil.ca.gov/delta-levees-investment-strategy.

[189] http://deltacouncil.ca.gov/delta-levees-investment-strategy. (Delta Stewardship Council website, 2017)

Other Levee Programs Addressing Flood Risk:

Delta Levees System Integrity

This program focuses on levee repair, maintenance and improvement, and habitat enhancement within the Sacramento-San Joaquin Delta. The program includes the Delta Levees Special Projects Program and the Delta Levees Maintenance Subventions Program. More information on these programs can be found at: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Delta-Levees-Special-Flood-Control-Projects and https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Delta-Levees-Maintenance-Subventions.

Delta Special Investigations

This program focuses on levee repair, maintenance, and improvements within the Delta. The program includes the following projects: Delta Knowledge Improvement, North Delta, and West Delta. More information on this program can be found at: https://www.water.ca.gov/LegacyFiles/floodsafe/fessro/docs/special_investigations_update.pdf and http://water.ca.gov/floodsafe/fessro/docs/special_investigations_update.pdf.

Marysville Ring Levee

This project provides a 0.5 percent annual chance level of protection for the people of Marysville, critical infrastructure (California State Highways 20 and 70, railroad) and a 173-bed, Level III regional trauma center. Partners for this project include the USACE, DWR, Central Valley Flood Protection Board, Marysville Levee Commission, and Yuba County Water Agency. More information on this project can be found at: http://www.ycwa.com/the-ycwa/flood-management/marysville-ring-levee/.

Local Levee Assistance

Initiated by Proposition 84, this DWR cost-share program was created to assist flood management throughout the state. The program funds evaluations and critical repairs of flood projects at a cost share of up to 90 percent for multi-benefit projects that protect disadvantaged communities. The funds allocated for these grants are expended through competitive grants to local public agencies responsible for flood control at the project location. More information on this program can be found at: https://www.water.ca.gov/Work-With-Us/Grants-And-Loans/Local-Levee-Assistance-Program.

Progress Summary 7.Q: Lower Elkhorn Basin Levee Setback Project

Progress as of 2018: The California Department of Water Resources (DWR) is working on the Lower Elkhorn Basin Levee Setback project—the first state-led construction project to increase flood protection in the Central Valley. The project is the first step toward implementation of the Yolo Bypass Multi-Benefit Improvements outlined in the 2017 Central Valley Flood Protection Plan update and Sacramento Basin Wide Feasibility Study.

The project will set back the north levee of the Sacramento Bypass and the eastern Yolo Bypass levee between Interstate 5 and the Sacramento Bypass by 1,500 feet. This is the first step to adding capacity to the Sacramento Flood System in the Yolo Bypass. This initial project will lower the water surface elevation adjacent to the urban areas of Sacramento and West Sacramento and is a part of the larger effort that will the elevation as much as 3 feet.

The Lower Elkhorn Basin Levee Setback project and the efforts in the Yolo Bypass involve more than just flood protection. The Yolo Bypass has a history of successfully combining agriculture, flood capacity, and environmental benefits. Portions of the bypass are farmed for rice in the summer and flooded for birds in the winter. They are also a part of the flood bypass system and can relieve pressure from high water on levees adjacent to urban areas. The Lower Elkhorn Basin Levee Setback project and other projects in the area will continue this practice. Land that becomes a part of the bypass area will be farmed in a similar way to other areas within the bypass. There is also an opportunity for an environmental corridor adjacent to the Tule Canal in the bypass, as well as recreational opportunities.

Hamilton City J levee

This project would provide increased flood protection for an agricultural support community and 1,500 acres of restored habitat. Partners for this project include the USACE, Central Valley Flood Protection Board, and Reclamation District 2140. For more information on this project, see Best Practices Highlight 7.G or visit: http://www.sacriver.org/aboutwatershed/roadmap/projects/hamilton-city-levee-setback.

Best Practices Highlight 7.F: Hamilton City Flood Damage Reduction and Ecosystem Restoration Project

Hamilton City is located along the Sacramento River about 85 miles north of Sacramento in Glenn County. Given its proximity to the Sacramento River, the city has an extensive history of flood evacuations and flood fighting to avoid failure of the private "J" levee, which is the only existing protection. The existing levee protects the town's population of approximately 2,070 residents and 758 properties and is substandard. The "J" levee, built in the early 1900s to contain flows in the Sacramento River, failed twice in the 1970s and has required emergency reinforcement five times since 1983. The "J" levee does not meet current construction standards and could fail even with river levels below the top of the levee. See Figure 7.M for an overview map of the project area.

A 2004 feasibility study by the U.S. Army Corps of Engineers (USACE) and the Reclamation Board of the State of California determined that the project could reduce the chance of flooding from once every 10 years to once every 75 years, with an expected $577,000 decrease in annual flood damages.

The community's flood damage reduction and ecosystem restoration project is an example of successful collaborative partnerships in which stakeholders have come together to help coordinate the project and secure funding, land, and other resources in an effort to construct the new levee. The project aims to reduce flood risk and damage, to repair the river ecosystem through restoration of river function and improved habitat, and to form successful partnerships between stakeholders in the process. The project, which includes a 6.8-mile setback levee, 1,450 acres of floodplain, and 1,361 acres of habitat restoration, is expected to cost $72.9 million.

The project, which began in 2015, is the first in the nation to be authorized for construction under the USACE guidelines to develop multi-purpose projects that include both flood risk reduction and ecosystem restoration. Reclamation District 2140 was formed to be the non-federal sponsor of the project and will own, operate, and maintain the levee once construction has been completed. State funding (about $5 million) was provided through the Flood Corridor Program.

For more information regarding the Hamilton City project, visit the following websites:
http://www.spk.usace.army.mil/Missions/Civil-Works/Hamilton-City/,
http://rd2140.org/hamilton-city-levee-update/ and
http://bondaccountability.resources.ca.gov/Project.aspx?ProjectPK=8589&PropositionPK=5.

Figure 7.M: Hamilton City Flood Damage Reduction and Ecosystem Restoration Project Overview



Source: Reclamation District 2140, http://rd2140.org/hamilton-city-levee-update/

Best Practices Highlight 7.G: Local Levee Assistance: Mission Beach Seawall, San Diego

The Local Levee Assistance Program was established by the California Department of Water Resources to provide financial assistance to local public agencies responsible for flood management outside the Sacramento-San Joaquin Delta. The Local Levee Assistance Program helped fund the design of improvements to repair and replace portions of an existing seawall and adjacent walkway at Mission Beach in San Diego, a major tourism and business area. This $1.2 million project demonstrates collaboration between state and local governments and the program's ability to fund flood management projects beyond traditional levee repair projects.

Mission Beach Seawall, San Diego



Source: California Department of Water Resources, 2014 Flood Management Activity Highlights: Managing Risk and Protecting the Environment.

7.5 DAM FAILURE AND SAFETY HAZARDS, VULNERABILITY, AND RISK ASSESSMENT

7.5.1 IDENTIFYING DAM HAZARDS – FAILURES AND OVERTOPPING

Dam failure is the uncontrolled release of impounded water from behind a dam. Flooding, earthquakes, blockages, landslides, adverse geological conditions, lack of maintenance, aging infrastructure, improper operation, poor construction, vandalism, and terrorism can all cause dam failure. Dam failure from overtopping is a specific failure mechanism resulting from inadequate spillway capacity or other spillway issues and seiches. Dam failure can result in catastrophic downstream flooding that may affect life and property.

Dam failure from overtopping can occur when the inflow volume into a reservoir (primarily caused by stormwater runoff) exceeds the volume of water that can be stored and evacuated from a reservoir via its spillway. With a changing climate that includes an expectation of increased extreme weather events in California, including prolonged periods of severe drought and intense wet periods with less snowpack and degraded conditions in source watersheds, dam operation becomes more difficult and the risk of spillway activation and dam failure from overtopping may increase.

7.5.2 PROFILING DAM HAZARDS – FAILURES AND OVERTOPPING

Dams and reservoirs of jurisdictional size are defined in the California Water Code Sections 6000 through 6008. A jurisdictional dam in California has a height greater than 6six feet while impounding 50 acre-feet or more or a height greater than 25 feet with storage capacity of 15 acre-feet or more. As of early 2018, there are more than 1,537 dams of jurisdictional size in California. Approximately 1,250 of these dams are under jurisdiction of the California Department of Water Resources (DWR), Division of Safety of Dams (DSOD). Dams and reservoirs owned by the federal government are not subject to state jurisdiction except as otherwise provided by federal law. In California, there are approximately 287 dams owned by federal government agencies such as the United States Forest Service (USFS), United States Bureau of Reclamation (USBR), United States Army Corps of Engineers (USACE), and the United States military.

Los Angeles County leads the state with 91 jurisdictional dams, followed by Sonoma County with 64 dams. Del Norte County is the only county in the state that has no dams of jurisdictional size.

The term “dam failure” encompasses a wide variety of circumstances characterized by damage to a component of the dam or an appurtenant structure leading to an uncontrolled release of impounded water. Situations that would constitute a dam failure vary widely, from small problems to a partial or catastrophic collapse of the entire dam or appurtenant structure. Potential causes of a dam failure are numerous and can be attributed to adverse geologic conditions, deficiencies in the original design of the dam, the quality of its construction, the maintenance of the dam and operation of the appurtenances of the functioning dam, and acts of nature including flooding from precipitation and damage from earthquakes. Most of these causes and deficiencies are related to the dam having been constructed in an era a dam was constructed that, which pre-dates our current engineering knowledge. Water overtopping the dam crest is a cause of failure in earthen dams. Overtopping can cause erosion of the dam crest and potentially a dam breach. Piping of dam fill material within earthen dams is another failure mechanism. Piping is a form of erosion that occurs internal to an embankment or its foundation, caused by internal flaws such as fracturing within rock or soil, rodent burrowing, and/or the presence of extensive root systems from vegetation growing on and around the dam.

In the past 50 years, there have been only a small number of dam failures in California. The most catastrophic dam failure in California’s history is that of the infamous St. Francis Dam in Los Angeles County, which failed in March 1928, shortly after construction of the dam was completed. This failure resulted in the deaths of more than 450 people and the destruction of nearly 1,000 homes and buildings. Numerous roads and bridges were also destroyed or damaged beyond repair. The Division of Safety of Dams (DOSD) was established as a direct result of this catastrophe. Other significant dam incidents in California’s history include the Baldwin Hills Dam failure in 1963, the near-failure of the Lower San Fernando Dam in 1971, and the failure of the spillway system at Oroville Dam in 2017.

Construction at the Oroville Dam Spillway in January 2018



Source: California Department of Water Resources

In February 2017, the gated spillway at Oroville Dam, the tallest dam in the United States, suffered a failure within its concrete chute. A 60-foot-deep hole developed in the lower third of the chute as a result of normal spillway operations undertaken to lower the reservoir in advance of a moderately large storm. The subsequent occurrence of the storm in the days after the initial incident and the inability to fully use the primary spillway led to the filling of the reservoir and the use of its unlined emergency spillway for the first time ever. After two days of usage and erosion of the unlined hillside and head cutting, concerns regarding the stability of the emergency spillway weir developed, and nearly 200,000 people downstream were evacuated.

The incident emphasized the importance of re-evaluations of appurtenant structures, including understanding the original design and construction; inspections alone were not likely to have predicted the incident but, in conjunction with a re-evaluation, the underlying causes may have been discovered. It is of note that the storms that occurred were below historical maximums, but the 2016-2017 water year was the wettest ever for that region of California. The event emphasized the importance of dam appurtenances, and especially the importance of having adequate outflow capacity and spillway design features.

Continued Repairs on the Oroville Dam Spillway in February 2018



Source: California Department of Water Resources

7.5.3 ASSESSMENT OF DAM FAILURE VULNERABILITY AND POTENTIAL LOSSES

State's Role in Vulnerability Assessment

The State of California has not made local vulnerability assessments quantitatively. The major role that California, and specifically DOSD, has traditionally had is to assess the safety of dams, including the dam's vulnerability to hazards such as floods and earthquakes, but not necessarily to assess downstream consequences. In order for the state to look at the vulnerabilities of downstream communities, regularly updated inundation maps are needed. Prior to 2017, California did not have these maps. The state took a major step forward in having the capability to determine downstream vulnerabilities in 2017, with the passage of Senate Bill 92 requiring dam owners with certain hazard classifications to develop inundation maps and emergency action plans for their dams.

As a result of Senate Bill 92 and the subsequent updated inundation maps, the state will assess potential vulnerability and losses to dam failure for most dams in the state. These efforts will be possible once the inundation mapping program and emergency action plan development is completed in California by 2021.

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans (LHMPs). Local planning departments have access to the state's inventory of inundation maps, which are kept on a server and published annually as DVDs. These DVDs are provided without cost to both governmental agencies and non-governmental parties upon request.

7.5.4 CURRENT DAM FAILURE HAZARD MITIGATION EFFORTS

Dam Safety Legislation and Programs

Since 1929, the state has supervised all non-federal dams in California to prevent failure for the purpose of safeguarding life and protecting property. Supervision is carried out through the state's Dam Safety Program under the jurisdiction of DWR. The legislation requiring state supervision was passed in response to the St. Francis Dam failure and concerns about the potential risks to the general populace from a number of water storage dams. The law requires:

- Examination and approval or repair of dams completed prior to August 14, 1929 (the effective date of the statute)
- Approval of plans and specifications for and supervision of construction of new dams and the enlargement, alteration, repair, or removal of existing dams
- Supervision of maintenance and operation of all dams under the state's jurisdiction

The 1963 failure of the Baldwin Hills Dam in Southern California led the legislature to amend the California Water Code to include within state jurisdiction both new and existing off-stream storage facilities. Dams and reservoirs subject to state supervision are defined in California Water Code Sections 6002 through 6009. In administering the Dam Safety Program, DWR must comply with the provisions of the California Environmental Quality Act (CEQA). As such, all formal dam approval and revocation actions must be preceded by appropriate environmental documentation.

In 1972, Congress moved to reduce the hazards from the 28,000 non-federal dams in the country by passing Public Law 92-367, the National Dam Inspection Act. With the passage of this law, Congress authorized the USACE to inventory dams located in the United States. The action was spurred by two disastrous earthen dam failures during the year in West Virginia and South Dakota that caused a total of 300 deaths.

The Water Resources Development Act of 1986 (Public Law 99-662) authorized the USACE to maintain and periodically publish an updated National Inventory of Dams (NID). The Water Resources Development Act of 1996 (Public Law 104-303), Section 215, re-authorized periodic updates of the NID by the USACE. Section 215 further established the National Dam Safety Program and named the Administrator of FEMA as its coordinator. The National Dam Safety and Security Act of 2002 (Public Law 107-310) added security to the list of critical dam safety issues. The Dam Safety Act of 2006 (Public Law 109-460) added condition assessment ratings of dams to the NID and reauthorized the National Dam Safety Program. The Water Resource Reform and Development Act of 2014 reauthorized the National Dam Safety Program most recently.

On the heels of the Oroville Dam incident in February 2017, the Governor announced a four-point plan to bolster dam safety and flood protection in California. In the spring of 2017, the state legislature passed Senate Bill 92, which was signed by the Governor on June 27, 2017. Along with the Governor's Executive Order action, this law bolsters dam safety provisions in the California Water Code and Government Code. It tasked DWR/DSOD with additional dam safety items and required that DWR/DSOD review and approve dam inundation maps for Emergency Action Plans (EAPs). The new language also required that the California Governor's Office of Emergency Services (Cal OES) review and approve EAPs, provide that the EAP included the required/approved inundation maps.

Consistent with Senate Bill 92, the new Water Code resulted in the following:

- DWR has updated the classification of the public safety risk of all state jurisdictional dams based on downstream hazard potential and reviews of critical appurtenant structures. (California Water Code Section 6160)
- For state jurisdictional dams identified as significant, high, or extremely high hazard classifications, DWR is required to review, provide comments, and when complete, approve inundation maps (incorporating enhanced mapping technology) prepared by dam owners for the failure of their dam and identified critical appurtenant structures under various failure scenarios unique to the dam. (California Water Code Sections 6060 and 6161)
- DWR will make approved dam failure inundation maps publicly available. (California Water Code Section 6161)
- All state jurisdictional dams excluding low hazard dams will be required to submit an Emergency Action Plan (EAP) using these approved inundation maps. Cal OES shall review and approve the EAP upon DWR/DSOD approval of the dam inundation map(s) prepared by the dam owner. (California Water Code Section 6161)
- All state jurisdictional dams excluding low hazard dams will be required to do a notification exercise once a year. (California Government Code Section 8586.9)
- Cal OES will assist local public safety agencies in integrating EAPs within their all hazards plans. (California Government Code Section 8586.9)
- All state jurisdictional dams shall update their inundation map and EAP every 10 years or sooner if the dam system changes significantly or local development patterns change. (California Water Code Sections 6060 and 6161)
- New regulatory tools for enforcement to support the above requirements will range from monetary fines to operational restrictions for failure to comply. (California Water Code Section 6060 and 6161)
- DSOD will receive $3 million in budget allocations (funded by fees paid for by dam owners) to conduct more extensive evaluations of appurtenance structures, such as spillways, gates, and outlets, than the previous visual inspections. This includes geologic assessment and hydrological modeling, which is being expedited for dams that have spillways and structures similar to the Oroville Dam before the 2018-2019 flood season.

Additional information about inundation mapping and EAPs, as amended by Senate Bill 92, is found in the Government Code Section 8589.5.

Furthermore, the Governor has requested that the federal government adopt the state's new detailed evaluations of dam appurtenant structures at federal dams; update rule curves for reservoir regulation and flood control through the U.S. Army Corps of Engineers (USACE), allowing non-federal authorities to help fund the necessary reviews; and appropriate federal funding for the newly created federal program to rehabilitate high-hazard dams through the FEMA National Dam Safety Program.[190]

DWR adopted emergency regulations under the Administrative Procedure Act that establish criteria for dam owners to prepare and submit inundation maps for review and approval by DWR. Specifically, these emergency regulations specify definitions, failure scenarios, and submittal requirements for inundation maps for dams and critical appurtenant structures that could affect downstream life or property. DWR proposes these emergency regulations for adoption into the California Code of Regulations, Title 23, Division 2, Chapter 1, Article 6. Further information regarding these regulations can be found at: https://www.water.ca.gov/Programs/All-Programs/Division-of-Safety-of-Dams.

Following Office of Administrative Law's approval of the emergency regulations, DWR will initiate the permanent regulation rulemaking process for inundation maps.

Additionally, under Proposition 1, $2.7 billion of state funds are being invested in water storage projects, the largest single investment in new dams and reservoirs in decades. Potential projects to be funded under Proposition 1 include new dam construction and reservoir expansions.

[190] https://www.gov.ca.gov/2017/02/24/news19696/;
https://www.gov.ca.gov/wp-content/uploads/2017/09/Fact_Sheet_Governor_Brown_Four_Point_Plan_to_Bolster_Dam_Safety_and_Flood_Protection.pdf

Risk MAP

FEMA has recently launched an effort under its Risk MAP program to communicate risk of dam failure and to coordinate state and private mitigation and preparedness efforts. According to FEMA, most people living downstream of a dam are unaware of the potential hazards associated with dam failure, have never seen the respective dam failure inundation map, and are unaware of an evacuation plan or an EAP associated with the failure of that dam. There is a need, therefore, to include dam failure risk awareness as part of a comprehensive flood risk communication strategy and develop a communication strategy that reports on dam failure risk and promotes dam safety. The audience for these strategies includes dam owners/operators, dam regulators, emergency managers, floodplain managers, planners, public and private decision-makers, and the population at risk.[191]

Mitigation of dam failure is constantly occurring at both the federal and state level. For example, the U.S. Bureau of Reclamation is planning to replace the longest earthen section of Folsom Dam to mitigate earthquake damage. In addition, the Folsom Dam Joint Federal Project is a project to construct an auxiliary spillway at Folsom Dam that will work in conjunction with the existing spillways to help the Sacramento region achieve a 200-year level of flood protection. Project construction was completed in October 2017. The purpose of the Folsom Dam Joint Federal Project is to improve the ability to manage large flood events by allowing more water to be safely released earlier in a storm event and leaving more storage capacity in the reservoir to hold back the peak inflow when it arrives. A peak inflow of 450,000 cubic feet per second in a 200-year design storm, releases can be held to 160,000 cubic feet per second or less, which can be safely conveyed with the improved American River levees. The new auxiliary spillway also allows passage of the probable maximum flood without damaging the dam. This is an example of the complex modification of existing dam infrastructure to accommodate larger rain floods that may occur with or without climate change.

At the state level, as of early 2018, the 210-foot-high New Calaveras Dam is under construction to replace the existing upstream dam due to seismic stability issues, and officials are reviewing a similar project south of San Jose, which will mostly remove and replace a 235-foot-high dam to address seismic stability concerns. Finally, also as of 2018, the state is undertaking a massive project to reinforce and reconstruct the spillways at Oroville Dam. These are just a few examples of the numerous dam mitigation projects being undertaken as of 2018.

DWR Division of Safety of Dams

Engineers and engineering geologists at the DSOD review and approve plans and specifications for the design of dams and oversee their construction to ensure compliance with the approved plans and specifications. Reviews include site geology, seismic setting, site investigations, construction material evaluation, dam stability, hydrology, hydraulics, and structural review of appurtenant structures.

In addition, DSOD engineers inspect over 1,200 dams on a yearly schedule to ensure they are performing and being maintained in a safe manner. The DSOD also periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California.

California's Dam Safety Program has incorporated elements of the FEMA National Dam Safety Program. For example, the DSOD has categorized state-regulated, jurisdictional dams based on FEMA's hazard classifications.

The DSOD continues to work on a national level to effect positive changes to dam safety practices. DSOD staff are participating in the following NDSRB work groups: the Emergency Action Plan (EAP) work group, the research work group, and the National Inventory of Dam (NID) condition assessment work group. The SOD has also been heavily promoting the use of the Decision Support System for Water Infrastructural Security (DSS-WISE) as a tool that state regulators can use to quickly prepare inundation maps for dam break scenarios through the National Dam Safety Review Board.

[191] James E. Demby, Jr., PE, FEMA ,"Dam Failure – the Other Flood Hazard." Presentation, 2009 American Planning Association National Planning Conference, Minneapolis, April 25-29, 2009.

The DSOD reviewed the hazard classification of all its dams and sub-divided the high hazard classification into two classifications: High Hazard and Extremely High Hazard. As of August 2017, there are 1,249 dams under state jurisdiction, of which 474 are High Hazard and 196 are Extremely High Hazard (670 High Hazard per FEMA definitions). Remediation needs at this time have been identified at 97 dams, of which 60 are High or Extremely High Hazard.

More information can be found at: https://www.water.ca.gov/Programs/All-Programs/Division-of-Safety-of-Dams.

California Governor's Office of Emergency Services (Cal OES)

Senate Bill 92 was signed into law in 2017 establishing new rules that include mandated Emergency Action Plans (EAPs) for state-regulated dams that have been identified to have extremely high, high, and significant hazard classifications. Prior to this change, inundation maps, the cornerstone of emergency plans, were only created or updated at the time the dam was built or enlarged and did not take into account a failure of an appurtenant structure or failure of downstream flood facilities, such as a levee breach. A dam inundation map delineates the area that would be flooded by a particular dam breach or failure. It includes downstream effects and shows the probable path followed by water released from a failure of a dam or from extreme flood flows released through a dam's spillway and/or other appurtenant works.

EAPs are a critical component of a strong dam safety program. EAPs outline the action steps that are taken to protect life and property and include dam failure detection measures through inspections and maintenance, determinations of emergency levels based upon the threat of flooding, notification protocols for local government and the public, and other preventive measures dam owners and operators can take. EAPs use dam inundation maps to guide actions and notification protocols since they show the potential area of flooding and its impacts

Prior to Senate Bill 92, California had inadequate inundation maps, as well as insufficient requirements for the development of EAPs. Senate Bill 92 requires Cal OES to review and approve EAPs following DWR DSOD approval of the dam inundation map(s) prepared by the dam owner. In order to implement these state legislative requirements, Cal OES received $1.8 million in state funding to support five new permanent staff positions in the Dam Safety Planning Division, which is charged with reviewing and approving EAPs of all jurisdictional dams in California. The Division will implement Cal OES's program requirements related to dam safety and work closely with DWR DSOD in ensuring that the inundation maps have been approved and then incorporated into the new EAP for approval.

Dam owners are responsible for creating EAPs in accordance with FEMA's Federal Guidelines for Dam Safety: Emergency Action Planning for Dams, and based on their new or updated inundation maps. Dam owners are required to update their EAP regularly in accordance with Senate Bill 92. In order to assist dam owners with meeting legislative requirements, Cal OES is developing tools to aid dam owners in preparing EAPs and exercising their plans. Additionally, Cal OES will be working with dam owners and local public safety agencies to help integrate the EAPs into other emergency plans, such as local hazard mitigation plans and emergency operations plans. Cal OES will also coordinate emergency response drills with dam owners and local emergency management agencies.

FEMA Integration

The National Dam Safety Review Board advises FEMA's Administrator in setting national dam priorities and considers the effects of national policy issues affecting dam safety. In an effort to stay abreast of national dam safety efforts, the DSOD along with Cal OES are members on the National Dam Safety Review Board.

Mindful of the new legislative requirements and the importance of the federal guidelines to the program in California, Cal OES is the new advisory emergency management liaison on the National Dam Safety Review Board and sits on the Emergency Action Plan (EAP) Workgroup. As the Emergency Management Liaison, Cal OES will provide outside expertise and perspective to the National Dam Safety Review Board on emergency management and dam safety issues that are not available among the members, most of whom bring an engineering perspective to dam safety. Furthermore, Cal OES will identify and bridge gaps between the dam safety and emergency management communities and assist in developing partnerships among these critical stakeholders. In this role, Cal

OES and the DSOD are in a unique position to influence dam safety at the national level and enhance the integration of dam safety officials and the emergency management community. California has also integrated FEMA's Federal Guidelines for Dam Safety: Emergency Action Planning for Dams within Government Code Section 8589.5 as requirements for the development of EAPs for state jurisdictional dams.

Cal OES and DWR DSOD are also volunteering to host a FEMA pilot program for Dam Safety Collaborative Technical Assistance that kicked off in June 2018. This program, based in Ventura County, will bring together operators from five dam facilities (operated by three different entities) with the county Office of Emergency Services to prepare more resilient emergency action plans for both the dam facilities and downstream communities. In addition to local participation, representatives from FEMA's National Dam Safety Program, the National Integration Center's Technical Assistance team, FEMA Region IX, Argonne National Laboratory, Cal OES, and DWR will attend. This pilot program will serve as a foundation for Cal OES to develop and roll out a similar program to assist local public safety agencies statewide to integrate EAPs into local hazard plans (emergency operations plans and Local Hazard Mitigation Plans) in accordance with Senate Bill 92.

Progress Summary 7.R: Dam Inundation Mapping and MyPlan

Progress as of 2018: As part of the focus on dam safety in California, the California Governor's Office of Emergency Services (Cal OES) redirected Hazard Mitigation Grant Program funding to support the development of inundation maps for 18 high hazard California dams. These include dams that do not otherwise have financial or technical resources to complete the required inundation maps. California State University (CSU) Sacramento, Office of Water Program, assisted Cal OES in simplifying the inundation mapping process, improving the quality of the state's existing inundation maps, and expanding the number of inundation maps within California. CSU Sacramento provided support to continuing efforts by the Division of Safety of Dams (DSOD) and Cal OES to improve the quality and usefulness of the state's inundation mapping process by producing inundation maps using the Federal Emergency Management Agency (FEMA) National Dam Safety Program's Decision Support System for Water Infrastructural Security (DSS-WISE) software application recently developed by the University of Mississippi with FEMA financial support.

An opportunity for enhanced outreach to local governments and the public lies with inclusion of digital dam inundation mapping data on the MyPlan website. Corresponding dam inundation area layers will be created and added to MyPlan approximately 6 months after Cal OES approval of the related EAP for each dam. This will allow local planners to better plan for a dam failure incident within their jurisdictions.

Obstacles and Challenges

Under Senate Bill 92 (2017), inundation maps, along with corresponding Emergency Action Plans (EAPs), are due to Cal OES and the DWR DSOD on January 1, 2018 (for dams with a hazard classification of Extremely High), January 1, 2019 (for dams with a hazard classification of High), and January 1, 2021 (for dams with a hazard classification of Significant). It should be noted that dams classified as low hazard are exempt from the requirements of Senate Bill 92.

California faces some challenges in its efforts to mitigate the effects of dam hazards in California. There are 945 dams whose owners must submit EAPs by 2021. Some dam owners may lack resources to respond to the new state requirements. The financial burden on dam owners to produce the inundation maps is significant. Inundation maps are required to be produced by a qualified, licensed engineer for primary dams, as well as any critical appurtenant structures. With a limited pool of qualified engineers, there may not enough resources to produce the maps, and the expense to the owners may be increased if they need to contract out for mapping services.

With the statutory deadlines, there are an overwhelming number of maps and EAPs to review in a short time period. As of the spring of 2018, the DSOD had received inundation maps for over 150 dams, and will ultimately receive over 1,000 more inundation maps by the end of 2020. The DSOD independently reviews and verifies the accuracy of the maps through modeling by its technical experts. Additionally, as of the spring of 2018, the Cal OES Dam Safety

Planning Division had received 179 EAPs for review and is responsible for completing review of each EAP within 60 days of receipt in accordance with Senate Bill 92.

Many of the 179 EAPs submitted to Cal OES were determined to be incomplete and brought to light the need for updated guidance to support dam owners in developing an EAP. As a result, Cal OES and the DSOD are working to create updated sample EAP and review tools.

The review processes for both the inundation maps and EAPs is time-consuming and staff resources are limited. The aggressive schedule for submission of both inundation maps and EAPs from 2018 to 2021 will stretch both DSOD and Cal OES capability to meet the statutory requirements of the forward-leaning and comprehensive California Dam Safety Program.

7.5.5 ADDITIONAL DAM FAILURE HAZARD MITIGATION OPPORTUNITIES

The DSOD is required by state law to work with other state and federal agencies, dam owners and operators, floodplain managers, planners, and the public to make dam inundation maps available for the benefit of citizens interested in learning their dam failure inundation risk. Dam inundation maps can be useful in the preparation of Local Hazard Mitigation Plans (LHMPs) and general plan safety element updates. Inter-agency coordination to support the transparency of and improved access to inundation mapping is pending.

Oroville Dam during the Oroville Spillway Assessment Visit, February 14, 2017



Source: California Governor's Office of Emergency Services (Cal OES)

CHAPTER 8 – FIRE HAZARDS: RISKS AND MITIGATION

CHAPTER CONTENT

8.1 Wildfire Hazards, Vulnerability, and Risk Assessment
- 8.1.1 Identifying Wildfire Hazards
- 8.1.2 Profiling Wildfire Hazards
- 8.1.3 Assessment of State Wildfire Vulnerability and Potential Losses
- 8.1.4 Assessment of Local Wildfire Vulnerability and Potential Losses
- 8.1.5 Current Wildfire Hazard Mitigation Efforts
- 8.1.6 Additional Wildfire Hazard Mitigation Opportunities

8.2 Urban Structural Fire Hazards, Vulnerability, and Risk Assessment

About Chapter 8

Among California's three primary hazards, wildfire, and particularly wildland-urban interface (WUI) fire, has represented the third greatest source of hazard to California, both in terms of recent state history as well as the probability of future destruction of greater magnitudes than previously recorded. More recently, with the catastrophic wildfire events of 2017 and 2018, fire has emerged as an annual threat roughly comparable to floods. Fire and flood fire hazards are surpassed only by high magnitude earthquake hazards, which typically occur less frequently but can result in extreme disaster events.

For the 2018 State Hazard Mitigation Plan (SHMP), the fire hazards risk assessment has been expanded to include separate discussions on wildfire hazards and structural fire hazards. Structural fire hazards can occur as a cascading hazard emerging from wildfires or earthquakes, or as an independent hazard event. In either case, fire hazard mitigation actions are crucial in minimizing potential risk. Preparation and implementation of Local Hazard Mitigation Plans (LHMPs) with linkage to a jurisdiction's general plan, play an important role in the fire mitigation process.

For more information on the criteria and template used for hazard risk assessments and a discussion of the hazard classification system, see *Chapter 1: Introduction, Section 1.2.3*.

8.1 WILDFIRE HAZARDS, VULNERABILITY, AND RISK ASSESSMENT

8.1.1 IDENTIFYING WILDFIRE HAZARDS

In general, a wildfire is defined here as any free-burning vegetative fire that initiates from an unplanned ignition, whether natural (e.g., lightning) or human-caused (e.g., powerlines, mechanical equipment, escaped prescribed fires), where the management objective is full suppression. While wildfires can potentially lead to benefits to an ecosystem if within the range of natural variability for a given ecotype and geographical area, they can also lead to deleterious effects to both the natural and built environment.

In California, the combination of complex terrain, Mediterranean climate that annually facilitates several month long rain-free periods, productive natural plant communities that provide ample fuels, and ample natural and anthropogenic ignition sources, has created a land forged in fire. Excluding fires occurring in the desert, estimates of acreage burned prior to the arrival of European settlers range between 4.5 and 12 million acres annually[192] with frequency, size, and intensity varying based on ecotype and geographic area. These findings indicate the dramatic historical influence of natural wildfire, which supported and maintained ecosystem structure and function in California's wildlands.

[192] Stephens et al., 2007

Dramatic changes in fire activity accompanied the European settlement of California, partly due to agriculture, grazing, mining, and logging, particularly of older trees. These changes were magnified through land use practices (agriculture, urbanization) that removed natural fuel. At the turn of the 20th century, great debate ensued on whether the state should adopt the federal approach of total fire exclusion or to use "light burning" techniques that were historically practiced by the state's indigenous peoples. In 1923, the California Forestry Committee voted unanimously to adopt the federal approach to suppress all wildland fires, which has led to elevated fuel loading, and a shift to dense, younger trees, in large areas of the state's coniferous forests.

8.1.2 PROFILING WILDFIRE HAZARDS

Current and Historical Trends in Wildland Fire

While California has long been recognized as one of the most fire-prone natural landscapes in the world, the 2017 and 2018 wildfire years saw unprecedented wildfires, which eclipsed fire events from previous years. As noted throughout this chapter, the 2017 and 2018 wildfires were by far the most destructive and deadly in recent California history. During 2017, over 9,000 fires were ignited in California.[193] All other 2017 wildfire events were overshadowed by two fire events of catastrophic size and destruction; the Northern California Wildfire Complex in October 2017 and the Thomas Fire in December 2017; both of which were driven by extreme weather conditions coupled with large volumes of dry vegetation, affected by drought, in wildland-urban interface areas (WUI). The fires resulted in over 40 fatalities. The Thomas Fire, which burned through Ventura and Santa Barbara Counties, was the largest single recorded wildfire, by acreage, in California history to date as of January 2018, while the Tubbs Fire (part of the October 2017 Northern California Wildfire Complex) destroyed over 5,000 structures and took the lives of 22 people.

Palm trees burning during the 2017 Thomas Fire



Source: C. Dicus

As of the final writing of the 2018 SHMP in September 2018, over 5,700 wildfires have burned or are actively burning in California during the 2018 fire year.[194] This includes the catastrophic Mendocino Complex Fire, which has burned over 450,000 acres and is 98 percent contained as of September 12, 2018, surpassing the 2017 Thomas Fire in size

[193] http://cdfdata.fire.ca.gov/incidents/incidents_stats?year=2017
[194] http://cdfdata.fire.ca.gov/incidents/incidents_stats?year=2018

as the largest wildfire in California's history. The Carr Fire, which burned in Shasta and Trinity Counties in July and August 2018, destroyed over 1,600 structures, caused multiple fatalities, and burned 229,651 acres. Table 8.A lists the number of wildfires and the number of acres burned in California each year from 1987 to 2017. During this three-decade period, California annually averaged 8,782 fires that burned 555,762 acres. While the overall total number of fires per year has declined since 1987, the number of acres burned annually is highly variable between years, with an increase in larger single fires burning larger areas in some years, typically due to extreme weather conditions. An explanation of FRAs, SRAs, and Local Responsibility Areas (LRAs) is included in *Section 8.1.5.3*.

Table 8.A: California Wildfires and Acres, 1987-2017, as of January 2018

	CAL FIRE (SRA)		FEDERAL FIREFIGHTING AGENCIES (FRA)		LOCAL GOVERNMENTS (LRA)*		TOTAL	
	Number of Fires	Acres Burned	Number of Fires	Acres Burned	Number of Fires	Acres Burned	Number of Fires	Acres Burned
1987	8,062	87,000	4,374	744,000	1,040	42,000	13,476	873,000
1988	8,121	191,000	4,160	96,000	1,009	58,000	13,290	345,000
1989	6,635	73,600	2,547	87,800	842	12,000	10,024	174,400
1990	7,283	212,100	2,670	128,100	595	25,000	10,548	365,200
1991	6,271	23,100	2,681	18,800	657	2,300	9,609	44,200
1992	7,939	191,490	3,682	84,340	426	4,915	12,047	282,745
1993	6,688	122,606	1,774	67,646	227	119,527	8,689	309,779
1994	7,207	140,792	2,698	359,227	364	26,200	10,269	526,219
1995	6,601	121,198	1,563	78,414	328	10,203	8,492	209,815
1996	7,237	232,624	2,637	488,010	736	31,738	10,610	752,372
1997	6,835	57,788	2,180	198,431	487	27,666	9,502	283,885
1998	5,227	92,456	1,860	90,246	485	32,710	7,572	215,412
1999	7,562	285,272	3,139	865,621	424	21,957	11,125	1,172,850
2000	5,177	72,718	1,884	218,578	561	3,730	7,622	295,026
2001	6,223	90,984	2,567	275,152	527	11,203	9,317	377,340
2002	5,759	112,810	1,837	366,842	575	58,564	8,171	538,216
2003	5,961	404,328	1,783	399,635	543	161,807	8,287	965,770
2004	5,574	168,134	1,852	110,082	472	32,808	7,898	311,024
2005	4,908	74,004	1,604	139,399	725	65,811	7,237	279,214
2006	4,805	222,896	2,400	603,378	650	37,071	7,855	863,345
2007	3,610	434,667	1,932	990,730	501	95,565	6,043	1,520,362
2008	3,593	380,310	2,203	1,153,973	459	59,407	5,255	1,593,690
2009	2,858	75,960	1,820	339,908	2,332	36,101	7,010	451,969
2010	2,434	25,438	1,616	98,871	2,344	10,153	6,394	134,462
2011	3,056	51,889	2,021	73,124	2,655	103,586	7,732	228,599
2012	2,922	128,956	1,562	687,013	2,557	13,255	7,041	829,224
2013	3,672	114,473	2,213	450,126	3,004	37,036	8,889	601,635
2014	2,920	163,067	1,960	451,810	2,353	10,663	7,233	625,540
2015	3,231	291,282	2,184	577,115	2,868	6,137	8,283	880,899
2016	2,816	215,671	1,215	394,910	2,923	12,078	6,954	622,658
2017[a]	7,117[c]	505,956[c]	2,016[b]	742,650[b]	[a]	[a]	9,133	1,248,608

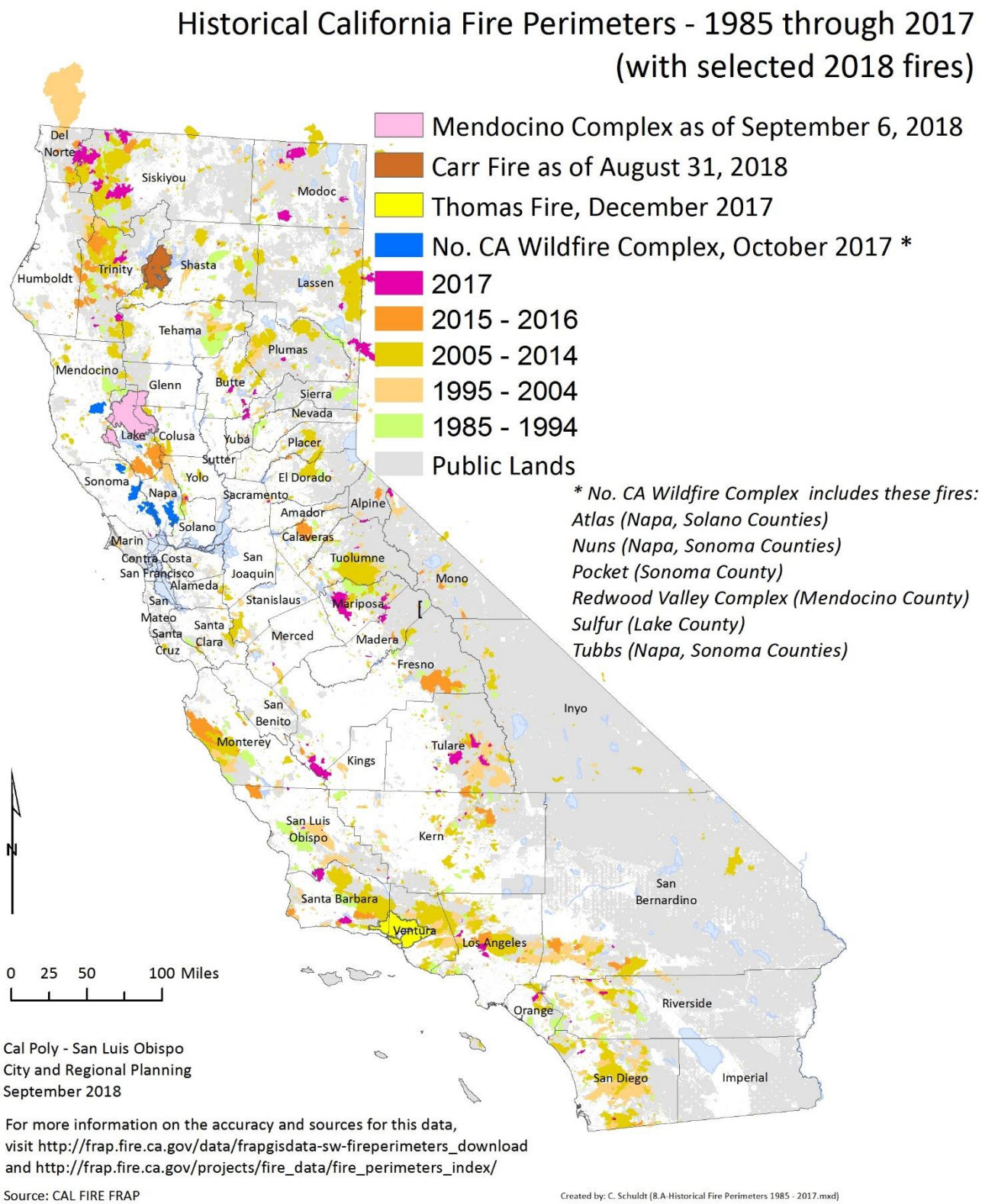
**This category includes county fire departments that protect State Responsibility Area (SRA) under contract in Kern, Los Angeles, Marin, Santa Barbara, and Ventura Counties. Starting in 2009, the "Local Governments" category also includes local fire departments that have a back contract with the California Department of Forestry and Fire Protection (CAL FIRE) for emergency response and fire protection.*

a: 2017 Local Responsibility Area (LRA) data pending publication of 2017 Annual Wildfire Activity Statistics Report (Redbook), not yet published as of May 2018. B: Preliminary data; does NOT include other Federal Responsibility Area (FRA) lands, including U.S. Bureau of Land Management (BLM), National Park Service, U.S. Department of Fish and Wildlife, or Bureau of Indian Affairs (BIA) lands (all in U.S. Department of Interior). c: SRA data preliminary.

Source: 1987-2016 data: California wildfires and Acres for all Jurisdictions, as of August 2017; http://cdfdata.fire.ca.gov/pub/cdf/images/incidentstatsevents_269.pdf;

2017 data: CAL FIRE Incident Information, 2017 Combined year-to-date; http://cdfdata.fire.ca.gov/incidents/incidents_stats?year=2017

MAP 8.A: California Fire Perimeters 1985-2017 and Selected 2018 Fires



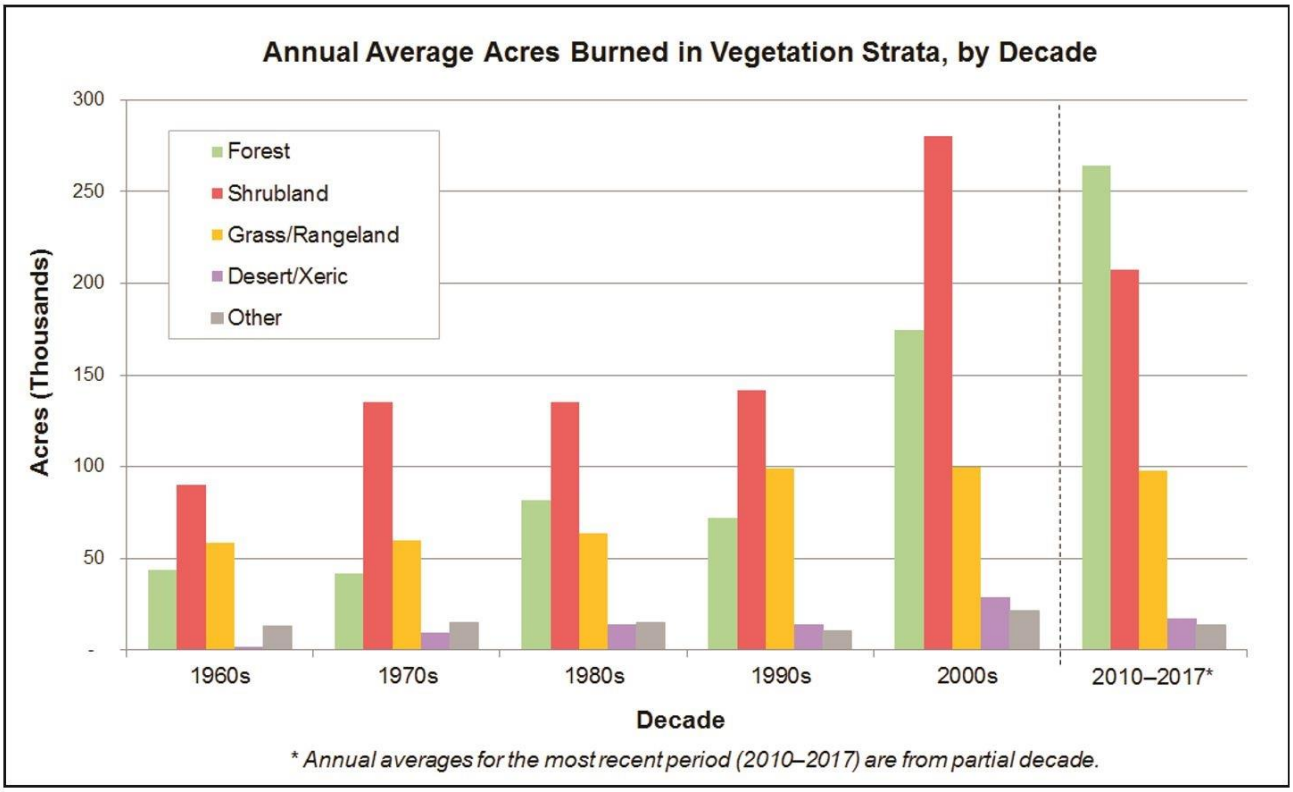
Map 8.A, based on CAL FIRE datasets shows fire perimeters from 1985 to 2017. Fires are shown by decade intervals, overlaid on public lands shown in grey. The most significant 2017 fires—the Thomas Fire, which burned the largest number of acres ever recorded, and the fires that make up the Northern California Wildfire Complex, which burned the largest number of structures on record—are delineated with special coloring on the map.

With climate change future years are projected to see a continuation or worsening of fire events across California. In general, the highest annual acreage burned wildfires occurs when ignitions coincide with extreme fire weather events (e.g., the 2017 Thomas Fire and the 2007 Southern California fire sieges, both of which occurred during severe Santa Ana winds) or when numerous ignitions occurred simultaneously and overwhelmed fire suppression capabilities (e.g., the 2008 lightening outbreak).

Chart 8.A shows that shrublands have historically experienced the greatest number of acres burned in California, which is not surprising given the high-intensity nature of fires in this ecotype coupled with a geographic range that commonly occurs near higher urban populations in the state (which result in increased numbers of human-related ignitions).

However, coniferous forests are burning in larger acreages in recent decades, with a significant increase in forest acreage burned during the 2010-2017 partial decade, which may be due to increased fuel loading in that ecotype. The increased fuel loading has been caused in part by a century of fire exclusion policies that limited the occurrence and extent of once-frequent but low-intensity fires that reduced woody debris and understory vegetation that increases fire intensity and severity. At present, there is heightened risk of large, high-severity fires in California's coniferous forests after the five-year (2012 to 2017) statewide drought that, along with other factors, resulted in the die-off of over 100 million trees.

Chart 8.A: Annual Acres Burned by Vegetation Type and Decade, 1960-2017



Source: CAL FIRE, California's Forests and Rangelands: 2017 Assessment

Twenty-two fires greater than 125,000 acres in size have burned in California. While modern day fires still burn far fewer acres than in the past, in general, large, destructive wildfires are increasingly becoming the "new normal" in California, even with increased firefighting personnel, equipment, technology, and training.

As shown in Table 8.B, 19 of the largest wildfires in California history have occurred since 1987, including the largest ever recorded, the Mendocino Complex Fire which was ignited in July 2018.

The increasing trend is due to a myriad of factors, including:

- Increased fuel loading following a century of fire exclusion policies
- More human-caused ignitions
- Climate change, which is influencing drought
- Greater silvicultural insect and disease impacts
- Increased tree mortality
- Lengthening of the "fire season," or annual time frame during which vegetative fuels are receptive to combustion.

Table 8.B: Largest California Wildfires, 125,000 Acres Burned or Greater

	FIRE NAME (cause)	IGNITION DATE	COUNTY	NUMBER OF ACRES BURNED	STRUCTURES DESTROYED	DEATHS
1	*MENDOCINO COMPLEX* [a] *(UNDER INVESTIGATION)*	July 2018	Mendocino, Lake, Colusa, Glenn	459,123[a]	280[a]	1[a]
2	*THOMAS (UNDER INVESTIGATION)*	December 2017	Ventura, Santa Barbara	281,893	1,063	2
3	*CEDAR (HUMAN RELATED)*	October 2003	San Diego	273,246	2,820	15
4	*RUSH (LIGHTNING)*	August 2012	Lassen	271,911 (CA)	0	0
5	*RIM (HUMAN RELATED)*	August 2013	Tuolumne	257,314	112	0
6	*ZACA (HUMAN RELATED)*	July 2007	Santa Barbara	240,207	1	0
7	*CARR FIRE (HUMAN RELATED)* [b]	July 2018	Shasta, Trinity	229,651[b]	1,604 [b]	7[b]
8	*MATILIJA (UNDETERMINED)*	September 1932	Ventura	220,000	0	0
9	*WITCH (POWER LINES)*	October 2007	San Diego	197,990	1,650	2
10	*KLAMATH THEATER COMPLEX (LIGHTNING)*	June 2008	Siskiyou	192,038	0	2
11	*MARBLE CONE (LIGHTNING)*	July 1977	Monterey	177,866	0	0
12	*LAGUNA (POWER LINES)*	September 1970	San Diego	175,425	382	5
13	*BASIN COMPLEX (LIGHTNING)*	June 2008	Monterey	162,818	58	0
12	*DAY (HUMAN RELATED)*	September 2006	Ventura	162,702	11	0
15	*STATION (HUMAN RELATED)*	August 2009	Los Angeles	160,557	209	2
16	*ROUGH (LIGHTNING)*	July 2015	Fresno	151,623	4	0
17	*MCNALLY (HUMAN RELATED)*	July 2002	Tulare	150,696	17	0
18	*STANISLAUS COMPLEX (LIGHTNING)*	August 1987	Tuolumne	145,980	28	1
19	*BIG BAR COMPLEX (LIGHTNING)*	August 1999	Trinity	140,948	0	0
20	*HAPPY CAMP COMPLEX (LIGHTNING)*	August 2014	Siskiyou	134,056	6	0
21	*SOBERANES (ILLEGAL CAMPFIRE)*	July 2016	Monterey	132,127	68	1
22	*CAMPBELL COMPLEX (POWERLINES)*	August 1990	Tehama	125,892	27	0

Source: California Department of Forestry and Fire Protection (CAL FIRE), Top 20 Largest California Wildfires, retrieved on September 12, 2018: http://fire.ca.gov/communications/downloads/fact_sheets/Top20_Destruction.pdf

[a] As of September 12, 2018, the Ranch Fire, part of the Mendocino Complex Fire is actively burning, with 98 percent containment. Therefore final data for this fire will differ from the preliminary data listed above. See CAL FIRE 2018 Redbook, once published for final fire incident data for the Mendocino Complex.

[b] As of September 12, 2018, the Carr Fire is 100 percent contained. See CAL FIRE 2018 Redbook, once published for final fire incident data for the Carr Fire.

Historic fire perimeters, displayed in Map 8.A, indicate a pattern that many wildfires occur in the foothills of both coastal and interior mountain ranges, especially in mountainous regions near populated areas of Southern California. Highlighted in Map 8.A with special colors are the October 2017 fires in Northern California, which collectively burned more structures than any fire event in California history and the December 2017 Thomas Fire in Ventura and Santa Barbara Counties, which is the largest fire in recorded California history. Wildfire annual perimeters can be viewed using the online mapping tool at: http://frap.fire.ca.gov/data/frapgisdata-sw-fireperimeters_download or https://www.geomac.gov.

Map 8.B shows fire frequency from 1950 to 2017 across the state, based on datasets prepared by CAL FIRE. The analysis of number of repeat fires burned in a given area as shown in Map 8.B, illustrates that some areas in California are prone to burn with higher regularity than other areas and therefore have a heightened exposure to loss. This is of special concern in the South and Central Coast bioregions, which show the highest frequencies. These bioregions have significant amounts of shrubland plant communities (see Chart 8.A) where wildfires typically occur as high-intensity, stand-replacement fires.

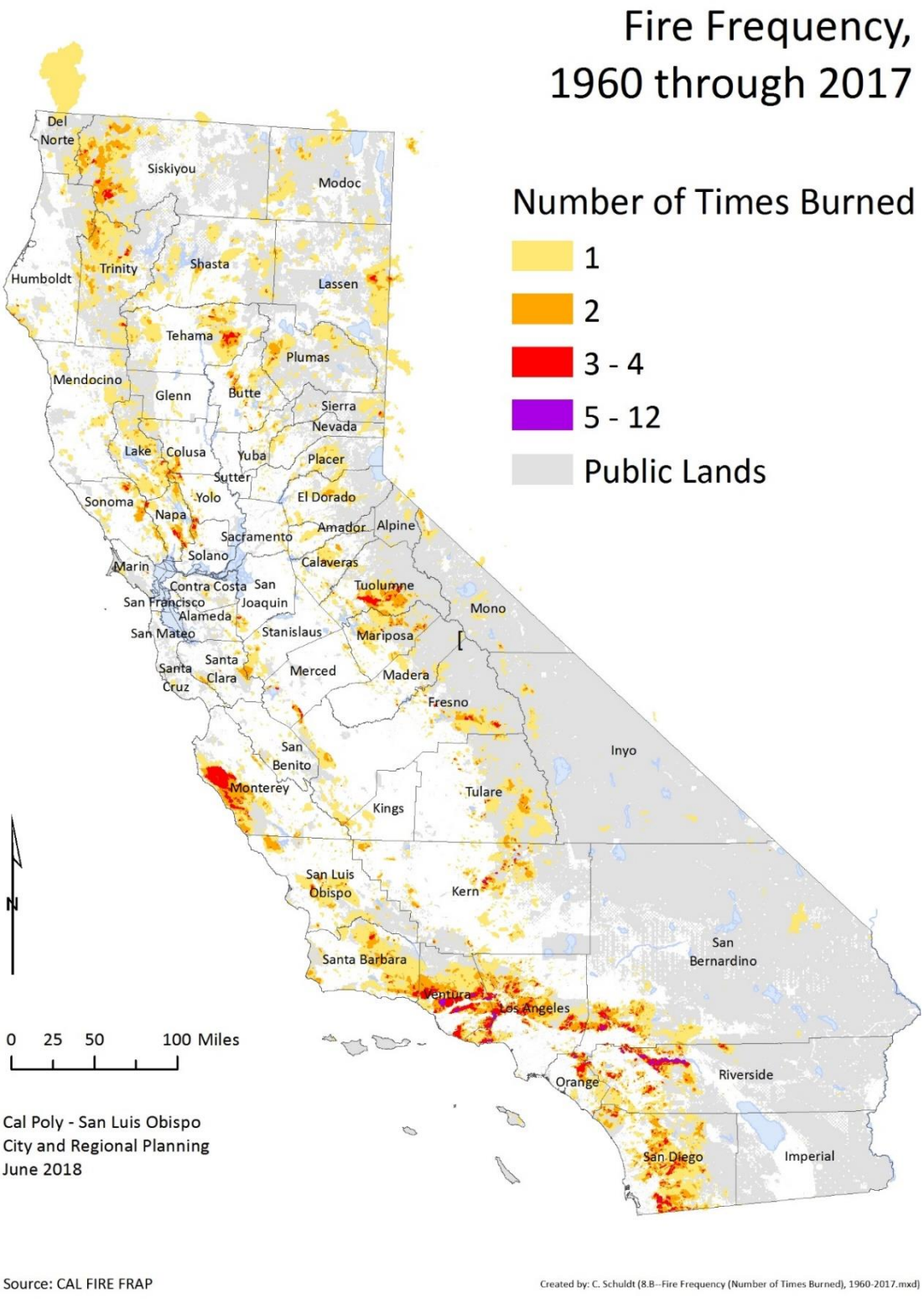
While higher fire frequency has historically occurred in mixed-conifer forests, those fires were commonly low-intensity surface fires. However, given fuel buildup following a century of fire exclusion, a lengthened fire season predicted by many climate change models, forest management practices which removed many of the older, larger trees, and massive tree die-off following epidemic bark beetle infestations, fires in mixed-conifer forests are likely to continue to grow in both size and intensity.

California National Guard Helicopter Water-Drop Efforts During the Carr Fire, August 2018



Source: U.S. Army National Guard photo by Army Sgt. Lani O. Pascual

MAP 8.B: Fire Frequency (Number of Times Burned), 1950-2017



Map 8.B shows the distribution of burn frequency from 1950 to 2017. The South and Central Coast bioregions which have significant amounts of shrubland plant communities (see Chart 8.A) show highest burn frequencies.

Wildland Fire vs. Wildland-Urban Interface Fires

Fire science distinguishes between two types of wildfires: "wildland" fires, which burn predominately in undeveloped areas, and "wildland-urban Interface" (WUI) fires. This distinction is important because mitigation, damage, and actions related to the two types may differ significantly.

Wildland fires that burn in natural settings with little or no development are part of a natural ecological cycle and may be beneficial to the landscape if they burn within the historic range of variability for fire size and intensity. Many species are adapted to California's natural fire regimes and flourish after a low or mixed severity burn. These fires also enhance ecosystem function by creating landscapes that have more variation, are more resilient to other disturbances, and are better able to withstand extremes in precipitation. The wildland fire may result in secondary negative impacts in the form of air pollution, soil erosion (resulting in siltation of streams and lakes), or mudslides, though these impacts tend to be far less than would occur following high severity fires in areas of historic fire suppression. However, unless these fires or their related secondary impacts occur in or near developed areas (see Map 8.C), they are rarely classified as disasters because they do not affect people or the built environment. Wildland fires, regardless of size, that burn primarily on federally managed lands are only rarely classified as disasters. For example, the 2007 Zaca Fire (240,207 acres) and 2009 Station Fire (160,577 acres), both of which burned on U.S. Forest Service lands, were enormous in size but did not result in federal disaster status. Those fires stand in contrast to the October 2017 Northern California wildfires, which were smaller in acreage but much more destructive, due to their proximity to larger urbanized areas.

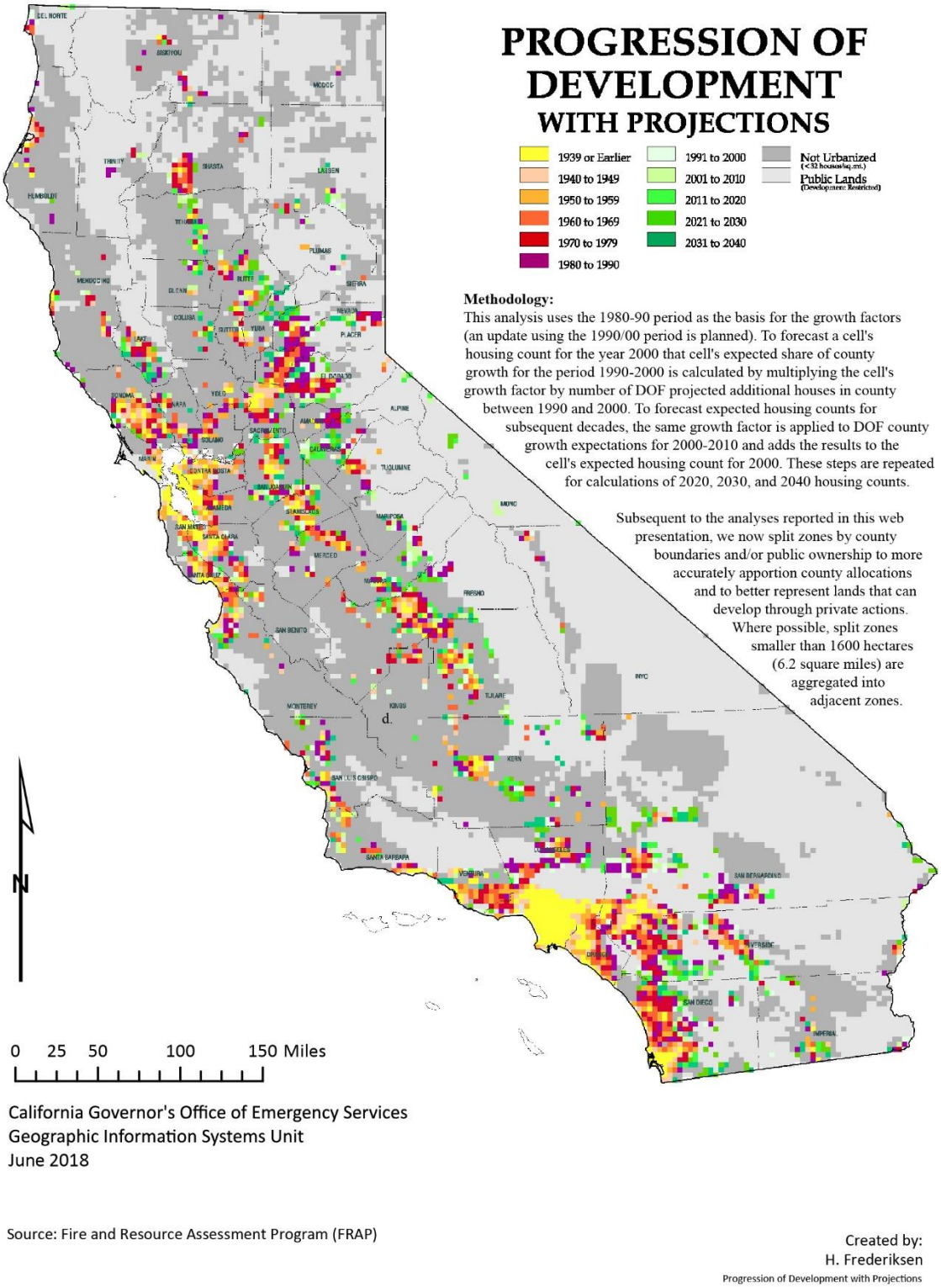
Research following century-old policies of fire exclusion and aggressive suppression has provided better understanding of the importance fire plays in the natural cycle of certain ecotypes, particularly mixed-conifer forests. As a result, prescribed fires have been used more extensively as a land management tool to replicate natural fire cycles. Unfortunately, a century of fire exclusion has led to a significant buildup of fuels in many mixed-conifer forests, which historically experienced frequent, low-intensity surface fires; thus there are significant areas where prescribed fires, in conjunction with mechanical thinning, may be appropriate to restore more natural forest conditions.

The WUI is characterized by the intersection of the natural and the built environments and has been defined as "the area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels" (Society of American Foresters). The WUI can be configured in many ways including a classic "interface" (e.g., a community that abuts a National Forest at a distinct boundary), an "intermix" (e.g., vegetative fuels distributed between buildings throughout a subdivision between buildings), or an "occlusion" (e.g., a community that completely surrounds a designated open space area).

WUI fires represent an increasingly significant concern for the State of California. California has a chronic and destructive WUI fire history with significant losses of life, structures, infrastructure, agriculture, and businesses. Most local governments that have submitted Local Hazard Mitigation Plans (LHMPs) have identified fire and WUI fires as specific hazards. Even relatively small-acreage WUI fires may result in disastrous damage.

Most WUI fires are suppressed before they exceed 10 acres. The remainder usually occur during episodes of hot, windy conditions that exceed initial attack capabilities and, therefore, are more likely to cause heightened losses to the built environment. Many WUI fires occur in areas that have a historical pattern of wildland fires that burn under extreme conditions. The most common extreme fire behavior factor is high, dry, warm foëhn winds, such as Santa Ana or Diablo winds, that occur in a predictable location and seasonable pattern. The pattern of increased damages is directly related to increased urban spread into areas that have historically had wildfire as part of the natural ecosystem.

Map 8.C: California's Projection of Development Based on Historical Factors



California has widespread WUI fire vulnerability, as indicated by Map 8.C. The map is based on CAL FIRE FRAP data that depict an increasing pattern of projected development encroaching into previously wildland area resulting in increased WUI zones.

The Challenge of Wildland-Urban Interface Fire and Repetitive Fire Loss

California has had a long history of disastrous WUI fires beginning with the 1923 Berkeley Fire that destroyed 584 buildings while burning only 123 acres. Many geographic areas have experienced repetitive WUI fires. For example, the area burned in the 1923 Berkeley Fire burned again in the 1991 Tunnel Fire, which is the second most destructive fire in state history. Similarly, the 2007 Witch Creek Fire (1,650 structures burned) in San Diego County reburned portions of the 2003 Cedar Fire area (2,820 structures burned).

Because of repeated losses in California, many WUI fires result in changes to state policies and regulations. Some significant WUI fires and their resultant changes include:

- The 1961 Bel Air Fire, which resulted in examination of wooden roofs in WUI areas
- The 1970 Fire Siege, which resulted in development of the Incident Command System (ICS) and enhanced state and federal wildland fire service mutual aid methods for WUI fires
- The 1980 Southern California Fire Siege, which resulted in the creation of the CAL FIRE Vegetation Management Program
- The 1985 Fire Siege, which resulted in major expansion of local government fire service mutual aid on WUI fires
- The 1988 49er Fire, which was identified as the "WUI fire problem of the future" due to urban expansion from the Sacramento metropolitan area into the Sierra foothills
- The 1991 Tunnel Fire, which resulted in creation of the Standardized Emergency Management System (SEMS) in California and legislation requiring Fire Hazard Severity Zone mapping in LRAs (Assembly Bill [AB] 337-Bates)
- The 1993 Laguna Fire, which resulted in creation of the California Fire Safe Council (CFSC) concept and changes to flammable roofing codes
- The 2003 Fire Siege, which resulted in changes to defensible space clearances from 30 feet to 100 feet and formation of the Governor's Blue Ribbon Commission on WUI fires
- The 2007 Angora Fire, which resulted in a California-Nevada Governors' Blue Ribbon Commission examination of WUI fire issues in Lake Tahoe area
- The 2008 Sylmar Fire in Los Angeles, which led to revision of mobile home fire safety requirements
- The 2009 Station Fire in the Angeles National Forest which led to re-examination of wildland fire management in proximity to urban areas
- The 2017 Northern California Fires and Thomas Fire which led to the July 12, 2018 California Public Utilities Commission resolution extending de-energization to all electric Investor Owned Utilities (IOU) during dangerous conditions to prevent wildfires
- The 2017 Northern California Fires and Thomas Fire have resulted in the introduction of multiple state bills to address fire hazards, which are being considered by state legislature in 2018 (pending at the time of final publication of the 2018 SHMP)

While the number of acres burned fluctuates from year to year, a trend over the last 30 years that has remained constant is the rise in wildfire-related losses. Likewise, fires that originate in the WUI from structures or other improvements can cause damage to wildland resources. The challenge is in how to reduce wildfire losses within a framework of California's diversity of natural and built environments.

Table 8.C shows the most disastrous WUI fires listed in order of structures destroyed. As of August 2018, eighty-five percent of the most damaging WUI fires (as measured by number of structures burned) have occurred in the last three decades.

Table 8.C: Top 20 Most Destructive California Wildland-Urban Interface (WUI) Fires, by Structures Destroyed

	FIRE NAME	IGNITION DATE	COUNTY	NUMBER OF ACRES BURNED	NUMBER OF STRUCTURES DESTROYED	DEATHS
1	*TUBBS*	October 2017	Sonoma	36,807	5,636	22
2	*TUNNEL*	October 1991	Alameda	1,600	2,900	25
3	*CEDAR*	October 2003	San Diego	273,246	2,820	15
4	*VALLEY*	September 2015	Lake, Napa, Sonoma	76,067	1,955	4
5	*WITCH*	October 2007	San Diego	197,990	1,650	2
6	*CARR*	July 2018	Shasta, Trinity	229,651[a]	1,604[a]	7[a]
7	*NUNS*	October 2017	Sonoma	54,382	1,355	2
8	*THOMAS*	October 2017	Ventura, Santa Barbara	281,893	1,063	2
9	*OLD*	October 2003	San Bernardino	91,281	1,003	6
20	*JONES*	October 1999	Shasta	26,200	954	1
12	*BUTTE (POWERLINES)*	September 2015	Amador, Calaveras	70,868	921	2
12	*ATLAS*	October 2017	Napa, Solano	51,624	781	6
13	*PAINT*	June 1990	Santa Barbara	4,900	641	1
14	*FOUNTAIN*	August 1992	Shasta	63,960	636	0
15	*SAYRE*	November 2008	Los Angeles	11,262	604	0
16	*CITY OF BERKELEY*	September 1923	Alameda	130	584	0
17	*HARRIS*	October 2007	San Diego	90,440	548	8
18	*REDWOOD VALLEY*	October 2017	Mendocino	36,523	544	9
19	*BEL AIR*	November 1961	Los Angeles	6,090	484	0
20	*LAGUNA FIRE*	October 1993	Orange	14,437	441	0

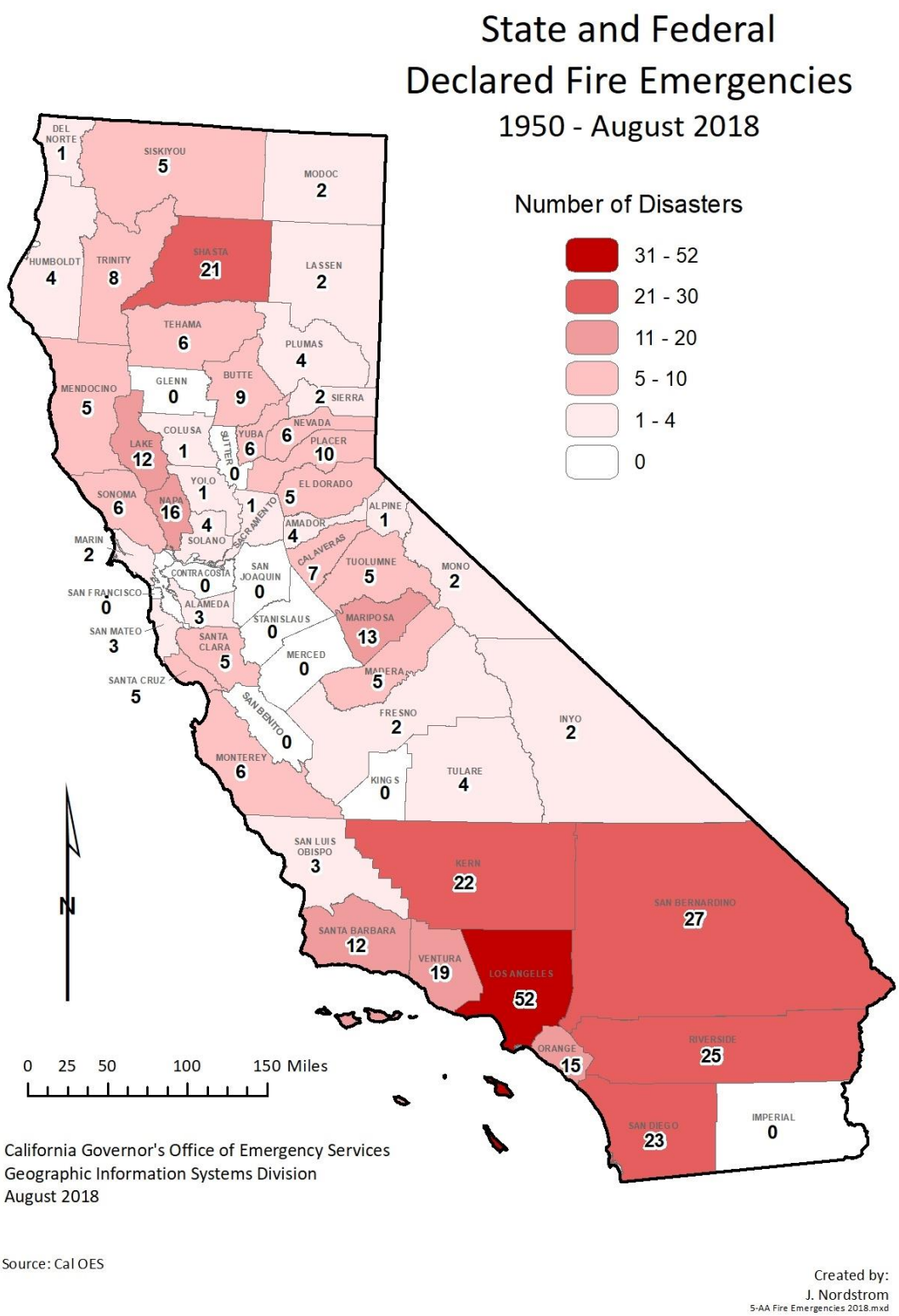
Source: California Department of Forestry and Fire Protection (CAL FIRE), Top 20 Largest California Wildfires, retrieved on September 12, 2018: http://fire.ca.gov/communications/downloads/fact_sheets/Top20_Destruction.pdf

[a] As of September 12, 2018, the Carr Fire is 100 percent contained. See CAL FIRE 2018 Redbook, once published for final fire incident data for the Carr Fire.

It should be noted that while most counties have experienced a state or federally declared fire disaster (see Map 8.D), the majority of those declarations have occurred in Southern California, due to a large population base located in areas that commonly have volatile shrublands, steep slopes, and annually occurring Santa Ana winds. However, there are growing concerns regarding increased wildfire frequency and severity in Northern California shown in climate change models. These concerns were substantiated in 2017 and 2018 with the catastrophically destructive nature of three record breaking fires, the October 2017 Northern California fires in Sonoma, Napa, and Solano Counties; the 2018 Carr Fire in Shasta County; and the 2018 Mendocino Complex in Mendocino, Lake, Glenn, and Colusa Counties.

Declaration of a wildland fire event as a federal disaster is based on monetary thresholds of damages. Some wildland fires, while significant in size and destruction of natural resources, may be located in remote areas with minimal development, these fires thus may not result in high dollar value of losses since destruction of structures or infrastructure may be minimal in these areas.

MAP 8.D: State and Federal Declared Fire Disasters, 1950-February 2018



Map 8.D shows declared wildfire disasters from 1950 to August 2018. The highest numbers were in Southern California, showing the influence of major populated urban areas in Los Angeles and other nearby counties on fire emergency and disaster events.

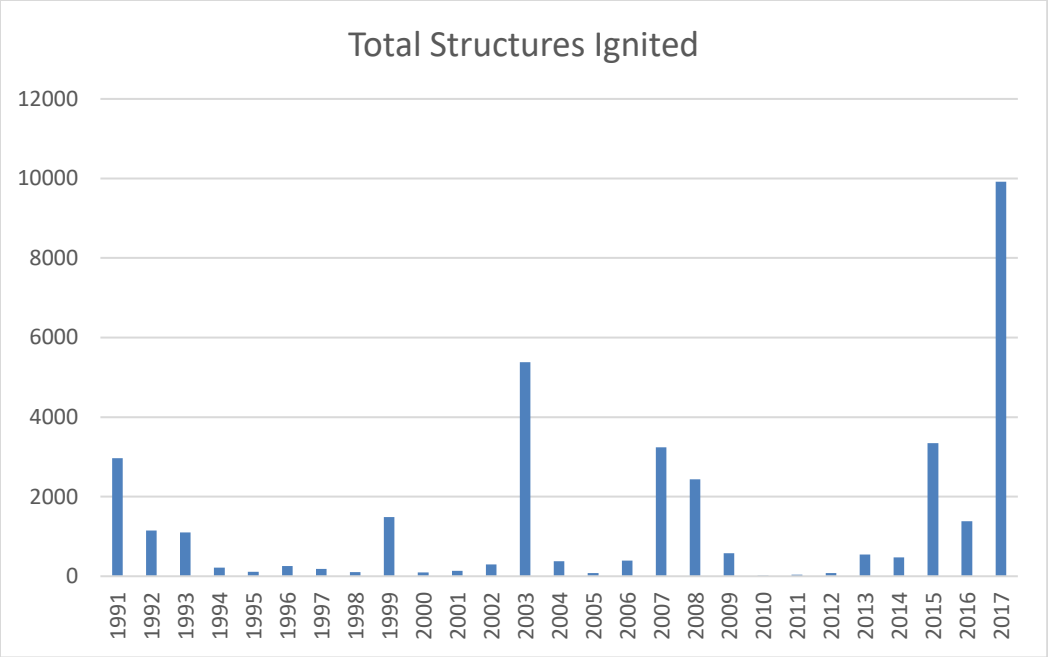
Significant WUI Fire Events

Via aggressive initial attack, CAL FIRE aims to limit 90 percent of all wildfires to fewer than 10 total acres burned. As evidenced by the historical FIRE data presented in Tables 8.B and 8.C, some ignitions exceed initial firefighting capabilities and grow to large fire events (defined by the state as fires exceeding 300 acres). These large fires commonly burn under severe weather conditions. Structures do not burn exclusively in large fire events but are certainly at greater risk during these events, because large fires commonly occur during heightened fire weather and because firefighting capabilities are overtaxed.

Chart 8.B shows the number of structures ignited during large wildfires (i.e., greater than 300 acres) from 1991 to 2017. It should be noted that the large-scale destruction shown in 2017 only includes data from the October Tubbs Fire and others in Northern California (over 5,000 structures lost) and the December Thomas Fire (over 1,000 structures lost). Complete final 2017 wildfire data are pending release of the 2017 Historical Wildfire Activity Statistics (Redbook), not yet published as of August 2018.

While structures burn every year, most damaging fires have occurred when ignitions coincided with severe weather that included critically high temperatures, low relative humidity, and perhaps most importantly, high winds. For example, both the October 2017 northern California fires and the December 2017 Thomas fire occurred during extreme wind events.

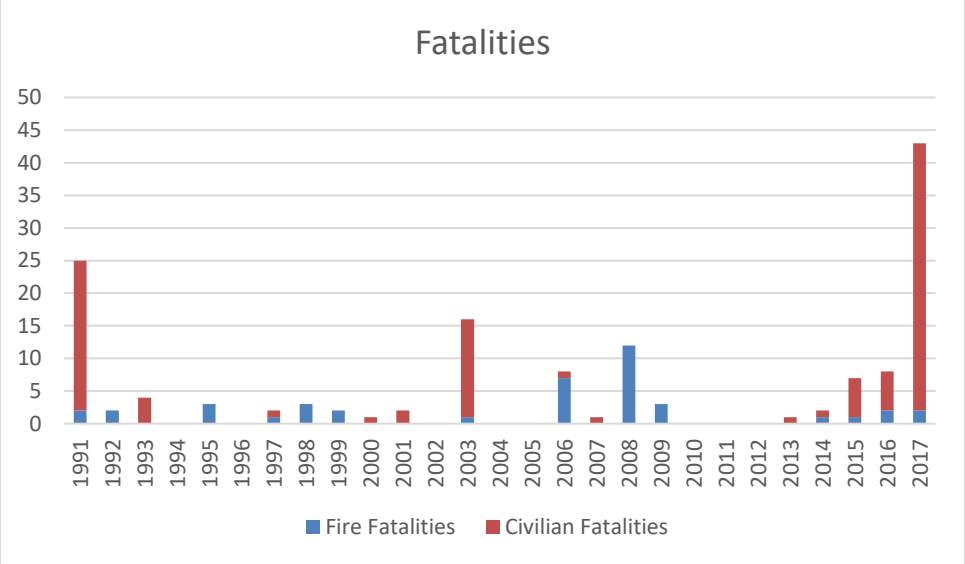
Chart 8.B: Number of Structures Ignited During a Large Wildfire (Greater than 300 Acres), 1991-2017



Source: Data from annual California Department of Forestry and Fire Protection (CAL FIRE) Historical Wildfire Activity Statistics (Redbooks).
Note: 1991 only includes data from the Tunnel Fire in Oakland and from fires originating on sites in which the state had primary fire response obligations. Beginning in 1992, the State began accounting for all fire damages for all jurisdictions.
2017 fire data included is preliminary and only includes preliminary data from the October 2017 Northern California fires and the December 2017 Thomas Fire.

The 2018 Carr Fire (1,604 structures lost), the 2017 Tubbs Fire (5,636 structures lost), and the 2015 Valley Fire (1,955 structures lost) all involved extreme weather conditions. Unfortunately, these conditions also seem to correlate with firefighter and civilian casualties, as shown in Chart 8.C. Data are from annual CAL FIRE Historical Wildfire Activity Statistics (Redbooks). Specific data from the CAL FIRE Redbooks can be found at http://www.fire.ca.gov/fire_protection/fire_protection_fire_info_redbooks.

Chart 8.C: Firefighter and civilian fatalities occurring during a large wildfire (>300 acres) from 1991 to 2017



Source: 1991-2016 data per annual California Department of Forestry and Fire Protection (CAL FIRE) Historical Wildfire Activity Statistics (Redbooks).
**2017 fire data are preliminary; final data are pending release of 2017 Redbook, not yet published as of August 2018.*
Note: 1991 only includes data from the Tunnel Fire in Oakland and from fires originating on sites in which the state had primary fire response obligations. Beginning in 1992, the State began accounting for all fire damages for all jurisdictions.

Because the potential for destructive wildfires exists throughout the state, CAL FIRE's Fire and Resource Assessment Program (FRAP) is legally mandated to periodically identify the potential fire hazard across California. Three designations of Fire Hazard Severity Zones (FHSZs)—moderate, high, and very high—have been assigned to all areas where the State of California has primary fire protection responsibility, called State Responsibility Areas (SRAs). FHSZ designation is based upon a quantitative assessment of potential fire behavior and burn probability of a given area. FHSZs in SRAs are shown in Map 8.E.

While the entirety of California has been assessed for wildfire threat (see Map 8.F), the assessment might not capture threats on Federal Responsibility Area (FRA) lands, where the FHSZ designation is not used. Further, Local Responsibility Area (LRA) lands are only included if 1) the parcel is designated as a Very High Fire Hazard Severity Zone (VHFHSZ), and (2) the local jurisdiction has elected to accept the state's recommended designation. Many LRA jurisdictions choose to not accept a recommended VHFHSZ designation due to reasons such as perceived negative impacts on property values, potential loss of residential fire insurance, and others. If an LRA jurisdiction chooses to adopt the state's recommendation for a VHFHSZ designation, then residents there are mandated to comply with various state mitigation regulations, including maintaining vegetative defensible space and adhering to the WUI Fire Code for any new construction in which over 50 percent of the structure will be affected. (Note: Explanation of Federal Responsibility Areas [FRAs], State Responsibility Areas [SRAs], and Local Responsibility Areas [LRAs] is included in *Section 8.1.5.3*.)

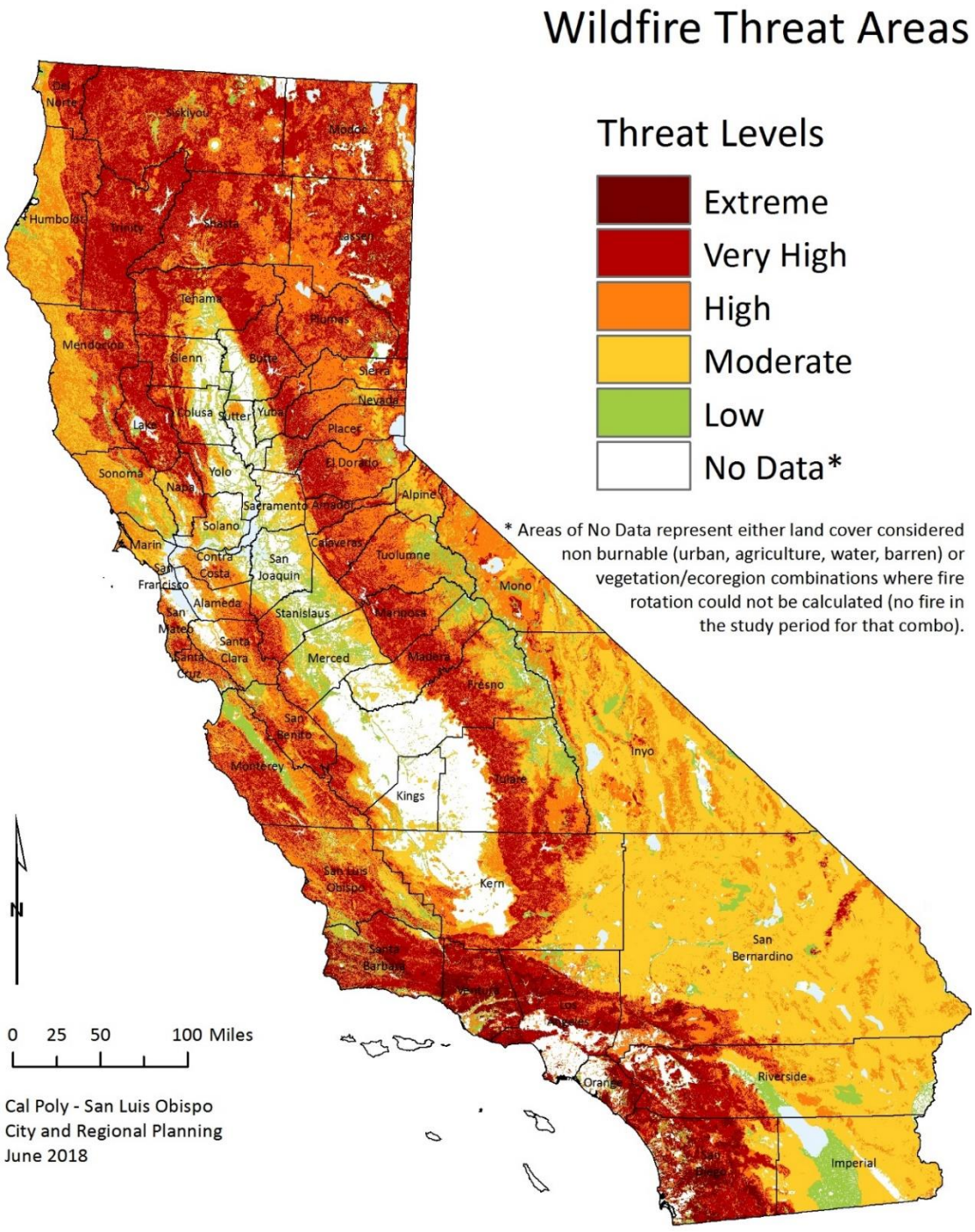
FHSZ designations identify the potential fire hazard (not risk) in a given area in the absence of mitigation activities. "Hazard" is defined here as the physical condition that can lead to damage to a particular asset or resource. Thus, fire hazard involves the physical conditions related to fire and its ability to cause damage, specifically how often a fire burns a given locale and what the fire is like when it burns (its fire behavior). Thus, fire hazard only refers to the potential characteristics of the fire itself. Risk, however, is defined as the likelihood of loss by wildfire. Thus, a home designated as being in a VHFHSZ might actually be at low risk of loss, due to proper construction materials and maintenance of vegetative fuels. Similarly, a home might be located in a moderate FHSZ (the lowest designation) but be at high risk of burning if the home is constructed with combustible materials and has dense, flammable vegetation that abuts the structure.

MAP 8.E: Fire Hazard Severity Zones in State Responsibility Areas



Map 8.E shows Fire Hazard Severity Zones only in SRAs. SRAs are essentially private lands in WUI areas within unincorporated county areas. They do not include Local Responsibility Areas (LRAs) within cities or federally owned lands such as national forests. Additional maps can be found on CAL FIRE's FRAP website: http://frap.fire.ca.gov/.

Map 8.F: State of California Fire Threat

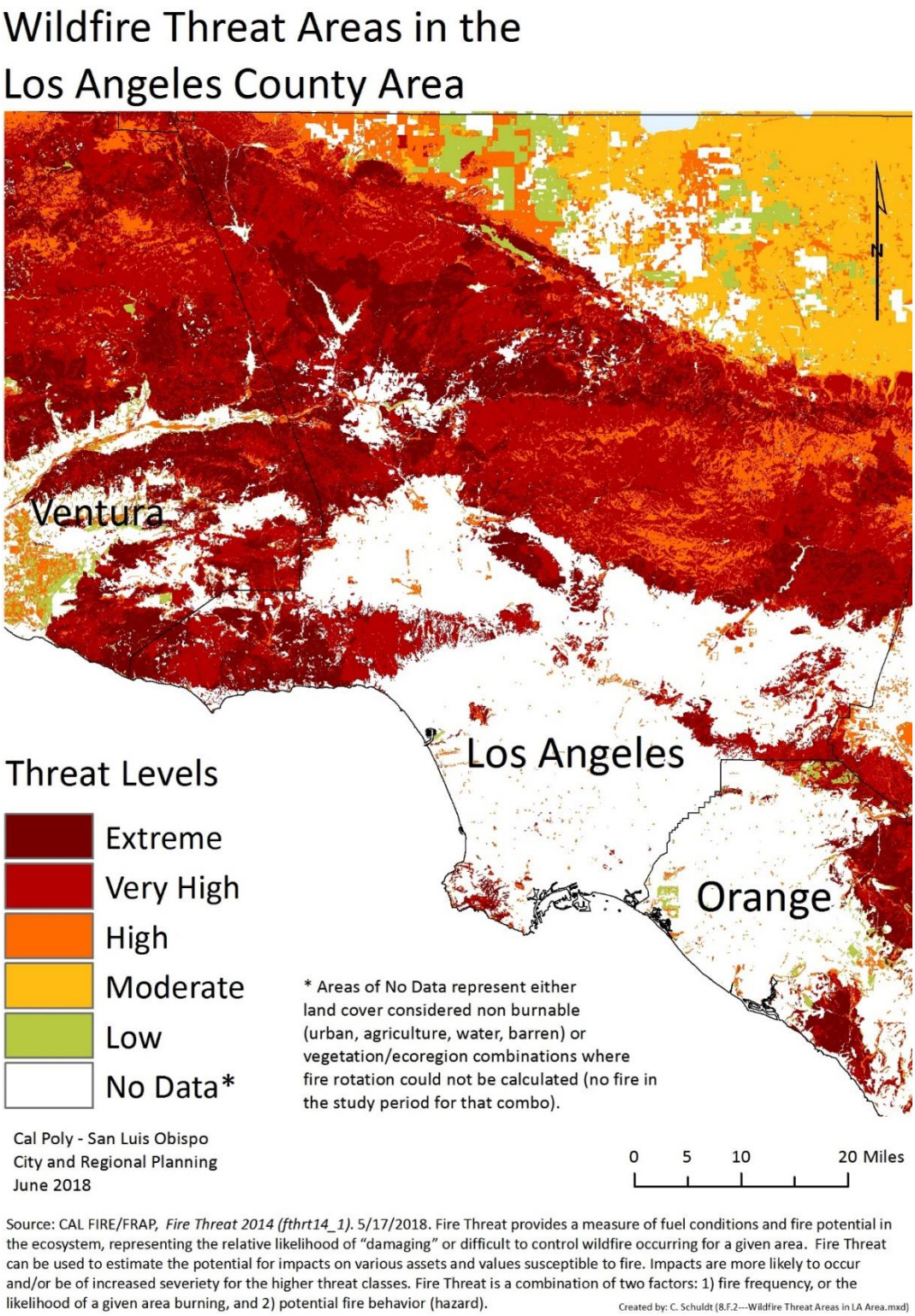


Source: CAL FIRE/FRAP, *Fire Threat 2014 (fthrt14_1).* Fire Threat provides a measure of fuel conditions and fire potential in the ecosystem, representing the relative likelihood of "damaging" or difficult to control wildfire occurring for a given area. Fire Threat can be used to estimate the potential for impacts on various assets and values susceptible to fire. Impacts are more likely to occur and/or be of increased severiety for the higher threat classes. Fire Threat is a combination of two factors: 1) fire frequency, or the likelihood of a given area burning, and 2) potential fire behavior (hazard).

Created by: C. Schuldt (8.F--Wildfire Threat Areas.mxd)

Map 8.F, prepared using 2014 fire threat data published by CAL FIRE, shows wildfire threat widely distributed across hilly and mountainous terrain throughout California. Threat is a measure of the potential fire severity. Those urban areas shown as facing a moderate to very high threat in this model are areas exposed to WUI fires and windblown embers that could result in urban conflagration.

Map 8.G: Wildfire Threat in the Los Angeles County Area



Map 8.G is an enlargement of part of Map 8.F and shows the Los Angeles County area. As noted in the map, CAL FIRE does not develop threat data on various areas within the state (represented in white in the map) where land cover is considered non-burnable (urban, agriculture, water, or barren) or where vegetation/ecoregion combinations where fire rotation could not be calculated.

Climate Change and Wildfire Hazard

Climate change has the potential to alter wildfire hazards in frequency, size, and severity beyond the historic range by increasing the length of the fire season, creating drier fuels, decreasing forest health,[195] and altering ignition patterns. The impact of climate change, as a driver for increased wildfire severity, is expected to be greatest in the mixed-conifer forests of the Sierra Nevada and Northern California; less impact is expected for fires in chaparral shrublands, which are expected to be more driven by increases in human-caused ignitions.[196]

Both the 2009 California Climate Adaptation Strategy[197] and the *Safeguarding California Plan: 2018 Update* to the Climate Adaptation Strategy describe the ways in which climate change alters some of the primary factors that govern wildfire behavior: weather, fuels, and topography. While climate change does not affect topography, weather (wind, temperature, etc.) and fuels (vegetation type, amount, and moisture) are influenced by climate change. While shifts in seasonal precipitation and temperature are the primary driver of changes in wildfire frequency and severity, several other factors influence wildfire hazards. These complex interacting influences may be summarized as follows:

To assess local risk and develop hazards mitigation measures, communities must include local experts for understanding forest health and conditions in their region in the strategy development process.

- *Temperature:* Climate change is projected to result in increased average temperature, as well as increased numbers of extreme heat and heat wave events. These changes alter moisture levels in vegetation (fuel) and, ultimately, fuel type. The overall outcome of these shifts is an increase in the expected number of large, high-intensity fires expected.
- *Precipitation Changes and Drought*: Climate change may reduce the annual total amount of rain, but just as critical to its influence on wildfire are expected changes in annual distribution of precipitation and in the duration and frequency of drought events. Periods without precipitation influence fuel moisture and the associated fire potential and behavior.
- *Fuel Health and Structure*: Long-term changes in precipitation and temperature patterns can alter both the health of an undeveloped area and its vegetative structure. Less healthy trees and vegetation may be more vulnerable to fire, thus altering the fire behavior. In addition, climate change may alter the composition of species defining a particular landscape. This alteration in species composition may include increased populations of exotic and invasive species. These changes will influence wildfire frequency, severity, and behavior.
- *Pests:* Changes to the annual patterns of temperature and precipitation can alter the timing, population, and type of pests in a landscape. Shorter, warmer winters or prolonged drought result in stressed trees. These trees are suitable habitat for many pests and result in larger pest populations. For example, many species of bark beetle are associated with high levels of tree mortality in California forests.[198] Dead trees increase the wildfire potential of a forest and cause heightened fire behavior, especially before dead needles fall and begin decomposition.
- *Fire Ignition and Behavior:* In addition to change in seasonal temperature and precipitation patterns, climate change is associated with increased wind and storm frequency and severity. These changes can increase ignitions via lightning[199] and be further exacerbated by high winds that can serve to bolster large wildfires.[200]

The above descriptions are only general summaries of the interacting influences of climate change. To assess local risks and develop mitigation measures, communities must include local experts in order to understand forest health and conditions in their region.

[195] California Natural Resources Agency & California Emergency Management Agency. California Adaptation Planning Guide. 2012. Sacramento: author.
[196] Keeley & Syphard 2017
[197] California Natural Resources Agency. 2009 California Climate Adaptation Strategy. 2009. Sacramento: author, 200 p.
[198] http://www.tuolumnecounty.ca.gov/DocumentCenter/View/5742
[199] Price and Rind, 1994; Lutz et al., 2009.
[200] Miller and Schlegel, 2006.

As mentioned previously, wildland fire can have secondary negative impacts in the form of air pollution, soil erosion resulting in siltation in streams and lakes, or mudslides. One result of the increased wildfire intensity and frequency caused by climate change is increased particulate matter resulting from combustion. Particulate matter, one of six U.S. Environmental Protection Agency (EPA) criteria air pollutants, is a mixture that can include organic chemicals, dust, soot, and metals. These particles increase air pollution and cause short- and long-term adverse health effects. Smaller particulate matter is capable of reaching deep into the lungs and causing a host of diseases, including lung cancer, heart disease, respiratory disease, acute respiratory infections, and mortality. For more information about air pollution hazard and particulate matter, see *Section 9.1.2*.

Neighborhoods Destroyed During the October 2017 Wildfires



Source: California Governor's Office of Emergency Services (Cal OES)

Urban Fire Conflagration Potential

Although the SHMP focuses primarily on wildfires, it also recognizes the potential threat of urban conflagrations, or large disastrous fires in which structures themselves are the primary fuel that carries the fire. These urban fires are a significant hazard that can occur due to wildfires, earthquakes, gas leaks, chemical explosions, arson, or other ignition sources.

While ignition sources for urban conflagrations within developed areas have been reduced via improvements in community design, construction materials, and building fire protection systems, continued development in fire-prone areas subsequently increases the potential for an urban conflagration via WUI fires, especially in high-density developments that are adjacent to wildland areas that are prone to seasonably strong, dry winds (e.g., Diablo winds in the Bay Area or Santa Ana winds in Southern California). For example, the 2017 Tubbs Fire moved from the wildlands into urbanized Santa Rosa in Sonoma County and, after crossing the six-lane U.S. Highway 101, destroyed approximately 1,500 homes in the Coffey Park neighborhood alone. This portion of the Tubbs Fire movement was fueled primarily by house-to-house spread. Similarly, the 1991 Tunnel Fire near Oakland began as a vegetation fire and then transitioned into an urban conflagration that eventually burned 2,900 structures and was also largely propagated by house-to-house spread. Thus, in both cases, the fires began in wildland areas, fueled by dry vegetation and high winds, and then transformed into fires in residential areas, fueled largely by the structures themselves.

Urban conflagration fires remain a risk to human safety. One reason for this ongoing risk is the current trend toward increased urban density and infill in areas adjacent to the wildland-urban interface (WUI). In an effort to keep housing more affordable and close to urban jobs, areas previously left as open space due to steep slopes and high wildland fire risk are being reconsidered as infill areas for high-density housing. These types of high-density infill, particularly in areas prone to seasonable hot, dry winds, are most prone to urban conflagrations.

Destruction from the October 2017 Wildfires



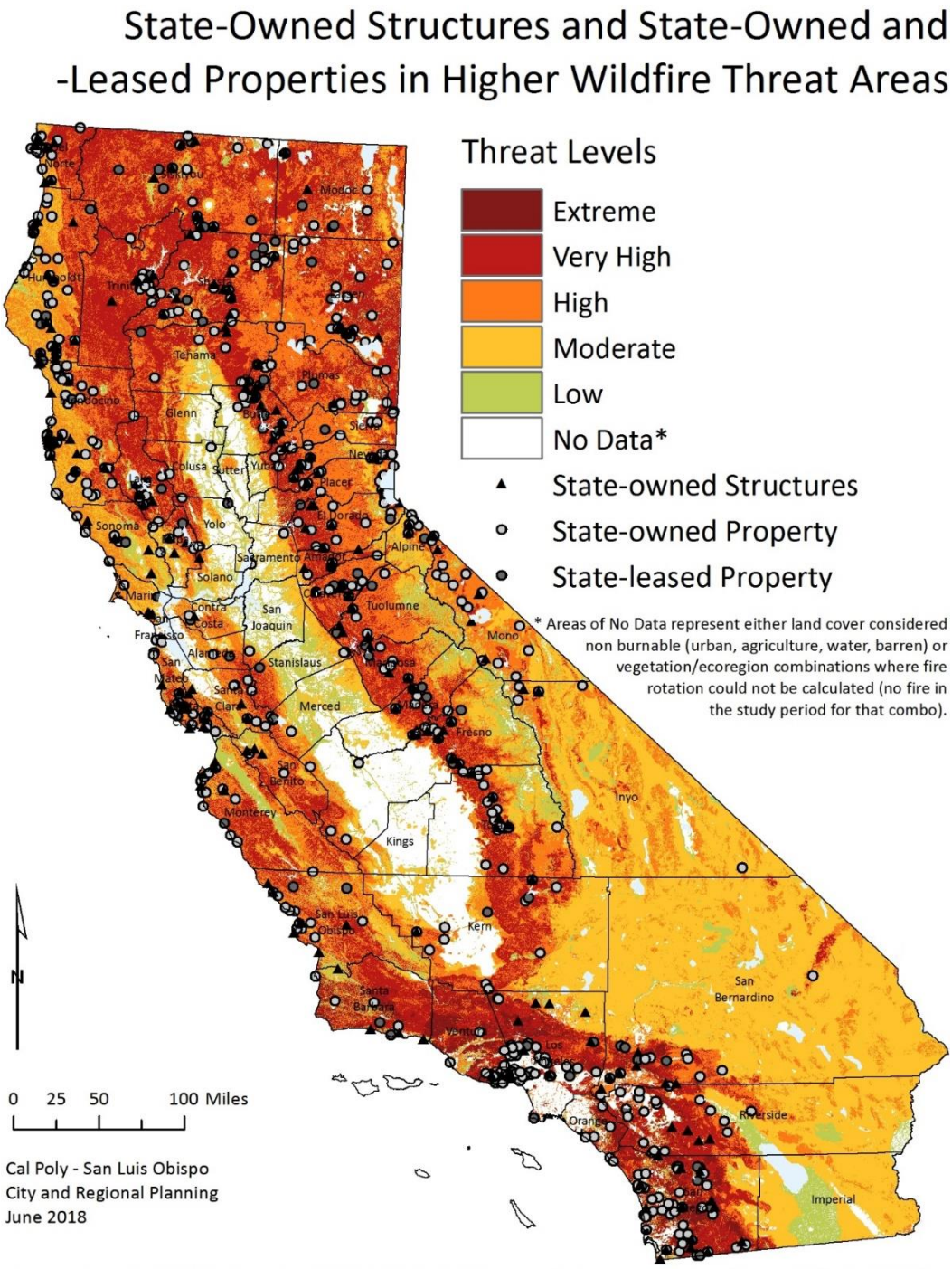
Source: California Governor's Office of Emergency Services (Cal OES)

8.1.3 ASSESSMENT OF STATE WILDFIRE VULNERABILITY AND POTENTIAL LOSSES

8.1.3.1 POTENTIAL DOLLAR LOSSES FOR STATE-OWNED AND -LEASED FACILITIES

Estimating potential dollar losses for state-owned and -leased facilities involves a careful review of locations of these facilities in relation to varying kinds of wildfire hazards. Many of these facilities are within urban areas where wildfire threat is relatively low. However, some facilities are within urban fringe areas, including WUIs, and a few are within VHFHSZs. Completion of the current CAL FIRE remapping will provide specific new insights into the state's overall risk exposure due to wildfire threats to critical facilities.

Map 8.H: State-Owned Buildings and State-Owned and Leased Properties in Higher Wildfire Threat Areas



Source:. Source: CAL FIRE/FRAP, *Fire Threat 2014 (fthrt14_1).* Fire Threat provides a measure of fuel conditions and fire potential in the ecosystem, representing the relative likelihood of "damaging" or difficult to control wildfire occurring for a given area. Fire Threat can be used to estimate the potential for impacts on various assets and values susceptible to fire. Impacts are more likely to occur and/or be of increased severiety for the higher threat classes. Fire Threat is a combination of two factors: 1) fire frequency, or the likelihood of a given area burning, and 2) potential fire behavior (hazard). State Property Inventory data from California Dept. of General Services, March 2017.

Created by: C. Schuldt (8.G--State Property and Wildfire Threat.mxd)

Map 8.H indicates the location of state-owned buildings and state-owned and -leased properties in extreme, very high, high, and moderate fire threat areas. Concentrations of state-owned buildings and state-owned and -leased properties subject to these higher fire threats are found primarily in mountainous areas.

Table 8.D shows an estimate of maximum potential exposure of state-owned and -leased facilities to wildfires, given best available data. It identifies a total wildfire risk exposure of $34.6 billion for buildings in very high and extreme Risk areas. These figures overstate potential losses from this hazard for two fundamental reasons: 1) wildfire events are centered within one region or another, and 2) only a small portion of the facilities inventory within a region may be affected by any given wildfire event.

Table 8.D: Potential Loss of State Facilities from Wildfire Hazards

	State Ownership Status	Number of Buildings	Square Feet	$ at Risk (billions)
Zone 2 (High Risk)	Own	8,115	107,041,618	37.46
	Lease	1,561	14,369,254	5.03
	Total	*9,676*	*121,410,872*	*42.49*
Zone 3 (Very High Risk)	Own	13,073	90,591,456	31.71
	Lease	451	1,901,682	0.67
	Total	*13,524*	*92,493,138*	*32.38*
Zone 4 (Extreme Risk)	Own	1,080	6,228,278	2.18
	Lease	33	107,619	0.04
	Total	*1,113*	*6,335,897*	*2.22*
Zones 2-4 TOTAL				***Greater than $77 billion***

Source: Department of General Services, California Governor's Office of Emergency Services (Cal OES)

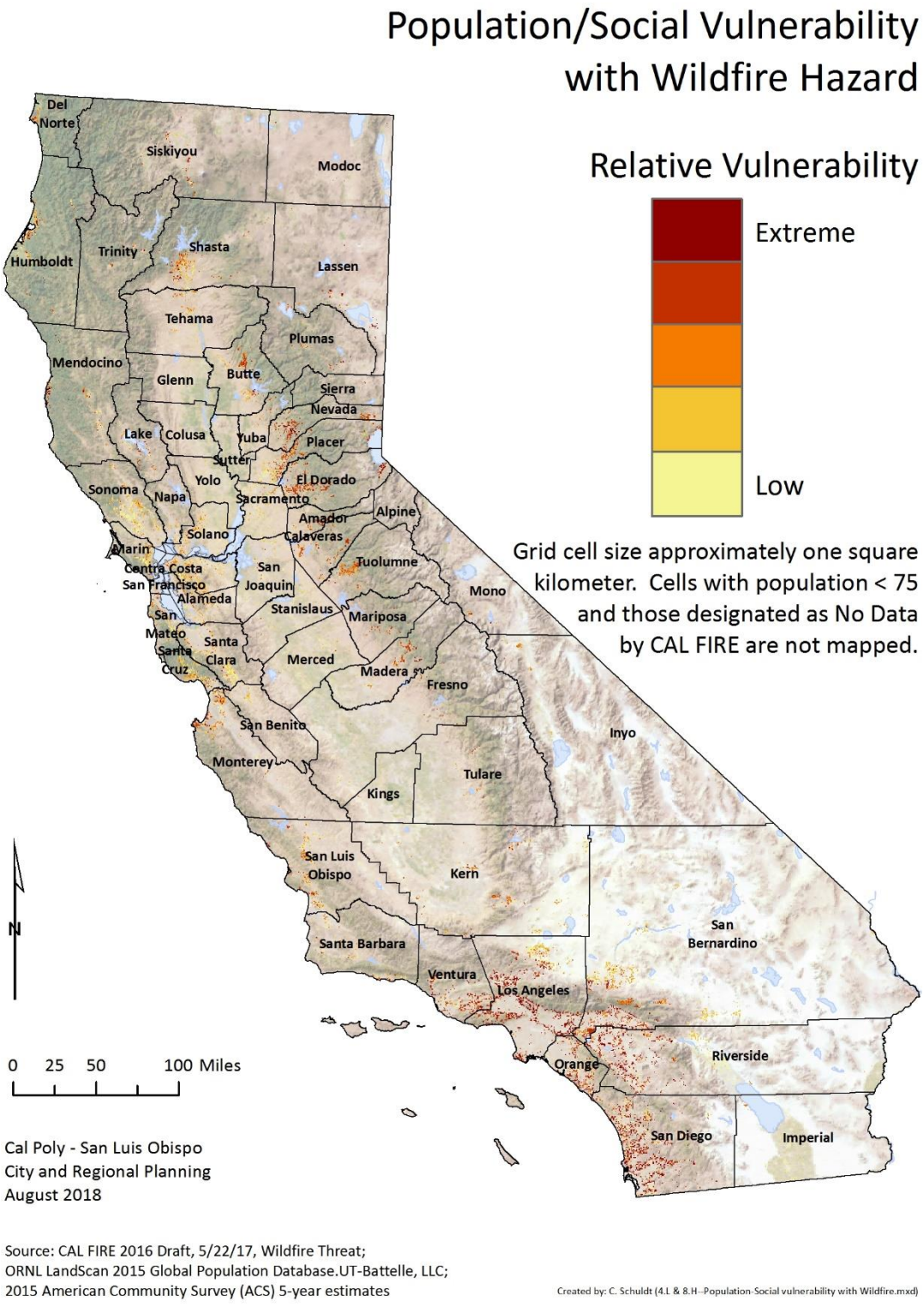
8.1.3.2 WILDFIRE VULNERABLE AREAS AND POPULATIONS

Wildfires are the most frequent source of declared disasters and account for the third highest combined losses. Wildfire vulnerability in California is found chiefly in wildland-urban-interface (WUI) communities, located largely on the periphery of suburban areas in Southern California, coastal mountains, and heavily wooded areas of the Sierra Nevada. Some areas burn frequently, particularly the hills surrounding Los Angeles, San Diego, and Big Sur, as well as more isolated mountains in the Coast Ranges and Sierra Nevada.

Map 8.I uses 2017 wildfire threat Geographic Information Systems (GIS) data compiled by CAL FIRE's Fire and Resource Assessment Program (FRAP) to show areas where vulnerable populations are subject to wildfire hazard. Its original data take into account fuel loads and fire history, among other factors, to create five threat classes: extreme, very high, high, moderate, and little or no threat. Map 8.I shows moderate to high concentrations of population/social vulnerability in areas at high risk of wildfire hazards. Most heavily affected areas are in the hilly and mountainous portions of the San Francisco Bay Area, Southern California, and the Sierra Nevada.

For details about development of the social vulnerability model, see *Chapter 4, Section 4.4.4 Statewide GIS Hazard Analysis*, and *Appendix N* which describes the indexing used for preparing/updating of the model.

Map 8.I: Population/Social Vulnerability with Wildfire Hazard



8.1.3.3 FIRE EFFECTS ON INFRASTRUCTURE

A given fire's impact can ripple well beyond the actual final boundary if critical infrastructure is impaired. For example, if communication infrastructure (e.g., internet, phone, television, radio) is interrupted, then residential emergency notification can be severely hampered. For example, during the 2017 Tubbs Fire, many cell phone towers were reportedly destroyed early in the fire, which may have affected residents who opted in for emergency notifications via their cell phones. Similarly, notification via radio and television can be impaired, which can delay notification and subsequent residential evacuation. Likewise, destruction of radio relay towers can hamper communications and subsequent safety of first responders. After the fire, the burned infrastructure can severely impair communication well outside the fire boundary; for example, it was reported that destruction of communication infrastructure during the Tubbs Fire in Sonoma and Napa Counties affected cell coverage for subscribers to one cell provider for approximately a week in areas as far away as Humboldt County.

Like communication infrastructure, destruction of energy delivery systems (e.g., electricity) can severely hamper communication (and subsequent emergency notification) to residents via internet, phone, radio, television, and others. It can also affect critical medical services and other equipment (e.g., water pumps) if redundancies such as generators are not in place. Further, downed power lines can block roadways, impeding ingress by first responders and egress by evacuees. Because power needs are ubiquitous during and after a fire event, rapid replacement of destroyed electrical delivery infrastructure should be considered paramount in the early stages of fire recovery.

Transportation infrastructure (e.g., roads, bridges, and rail) can severely impair emergency response by both first responders and by residents. For example, U.S. Highway 101 was periodically closed during the 2017 Thomas Fire, which impaired movement of residents, tourists, and commerce that relied on roadways for deliveries.

The 2017 Thomas Fire burns along Highway 101



Source: C. Dicus

Similarly, damaged railways in the 2004 Gaviota Fire near Santa Barbara and the 2016 Blue Cut Fire near the Tejon Pass in San Bernardino severely impaired north/south rail in California, resulting in immense losses to the rail

industry and the customers that relied on their services. Damaged roadways, bridges, and railways can impair transportation for extended periods of time, especially if alternatives are limited.

Water delivery systems and water storage facilities may be dramatically affected by fire. With the exception of the North Coast, most watersheds in California have extensive downstream water supply infrastructures serving the majority of urban and rural residents, larger municipalities, and agricultural users. Increased sediment loading due to soil erosion resulting from severe fires can also decrease storage capacity in dams and reservoirs. As these source watersheds are an essential component of the state's water system, actions to restore and maintain forested watersheds (including prescribed fire and preventing fragmentation and development through conservation easements) can reduce the risk of damaging fires that impair water supplies. To protect water delivery, the State Water Resources Control Board recommended to public water systems that they take necessary precautions to prepare for and mitigate potential effects from a wildfire by maintaining defensible space.

8.1.3.4 WILDFIRE AND EFFECTS ON THE NATURAL ENVIRONMENT

Fire is a natural and critical ecosystem process in most of California's diverse terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation in the state. Many of California's ecosystems are adapted to a historic "fire regime," which characterizes historic patterns of fire occurrence in a given area. Fire regimes include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability dependent on ecotype and geographical location.[201]

Ecosystem stability is impaired when any of the attributes for a given fire regime diverge from their range of natural variability, a phenomenon that is becoming increasingly common throughout California. In general, when compared to historic fire regimes, many mixed-conifer forests now experience fewer acres burned[202], but the fires that do occur are more intense and severe, while chaparral shrublands experience fire at a greater frequency. Both trends have profound impacts on ecosystem stability throughout California.

A principal cause of intensifying wildfire severity in mixed-conifer forest types in the state is the mounting quantity and continuity of forest fuels that have been brought about by a century of fire exclusion. Fire exclusion in California and throughout the western U.S. has been attributed largely to fire suppression, elimination of Native American ignitions, and introduction of grazing that removed fine fuels necessary for fire spread in and between forested stands. Conifer forests that historically experienced frequent but low-intensity surface fires, which are prevalent in the montane areas of California, are now predisposed to high-intensity, high-severity crown fires because of both fire suppression practices and the removal of many of the older, more fire-resistant trees.

Conversely, native chaparral shrublands, which typically burn in high-intensity stand-replacing events, are threatened due to too-frequent ignitions, which are leading to a type conversion to non-native grasslands.[203] This trend is particularly acute in Southern California, where burgeoning population growth in fire-prone areas has resulted in increased ignitions through accident or arson.[204]

Detrimental Effects of Wildfire on Ecosystem Components

CAL FIRE's Fire and Resource Assessment Program (FRAP) is required by the California legislature to produce periodic assessments of the forests and rangelands of California. The Forest and Range 2003 Assessment, the subsequent California's Forests and Rangelands: 2010 Assessment, along with the 2010 California Fire Plan identified some detrimental effects of fire for various ecosystem components, focusing primarily on impacts that follow high-intensity stand-replacing events outside the range of natural variability in conifer stands.

[201] Sugihara et al., 2006.
[202] See Marlon et al. 2012 for a description of the "fire deficit"
[203] Keeley et al., 2009.
[204] Syphard et al., 2008

In August 2018 CAL FIRE released California's Forests and Rangelands: 2017 Assessment. Due to the timing of the 2017 Assessment release, a detailed description of 2017 Assessment content addressing wildfire effects on ecosystems could not be included in the 2018 SHMP, however, certain detrimental effects of wildfire on ecosystem components identified in the 2003 and 2010 Assessment are described below.

Fire Effects on Timberlands

Timberlands, defined as conifer-dominated habitat types that likely support 20 cubic feet of volume growth per year and are not in reserved status, are a significant economic resource in California and are the primary economic base in some rural areas. Fire can pose significant risk to timber assets through direct loss from combustion, mortality of growing stock, and fire-induced susceptibility to insect, pathogen, and decay mechanisms. The actual loss of timber value associated with a given fire event is a function of tree structure, fire severity, and post-fire salvage opportunity. Roughly three-quarters of California's timberlands face a high fire threat or greater and over half of these lands have very high or extreme fire threat conditions. Only about one-fifth of California's timberlands face a moderate fire threat, where expected losses to timber assets are likely to be low. While some of the standing timber value can be salvaged following a wildfire, many of California's timber assets are exposed to significant risk from wildland fire.

Fire Effects on Woodlands

California's extensive woodland vegetation, especially hardwood woodlands, provides key habitat for many species. The risk of habitat loss associated with fire in woodland areas is highly variable, due to both varying habitat quality and the unique fuel and vegetation response characteristics of specific areas. Habitat characteristics such as tree canopy height and closure, presence or absence of a developed shrub understory, and occurrence of special habitat elements—such as snags and downed logs—are important determinants of habitat quality for many species. Roughly two-thirds of California's hardwood woodlands are exposed to very high or extreme fire threat. While many areas may respond favorably to wildland fire, initial changes in the post-fire environment may cause temporary habitat loss and species dislocation.

Fire Effects on Recreation and Open Space

After a wildfire, significant alteration of watershed lands and the associated stream systems is noticeable for periods varying from a few years to decades. In the short term, the presence of partially burnt vegetation reduces recreational and open space values. Fires can also destroy campgrounds, trails, bridges, and other recreational facilities within the area. Increased amounts of downstream sedimentation may significantly affect streams and lakes, which tend to be the most heavily used spots within larger recreational areas. As the vegetation grows back and damaged recreational infrastructures are replaced, the recreational and open space values would increase. However, it may take decades before vegetation types such as mature forests return to their pre-burn character. Grasslands and shrublands, on the other hand, can return to their pre-burn character within a decade.

Fire Effects on Water and Watersheds

Wildfires can have significant adverse effects on watershed lands, watercourses, and water quality. Large, hot fires cause serious, immediate damage from which a watershed can take decades to recover. By burning off vegetation and exposing mineral soil, fire impairs the ability of a watershed to hold soil in place and to trap sediment before it enters stream systems. Loss of vegetation also means less water being absorbed by plants, causing a short-term increase in the quantity and the delivery rate of water entering streams. This can have significant effects downstream from the site of a fire, such as with the fire-flood cycle commonly experienced in Southern California. This increased runoff and its large sediment load can cause costly damage to downstream assets such as homes, roads, debris basins, and other infrastructure. It can also result in the loss of human life when at-risk residents are not evacuated.

Fire Effects on Soils

Fire presents a significant risk to soil, especially in denuded watersheds, through accelerated erosion potential in the immediate post-fire environment, particularly when subjected to severe rainstorms prior to any vegetation

recovery.[205] The Fire and Resource Assessment Program (FRAP) has developed a statewide risk assessment based on the expected marginal increase in surface erosion from a potential fire.

Erosion is a natural process that occurs across a watershed at varying rates, depending on soils, geology, slope, vegetation, and precipitation. The intensity of a fire and the subsequent removal of vegetative cover increase the potential rate of soil erosion and new sediment sources. Wildfires affect surface erosion in a watershed by altering detachment, transport, and deposition of soil particles. Most wildfires create a patchwork of burned areas that vary in severity. Severely burned areas suffer increased erosion due to loss of the protective forest floor layer and creation of water-repellent soil conditions that can cause flooding, downstream sedimentation, and threats to human life and property.

Fire Effects on Riparian and Aquatic Habitats

Wildfire can produce a wide range of water quality and aquatic habitat outcomes, from beneficial to catastrophic. Increased erosion and sediment deposition can result in channel aggradations (i.e., wider, shallower channels), filling of pools that provide important fish habitat, increased turbidity that makes it harder for fish to find food and can damage gills, and changes in water chemistry.

Wildfire outcomes are determined by weather, fuels, terrain, and, to a lesser extent, suppression efforts. Large wildfires pose the greatest risk to water quality and riparian habitat. If a wildfire encounters fuel levels that have been reduced through prescribed burning and/or mechanical means, there is a good chance the fire would produce conditions more favorable to maintaining good water quality and aquatic habitat. Highly destructive fires are thus minimized.

Fire Effects on Water Quality and Green Infrastructure

Wildfires can potentially affect water quality through increased sedimentation and increased turbidity and through increases in nutrient loadings. Concentration of nutrients (phosphorous and nitrogen) are increased from burned vegetation and delivered to streams through surface runoff. Stream temperatures often increase after fire occurs, typically through the removal of overhead protective vegetation. Elevated stream temperatures are detrimental to most cold-water fish species.

Trade-Offs in Fire Hazards vs. Ecosystem Services Provided by Vegetation

To facilitate sustainable, disaster-resistant communities, there is a critical need to assess the tradeoffs in vegetation's potential to facilitate destructive wildfires versus the biological and economic benefits that it provides. Paradoxically, vegetation is both an asset and a liability to residents living in the WUI areas. The same vegetation that regularly burns with great intensity and destruction simultaneously provides both tangible and intangible benefits to local communities.[206]

Minimizing fire hazard while maximizing the economic, biological, aesthetic, and social values that vegetation provides are seemingly conflicting objectives in the WUI, particularly to those living in high hazard areas with elevated population densities.

Continued immigration to highly fire-prone areas in California will likely continue unabated in the near future. For example, the population of San Diego, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties in Southern California was 19.2 million in 2000 and is expected to grow by at least 15 percent over the next 10 years[207], which will increase both wildfire risk and the likelihood of ignition.[208]

Increased development in fire-prone areas in California has exponentially increased the costs and losses associated with WUI fires in the last two decades. Indeed, in spite of increased fire agency staffing, equipment, and training,

[205] Wells et al., 1979
[206] Dicus and Zimmerman 2007; Dicus et al., 2009
[207] California Department of Finance, 2004
[208] Syphard et al., 2008

85 percent of the 20 most destructive wildfires in California history have occurred over the last 30 years. Since 1987, these top destructive wildfires have collectively resulted in the loss of over 100 lives and over 25,000 structures (see Table 8.C).

Landmark wildfire disaster events since 1990 include:

- 2001 Tunnel Fire, which killed 25 and burned 2,900 structures over 1,600 acres
- 2003 Southern California fires, which killed 22 people, consumed over 4,800 homes, and cost $123 million to suppress over 750,000 acres[209]
- 2007 Southern California fire siege, which killed 17 people, consumed 3,069 homes, and cost $155 million to suppress over 750,000 acres[210]
- 2013 Rim Fire, which burned 112 structures and consumed over 250,000 acres
- 2015 Valley Fire, which killed 4 people and consumed 1,955 structures over 76,067 acres
- 2017 Northern California Fires, which killed 44 people and consumed almost 9,000 structures
- 2017 Thomas Fire, which killed 2 people and consumed 1,063 structures over 281,893 acres
- 2018 Mendocino Complex Fire (consisting of the Ranch Fire and River Fire), which, as of August 15, 2018 consumed over 360,000 acres and was still actively burning (Ranch Fire), making it the largest wildfire complex (by acreage burned) in recorded California history[211]

Given the ever-increasing migration of residential neighborhoods closer to California's WUI, similar destructive wildfires are likely for the foreseeable future. Thus, in addition to other mitigation approaches, effective fuel treatments in the WUI, proactive conservation, and long-term commitments to manage for more resilient forests with older fire resistant trees, coupled with actions to create fire adapted neighborhoods (e.g., home retrofits, defensible space), are all critical to maintaining sustainable communities.

However, treatment- and development-induced losses in tree and shrub canopy cover cost society in many direct and indirect ways. Vegetation is more than fuel; depending on its composition and structure, it can provide, various tangible and intangible benefits to society, dependent on its composition and structure. For example, WUI vegetation not only enhances community attractiveness but also reduces home cooling costs and air pollution[212], lessens needed storm water runoff infrastructure[213], sequesters carbon[214], and provides wildlife habitat.

The need to adequately understand how fuel treatments affect both fire hazard and societal benefits is especially critical in light of legislation that calls for a significant increase in mandatory fuel treatments around structures. California Senate Bill 1369, signed into law as a direct result of the 2003 California fires, amended Public Resources Code Section 4291 to increase mandatory vegetation clearance around homes in all designated areas where the state has primary suppression responsibilities. These new standards have the potential to significantly reduce the losses caused by wildfire but will also likely reduce the many tangible benefits to society that vegetation provides.[215] Thus, there is an acute need for California land managers to develop fuel management strategies in the WUI that minimize fire risk while simultaneously reducing loss of native vegetation and the many societal benefits that it provides.

[209] California Department of Forestry and Fire Protection, 2004
[210] California Department of Forestry and Fire Protection, 2009b
[211] Note: as of the time of final publication of the 2018 SHMP in August 2018, the Mendocino Complex fire is still actively burning. On August 15, 2018 CAL FIRE's statewide fire map reports the fire at 314,925 acres burned and 64% contained. For more information about the Mendocino Complex Fire, visit: http://www.fire.ca.gov/current_incidents/incidentdetails/Index/2175
[212] Taha et al., 1997
[213] Sanders 1986
[214] Nowak and Rowntree, 1991
[215] Dicus et al., 2009

8.1.4 ASSESSMENT OF LOCAL WILDFIRE VULNERABILITY AND POTENTIAL LOSSES

This section addresses local wildfire hazard vulnerability and potential losses based on estimates provided in local risk assessments, comparing those with state risk exposure findings presented in the GIS analysis in *Section 4.4.4* of *Chapter 4: Profiling California's Setting*.

8.1.4.1 FIRE EFFECTS ON HOUSING

Wildfire poses significant risk to the people of California and their homes, as evidenced by an increasing trend in structural losses from wildland fires. The risk is predominantly associated with wildland-urban interface (WUI) areas. WUI is a general term that applies to development interspersed within or adjacent to landscapes that support wildland fire.

Threatened Homes in Wildland-Urban Interface Area



Source: California Department of Forestry and Fire Protection (CAL FIRE)

According to California's Forests and Rangelands 2017 Assessment, development patterns around the state have resulted in construction of approximately 3 million housing units within Fire Hazard Severity Zones (FHSZ) that are potentially at risk from wildfire. Of those housing units, close to 2.2 million are within the Wildland Urban Interface (WUI), 83 percent of which are in "dense interface" and 17 percent of which are in "intermix". Dense interface WUI can be described as a fully developed residential area that terminates at the edge of a wildland area, while intermix WUI, as the name indicates, occurs where residential units are intermittently scattered through a wildland area.

In urban counties, such as Los Angeles, areas of dense development are typically located next to unpopulated open space (usually in public ownership), thus, such housing units are primarily in the "dense interface". In rural counties low-density "intermix" dispersed within wildland fuels tend to be more common; in such areas about half of the housing units are in Intermix (e.g., Butte, Eldorado, Santa Cruz, and Sonoma).[216]

[216] California's Forests and Rangelands 2017 Assessment. CAL FIRE FRAP, http://frap.fire.ca.gov/assessment/2017/assessment2017

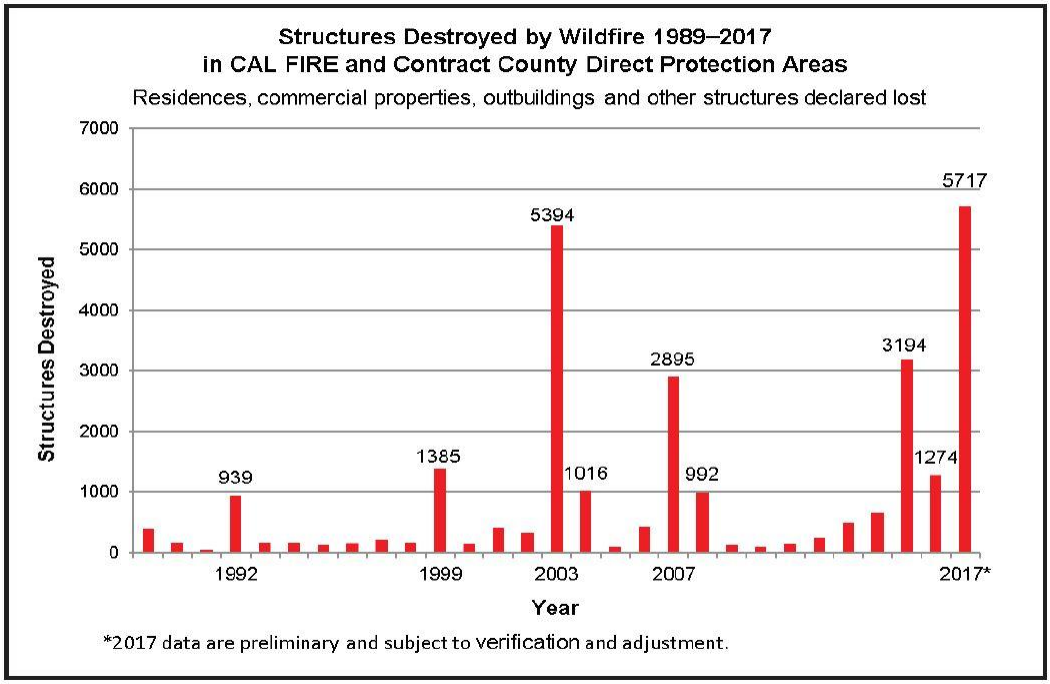
Aerial Images Illustrating Dense Interface and Intermix WUI Development



Source: California Department of Forestry and Fire Protection (CAL FIRE), California's Forests and Rangelands 2017 Assessment

The 2017 assessment notes that "a large proportion of the housing units (HU) within FHSZ are in the southern portion of the state. The top five counties for FHSZ HU, all in Southern California, contain about half of all statewide HU in FHSZ, and 62 percent of the HU in the Very High class. However, this is clearly a statewide problem—37 counties have at least 10,000 HU in FHSZ". Across the state, 67 percent of housing units in the interface WUI are within high or very high FHZS.[217] Since 1989 there have been 7 years where loss of more than 1,000 structures occurred in CAL FIRE/contract county direct protection areas, including 2015, 2016, and 2017,[218] as a result of increasing wildfire frequency and severity. This increase is illustrated in Chart 8.D.

Chart 8.D: Structures Destroyed by Wildfire 1989-2017



Source: California Department of Forestry and Fire Protection (CAL FIRE), California's Forests and Rangelands 2017 Assessment

[217] California's Forests and Rangelands 2017 Assessment. CAL FIRE FRAP, http://frap.fire.ca.gov/assessment/2017/assessment2017
[218] California's Forests and Rangelands 2017 Assessment. CAL FIRE FRAP, http://frap.fire.ca.gov/assessment/2017/assessment2017

8.1.4.2 LOCAL HAZARD MITIGATION PLAN HAZARD RATINGS

In the review of Local Hazard Mitigation Plans (LHMPs) approved as of May 2017, the most significant hazards reported continue to be earthquakes, floods, and wildfires—the three primary hazards also identified on a statewide basis by the 2013 SHMP.

Map 8.J summarizes relative ratings of wildfire hazards in the 2018 review of LHMPs. Displayed are predominant wildfire hazard ratings shown as high (red) and moderate to low (orange) rankings, reflecting ratings given by the jurisdictions with LHMPs within each county. Counties shown without color represent either jurisdictions not having LHMPs approved by the Federal Emergency Management Agency (FEMA) or counties where data are missing or problematic. For a detailed evaluation of LHMPs approved as of May 2017, see *Chapter 5: California Local Hazard Mitigation Planning*.

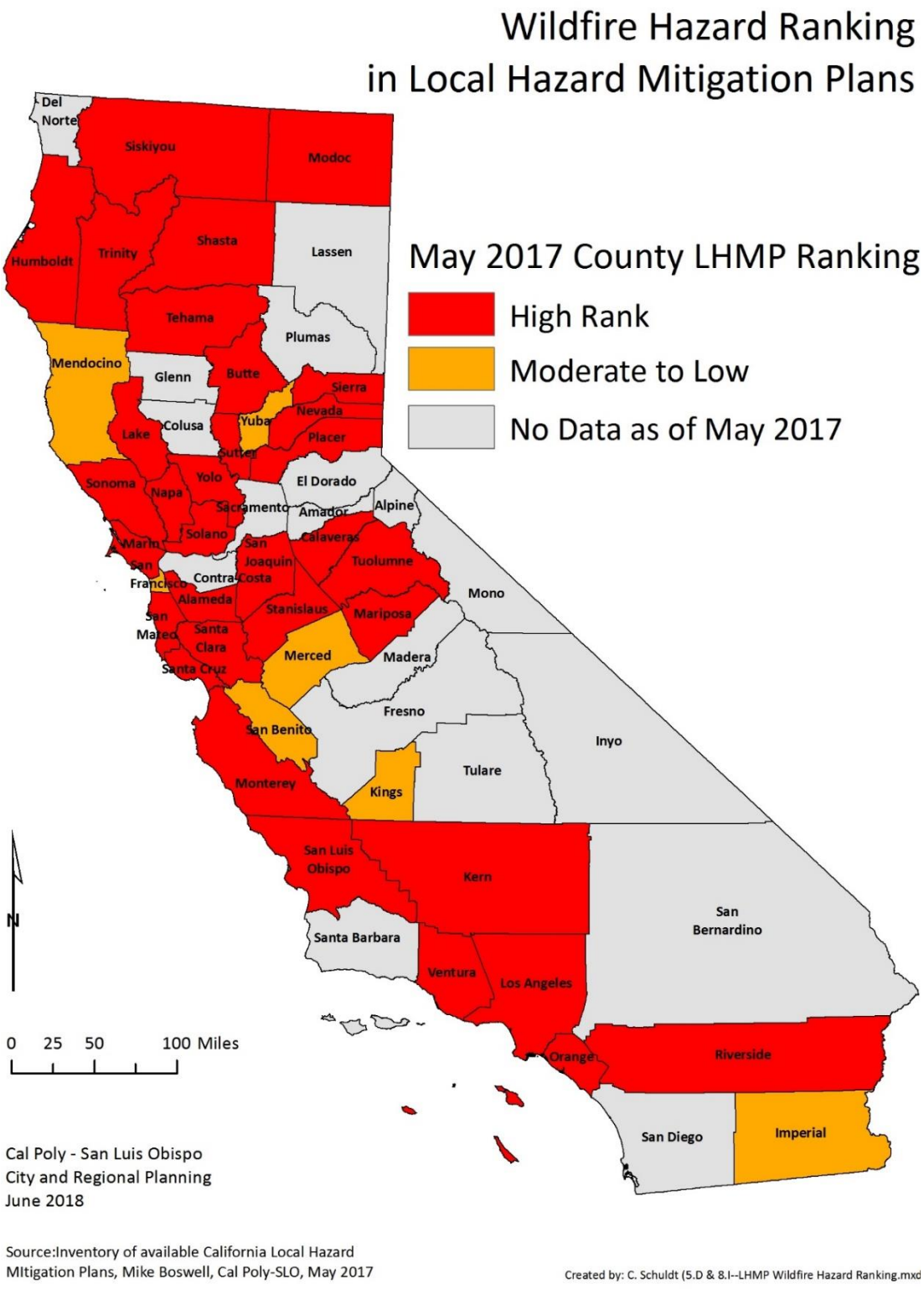
Implications for Local Loss Potential

Local hazard ratings are highly variable, responding to a wide variety of very specific local conditions. Each county has its own set of variables conditioning wildfire loss potential within its cities and unincorporated area. Descriptions of loss potential are very specific within individual LHMPs and are not consistently drawn up between plans, nor is there even coverage of all cities and unincorporated areas. Such variability will diminish as more cities and counties prepare LHMPs and greater standardization enables comparability of local data with statewide data.

Comparison with Statewide Vulnerability

Map 8.J reveals that most LHMPs reviewed in 2017 in Southern California and San Francisco Bay Area counties, some Central Valley counties, and many North Coast and Sierra Mountain counties rated wildfires high in their hazard rankings. This is consistent overall with the patterns of wildfire hazards and population/social vulnerability patterns identified in Map 8.I, Population/Social Vulnerability with Wildfire Hazard.

Map 8.J: Wildfire Hazard Ranking in Local Hazard Mitigation Plans



Map 8.J identifies wildfire hazards as being a predominant concern in the 2017 LHMP review for most Southern California and many San Francisco Bay Area counties with approved LHMPs, as well as many Sierra Mountain counties. For those counties labeled as "no or insufficient data," either the approved LHMP did not include wildfire as a risk or there is no approved LHMP for that county.

8.1.5 CURRENT WILDFIRE HAZARD MITIGATION EFFORTS

Once thought of as a seasonal hazard, wildfires are an almost everyday occurrence in California. However, much of the state's approach to dealing with wildfire is still seasonal in nature. Flammable expanses of brush, diseased timberland, overstocked forests, hot and dry summers, extreme topography, intense fire weather wind events, summer lightning storms, and human acts all contribute to California's wildfire threat. Destructive fire events in 2015, 2016 and 2017, including the Tubbs Fire in Santa Rosa, are reminders of the urgent need to stay vigilant about reducing loss from future catastrophic fire events through mitigation efforts.

Wildfire and human development have always been in conflict. Wildfire is a natural part of the environment and human development has expanded further into the wildlands as non-wildland areas build out. This inherent conflict requires careful management in order to reduce or eliminate losses of life, property, and resources from wildfires.

Some past management practices have failed to address the comprehensive nature of the human/wildfire conflict and have exacerbated conditions that can lead to more damaging fires. One example is focusing on wildfire suppression without pro-active management of hazardous fuels or defensible space. Another is historical development in WUI fire areas without performance-based fire-resistant construction standards or fire-safe development requirements. Daily actions and decisions often fail to consider WUI fire risks and the potential for resulting losses.

Managing the human/wildfire conflict requires a commitment of resources and a focused mitigation plan over the long-term. The approach should be system-wide and may include the following:

- An informed, educated public that takes responsibility for its own decisions relating to wildfire protection
- Land use policies and standards that protect life, property, and natural resources
- Building and fire codes that reduce structural ignitions from windblown embers and flame contact from WUI fires and impede or halt fire spread within the structure once ignited
- Construction and property standards that provide defensible space
- Forest management commitments to manage for more natural forest conditions
- An effective regulatory mechanism for permitting an aggressive hazardous fuels management program
- An effective wildfire suppression program

8.1.5.1 LEGISLATION AND REGULATIONS

2018 Pending Wildfire Hazard Legislation

Following the 2017 Thomas and Northern California fires, California legislators responded by proposing new legislation to address wildfire hazards and support various wildfire mitigation efforts. Some of the mitigation efforts proposed by pending legislation focus on forest management actions, while others address built environment considerations. Some of topics addressed by the pending legislation include the following:

- Require state agencies to promote watershed health and promote post-fire recovery by implementing projects that promote use of woody biomass
- Develop and implement an insurance pool for certified prescribed burn managers
- Change fire safety planning efforts, defensible space requirements, and electrical transmission or distribution line vegetation clearance requirements
- Authorize the state to cover up to 90 percent of costs associated with removal of dead or dying trees in counties experiencing the Governor's declared Tree Mortality Crisis
- Authorize federal, state, and local agencies to engage in collaborative forestry management and enhance CAL FIRE's role in identifying wildfire hazards as local governments plan for new housing and neighborhoods
- Require mitigation plans by electrical corporations and wildfire mitigation measures prepared by local publicly owned utilities to include a description of factors used to determine when it may be necessary to deenergize

electrical lines (note: in July 2018 the California Public Utility Commission passed a resolution extending authority to all electric utilities to shut off electric power during dangerous conditions to prevent wildfires)

As of the fall of 2018, the outcomes of these and other 2018 legislative efforts to address wildfire hazard are still pending.

Senate Bill 109, the Budget Act of 2017, Funding Wildfire Mitigation

Senate Bill 109 has allocated $220 million from the Greenhouse Gas Reduction Fund to CAL FIRE to address fire protection and resource management to mitigate wildfire. The funds appropriated to CAL FIRE are intended to be used for state and local healthy forest and fire prevention programs and projects that improve forest health and reduce greenhouse gas emissions caused by uncontrolled wildfires, including, but not limited to, vegetation management, forest overgrowth reduction, biomass energy generation, and measures to ensure future wildfires are more consistent with historic regenerative fire regime.

These funds are available as local assistance grants, grants to Fire Safe Councils, grants to qualified non-profits, and fund for public education to reduce fire risk in State Responsibility Areas (SRAs).

Even with ample "defensible space" this residence, likely ignited via lofted embers, was destroyed



Source: C. Dicus

Executive Order B-52-18 Addressing Tree Mortality and Wildfire

In the face of the worst wildfires in California's history, Governor Brown issued an executive order on May 10, 2018 to combat dangerous tree mortality, increase the ability of forests to capture carbon, and systematically improve forest management. The issuance of Executive Order B-52-18 coincides with the release of the California Forest Carbon Plan: Managing our Forest Landscapes in a Changing Climate, prepared jointly by the California Department of Forestry and Fire Protection (CAL FIRE), California Environmental Protection Agency (CalEPA), and California Natural Resources Agency (CNRA).

The plan's intent is to provide a detailed implementation plan for the forest carbon goals embodied in the California Air Resources Board (CARB) 2030 Target Scoping Plan Update, which outlines strategies to achieve the 2020 greenhouse gas emissions (GHG) reduction goals.

Key elements of Executive Order B-52-18 include:

- Doubling the land actively managed through vegetation thinning, controlled fires and reforestation from 250,000 acres to 500,000 acres.
- Launching new training and certification programs to help promote forest health through prescribed burning.
- Boosting education and outreach to landowners on the most effective ways to reduce vegetation and other forest-fire fuel sources on private lands.
- Streamlining permitting for landowner-initiated projects that improve forest health and reduce forest-fire fuels on their properties.
- Supporting the innovative use of forest products by the building industry.
- Expanding grants, training, and other incentives to improve watersheds.

Executive Order B-52-18 will improve the health of the state's forests and help mitigate the threat and impacts of deadly and destructive wildfires, which hinder the state's progress toward its climate goals. Forests serve as the state's largest land-based carbon sink, drawing carbon from the atmosphere and storing it in trees and shrubs and in forest soils. But even a single wildfire can immediately cancel all those benefits.[219]

To support implementation of Executive Order B-52-18 and the California Forest Carbon Plan, a Forest Management Task Force was convened in June 2018, and $96 million is allocated to these efforts in the Governor's May budget revision. For more information about the California Forest Carbon Plan, visit: http://fire.ca.gov/fcat/.

Senate Bill 1241 (2012): Legislation for Local Wildfire Hazard Planning

This legislation is a significant addition to hazard mitigation efforts for wildfire areas because it follows the legislative model used in the 2007 flood legislation of hazard mitigation through state oversight of general plans. Similar to flood legislation adding floodplain planning responsibilities to local general plans (AB 162, etc.), Senate Bill (SB) 1241, passed in 2012, mandates wildfire planning responsibilities by local agencies through requirements regarding 1) wildfire updates to general plans, 2) mandatory findings for subdivision approvals in State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs), and 3) California Environmental Quality Act (CEQA) checklist updates for wildfire safety.

Senate Bill 1241 and the Safety Element

California planning and zoning law requires that cities and counties adopt a comprehensive general plan with various elements including a safety element for protection of the community from unreasonable risks associated with various hazards, including wildfires. All elements of a general plan, whether mandatory or optional, must be consistent with one another.

SB 1241 added language to Government Code Section 65302 that addresses local general plan safety elements by:

1. Revising safety element requirements for SRAs areas and VHFHSZs
2. Requiring local general plan safety elements, upon the next revision of the housing element on or after January 1, 2014, to be reviewed and updated as necessary to address the risk of fire in SRAs and VHFHSZs
3. Requiring each safety element update to take into account the most recent version of the California Governor's Office of Planning and Research (OPR) "Fire Hazard Planning" document
4. Requiring OPR, at the next update of its general plan guidelines, to include the provisions of SB 1241 (2012), or a reference to the provisions of SB 1241 (2012), as well as any other materials related to fire hazards or fire safety deemed appropriate for reference

[219] https://www.gov.ca.gov/2018/05/10/governor-brown-issues-executive-order-to-protect-communities-from-wildfire-climate-impacts/

Local general plan safety element updates are required to include:

1. Comprehensive review of local fire hazards in relation to distribution of existing or planned uses in SRAs and VHFHSZs within that jurisdiction
2. Goals, policies, and objectives for protection of the community from unreasonable risk of wildfire based on the identified fire hazard information
3. Feasible implementation measures to carry out the defined goals, policies, and objectives
4. Attachment of or reference to any previously adopted fire safety plan that fulfills the goals of Government Code Section 65302

For any jurisdiction containing SRAs or VHFHSZs, Government Code Section 65302.5 also requires that the draft safety element update be submitted to the State Board of Forestry and Fire Protection and to every local agency that provides fire protection for the territory in the city or county for review at least 90 days prior to the adoption or amendment of that safety element. Any recommendations provided by State Board of Forestry and Fire Protection or any local fire protection agency must be considered by the city council or county board of supervisors. Any rejection of recommendations must be communicated in writing to the State Board of Forestry and Fire Protection or local fire protection agency.

In May 2015, OPR released an update to its General Plan Technical Advice Series – Fire Hazard Planning that incorporates the requirements of SB 1241 (2012). This document reviews SB 1241 and other federal and state fire hazard planning requirements; ways that fire protection policies can be developed to meet specific, local needs and conditions; and issues relating to fire safety that local jurisdictions should consider while developing their general plan. The document also includes an appendix with funding resources, further fire protection planning resources, and examples of fire hazard planning policies and programs from communities around California. The document is available for download from OPR's website at:
http://opr.ca.gov/docs/Fire_Hazard_Planning_Public_Review_Draft_June_24_2014.pdf.

Senate Bill 1241 and the Subdivision Map Act

The Subdivision Map Act requires the legislative body of a city or county to deny approval of a tentative map, or a parcel map for which a tentative map was not required, unless it makes certain findings.

SB 1241 (2012) added new required findings to Government Code Section 66474.02. The legislative body of a county or city must make the following three findings prior to approval of a tentative map or parcel map for any area located within an SRA or VHFHSZ:

1. That the design and location of each lot in the subdivision and the subdivision as a whole are consistent with any applicable regulations adopted by the State Board of Forestry and Fire Protection per Sections 4290 and 4291 of the Public Resources Code
2. That structural fire suppression services will be available for the subdivision (this finding must be supported by substantial evidence in the record)
3. That ingress and egress for the subdivision meets the regulations regarding road standards for fire equipment access per Sections 4290 and 4291 of the Public Resources Code

Senate Bill 1241 and the California Environmental Quality Act

The California Environmental Quality Act (CEQA) requires a lead agency to prepare and certify the completion of an environmental impact report (EIR) on a project that it proposes to carry out or approve that may have a significant effect on the environment, or to adopt a negative declaration if it finds that the project will not have that effect. CEQA requires OPR to prepare and develop guidelines for the implementation of CEQA by public agencies.

SB 1241 (2012) requires OPR to prepare, develop, and transmit to the Secretary of the California Natural Resources Agency recommended proposed changes or amendments to the initial study checklist for the inclusion of additional, specific questions related to fire hazard impacts for projects located in SRAs and VHFHSZs. Proposed updates to the

CEQA Guidelines were issued by OPR in November 2017 and included updates to the initial study checklist to add new questions addressing the requirements of SB 1241. OPR also updated the Fire Hazard Planning General Plan Technical Advice Series in response to SB 1241, in 2015. To download the Fire Hazard Planning General Plan Technical Advice Series, visit: http://opr.ca.gov/ceqa/technical-advisories.html.

Progress Summary 8.A: Senate Bill 1241 (2012) and CAL FIRE's Land Use Planning Program

Progress as of 2018: The Land Use Planning Program (LUPP) was established within the California Department of Forestry and Fire Protection (CAL FIRE) Office of the State Fire Marshall (OSFM) in June 2013 to implement the provisions of Senate Bill (SB) 1241. The primary function of the Land Use Planning Program is to provide planning and technical assistance to local jurisdictions to ensure that the safety elements of their general plans meet all required components of the law. The Land Use Planning Program also offers additional assistance to local jurisdictions in adoption of local fire ordinances and fire hazard maps, community planning and development, and damage inspection and recovery following devastation from wildfires and floods.

Staff of the Land Use Planning Program (with 11 positions throughout the state, as of 2017) work in close collaboration with the Board of Forestry and Fire Protection. It is the staff's statutory responsibility to review draft safety elements or existing safety elements and recommend changes to the planning agency regarding uses of land and policies in State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs) that will protect life, property, and natural resources from unreasonable risks associated with wildland fires; and methods and strategies for wildland fire risk reduction and prevention within SRAs and VHFHSZs.

Thirty local general plan safety elements have been reviewed and commented upon by Land Use Planning Program staff since 2015. This number is expected to increase significantly over the next few years, as many jurisdictions are approaching their mandatory general plan housing element updates.

Additional information regarding the Land Use Planning Program can be found at: http://osfm.fire.ca.gov/fireplan/fireplanning.

Defensible Space Law

A state law that became effective in January 2005 extended the required defensible space clearance around homes and structures from 30 feet to 100 feet. In summary, Public Resources Code Section 4291 now states that a person who owns, leases, controls, operates, or maintains a building or structure in, upon, or adjoining a mountainous area, forest-covered lands, brush-covered lands, grass-covered lands, or land that is covered with flammable material shall at all times maintain defensible space of 100 feet from each side and from the front and rear of the structure, but not beyond the property line. Numerous local jurisdictions have adopted more stringent standards.

Proper clearance to 100 feet dramatically increases the chance of a house surviving a wildfire. The vegetation surrounding a building or structure is fuel for a fire. Even the building or structure itself is considered fuel. Research and experience have shown that fuel reduction around a building or structure increases the probability of it surviving a wildfire.

Good defensible space allows firefighters to protect and save buildings or structures safely without facing unacceptable risk to their lives. Fuel reduction through vegetation management coupled with ignition-resistant construction is the key to creating good defensible space. However, even with adequate defensible space, a structure may ignite via lofted embers.

Defensible space programs, otherwise known as fire safe inspections, can be implemented at many different levels. For example:

- CAL FIRE uses firefighters to inspect high hazard areas
- The United States Forest Service (USFS) inspects where it has direct protection responsibility on private lands
- Fire Safe Council inspections are conducted with the support of grant dollars, homeowners association dues, and counties funds such as Title III
- Local fire agencies, both paid and volunteer, inspect with firefighters and volunteers

For these residences adequate "defensible space" successfully reduced risk of ignition



Source: C. Dicus

Fire Safe Development Regulations

The Fire Safe Development Regulations implement Public Resources Code Section 4290 and stipulate minimum requirements for building construction in SRAs. These regulations address ingress and egress (road widths, turnouts, etc.), building and street sign visibility, emergency water standards, and fuel modification.

In June 2012, CAL FIRE and the Board of Forestry and Fire Protection formed a workgroup to revise the Fire Safe Development Regulations. The workgroup made the first significant changes to the regulations since they were initially effective in 1991 and identified future areas of study. Changes to the regulations were effective January 1, 2016.

This workgroup was re-engaged in 2017 to align the update timeline for the Fire Safe Regulations with the triennial California Fire Code cycle. The workgroup has been reviewing the existing regulations based on feedback received from the 2016 updates to reduce inconsistencies and improve clarity. These changes are anticipated to be effective with the 2020 California Fire Code on January 1, 2020.

Progress Summary 8.B: Board of Forestry and Fire Protection Research Efforts

Progress as of 2018: In an effort to ensure existing state regulations are effective, the Board of Forestry and Fire Protection has engaged various research efforts. In 2016, the Board engaged a mitigation planning team at California State Polytechnic University San Luis Obispo to assess impacts of fire on single access subdivisions and develop a performance-based metric to evaluate evacuation from single access subdivisions. The research effort culminated in a report titled "Single-Access Subdivision Assessment Project: Developing a Planning Tool for Evaluating Proposed Developments Accessible by Dead-End Roads" available publicly on the Board's FIRE website.

Wildfire risk in California poses significant threat to communities located on one or more dead end roads. Such subdivisions possess only a single entry point through which emergency access and evacuation must travel, and are some also have access roadways with inadequate widths, steep grades, or obstacles in the roadway that can threaten safe movement. These factors can combine to interfere with efficient evacuation as well as the ability of responders to combat wildfires. Such issues were evident in the October 2017 wildfires in Northern California, the 2017 Thomas Fire in Southern California, and the Montecito debris flow in early 2018.

The Single-Access Subdivision Assessment Project report provides a mathematical access model to address potentially life-threatening situations that may arise when single-access subdivisions are faced with threats and obstacles that can interfere with egress and ingress, slowing wildfire evacuation and firefighting equipment access. The report's mathematical access model, which measures the length of time required to fully evacuate a subdivision or community under specific circumstances such as road grade, curvature, width, length, and obstacles, may be useful to jurisdictions during general plan preparation and subdivision planning as a tool to evaluate access and evacuation requirements in relation to wildfire and possibly other hazard events.

Wildland-Urban Interface Building Code

More than 50 percent of structures lost in WUI fires are in fires that burn more than 300 structures. These fires are what CAL FIRE has termed "conflagration" fires. These fires burn during extreme fire behavior conditions that usually include high winds and hot temperatures, allowing flames to spread rapidly. Extreme winds sometimes blow embers ½ to 1 mile from the main fire into WUI areas. These fires are located near homes and move so fast and so destructively that it is not possible for enough firefighters and equipment to arrive on scene soon enough to control the fire. The solution to this problem is to design and build communities that are resistant to the unwanted effects of WUI fires. Reducing structural ignitions from windblown embers or direct flame contact through use of appropriate design, materials, and assemblies is the goal of the WUI fire and building codes.

For this reason, state and local governments in California have enacted numerous laws related to protecting communities from wildfire. Many of the laws focus on roofing or vegetation, the two major factors that affect structure loss during wildland fires. In many cases, these laws were passed immediately following a major fire.

On September 20, 2005, the California Building Standards Commission approved the Office of the State Fire Marshal's emergency regulations amending the California Code of Regulations (CCR), Title 24, Part 2, known as the 2007 California Building Code, to add Chapter 7A Materials and Construction Methods for Exterior Wildfire Exposure. This chapter has been revised triennially with the California Building Code and identifies the following scope, purposes, and application:

- *701A.1 Scope*. This section applies to building materials, systems, and/or assemblies used in the exterior design and construction of new buildings located within a Wildland-Urban Interface Fire Area as defined in Section 702A.
- *701A.2 Purpose*. The purpose of this section is to establish minimum standards for the protection of life and property by increasing the ability of a building located in any Fire Hazard Severity Zone within State Responsibility Areas or any Wildland-Urban Interface Fire Area to resist the intrusion of flames or burning embers projected by a vegetation fire.

- *701A.3 Application*. New buildings located in any Fire Hazard Severity Zone or any Wildland-Urban Interface Fire Area designated by the enforcing agency constructed after the application date shall comply with the provisions of this section.

The current standards in Chapter 7A of the 2016 California Building Code[220] include minimum criteria for the following elements of construction:

- Roofing
- Vents
- Exterior coverings (including walls, roof eaves/soffits, exterior porch ceilings, floor projections, underfloor protection, and underside of appendages)
- Exterior windows and doors
- Decking
- Accessory structures

8.1.5.2 FIRE HAZARD SEVERITY ZONE MAPPING FOR MITIGATION ACTION

Public Resources Code Sections 4201-4204 and Government Code Sections 51175-89 direct the California Department of Forestry and Fire Protection (CAL FIRE) to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZs), define the application of various mitigation strategies to reduce risk associated with wildland fires. FHSZs are mapped within State Responsibility Areas (SRAs). The zones will provide specific designation for application of defensible space and building standards consistent with known mechanisms of wildfire impacts on people, property, and natural resources.

Wildland-urban interface (WUI) building codes that have been adopted by the California Building Standards Commission took effect January 1, 2008 and use Fire Hazard Severity Zone (FHSZ) maps as the basis for applicability of certain code sections.

Progress Summary 8.C: Fire Hazard Severity Zone Mapping and State/Local Responsibility Areas

Progress as of 2018: The California Department of Forestry and Fire Protection (CAL FIRE) has remapped both state and local fire responsibility areas to provide updated map zones, based on new data, science, and technology that will create more accurate zone designations such that mitigation strategies are implemented in areas where hazards warrant these investments. Data for State Responsibility Areas (SRAs) are now updated annually using funds from the California Fire Prevention Fee. An online SRA viewer reflecting these annual data updates is available on the Board of Forestry and Fire Protection website: http://www.fire.ca.gov/firepreventionfee/sraviewer. The online viewer is updated annually and replaces the SRA county maps.

Data for Local Responsibility Areas (LRAs) are now updated annually. CAL FIRE has made recommendations for Very High Fire Hazard Severity Zones (VHFHSZ) for over 200 cities. The VHFHSZ recommendations are available at: http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps_citylist.php.

Many local governments have made similar designations under their own authority. FHSZ mapping was adopted in 2007 and 2008 for most LRAs. LRA FHSZ maps must be ratified by the local government agency and the state for full adoption. There are still a few LRA maps pending local ratification prior to being fully adopted.

[220] https://codes.iccsafe.org/public/chapter/content/1774/

Best Practices Highlight 8.A: City of San Diego's Campaign to Mitigate Wildfire Hazard and Protect Sensitive Resources

What does it take to make significant wildfire hazard mitigation progress? For San Diego, California, it took recognition that fire season is a year-round reality. Fires such as the Cedar Fire in 2003 (the largest fire by acreage in California's history) and the Witch Fire in 2007 each resulted in the destruction of many homes and served as the city's call to action to better address wildfire hazards.

The challenge for San Diego comes from its many linear miles of wildland-urban interface (WUI) where the backyards of homes meet dense stands of native-naturalized vegetation. The development and landscaping of many homes occurred without full understanding of fire severity, resulting in increased wildfire vulnerability. Within San Diego's WUI areas, up to 80 percent of homes previously damaged by wildfire might have been saved if certain fire-safe practices had been followed. To better address and mitigate wildfire risk in WUI areas, the City of San Diego has implemented an array of coordinated fire safe practices including building code standards, a brush management program, and a public awareness campaign.

Use of Fire Hazard Severity Zones to Determine Best Mitigation Measures

State law requires that all local jurisdictions identify Very High Fire Hazard Severity Zones (VHFHSZs) within the area where the jurisdiction is responsible for fire protection. The determination of very high fire hazard severity is based on vegetation density, slope severity, fire department response time, and other relevant factors that contribute to fire severity. The City of San Diego worked closely with the California Department of Forestry and Fire Protection (CAL FIRE) to establish VHFHSZs within the city and develop a fire hazard severity map. The purpose of the fire hazard severity map is to classify lands in accordance with whether a very high fire hazard is present. The fire hazard severity information provided by the map enables City officials to better define mitigation measures such as vegetation management and implementation of building standards to best minimize loss of life, resources, and property.

Building Standards

For properties in VHFHSZs, the City of San Diego's Building Code requires specific additional fire safe building standards be met for new construction projects, as well as additions and exterior alterations to existing buildings. For projects within the City's designated VHFHSZs, additional building standards in the Municipal Code may also apply in conjunction with Building Code standards for new construction.

Landscape Regulations

To reduce the risk of fire through site design and the management of flammable vegetation, the City has introduced fire safe landscape requirements in the San Diego Municipal Code (Section 142.0401). Under its comprehensive brush management program, the City now requires defensible space buffer zones to be created between all structures and contiguous areas of native or naturalized vegetation. In order to ensure necessary reduction of fire hazards around WUI structures while protecting sensitive biological resources, the City has published a brush management guide. The guide explains specific brush clearance techniques and appropriate times for brush management activities to minimize impacts to undisturbed native vegetation.

Ready, Set, Go!

Public education is a crucial part of the success of San Diego's wildfire adaptation efforts. As part of this effort, the San Diego Fire-Rescue Department produced "Ready, Set, Go!" a personal wildland fire action guide for San Diego residents. The "Ready, Set, Go!" program works in a complementary and collaborative fashion with the Firewise Communities Program and other wildland fire public education efforts. The program explains brush clearing and defensible space, along with measures like using fire-resistant plants and disallowing or being cautious of flammable/combustible materials near residences, and encourages residents and homeowners to take an active role in wildfire mitigation efforts. The guide can be downloaded at: https://www.sandiego.gov/fire/safety/tips/readysetgo.

Natural Hazard Disclosures and Disclosure Maps

Natural Hazard Disclosures in real estate transactions have been required for wildland fire hazards since 1990 but were not widely used until the late 1990s. Natural Hazard Disclosures are required in Very High Fire Hazard Severity Zones (VHFHSZs) in LRAs and in all SRAs regardless of fire hazard.

CAL FIRE provides Natural Hazard Disclosure maps and data for two types of fire hazard areas referred to in legislation as disclosure items in real estate transactions. For more information, visit: http://frap.fire.ca.gov/projects/hazard/hazard.

8.1.5.3 WILDFIRE PROTECTION RESPONSIBILITY IN CALIFORNIA

There are literally hundreds of agencies that have fire protection responsibility for wildland and WUI fires in California. Local, state, tribal, and federal jurisdictions have legal (and financial) primary responsibility for wildfire fire protection. In some instances, two fire organizations have dual primary responsibility on the same parcel of land —one for wildland fire protection and the other for structural or "improvement" fire protection.

This layering of responsibility and resulting dual policies, rules, practices, and legal ordinances can cause conflict or confusion. To address wildland fire jurisdictional responsibilities, the California state legislature adopted Public Resource Code Section 54102, Government Code Section 51175, and Health and Safety Code Section 13108.5 establishing Federal Responsibility Areas (FRAs), State Responsibility Areas (SRAs), and Local Responsibility Areas (LRAs).

Federal Responsibility Areas (FRAs)

Federal Responsibility Areas (FRAs) are fire-prone wildland areas that are owned or managed by a federal agency such as the U.S. Forest Service, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Department of Defense. Primary financial and rule-making jurisdictional authority rests with the federal land agency. In many instances, FRAs are interspersed with private land ownership or leases. Fire protection for developed private property is usually NOT the responsibility of the federal land management agency; structural protection responsibility is that of a local government agency or fire protection district.

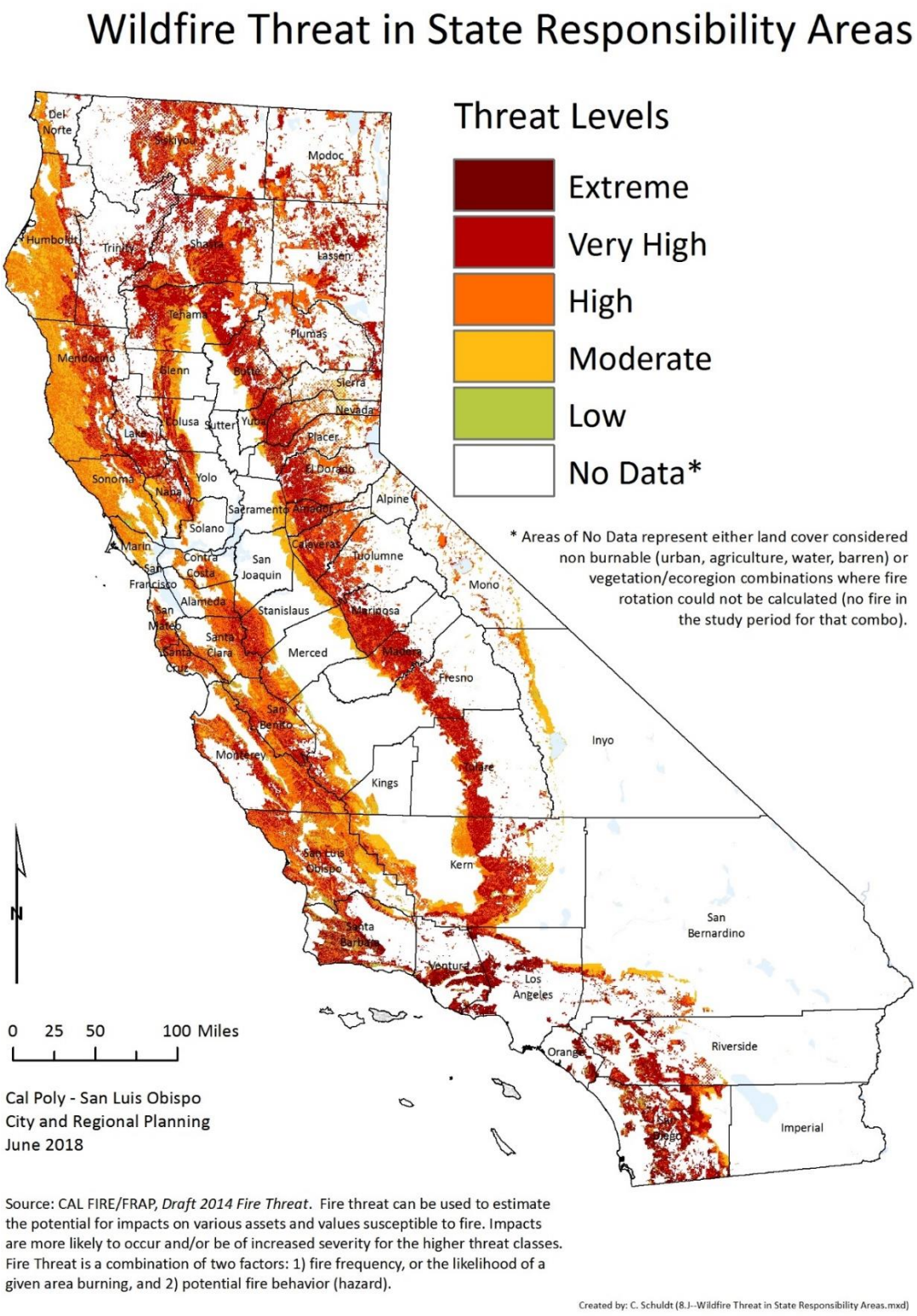
State Responsibility Areas (SRAs)

State Responsibility Areas (SRAs) are those lands in which the State of California has primary fire protection responsibilities. These are areas where CAL FIRE has legal and financial responsibility for wildland fire protection and where CAL FIRE administers fire hazard classifications and building standard regulations.

SRAs are defined as lands that 1) are county unincorporated areas, 2) are not federally owned, 3) have wildland vegetation cover rather than agricultural or ornamental plants, 4) have watershed and/or range/forage value, and 5) have housing densities not exceeding three units per acre.[221] As in FRAs, where SRAs contain built environment or development, the responsibility for fire protection of those improvements (non-wildland) is typically that of a local government agency. Map 8.K shows wildfire threat within SRAs.

[221] CAL FIRE web page, url: http://frap.fire.ca.gov/projects/hazard/hazard#SRAdef

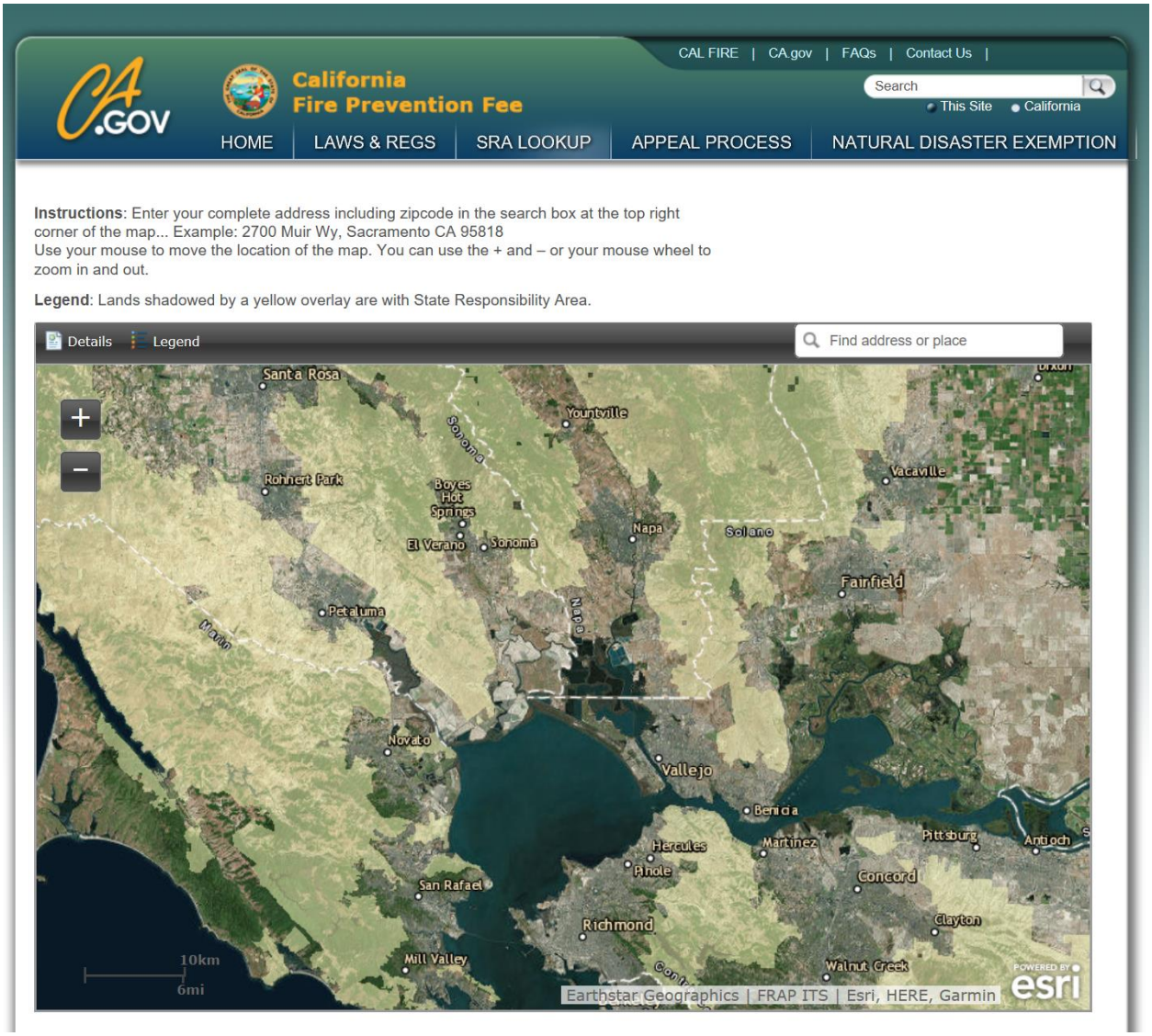
Map 8.K: Wildfire Threat in State Responsibility Areas



Source: CAL FIRE/FRAP, *Draft 2014 Fire Threat*. Fire threat can be used to estimate the potential for impacts on various assets and values susceptible to fire. Impacts are more likely to occur and/or be of increased severity for the higher threat classes. Fire Threat is a combination of two factors: 1) fire frequency, or the likelihood of a given area burning, and 2) potential fire behavior (hazard).

Created by: C. Schuldt (8.J--Wildfire Threat in State Responsibility Areas.mxd)

Map 8.L: State Responsibility Area Viewer Example—SRA in Northern California



Source: http://www.fire.ca.gov/firepreventionfee/sraviewer

CAL FIRE now maintains a State Responsibility Area map viewer that allows users to view the spatial distribution of SRAs at different scales and for different areas of the state. It can also be used to search for a specific address to help determine if the location is within or outside an SRA. SRA boundaries are those adopted by the Board of Forestry and Fire Protection and are updated annually to reflect changes. Map 8.L shows an example map created using CAL FIRE's SRA data viewer.

Local Responsibility Areas (LRAs)

Local Responsibility Areas (LRAs) include land within incorporated cities, cultivated agriculture lands, non-flammable areas in unincorporated areas, and those lands that do not meet the SRA or FRA criteria. LRA fire protection is typically provided by city fire departments, fire protection districts, and counties, and by CAL FIRE under contract to local governments.

LRAs may include areas in which the financial and jurisdictional responsibility for improvement AND wildland fire protection is that of a local government agency.

Rule-Making Authority and Financial Responsibility

The significance of the FRA, SRA, and LRA designations relates to the rule-making authority and financial responsibility for fire protection. Local government agencies (cities and counties) typically control the authority to enact and enforce land use ordinances, building codes, and fire codes for development within their boundaries, although some state regulations apply in LRAs designated as Very High Fire Hazard Severity Zone (VHFHSZs). The significance of these terms for land use and building regulation is discussed later in this section.

CAL FIRE has mapped all LRAs in which the designated Fire Hazard Severity Zone has been determined to be "Very High" (the most hazardous designation); local authorities can then elect to adopt these designations. Once adopted, the designations require equivalent residential vegetation maintenance and building standards as in SRA lands. Some LRA jurisdictions choose not to adopt these designations based upon factors such as perceived impacts on residential property values, fire insurance availability and rates, and others. This land use authority includes those areas where the local agency shares fire protection responsibility with either FRAs or SRAs. Financial responsibility for wildland fire protection is a significant issue because wildland fire protection is very expensive and considerably more expensive in WUI areas.

8.1.5.4 WILDFIRE HAZARD MITIGATION PLANS AND PROGRAMS

Strategic Fire Plan and Wildland Fire Suppression

Initially approved by the California State Board of Forestry and Fire Protection in 2010, the Strategic Fire Plan was revised in 2016. The Strategic Fire Plan forms the basis for assessing California's complex and dynamic natural and human-made environment and identifies a variety of actions to minimize the negative effects of wildland fire.

Vision

The vision of the Strategic Fire Plan is for a natural environment that is more resilient and human-made assets that are more resistant to the occurrence and effects of wildland fire through local, state, federal, and private partnerships.

Goals and Objectives

Through government and community collaboration, the following goals established in the Strategic Fire Plan will enhance the protection of lives, property, and natural resources from wildland fire, as well as improve environmental resilience to wildland fire. Each goal listed here is meant to build upon the previous one (e.g., Goal 3 builds upon the accomplishments in Goals 1 and 2). Although full attainment of a goal is ultimately dependent upon the success of previous goals, any of the goals can be worked on at any given time based on available funding and other opportunities. The goals are as follows:

1. Identify and evaluate wildland fire hazards and recognize life, property and natural resource assets at risk, including watershed, habitat, social, and other values of functioning ecosystems. Facilitate the sharing of all analyses and data collection across all ownerships for consistency in type and kind.
2. Articulate and promote the concept of land use planning as it relates to fire risk and individual landowner objectives and responsibilities.
3. Support and participate in the collaborative development and implementation of wildland fire protection plans and other local, county, and regional plans that address fire protection and landowner objectives.
4. Increase awareness, knowledge, and actions implemented by individuals and communities to reduce human loss and property damage from wildland fires, such as defensible space and other fuels reduction activities, fire prevention and fire safe building standards.
5. Develop a method to integrate fire and fuels management practices with landowner priorities and multiple jurisdictional efforts within local, state, and federal responsibility areas.
6. Determine the level of fire suppression resources necessary to protect the values and assets at risk identified during planning processes.

7. Address post-fire responsibilities for natural resource recovery, including watershed protection, reforestation, and ecosystem restoration.

Other Aspects of the Plan

CAL FIRE has developed an estimate of fire risk in WUI areas that is consistent with National Fire Plan methods but is more refined in terms of both mapping extent and quantification of risk. CAL FIRE uses spatial data to distinguish fire-related characteristics from assets and applies spatial rules for determining relative risk of loss. For more information, see: http://cdfdata.fire.ca.gov/fire_er/fpp_planning_cafireplan.

The 2010 Strategic Fire Plan (revised in 2016) is a different fire plan from those developed in the past. The plan recognizes that fire will occur in California and works to answer the question of "how do we utilize and live with that risk of wildfire?" The approach taken in the revised plan is to focus on a vision and goals and objectives that will help reach that vision. The overall vision is to create a state that is more resistant and resilient to the damaging effects of catastrophic wildfire while recognizing fire's beneficial aspects. The 2010 Strategic Fire Plan (revised in 2016) is a living document.

Wildland Fire Suppression

In addition to the Strategic Fire Plan's broad goals, CAL FIRE has a suppression goal to contain 95 percent of fires at 10 acres or less. Statewide, approximately 97 percent of all vegetation fires are contained within the first few hours after they are reported. The remaining 3 percent either move too quickly or are too intense for available fire suppression resources to handle. Multiple large fires can quickly draw down the pool of fire suppression resources, making it more difficult to bring the fires under control.

Progress Summary 8.D: Strategic Fire Plan

Progress as of 2018: A revised version of the 2010 Strategic Fire Plan, released in April 2016, is the current fire plan and considered the state's road map for reducing risk of wildfire. A new Fire Plan Workgroup made up representatives from the State Board of Forestry and Fire Protection of and the California Department of Forestry and Fire Protection (CAL FIRE) has been formed to update the plan for 2018. The entire current fire plan can be viewed at: http://osfm.fire.ca.gov/fireplan/fireplanning.php and http://www.bof.fire.ca.gov/board_committees/resource_protection_committee/current_projects/resources/strategicfireplan_june2010_06-04_photos.pdf.

California's Forests and Rangeland Assessment

California law requires that CAL FIRE make periodic assessments of forest and range resources and that the Board of Forestry and Fire Protection use the results to develop a policy statement and strategic plan. In addition, the 2008 Federal Farm Bill amended the Cooperative Forestry Assistance Act (CFAA) to require that states prepare state forest resource assessments and resource strategies. The CFAA amendments are reflected in the United States Department of Agriculture (USDA) Forest Service State and Private Forestry "Redesign Program" (http://www.fs.fed.us/spf/redesign/index.shtml). The intent of this program is for the states to identify priority landscape areas and to underscore work needed to address national, regional, and state forest management priorities. In June 2010, the Fire and Resource Assessment Program (FRAP) finished the assessment. For more information about the 2010 assessment, visit: http://frap.fire.ca.gov/assessment/2010/assessment2010.

2017 Update of California's Forests and Rangelands Assessment

CAL FIRE FRAP and the U.S. Forest Service (USFS) Region 5 released California's Forests and Rangelands: 2017 Assessment update in mid-August 2018. The 2017 assessment revisits topics from the 2010 assessment as well as reviving the inclusion of Montreal Process Criteria and Indicators to assess the state's progress toward or away from sustainable forestry. The 2017 Assessment covers a broad range of topics across both private and public lands. Each chapter includes a number of indicators that collectively are used to evaluate the sustainability of forest and rangelands. In the 2017 chapters addressing wildfire, reducing community wildfire risk, and climate change are again

included, as well as new chapters are dedicated to the topics of urban forestry and California's non-metro regional economy.

To download the 2017 assessment, visit: http://frap.fire.ca.gov/assessment/2017/assessment2017.

California's Forests and Rangelands 2010 Assessment

One of the overarching findings of the 2010 Forests and Rangelands Assessment is that California is a complex wildfire-prone and fire adapted landscape. Natural wildfire has supported and is critical to maintaining the structure and function of California's ecosystems. As such, the ability to use wildfire, or to mimic its impact by other management techniques, is a critical management tool and policy issue. Simultaneously, wildfire poses a significant threat to life, public health, infrastructure and other property, and natural resources.

Data suggest a trend of increasing acres burned statewide, with particular increases in conifer vegetation types. This is supported in part by the fact that the three largest fire years since 1950 have all occurred this decade. Wildfire-related impacts are likely to increase in the future based on trends in increased investment in fire protection, increased fire severity, fire costs, and losses, and research indicating the influence of climate change on wildfire activity.

Both the assessment and resource strategies documents are organized around themes and sub-themes delineated in the federal Redesign Program. For each sub-theme, an analytical framework was designed that uses GIS techniques to perform a spatial analysis of the pattern of assets and threats across landscapes. Assets include items of commercial and non-commercial value, both natural and human-made, such as buildings, commercial standing timber, and production of water. Threats are agents that can trigger major negative impacts on assets; examples include wildfire, development, and insect outbreaks. Location information on various assets, and potential threats to those assets, are taken together to identify high value/high threat areas. These delineate landscapes (called "priority" landscapes) where strategies and actions especially need to be focused.

Role in Supporting Hazard Mitigation

Several of these 2010 assessment themes and related strategies provide information that supports hazard mitigation planning and action. Three chapters are of special interest and are mentioned here for those who wish more detailed information:

- *Wildfire Threat to Ecosystem Health and Community Safety* (http://frap.fire.ca.gov/frasc/frasc_topics-wildfire) This chapter reflects the findings cited above and contains three unique spatial analyses that generate priority landscapes:
    - Preventing Wildfire Threats to Maintain Ecosystem Health
    - Restoring Wildfire-Impacted Areas to Maintain Ecosystem Health
    - Preventing Wildfire Threats for Community Safety
- *Forest Pests and Other Threats to Ecosystem Health and Community Safety* (http://frap.fire.ca.gov/frasc/frasc_topics-wildfire) This chapter covers the impacts of forest pests, including both forest insects and diseases, in wildland areas and communities. Collectively, losses from forest pests typically exceed those from wildfire and create serious hazards. The chapter includes four unique spatial analyses that identify priority areas where forest management practices are most likely to prevent and mitigate impacts:
    - Restoring Forest Pest Impacted Areas to Maintain Ecosystem Health
    - Restoring Forest Pest Impacted Communities for Public Safety
    - Preventing Forest Pest Outbreaks to Maintain Ecosystem Health
    - Preventing Forest Pest Outbreaks for Community Safety

- *Planning for and Reducing Wildfire Risks to Communities* (http://frap.fire.ca.gov/frasc/frasc_topics-planning). This chapter looks at the current status of collaborative, community-based wildfire planning and the extent of available planning resources relevant to community wildfire safety and protection. It identifies priority communities where wildfire threat coincides with human infrastructure such as houses, transmission lines, and major roads. These priority communities are then summarized in terms of the presence of a Community Wildfire Protection Plan (CWPP) and Firewise Communities/USA recognition. The availability of community planning resources is also examined.

Assessment Prioritization of Threatened Assets

The process for developing the 2010 assessment was based on looking at the location of forest and range resource assets in the context of potential threats across the state. This information is used to determine priority landscapes that have high asset values that are likely to be threatened. The assessment helps guide efforts to acquire and direct funding that can enable programs and other tools that create desired future landscape conditions

A key function of the 2010 assessment is to support California in allocating financial resources available from the federal government. Increasing threats to natural resources and tighter limits on available funds mean that priorities must be carefully examined.

California Interagency Coordination Efforts

Leading the coordination of wildfire prevention is the California Wildfire Coordination Group (CWCG) Interagency Prevention Committee. The CWCG Prevention Committee was formed as a way to coordinate the pre-fire management efforts of its member agencies: Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), California Governor's Office of Emergency Services (Cal OES), CAL FIRE, California Fire Safe Council (CFSC), National Park Service (NPS), the U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), and a Contract County Representative. More information on this Committee can be found at: https://gacc.nifc.gov/oscc/cwcg/.

The CWCG Prevention Committee provides a forum for sharing information so that its member agencies can make decisions and operate pre-fire management programs in a coordinated, integrated fashion. Working together, they discuss and reach consensus on California wildfire prevention and fire loss mitigation strategies.

Examples of pre-fire management programs are:

1. Grants Clearinghouse administered by the California Fire Safe Council that provides a one-stop shop concept for fire prevention community assistance grants. It allows a mechanism for California Fire Alliance members to pool their grant resources and fund grant projects around California and parts of Nevada. The Grants Clearinghouse has provided an efficient organizational structure for mobilizing wildfire mitigation activities and strategies to deal with the WUI issues in California. Projects funded include a variety of fuel reduction projects supporting prescribed fire, mechanical treatments and grazing methods, education and outreach activity, Community Wildfire Protection Plan (CWPP) development, and biomass reutilization.

2. Workshops and Networking:
   - Development and maintenance of Community Wildfire Protection Plans
   - Environmental compliance/Best Management Practices
   - Networking lunches with local community groups active in fire prevention

The collaborative energy of the members has directly benefited the pursuit and mission of building fire-safe communities and healthy wildland ecosystems. The CWCG Prevention Committee provides a single point of contact between the local Fire Safe Councils and its member agencies, while, in turn, the local Fire Safe Councils provide a single point of contact for coordination with individual communities.

Additional work and benefits are:

- Establishing priorities and opportunities for joint actions to collect information, maintain records, and monitor progress
- Maintaining awareness of social, economic, and technological advances; assessing how these changes influence wildfire threats; and informing decision-makers how to decrease wildfire threats and promote healthy wildland ecosystems
- Clarifying and coordinating policies and exploring issues that affect communities threatened by wildfire
- Coordinating a common message in order to improve the quality of information
- Providing education to enhance the public's understanding of wildland fire ecosystems, hazard fuels reduction and mitigation, and wildland fire management

California Fire Safe Councils

Since its formation in 1993, the California Fire Safe Council (CFSC) has united Californians to speak with one voice about fire safety. CFSC is a leader in encouraging grassroots movements that make communities more fire safe, fire wise, and fire adapted. CFSC, a statewide non-profit organization, receives federal grants from agencies like the United States Forest Service (USFS), Bureau of Land Management (BLM), and National Park Service (NPS). These funds provide grant monies to local Fire Safe Councils and other community organizations in California using CFSC's innovative online Grants Clearinghouse. The Clearinghouse enhances existing relationships between communities and state and federal agencies and helps create new relationships by expanding funding opportunities for eligible organizations and agencies.

In its 10 years of grant making, CFSC has funded over 850 grants totaling over $81 million for projects to reduce hazardous fuels, provide wildfire prevention education, and create risk assessments and Community Wildfire Protection Plans (CWPPs). In 2017, CFSC selected 21 projects under its 2017 Grants Clearinghouse that will provide over $2.1 million in federal grant funds to support wildfire risk reduction activities in at-risk communities in 15 counties across California (see Table 8.E). In addition to the federal funds, the projects will use over $2.5 million in matching funds, both in-kind and cash contributions. To assist with the application process, CFSC programs staff provide free workshops across the state on CFSC's two grant programs, share insights into the federal grants process, train participants in best practices for composing successful CFSC grant applications, and assist with wildfire education and outreach as well as organizational issues such as capacity building and sustainability.

As State Liaison (2012-2017), CFSC promoted the Firewise program to its extensive list of Fire Safe Councils and community organizations. CFSC provided assistance to these community members and to local fire agencies that were working to achieve the prestigious recognition of Firewise. While acting as the State Liaison from 2012 to 2017, CFSC increased the number of Firewise Communities in California from 50 to 92 nationally recognized communities.

Table 8.E: Wildfire Mitigation Projects Funded by California Fire Safe Council

Year	Total Value of Projects	Number of Grants
2008	$5,281,054	77
2009	$17,791,675	160
2010	$20,874,237	158
2011	$8,950,627	81
2012	$5,437,783	52
2013	$4,937,941	53
2014	$4,028,427	38
2015	$3,358,081	25
2016	$2,149,999	20
2017	$2,100,000	21
Total	**$74,909,824**	**685**

Source: California Fire Safe Council; http://www.cafiresafecouncil.org/wp-content/uploads/2017/08/2017-Grant-Report.pdf

Local Fire Safe Councils (FSCs) are community-based organizations organized to educate groups on Fire Safe programs, projects, and planning, in addition to providing resources to assist communities to take the education into action. The FSCs have been instrumental in securing funding and resources and work closely with the local fire agencies to develop and implement project priorities. For example, the FSCs provide education about defensible space and provide free chipping service to help residents create defensible space by eliminating fuel loads. Much of the value in the FSCs lies in their ties to their communities; they educate their neighbors and assist with planning Fire Safe projects that fit the needs of their local area. Local FSCs have made great strides where agencies and governing bodies have struggled. Many communities have their own Defensible Space Programs (Public Resources Code Section 4291), neighbors helping neighbors with fire prevention education and improving their home's chances to survive a wildland fire by supporting the 100-foot defensible space requirement of state law. There are approximately 200 local and 20 countywide Fire Safe Councils.

Information regarding the California Fire Safe Council and the Grants Clearinghouse can be found at: http://www.Fire Safecouncil.org/.

Community Wildfire Protection Plan

A Community Wildfire Protection Plan (CWPP), as defined by the Healthy Forests Restoration Act (HFRA), enables a community to plan how it will reduce the risk of wildfire. This landmark legislation includes the first meaningful statutory incentives for the United States Forest Service (USFS) and the Bureau of Land Management (BLM) to give consideration to the priorities of local communities as they develop and implement forest management and hazardous fuel reduction projects.

In order for a community to take full advantage of this new opportunity, it must first prepare a Community Wildfire Protection Plan (CWPP). Local wildfire protection plans can take a variety of forms, based on the needs of the people involved in their development. CWPPs may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection—or all of the above. The process of developing a CWPP can help a community clarify and refine its priorities for the protection of life, property, and critical infrastructure in the wildland urban interface. It also can lead community members through valuable discussions regarding management options and implications for the surrounding watershed.

The development of a CWPP is a collaborative effort involving government entities and affected non-governmental interests, including community grassroots organizations, such as local, county, and regional Fire Safe Councils and local community residents. Communities throughout the state have been encouraged to develop a CWPP and integrate their CWPP planning process into other planning processes such as:

- County or city general plan preparation
- Local Hazard Mitigation Plan (LHMP) preparation
- Flood Mitigation Plans (prepared by communities participating in the National Flood Insurance Program [NFIP])
- Other local hazard, evacuation, and emergency planning efforts

For communities without a CWPP, a good starting place in the plan development process is working from an existing plan such as a general plan safety element or CAL FIRE Unit Plan and building in the CWPP minimum requirements, which consist of the following:

1. **Collaboration.** A CWPP must be collaboratively developed with local, state, and federal agencies that manage land in the vicinity of the community along with other non-governmental stakeholders (i.e., large industrial landowners and utility companies).

2. **Priorities for Fuel Reduction.** A CWPP must identify and rank areas for hazardous fuel reduction treatments on both federal and non-federal land. It needs to recommend the types and methods of treatment that, if completed, would reduce the risk to the community.

3. **Treatment of Structural Ignitability.** A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan.

4. **Final Certification and Agreement Page.** The CWPP must be agreed to and signed off by three entities: the local government, the local fire department, and the State Forester. Communities with a completed CWPP are required to attach this signature page to their plans.

Communities may be listed in or covered by a countywide CWPP and/or develop their own plans. El Dorado County is an example in which there is a countywide plan and approximately 17 communities covered by the countywide plan have been creating individual CWPPs supported by the El Dorado County Fire Safe Council.

Fuel Reduction Programs

Fuel reduction programs are administered and implemented at many of the same levels as defensible space programs.

CAL FIRE offers a Vegetation Management Program (VMP), a cost-sharing program that focuses on the use of prescribed fire and mechanical means for addressing wildland fire fuel hazards and other resource management issues on State Responsibility Area (SRA) lands. A significant provision of the VMP is the public-private partnership authorized by legislation, wherein state-funded CAL FIRE resources can be used on private land at state expense to reduce hazardous fire-prone vegetation. Prior to this legislation, use of public resources was not allowed on private land.

The California Forest Improvement Program (CFIP) provides cost-share assistance to private forest landowners, Resource Conservation Districts, and non-profit watershed groups. Cost-shared activities include management planning, site preparation, tree purchase and planting, timber stand improvement, fish and wildlife habitat improvement, and land conservation practices.

On July 25, 2017, Governor Edmund G Brown signed Assembly Bill (AB) 398, which suspended the State Responsibility Area Fire Prevention Fee (SRAFPF) until 2031. This change in funding replaced the SRAFPF funding with money allocated from the Greenhouse Gas Reduction Fund (GGRF). In addition to continuing to reduce the risk of wildland fires to habitable structures and communities, these fire prevention activities will help maximize carbon sequestration in healthy wildland habitat and minimize the uncontrolled release of emissions emitted by wildfires. For further information regarding the Fire Prevention Grants, visit: http://calfire.ca.gov/fire_prevention/firepreventiongrants.

In 2016-2017 funding cycle, the SRAFPF and Tree Mortality Grant Program had $15.75 million available for projects that focus on supporting local efforts to remove dead and dying trees that pose a threat to public health and safety and for projects that reduce the wildfire threat to habitable structures within State Responsibility Areas (SRAs). Eligible grantees may be local entities including, but not limited to, local government, fire districts, community services districts, water districts, and special districts with SRAs within their jurisdictions, or certified local conservation corps, Fire Safe Councils, or other non-profit organizations organized under Section 501(c)(3) of the federal Internal Revenue Code. Native American tribes are eligible for the tree mortality grants but are generally not eligible for the State Responsibility Area Fire Prevention Fund Grants. They can work with local districts or non-profit organizations to include desired project work in a grant proposal, however.

CAL FIRE works with local government agencies or non-profit organizations, (any California corporation organized under Section 501(c) (3)) to implement Community Assistance Grants (CAGs). In 2018, CAL FIRE has the following grant programs:

- CCI Forest Health
- CCI Urban and Community Forestry
- Fire Prevention
- California Forest Improvement Program
- Local Assistance For Tree Mortality
- Volunteer Fire Assistance

For more information about CAL FIRE's grant programs, visit: http://www.fire.ca.gov/grants/grants. CAL FIRE also assists local agencies and councils in the wildland-urban interface grant process. Some private entities, such as utility companies, also offer private landowners fuel reduction grants.

In addition to state-sponsored programs, the Natural Resources Conservation Service provides the Environmental Quality Incentives Program (EQIP). EQIP was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP contracts provide financial assistance to implement conservation practices. Program practices and activities are carried out according to an EQIP plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or measures needed to address the resource concerns.

Fire Safe Councils assist with the award and administration of the grants that are awarded through the Grants Clearinghouse; these grant dollars may come from federal agencies such as BLM or the USFS.

The FEMA Pre-Disaster Mitigation (PDM) grant program provides assistance to communities that have identified wildfire hazard mitigation needs such as creating defensible space, applying methods for ignition-resistant construction and hazardous fuel reduction, and obtaining planning grants.

Fire safe planning efforts such as the California Fire Plan (updated in 2010), CAL FIRE Unit Fire Plans, Local Hazard Mitigation Plans (LHMPs), general plan safety elements, and local Community Wildfire Protection Plans (CWPPs) are the road maps for reducing the risk of wildfire. These plans identify projects that fit within communities' priority areas and are considered to be of most value. These documents are invaluable to the implementation of Fire Safe programs throughout the state.

CAL FIRE Historical Wildfire Activity Statistics (Redbooks)

CAL FIRE prepares annual reports of wildfire activity statewide for each calendar year. The reports, also known as "Redbooks," summarize protection areas and annual wildfire statistics including:

- Number of fires by cause, by region
- Number of acres burned by cause, by region
- Dollar damage by cause, by region
- Statewide totals of number of fires, number of acres burned, wildfire arson, and CAL FIRE structures destroyed

While the reports are intended as a statistical record of wildfire incidents responded to by CAL FIRE, the information provided in these reports is an important precursor to mitigation efforts as it provides hard numbers about causes of fires that can be used to inform local and regional fire mitigation planning. Annual Redbooks from 1943 through 2016 are available on the CAL FIRE website at the following link:
http://www.fire.ca.gov/fire_protection/fire_protection_fire_info_redbooks.

CAL FIRE also reports incidents using a web-based intranet service called California All Incident Reporting System (CAIRS) for use by CAL FIRE staff. Due to data entry differences, data in CAIRS and Redbooks may differ in completeness.

Firewise USA

Firewise USA is a unique opportunity available to America's fire-prone communities. Its goal is to encourage and acknowledge action that minimizes loss of homes to wildfire. It teaches homeowners to prepare for a fire before it occurs. The program adapts especially well to small communities, developments, and residential associations of all types. As State Liaison (2012-2017), CFSC promoted the Firewise program to its extensive list of Fire Safe Councils and community organizations. CFSC provided assistance to these community members and to local fire agencies that were working to achieve the prestigious recognition of Firewise.

While acting as the State Liaison from 2012 to 2017, CFSC increased the number of Firewise Communities in California from 50 to 92 nationally recognized communities. Firewise Communities/USA is a simple, three-step template that is easily adapted to different locales. It works in the following way:

- Wildland fire staff from federal, state, or local agencies provide a community with information about coexisting with wildfire, along with mitigation information tailored to that specific area
- The community assesses its risk and creates its own network of cooperating homeowners, agencies, and organizations
- The community identifies and implements local solutions

National Cohesive Wildland Fire Management Strategy

In 2009, Congress passed the Federal Land Assistance, Management, and Enhancement Act (FLAME Act), which directs the United States Department of Agriculture (USDA) and the Department of the Interior (DOI) to develop a national cohesive wildland fire management strategy to comprehensively address wildland fire management across all lands in the United States.

Under the direction of the intergovernmental Wildland Fire Leadership Council (WFLC), the National Cohesive Wildland Fire Management Strategy effort (Cohesive Strategy) was initiated in 2010 through a three-phased approach to planning, risk analysis, and collaboration by federal, state, local, and tribal governments and non-governmental partners and public stakeholders. The phased approach allowed systematic and thorough engagement by stakeholders throughout the effort. Each phase included milestones that serve as the building blocks for subsequent steps. A report, The National Strategy, The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy (National Strategy), and the companion National Action Plan culminate the third phase of the Cohesive Strategy effort.

The National Strategy recognizes and accepts fire as a natural process necessary for the maintenance of many ecosystems and strives to reduce conflicts between fire-prone landscapes and people. By simultaneously considering the role of fire in the landscape, the ability of humans to plan for and adapt to living with fire, and the need to be prepared to respond to fire when it occurs, the Cohesive Strategy takes a holistic approach to the future of wildland fire management.

The Wildland Fire Leadership Council (WFLC) adopted the following vision for the next century:

> *To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.*

The primary national goals identified as necessary to achieving the vision are:

- *Restore and maintain landscapes:* Landscapes across all jurisdictions are resilient to fire- related disturbances in accordance with management objectives.
- *Fire adapted communities:* Human populations and infrastructure can withstand a wildfire without loss of life and property.
- *Wildfire response:* All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

Under the National Strategy, federal, state, and local fire agencies will endeavor to collaboratively solve the wildfire problem in California. As a fire does not distinguish political boundaries, this "all hands, all lands" approach is intended to examine and subsequently reduce fire risk on a landscape scale instead of looking toward solutions for a specific jurisdiction, as has largely been done historically.

"Communities at Risk"

To help protect people and their property from potential catastrophic wildfire, the National Fire Plan directs funding to be provided for projects designed to reduce the fire risks to communities. A fundamental step in achieving this goal was the identification of communities that are at high risk of damage from wildfire.

At the request of Congress, states have submitted lists of all communities within their borders that meet the criteria of structures at high risk from wildfire and are adjacent to federal lands. These high risk communities identified within the WUI were published in the Federal Register in 2001. With California's extensive WUI situation, the list of communities extends beyond only those adjacent to federal lands and includes 1,329 communities.[222] California's "Communities at Risk" are unique communities ranging from large cities, such as San Diego and Los Angeles, to small unincorporated areas with few residents.

Post-Fire Assessments of Effects of Wildfire

Post-disaster effects can also have catastrophic impacts on life, property and the environment. For example, the Thomas Fire, which burned 281,893 acres in December 2017 and January 2018, damaged or destroyed over 1300 structures, caused the evacuation of over 100,000 people, and severely damaged the watershed in Ventura and Santa Barbara Counties. The consequences of that watershed damage became immediately evident when significant rainfall on January 9, 2018 triggered debris flows and flash floods destroying 166 structures, damaging 395 more, and taking 21 lives in Santa Barbara County.

Burn Area Emergency Response Team and State Emergency Assessment Team

The United States Forest Service (USFS) has conducted Burn Area Emergency Response (BAER) team assessments for burned areas located on federal lands. The BAER teams provide a rapid assessment of the fire area and downstream values at risk to determine whether the potential post-fire effects pose a threat to life or property. However, BAER teams only examine federal lands. The directives issued in the Governor's Executive Order S-07-08 collectively require Cal OES, the California Resources Agency, and the California Environmental Protection Agency to provide a similar service to citizens living near burned areas on state, local, tribal, or private lands.

The State Emergency Assessment Teams (SEATs) have been used to conduct similar assessments where needed on State Responsibility Areas (SRAs). While BAER teams are comprised of USFS personnel, the funding and personnel availability for SEATs is not provided for by regulation or statute. In many cases, SEATs work closely with BAER teams to avoid duplication of effort and also to ensure that entire watershed effects are evaluated, since debris torrents and mudslides, which are more common after catastrophic wildfire, occur without regard to jurisdictional boundaries. Both SEATs and BAER teams set work priorities based on potential values and threats to life, property, safety, and resources.

[222] http://osfm.fire.ca.gov/fireplan/fireplanning_communities_at_risk

Watershed Emergency Response Team

Post wildfire evaluation work on non-federal lands in California has been conducted by the California Department of Forestry and Fire Protection (CAL FIRE) in numerous ways over the past 60 years, beginning with Emergency Watershed Protection (EWP) assessments identify and mitigate hydrologic and geologic risk following wildfire. In 2007, CAL FIRE Watershed Protection Program staff developed a draft prioritization form for use in identification of fires that could present the highest risk to lives and property. This approach was revisited in 2015, and has become the basis for Watershed Emergency Response Team (WERT) deployment. WERTs are assembled and deployed to better coordinate local assistance to ensure a rapid response in identification of life safety and property hazards resulting from wildfires. The primary goal is to avoid or reduce the risk posed by post-fire hazards downslope or downstream of burn areas. For more information about WERT see *Section 6.2.4*.

Debris Removal and Recovery Capabilities

In response to the worst fire season in California recorded history, the California Governor's Office of Emergency Services (Cal OES), City of Ventura, County of Ventura, County of Santa Barbara, Federal Emergency Management Agency (FEMA), United States Army Corps of Engineers (USACE), and CalRecycle partnered in a historic recovery mission in completing the major debris removal operations on more than 640 parcels across Ventura and Santa Barbara counties associated with the Thomas Fire.

Additionally, all major work for the removal of fire and ash debris has now been completed in Butte, Lake, Mendocino, Napa, Nevada, Sonoma, and Yuba Counties. So far, nearly 1.7 million tons of debris and over 400,000 pounds of household hazardous waste and asbestos across all seven counties has been removed.

Since the October 10, 2017, disaster declaration, nearly 4,500 households have been approved for FEMA individual assistance, for a total of more than $15.7 million. Of this amount, more than $9.6 million has been approved for housing assistance that can help with home repairs or replacement, rental assistance for residents to use to find another place to live temporarily while home repairs are being made, and more than $6.1 million for other needs assistance. Other needs assistance is a grant to pay for other uninsured or underinsured expenses such as disaster-related medical, dental, or funeral costs or personal property losses.

Reimbursements to state and local agencies have also been awarded, under the FEMA Public Assistance program. The Public Assistance program is intended to benefit everyone—neighborhoods, cities, counties and states. Public Assistance dollars help clean up communities affected by disaster-related debris, repair or replace infrastructure damaged by the disaster such as roads and bridges, and reimburse for emergency protective measures such as overtime costs for first responders or evacuation and sheltering activities. So far, more than $271.8 million in Public Assistance grants have been obligated for eligible disaster-related costs, and the coming months will see millions in additional federal and state assistance to cities, counties, utility districts, and other Public Assistance recipients

The U.S. Small Business Administration (SBA) is another partner agency that plays an integral role in disaster recovery. The SBA provided assistance to businesses of all sizes, private non-profits, homeowners, and renters in the form of low-interest disaster loans. The SBA has approved nearly 1,200 loans for homeowners, renters, and businesses for more than $151 million.

Although significant and historic recovery progress has been made over the last six months, preparing for future disasters remains essential as increased flood risks that follow fires will persist for several years.[223,224]

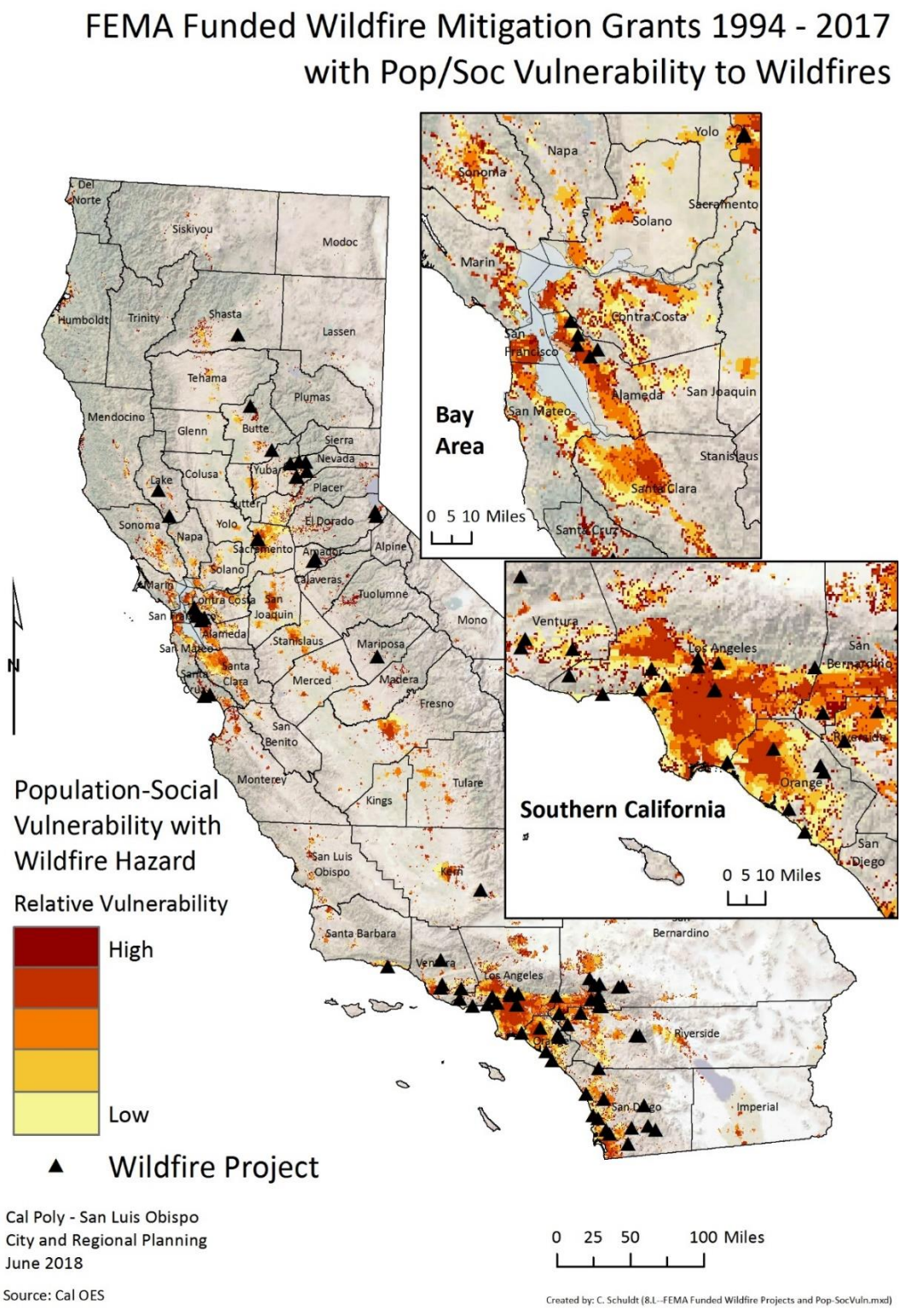
8.1.5.5 FEMA-FUNDED FIRE HAZARD MITIGATION PROJECTS

Map 8.M shows the pattern of wildfire-related Hazard Mitigation Assistance grant funded (Hazard Mitigation Grant Program and Pre-Disaster Mitigation) projects obligated since 1994 in relation wildfire vulnerability.

[223] "Major Debris Removal Operations are Complete in Southern California" May 11, 2018 Bryan May

[224] "Signs of Recovery Show Six Months After Most Destructive Wildfires in California History, Debris Removal Reaches Major Milestone" April 6, 2018 Brad Alexander

MAP 8.M: FEMA-Funded Wildfire Mitigation Projects and Population/Social Vulnerability



8.1.6 ADDITIONAL WILDFIRE HAZARD MITIGATION OPPORTUNITIES

California law requires each city and county to adopt a general plan "for the physical development of the city or county, and any land outside its boundaries which…bears relation to its planning" (Government Code Section 65300). The general plan is the "constitution" for all local development. It expresses the community's goals and embodies public policy relative to the distribution of future land uses, both public and private. The general plan must contain seven mandatory elements—land use, housing, circulation, conservation, open space, noise, and safety – and an additional environmental justice element if the planning area contains a disadvantaged community. Although WUI issues could be addressed in almost any of the mandatory elements, the most logical place for them is the safety element.

The goal of the safety element is to reduce the potential risk of death, injuries, property damage, and economic and social dislocation resulting from hazards such as fires, floods, earthquakes, and landslides. Within the safety element, local jurisdictions must address fire-safe standards, including evacuation routes, water supplies, road widths, and clearance around structures. Although fire safe planning has been required to be included in general plans since 1974, SB 1241 (2012) added more specific fire planning requirements to Government Code Section 65302.5 and intensifies the application of OPR's Fire Hazard Planning Guidelines in SRAs and VHFHSZs (see *Section 8.1.5.2*).

In 2003, OPR provided specific guidance for incorporating fire issues in the general plan in a publication entitled "Fire Hazard Planning," which is part of the General Plan Technical Advice Series. This document was updated in 2015 and can be downloaded at: http://opr.ca.gov/docs/Final_6.26.15.pdf.

The purpose of the document is to help local jurisdictions develop effective general plan policies related to fire hazard mitigation and to help Fire Safe Councils, concerned citizens, and other interested parties develop fire plans that contain policies that can easily be integrated into local general plans.

The "Fire Hazard Planning" publication encourages a collaborative approach to hazard mitigation planning that links local mitigation efforts with local land use decision-making and that involves state and local government agencies, elected officials, local planners, community members, non-profit organizations, fire districts, and others. This approach maximizes community safety and can help link planning and funding decisions. It has provided a model for other community guidance, such as that provided for communities in flood hazard zones represented by the California Department of Water Resources (DWR) handbook for communities implementing flood hazard legislation.

The "Fire Hazard Planning" document is further strengthened by the passing of Senate Bill (SB) 1241 in 2012. Among other things, SB 1241 requires communities to take the most recent "Fire Hazard Planning" document into account during periodic general plan safety element updates.

8.2 URBAN STRUCTURAL FIRE HAZARDS, VULNERABILITY, AND RISK ASSESSMENT

Identifying and Profiling Structural Fire Hazards

Structural fires are generally defined as fire originating in and burning any part or all of any building, shelter, or other structure, which may include residential, commercial, or industrial buildings. The U.S. Fire Administration (USFA) provides statistics on fires reported through the National Fire Incident Reporting System (NFIRS). The most recent report, published in 2014, documents fire loss in California broken down by property type.

Table 8.F: Reported Fire Loss in California by Property Type in 2014

Property Type	% of Deaths	% Injuries
Residential structures	60.2%	63.7%
Non-residential structures	3.1%	10.8%
Vehicles	19.4%	10.3%
Outside	13.3%	6.6%

Source: U.S. Fire Administration (USFA), 2017, https://www.usfa.fema.gov/data/statistics/states/california.html

As indicated in Table 8.F, residential and other structural fires accounted for more than half of all loss associated with fires in California in 2014. The figures, however, are total figures for all fires regardless of cause. Some casualties may be related to a single structure fire or may be a result of a larger fire or conflagration, including a wildfire. For example, residential casualty figures provided by the USFA for California for 2017 document 132 deaths.[225] Preliminary wildfire figures for California's 2017 wildfires count 41 casualties as a direct result of the October 2017 Northern California wildfires.

Single residential structural fires may be the most common type of structural fire occurring both in California and the United States as a whole and these types of fires are usually contained effectively with local fire suppression resources. While they may result in casualties, damage tends to be limited to the immediate area surrounding the burning structure.

Larger, more destructive fires in urban areas are referred to as urban conflagrations. These fires occurred with some frequency in the early urban history of the United States in major urban areas, including the cities of Boston (1872), Baltimore (1904), Chicago (1871, 1874), Jacksonville (1901), San Francisco (1851, 1906) and most recently Santa Rosa, during the October 2017 wildfires. These conflagrations tend to start as a single fire ignition in a structure and spread rapidly, causing major destruction. Common factors contributing to historical conflagration devastation included the predominance of wood construction which fueled the fires, lack of water and adequate firefighting resources. In several cases, high winds and dry conditions resulting from recent drought were cited as critical determinants of fire spread. Recently in California, however, the ignition of urban conflagration has also resulted from wildland fires during extreme weather conditions, such as occurred in Northern California in October 2017.

An additional source of urban conflagration is fire following earthquake, an example of which was the devastating fire following the Great San Francisco Earthquake in 1906. The urban fire conflagration that followed the 1906 San Francisco Earthquake did more damage than the earthquake itself. Many buildings and infrastructure were destroyed in the 1906 San Francisco Earthquake, partially as the direct result of shaking, but also due to the fires exacerbated by damaged infrastructure. A series of shocks broke the water mains that served residences primarily made of wood, and dozens of fires erupted as the shaking subsided. The losses included over 28,000 buildings, 500 city blocks, 3,000 lives, and the homes of over 200,000 people.[226]

[225] https://www.usfa.fema.gov/data/statistics/
[226] LOC, 2012

Urban Fire Conflagration

In addition those urban fires that ignite due to proximity wildland urban interface wildfires, urban structural fires and conflagration can also be triggered by many other conditions, including buildings not being built to code, buildings under construction, industrial releases and explosions, chemical explosions, earthquakes, gas leaks, arson, and civil unrest. A source of danger to cities throughout human history, urban conflagration has been reduced as a general source of risk to life and property through improvements in community design, construction materials, and fire protection systems.

For example, following the Great Chicago Fire of 1871, improvements in architecture, building design, and construction materials helped to reduce the likelihood of recurrence. Subsequent improvements in construction have been encouraged throughout the U.S. by modern building and fire codes. Although the frequency of urban conflagration fires has been reduced, they remain a risk to human safety. One reason is the current trend toward increased urban density and infill in areas adjacent to the wildland-urban interface (WUI). In an effort to keep housing close to urban jobs, areas previously left as open space due to steep slopes and high wildland fire risk are being reconsidered as infill areas for high-density housing.

The most recent example of a wildfire spreading into an urban area and resulting in urban conflagration is the October 2017 Tubbs Fire, which is described in the *Section 8.1* of this chapter. Fueled by high wind and urban structural fuel, this devastating fire, exemplifies the potential of a wildland urban-interface wildfire to penetrate farther into densely populated urban areas than previously anticipated. That fire developed into an urban conflagration and resulted in the destruction of over 5,000 structures and 22 fatalities.

Another example of urban conflagration linked to wildland fire in recent California history is the Oakland Hills firestorm, officially known as the Tunnel Fire. The firestorm occurred in October 1991, within a larger high fire hazard zone that is part of an approximately 60-mile stretch of hills running from the Carquinez Strait to San Jose in the east San Francisco Bay Area, in portions of the cities of Oakland and Berkeley. In Oakland 2,777 units were destroyed or badly damaged and 69 additional units were destroyed in Berkeley. The fire happened in a largely built-out residential area that has a long-standing fire history linked to hot, dry fall winds and the presence of dense, flammable vegetation. Seasonably strong, dry winds drove flames furiously and rapidly across an approximately 2.5 square mile area of densely developed hillside neighborhoods.[227]

Residential Warehouse Fire

Referred to as the "Ghost Ship" Fire, the warehouse fire that occurred in Oakland on December 2, 2016, resulted in 40 deaths, and left the city in a state of tragedy and loss. The warehouse was used as illegal studio living space with makeshift kitchens, large amounts of flammable materials such as wooden pallets and propane tanks, and appliances such as heaters, generators, and hot plates being used in dangerous conditions. The electrical system was overloaded and was observed to have been "modified," and extension cords and powerstrips, rather fixed outlets, were used throughout the warehouse to energize appliances.[228] According to the Oakland Fire Department's "Origin and Cause Report," the fire originated in northwest area of the building's first floor, but the Fire Department was unable to make a conclusive determination of the cause of the fire.

A host of lessons can be learned from this unfortunate disaster, from the dire need for more affordable housing in the Bay Area, to the importance of proper property management, to the necessity fire safety regulation compliance. When considering mitigating potential structural fires, building code requirements and building inspections should be key components of the mitigation program.

[227] K. C. Topping, J. Schwab, et al. Planning for Post-Disaster Recovery and Reconstruction, American Planning Association, Planning Advisory Service, Report No. 483/484. 1998. p. 261-262.

[228] Oakland Fire Departments' Origin and Cause Report, Incident #2016-085231, December 2, 2016 1315 31st Avenue; http://www.fireengineering.com/content/dam/fe/online-articles/documents/2017/oakland-ca-ghost-ship.pdf, retrieved June 1, 2017.

Construction Fires

The Santana Row Fire occurred in February 2002 in the downtown area of the City of San Jose. According to a technical report issued by the U.S. Fire Administration (USFA) in August 2002, 11 alarms were dispatched to the large structure fire and the numerous exposure fires ignited by flying embers. It required the combined effort of 221 firefighters and 65 pieces of apparatus. Fortunately, no one was killed and there were only minor injuries sustained by firefighters. Santana Row was to be a nine-building development that covered 42 acres and was spread out over several city blocks. Approximately six buildings in the 42-acre development were destroyed, causing more than $100 million in damage. Embers from the fire ignited roofs half a mile away, destroying more than 30 apartments and townhouses and causing an additional $2.5 million in damage. The cause of the fire ignition was unknown.[229]

In March 2014, a fire broke out in the Mission Bay area of San Francisco, destroying a seven-story, multi-million-dollar wood-frame apartment building under construction. Although the cause of the fire was unknown, it was fueled by a large amount of lumber, with no fire alarms or sprinklers yet installed. More than 150 firefighters and six ladder trucks responded to the fire. In addition to extinguishing the fire, efforts focused on keeping the fire from spreading to adjacent buildings, due to the high heat of the fire. One fire was ignited a block away due to embers landing on a roof, but it was quickly contained before it could spread. Low winds that day, combined with strong fire suppression, prevented this fire from becoming a significant urban conflagration.

The Temple Street Fire that occurred in Los Angeles in December 2014 provides another example of fire in unoccupied large buildings under construction. Hundreds of Los Angeles firefighters battled a massive apartment fire in the city's historic downtown, shutting down portions of two major freeways. The fire engulfed a seven-story apartment tower that was under construction on Fremont Avenue. The flames damaged two nearby buildings, including several floors of a 16-story office structure. The apartment building, one of several upscale complexes to be built in downtown Los Angeles over the past 10 years as part of an effort to revitalize the city's urban center, occupied an entire city block. The fire was fueled by the building's wooden framework. The cause of the massive fire remains unknown.

Industrial Fires

Industrial fires, depending on location, have the potential to become urban conflagrations. Also, depending on the contents of the fire, they can cause serious health problems due to both smoke and toxic materials. Examples include the 2016 Fruitland metal recycling plant fire in Maywood, California, which released heavy metals and chemicals into the air, prompting Los Angeles County to issue health advisories; and the May 2013 pallet fire in an industrial area of Fontana, in which towering stacks of wooden pallets covering a quarter acre of land turned into massive bonfires fanned by 25 mile-per-hour winds. Smaller spot-fires appeared in nearby brush but were extinguished by San Bernardino County firefighters before they could spread further.

Explosion Caused Fires

The San Bruno pipeline explosion occurred September 9, 2010, in San Bruno, California, a suburb of San Francisco, when a 30-inch (76-centimeter)-diameter steel natural gas pipeline owned by Pacific Gas & Electric exploded into flames in a residential neighborhood 2 miles (3.2 kilometers) west of San Francisco International Airport. The loud roar and shaking led some residents of the area, first responders, and news media to initially believe that it was an earthquake or that a large jetliner had crashed. It took crews nearly an hour to determine that the explosion was caused by a gas pipeline. As of September 29, 2010, the death toll was eight people. The U.S. Geological Survey (USGS) registered the explosion and resulting shock wave as a magnitude 1.1 earthquake. Eyewitnesses reported that the initial blast had a wall of fire more than 1,000 feet high.

The explosion caused a fire that quickly engulfed nearby houses. Strong winds fanned the flames, hampering firefighting efforts. The blaze was fed by a ruptured gas pipe, and large clouds of smoke soared into the sky. According to the local fire chief, it took 60 to 90 minutes to shut off the gas after the explosion, and thus the gas continued to fuel the fire. The explosion and resulting fire leveled 35 houses and damaged many more. Three of

[229] USFA-TR-153/August 2002

the damaged houses, deemed uninhabitable, were torn down in December 2010, bringing the total to 38. About 200 firefighters battled the eight-alarm fire that resulted from the explosions. The neighborhood continued to burn into the night even after the exploding gas main had been shut off. The explosion compromised a water main and required firefighters to truck in water from outside sources. Firefighters were assisted by residents who dragged fire hoses nearly 4,000 feet (1,200 meters) to working hydrants. Ordinary citizens drove injured people and burn victims to the hospital. Mutual aid responded from all over the Bay Area; responding agencies included the California Department of Forestry and Fire Protection (CAL FIRE), which sent 25 fire engines, four air tankers, two air attack planes, and one helicopter.

Terrorism/Civil Unrest

The most devastating foreign terrorism-caused urban conflagration in the United States occurred as a result of the September 11, 2001 attacks. Two airliners were crashed into the north and south towers, respectively, of the World Trade Center complex in New York City. Within one hour and 42 minutes, both 110-story towers collapsed, with debris and the resulting fires causing partial or complete collapse of all other buildings in the World Trade Center complex, including the 47-story 7 World Trade Center tower, as well as significant damage to 10 other large surrounding structures.

The most dramatic example of civil unrest contributing to urban conflagration occurred in the City of Los Angeles from April 29 to May 1, 1992, in response to an unpopular jury verdict. In the first 36 hours of the disturbance, 863 massive structures burned in a 105-square-mile area. A total of 50 persons died during the riots, and damages were estimated at over $1 billion, not all of which were a result of fires.[230]

Assessment of State Vulnerability and Potential Losses

There is no known comprehensive assessment of state vulnerability or potential losses due to urban structural fire hazards at this time. However, studies have been performed to analyze potential vulnerability due to fire following earthquakes, such as occurred during and after the 1906 San Francisco Earthquake (see *Section 6.1.4.1*). Estimating statewide vulnerability to urban fire would be a complex process, highly dependent on identifying a source or multiple sources of fire ignition, wind patterns, fuel load, topography, vegetation, land use, and firefighting resource capability and availability, including water. At this time, there is no FEMA-developed Hazards United States (HAZUS) module, as exists for earthquake and flood.

Insurance companies selling fire insurance in California each have their own system for assigning risk, setting insurance rates, and identifying geographic areas where they do not offer insurance. These formulas vary between providers and are proprietary. As such, they are not available for state or local government use.

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans (LHMPs).

As in the state vulnerability situation discussed above, there are no accessible vulnerability models available for use at the local government level. Local jurisdictions that have been mapped as containing high fire threat zones might be able to perform an initial analysis of vulnerability by overlaying the threat map with local land use, density, population, and building inventory data.

[230] https://www.usfa.fema.gov/downloads/pdf/publications/fa-142.pdf

Current Structural Fire Hazard Mitigation Efforts

California Building Code Requirements and Building Inspections

The 2016 California Building Code and Fire Code requirements regulate the design and construction of new and existing structures for fire safety. The Office of the State Fire Marshal is responsible for promulgating regulations that promote fire and life safety for inclusion into the State Building Codes including the California Building Code, California Fire Code, California Electrical Code, California Mechanical Code, California Plumbing Code, and California Historical Building Code. These documents are also referred to as California Code of Regulations (CCR), Title 24. The process incorporates a great deal of public participation and is guided by the State Building Standards Law.

Throughout the years, the State Fire Marshal has been given the responsibility of developing building standards affecting several industries. Because of the multi-faceted nature of fire protection, the Office of the State Fire Marshal has worked with local governments, fire officials, building officials, and the private sector to develop fire and life safety building standards addressing roof coverings, fire alarm systems, motion picture production facilities, hazardous materials, and organized camps. The Office of the State Fire Marshal also regulates the adoption of building standards in assembly, institutional, educational, and residential buildings as well as high-rises and any building containing state employees.[231]

Title 24, Part 9 is the California Fire Code. It includes the following general chapters:

1. Scope and Administration
2. Definitions
3. General Requirements
4. Emergency Planning and Preparedness
5. Fire Service Features
6. Building Services and Systems
7. Fire and Smoke Protection Features
8. Fire Protection Systems
9. Interior Finish, Decorative Materials, and Furnishings
10. Means of Egress

Additional specific topics and areas of regulation are included in subsequent chapters and can be found through the Office of the State Fire Marshal website at: http://osfm.fire.ca.gov/. One of those topic-specific chapters is Chapter 33, Fire Safety During Construction and Demolition, which includes specific requirements for buildings under construction, including:

- Installation and refueling of temporary heating equipment including oil-fired and LP-gas heaters
- Precautions against fire including prohibition of smoking, and storing of combustible debris, rubbish, and waste
- Storage, use, and handling of combustible materials and explosives
- Development of a pre-fire plan in cooperation with the Fire Chief
- Fire extinguishers, water supply, and standpipe requirements
- Access for firefighting equipment and personnel
- Means of egress including temporary stairways for buildings over 50 feet or four stories

[231] http://osfm.fire.ca.gov/codedevelopment/codedevelopment_title24development

Automatic Fire Suppression Requirements

All automatic fire suppression systems installed in California must meet standards adopted in the California Building and Fire Codes as well as manufacturing and performance standards, and bear the label of an approved testing laboratory.

California Code of Regulations (CCR), Section 904.7, Inspection, Testing and Maintenance Requirements for Engineered and Pre-Engineered Fixed Extinguishing Systems, states: "Inspection, Testing, and Maintenance shall be performed in accordance with the manufacturer's written instruction, which are approved and on file with the Office of the State Fire Marshal."

All businesses in California that test or service automatic fire extinguishing systems, including but not limited to fire sprinkler systems, engineered and pre-engineered fixed extinguishing systems, standpipe systems, and water flow alarm devices, must first be licensed through the Office of the State Fire Marshal or the Contractor's State Licensing Board. Applicants are granted Office of the State Fire Marshal licenses if they meet certain work experience and/or training requirements and pass an on-site field inspection of their facility.

Office of the State Fire Marshal

According to the website, the Office of the State Fire Marshal "provides support through a wide variety of fire safety responsibilities including: regulating buildings in which people live, congregate, or are confined; by controlling substances and products which may, in and of themselves, or by their misuse, cause injuries, death and destruction by fire; by providing statewide direction for fire prevention within wildland areas; by regulating hazardous liquid pipelines; by reviewing regulations and building standards; and by providing training and education in fire protection methods and responsibilities."[232]

The Office of the State Fire Marshal includes several task forces and provides educational materials, listings, and/or licensing for the following fire prevention matters:

- Automatic Extinguishing Systems
- Building Materials
- Fire Extinguishing
- Emergency Evacuation
- Residential Care Facilities
- Fire Hazard Recalls
- Fireworks
- Flame-Retardant Fabrics and Chemicals
- Fire Engineering
- Hydrostatic Testing
- Laboratory Accreditation
- Pipeline Safety
- Vapor Recovery

The website also contains a comprehensive list of all state regulations pertinent to fire prevention and response.

[232] OSFM, 2013, http://osfm.fire.ca.gov/aboutus/aboutus

California Governor's Office of Planning and Research Fire Hazard Planning Technical Advisory

California Governor's Office of Planning and Research (OPR) issued guidelines in 2015 to help local jurisdictions incorporate fire hazard planning into their general plans. In addition to the safety element, other affected general plan elements include land use, open space, conservation, and housing. The guidelines suggest that the following tasks be completed when considering fire risk in urban areas:

- Identify and classify fire hazard severity areas
- Evaluate age, condition, and size of structures (code-related issues)
- Evaluate use and occupancy of structures
- Evaluate construction materials and roofing assemblies
- Evaluate structure density
- Evaluate access and evacuation routes
- Evaluate vegetation management capabilities
- Evaluate historical fire data
- Evaluate projected future fire risk
- Evaluate other pertinent information (maps)
- Evaluate landscaping as potential fire hazard
- Evaluate neighborhood defensible space (island of safety)
- Identify fire protection jurisdictions
- Evaluate use of open space and other facilities as part of overall fire protection/mitigation plan
- Inventory urban forests and evaluate affect with regard to fire hazard

Additional information and details may be found at: http://opr.ca.gov/planning/general-plan/.

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CHAPTER 9 – OTHER HAZARDS: RISKS AND MITIGATION

CHAPTER CONTENT

9.1 Other Climate and Weather-Influenced Hazards
- 9.1.1 Agricultural and Silvicultural Pests and Diseases
- 9.1.2 Air Pollution
- 9.1.3 Aquatic Invasive Species
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9.3 Threat and Disturbance Hazards
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About Chapter 9

Chapter 9 assesses a variety of hazards and risks other than the three hazard groupings of earthquake, flood, and fire hazards examined in *Chapters 6 through 8*. Within this chapter hazards are grouped by "Other Climate and Weather-Influenced Hazards," "Technological Hazards," and "Threat and Disturbance Hazards." As suggested by the headings, the last two hazards groupings represent human-caused rather than natural disasters.

Some but not all of the hazards included in this chapter are typically characterized by more isolated, localized, and/or infrequent disaster incidents. For more information on the criteria and template used for hazard risk assessments and a discussion of the hazard classification system, see *Chapter 1: Introduction, Section 1.2.3*.

9.1 OTHER CLIMATE AND WEATHER-INFLUENCED HAZARDS

California is pursing climate change adaptation through a wide range of guidance and legislation such as Safeguarding California: Reducing Climate Risk, the California Adaptation Planning Guide, Executive Orders S-13-08 (2008) and B-30-15, and Senate Bill (SB) 246 (2015). Matching this state trajectory, the 2018 State Hazard Mitigation Plan (SHMP) integrates climate change considerations throughout the document as climate change has the potential to affect the severity, frequency, and location of hazards events.

Climate change is described broadly in *Section 4.3* and then discussed more specifically for each of the hazards potentially affected. These hazards require consideration of climate change in assessing risk and devising mitigation measures.

Section 9.1 assesses hazards that are influenced and potentially exacerbated by changes in climate and weather patterns, with the exception of various landslide, flood, and wildfire hazards, which are covered extensively in *Chapters 6, 7, and 8*. The discussion is limited to scientific assessments reviewed and validated by the appropriate state agency for the hazard and do not include the entirety of the peer-reviewed scientific literature. The National Aeronautics and Space Administration (NASA) provides the following description of these terms:

> *Weather is basically the way the atmosphere is behaving, mainly with respect to its effects upon life and human activities. The difference between weather and climate is that weather consists of the short-term (minutes to months) changes in the atmosphere. Most people think of weather in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure, as in high and low pressure. In most places, weather can change from minute-to-minute, hour-to-hour, day-to-day, and season-to-season. Climate, however, is the average of weather over time and space*.[233]

Long-term changes in the climate, especially those driven by the accumulation of human-created greenhouse gases in the atmosphere, are expected to change short-term weather patterns and thus change weather-related impacts, both short- and long-term. Most prominently, climate change is warming the average global temperatures, which will result in more frequent and intense extreme events related to changes in temperature and precipitation, such as heat waves and flooding.

In the SHMP, climate change is treated as a condition that will change and potentially exacerbate the impact of other hazards rather than as a distinct hazard with unique impacts. For example, extreme heat and heat waves are an existing hazard that will be exacerbated by climate change.

Impacts of climate change on the frequency, timing, and magnitude of flooding vary with the geography throughout the state. Areas that experience early run off from snowmelt coupled with intensified rain or coastal areas experiencing sea-level rise may be more affected by flooding than other areas of the state. Hazards that have the potential to be affected by climate change are grouped in this section. However, it is important to note that the hazards grouped in this section can also occur independent of climate change conditions.

It should also be noted that this section presents the "other climate and weather-influenced hazards" in alphabetical order. No hierarchy or ranking of priority of these hazards, or the climate-influenced hazards included in other chapters of the SHMP is implied.

[233] http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html

9.1.1 AGRICULTURAL AND SILVICULTURAL PESTS AND DISEASES

Identifying Insect Pest and Disease Hazards

California agriculture and forests are at risk from pests and diseases that, under certain conditions, can cause severe economic, environmental, or physical harm. Table 9.A identifies pests and diseases of concern.

Table 9.A: California Agriculture Pests and Diseases

Dangerous to	Pests and Diseases
Crops and other plants	Asian citrus psyllid/-Huanglong Bing (HLB) disease, Caribbean fruit fly, glassy-winged sharp shooter/Pierce's Disease, European grapevine moth, guava fruit fly, gypsy moth, Japanese beetle, Mediterranean fruit fly, melon fruit fly, Mexican fruit fly, olive fruit fly, oriental fruit fly, bark beetle
Trees	Polyphagous shot hole borers, bark beetle, gold spotted oak borer, sudden oak death (*Phythothora ramorum*), pitch canker, emerald ash borer, Asian longhorn beetle
Livestock or poultry	Foot and mouth disease, highly pathogenic avian influenzas (H5 and H7), Exotic Newcastle Disease
Humans	Africanized honeybee, mosquito
All	Red imported fire ant, bovine spongeform encephalopathy, zoonotic animal viruses

Source: http://www.cdfa.ca.gov/PHPPS/pdep/target_pests.html
Source: http://www.cdfa.ca.gov/ahfss/Animal_Health/pdfs/CA_Reportable_Disease_List_Poster.pdf

Agriculture pests and diseases can result in economic and human health disasters. For example, insect pest hazards can have a major economic impact on farmers, farm workers, packers, and shippers of agricultural products. They can also cause significant increases in food prices for consumers due to shortages. In addition, insect pests and diseases such as bark beetles, sudden oak death, and pitch canker in trees can destroy large expanses of forest and woodland, increasing the fuel load and contributing to greater fire risk.

Profiling Pest and Disease Hazards

Asian Citrus Psyllid

The Asian citrus psyllid (ACP) is a pest that acts as a carrier or vector spreading "Huanglong Bing" (HLB), a devastating disease of citrus trees. This bacterial disease is transmitted to healthy trees by the psyllid after it feeds on infected plant tissue.

The ACP damages citrus by withdrawing large amounts of sap from the plant and producing copious amounts of honeydew. The honeydew coats the leaves of the tree, causing sooty mold to grow. However, the most serious damage caused by ACP is due to its ability to effectively introduce a harmful bacterium that causes HLB disease. HLB is the most devastating disease of citrus in the world. HLB renders the fruit of the infected tree unusable. In a recent study in Florida, the presence of HLB increased citrus production costs by 40 percent.[234] It is estimated that over the last five years in Florida, HLB has caused the loss of over 6,600 jobs, over $1.3 billion in lost revenue to the citrus industry, and the loss of over $3.6 billion in total economic activity.[235]

As of 2017, California is actively eradicating the ACP and has identified only one plant infected with HLB.

Shot Hole Borer Beetles

The polyphagous shot hole borer (PSHB) and Kuroshio shot hole borer (KSHB) (Euwallacea spp.) are insects native to Southeast Asia; PSHB is from Vietnam and KSHB is from Taiwan. The known host range is huge, including 207 species in 58 plant families.

[234] Irey et al. 2008
[235] Hodges and Spreen 2012

Native California host species that can be infected by the shot hole borer include coast live oak and riparian species such as California sycamore, Fremont cottonwood, red willow, box elder, maples, and white alder. The effects of PSHB and KSHB on oak woodland and riparian ecosystems have subsequently decreased rangeland and recreational value, and increased fire risk in Southern California. Urban shade trees including English oak, silk tree, coral tree, Titoki tree, and Liquidambar (sweetgum) also host the shot hole borer. Loss of shade trees can have serious aesthetic and health effects. Commercial agricultural hosts include avocado, persimmon, olive, macadamia, eastern mulberry, hazelnut, loquat, peach, grapevine, citrus, cassava, and crabapple. Damages to these important commercial crops can cause severe economic losses.

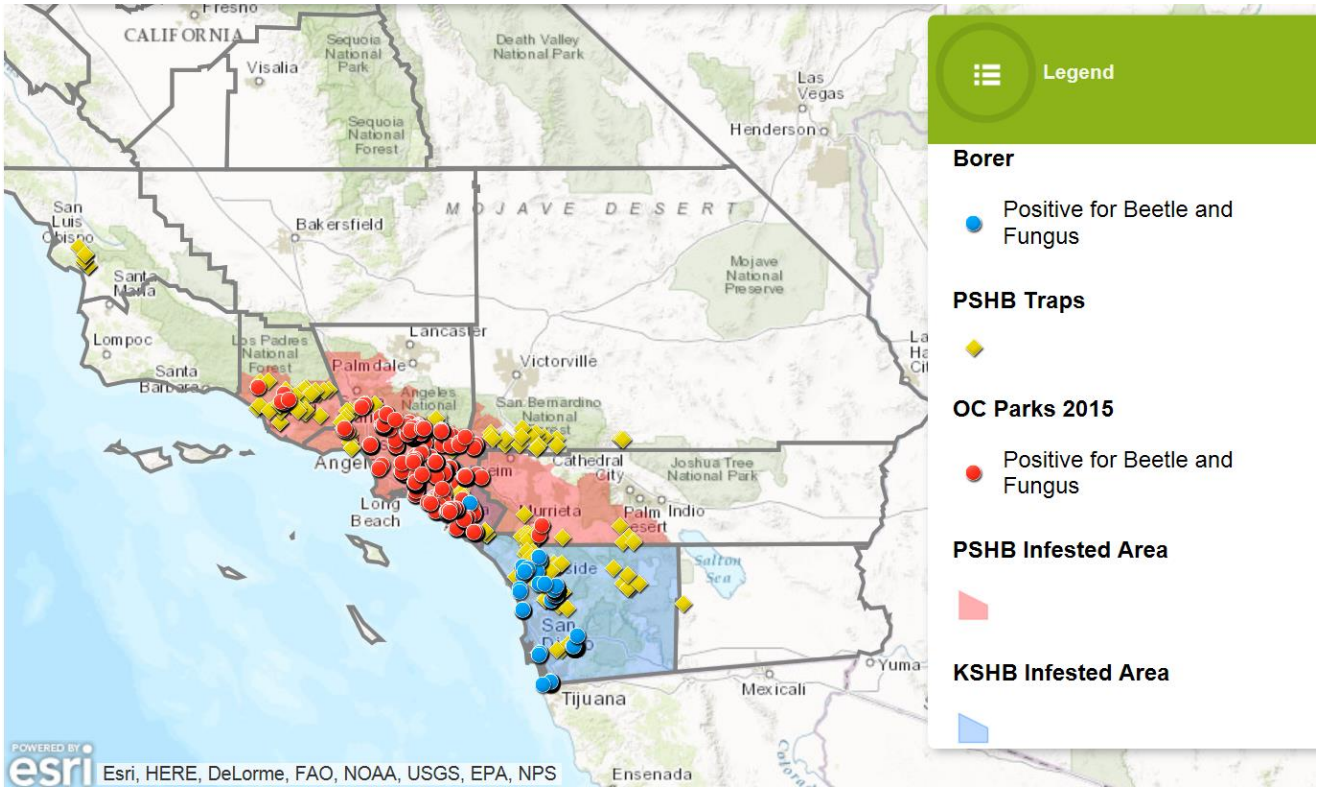
Some trees are reproductive hosts, while some are attacked but do not support the full development of the insect and the associated fungi. Table 9.B summarizes the different categories of host species in California, and Map 9.A shows spread of the PSHB and KSHB in the southern portion of the state.

Table 9.B: California Agricultural and Silvicultural Pests and Diseases, Change from 2012 to 2016

Number of:	2012	2016
Tree species attacked by beetle	286	303
Tree species infected by fungus	117	138
Agricultural crops affected	13	13
California native tree species affected	11	18
Tree families affected	62	64
Reproductive hosts	19	41

Source: California Board of Forestry and Fire Protection

Map 9.A: Polyphagous Shot Hole Borer and Kuroshio Shot Hole Borer Spread in Southern California



Source: Eskalen Lab, Department of Plant Pathology and Microbiology, University of California, Riverside (2016), https://ucanr.edu/sites/pshb/Map/.

Shot hole borers are moving toward northern areas already affected by tree mortality from bark beetle, which further threatens forests in Central California. Most pests prefer distressed or dying trees, but shot hole borers typically attack healthy trees. See *Section 9.1.11, Tree Mortality,* to learn more about vulnerability and mitigation strategies in those regions.

Bark Beetles

Native California conifer trees in the southern Sierra Nevada weakened by years of drought have experienced elevated levels of mortality from bark beetles. Bark beetles are host-specific, generally only attacking a preferred size class of a specific tree species. Bark beetles of specific concern include the western pine beetle (*Dendroctonus brevicomis*) which primarily attacks ponderosa pine; mountain pine beetle (*Dendroctonus ponderosae*), which primarily attacks sugar pine; fir engraver beetle (*Scolytus ventralis*) which primarily attacks true firs (white and red fir); and Jeffrey pine beetle (*Dendroctonus jeffreyi*), which primarily attacks Jeffery pine.

Total tree mortality in California counties from Kern County in the southern portion of the state to Placer County in the north was estimated to be upward of 75 million trees according to 2016 U.S. Forest Service aerial detection survey data. This mortality extends across both private and federal timberlands.

Foot and Mouth Disease

Foot and mouth disease (FMD) is a debilitating disease affecting all cloven–hoofed animals, including cattle, pigs, and sheep. Clinical signs commonly seen in cattle are drooling, lip smacking, and lameness, caused by blisters (vesicles) on the tongue, dental pad, and feet. Sheep and pigs have similar, but often less pronounced, clinical signs.

Many nations in the world are either endemic for various strains of FMD virus or dealing with FMD outbreaks. As of September 2017, there are 181 member counties of the World Organization for Animal Health, or OIE. Of these member countries, 98 have no official status, 68 are categorized as FMD-free, and 15 have FMD-free zones with and without vaccination use. As of 2017, North America and the majority of South America, Western Europe, New Zealand, Australia, and most Pacific island nations are free of the disease.[236] As of 2017, the following countries identified as having continuing FMD infection: Angola, Armenia, Botswana, Iran, Israel, Kuwait, Malawi, Mongolia, Morocco, Mozambique, Namibia, People's Republic of China, Saudi Arabia, South Africa, South Korea, Taiwan, Turkey, Zambia and Zimbabwe.[237] There are other countries where FMD is endemic, but they are not being tracked via OIE's "Immediate Notification and Follow-ups" reports.

Globally, the FMD virus situation changes quickly; the most current information is available in the OIE/World Animal Health Information Database.[238] The California Department of Food and Agriculture (CDFA) and the United States Department of Agriculture (USDA) work cooperatively to closely monitor and regulate the movement of livestock and animal products. Despite these efforts, the risk of disease introduction is always present. Viruses, bacteria, and pests are not controlled by borders and are capable of entering on imported animals, meat and meat products, travelers' clothing and shoes, equipment, and other contaminated objects. CDFA maintains a biosecurity web site providing information on biosecurity measures and provides specific training and exercises to prevent the introduction of this disease into the state and nation. The last outbreak of FMD in California was in 1929.

Bovine Spongiform Encephalopathy

Bovine spongiform encephalopathy (BSE), widely known as "Mad Cow Disease," is a fatal disease of cattle first recognized in the United Kingdom in 1986. Most research suggests that an abnormal protein, known as a prion, causes BSE. Scientific evidence shows the same disease agent that causes BSE in cattle also causes the new human disease, variant Creutzfeldt–Jakob disease. BSE spreads in cattle primarily through animal feed containing processed ruminant products. Cattle infected with BSE take two to eight years before showing signs of disease, which include changes in temperament such as nervousness or aggressiveness, and progressive incoordination.

[236] https://www.cdfa.ca.gov/ahfss/Animal_Health/FMD_Info.html
[237] https://www.cdfa.ca.gov/ahfss/Animal_Health/FMD_Info.html
[238] http://www.oie.int/

The National Veterinary Services Laboratory in Ames, Iowa, confirmed that a routine surveillance sample obtained from a Holstein cow carcass at a rendering plant in the Central Valley of California was positive for the atypical strain of BSE. No part of this carcass entered the human or animal food chain.

Other Animal Pests and Diseases

Diseases such as Exotic Newcastle Disease in poultry and tuberculosis in dairy cattle are credible threats to the state food supply and economy. Other diseases such as anthrax, and Deforming Wing Virus in honeybees, also pose a serious threat to the food supply.

Climate Change and Insect Pests and Diseases Hazard

California farmers contend with a wide range of crop-damaging pests and pathogens. Continued climate change is likely to alter the abundance and types of many pests, lengthen pests' breeding season, and increase pathogen growth rates. For example, the pink bollworm, a common pest of cotton crops, is currently a problem only in southern desert valleys because it cannot survive winter frosts elsewhere in the state. However, if winter temperatures rise 3 to 4.5 degrees Fahrenheit (°F), the pink bollworm's range would likely expand northward, which could lead to substantial economic and ecological consequences for the state.

According to a 2012 California Energy Commission report "Vulnerability and Adaptation to Climate Change in California Agriculture," change in climate can directly impacts crop growth through new temperature patterns and northward shifts of pests and disease. Additionally, longer growing seasons will possibly enable pest species to complete more reproductive cycles, which can increase severity of infestations.[239]

Temperature is not the only climatic influence on pests. For example, some insects are unable to cope in extreme drought, while others cannot survive in extremely wet conditions. Furthermore, while warming speeds up the lifecycles of many insects, suggesting that pest problems could increase, some insects may grow more slowly as elevated carbon dioxide levels decrease the protein content of the leaves on which they feed.

Possible future strategies to address climate change influences on insect pests and diseases might include:

- Inventorying and monitoring invasive species that threaten crops
- Downscaling climate change data to allow informed decisions on biodiversity planning by farmers and rural communities
- Strengthening the dissemination of knowledge, appropriate technologies, and tools to improve management practices related to agricultural biodiversity and ecosystem services

The above strategies were derived from Food and Agriculture Organization of the United Nations, Climate Change for Food and Agriculture, Technical Background Document from the Expert Consultation, 2008, available at: http://www.fao.org/uploads/media/FAO_2008a_climate_change_and_biodiversity_02.pdf.

Assessment of State and local Vulnerability and Potential Losses

No known state vulnerability or loss assessment is available at this time. Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

Current Insect Pests Hazard Mitigation Efforts

Agricultural Pests

The California Department of Food and Agriculture (CDFA) has extensive responsibilities for protecting the food supply, including protecting and responding to the invasion of plant diseases and pests. As part of the Plant Health and Pest Prevention Services and Pierce's Disease Control Program, CDFA administers the statewide programs.

[239] California Energy Commission, 2012. http://www.energy.ca.gov/2012publications/CEC-500-2012-031/CEC-500-2012-031.pdf

These includes the statewide exterior exclusion program, border protection stations, pest detection and emergency projects, trapping, interior exclusion quarantine programs, and Integrated Pest Control weed eradication and biological control programs.

The prevention, detection, immediate containment, and eradication of emergency animal diseases are high priorities. Some animal diseases have human health implications, and all affect production and marketability of livestock and poultry. Therefore, addressing animal disease contributes to a solid foundation for economic prosperity while decreasing human health risks for the people of California. Activities to achieve these goals include outreach and educational services, routine disease surveillance and disease investigations to detect the introduction and spread of injurious animal pests and diseases, and, when necessary, implementation of animal quarantine to control the spread of disease. The California Conservation Corps assists in mitigating the impacts of insect pests by providing human resources to assist in state and local eradication efforts, including surveying private yards and business landscapes to detect the glassy winged sharpshooter, striping citrus fruit infected by the Mexican fruit fly, and helping eradicate Exotic Newcastle Disease by cleaning and disinfecting backyards.

California county-level agriculture commissioners are charged with the protection of California agriculture, the environment, and the public's health and safety. These goals are accomplished through the management of programs that combine public outreach, industry, education, and enforcement actions. County-level agricultural commissioners carry out the following programs to accomplish these aims: Pest Exclusion, Pest Detection, Pest Eradication, Pest Management, Pesticide Enforcement, Seed Certification, Nursery Inspection, Fruits, Nuts and Vegetable Standardization, Egg Inspection, Apiary Inspection, and Crop Statistics.

CDFA licenses the agricultural commissioners and maintains a liaison office to ensure close coordination with the commissioners individually and as a group.

Silvicultural Pests

The movement of firewood is a potential source of introduction and dissemination of invasive silvicultural pests and diseases; thus, firewood management is the best control method for limiting the spread of pests and diseases that can damage forest resources. As shot hole borer beetles continue to spread throughout forests and crops in southern and central California, efforts to manage the movement of firewood have become increasingly important.

The California Firewood Task force was established in 2011, as part of the California Forest Pest Council, to facilitate educational campaigns such as “Buy It Where You Burn it.” The campaign stresses the following messages:

- Buy or collect firewood from a source near where it will be used.
- Don’t take firewood home from a trip.
- Find local firewood vendors at firewoodscout.org.
- Only obtain as much wood as you will need, and burn responsibly.

The California Firewood Task Force website includes information on invasive species of concern, consumer questions to ask when buying firewood from a vendor, firewood best management practices, and more. Also available on the website is Firewood Scout, a database of firewood dealers throughout the state that consumers can use when looking for local firewood vendors. For more information about the Firewood Task Force, visit: http://www.firewood.ca.gov/.

Additional control options include sanitation, chemical prevention, biocontrol, and advanced use of monitoring tools. However, these methods are still being tested and developed by researchers.

Governor Brown issued a Proclamation of a State of Emergency Executive Order on October 30, 2015 due to significant public safety hazards created by elevated levels of tree mortality in and amongst communities in the southern Sierra Nevada. A Tree Mortality Task Force was convened to coordinate the actions of federal, state, and local agencies addressing these public safety hazards. The Tree Mortality Task Force is chaired by the Governor’s Office, the California Department of Forestry and Fire Protection (CAL FIRE), and the California Governor’s Office of

Emergency Services (Cal OES). The high hazard counties participating in the Tree Mortality Task Force are Amador, Calaveras, El Dorado, Fresno, Kern, Madera, Mariposa, Placer, Tulare, and Tuolumne. Each of these counties has declared a local state of emergency and has convened a county-level task force to coordinate hazard mitigation activities at the local level.

Invasive Species Council of California

The Invasive Species Council of California (ISCC) was established in 2009 to provide leadership and authority in state government regarding invasive species, with its primary goal being to guide efforts to keep invasive species out of the state and to eradicate incipient populations of undesirable species. ISCC is an inter-agency council chaired by the Secretary of the California Department of Food and Agriculture with members from the California Natural Resources Agency, the California Environmental Protection Agency, the California Business, Transportation and Housing Agency, the California Health and Human Services Agency, and the California Governor's Office of Emergency Services (Cal OES). The ISCC has appointed a California Invasive Species Advisory Committee (CISAC) primarily tasked with making recommendations to develop an Invasive Species Action Plan and prioritize actions defined in the plan. For more information regarding the ISCC and the CISAC, visit: http://www.iscc.ca.gov/.

Agricultural pests and diseases are an economic hazard and, in some cases, a hazard to human health. Mitigation for pests and diseases should include an integrated pest management strategy. For additional information, visit:

- www.ipm.ucdavis.edu/GENERAL/tools.html
- http://cadms.ucdavis.edu/
- http://www.vetmed.ucdavis.edu/vetext/index.cfm

Progress Summary 9.A: Initiatives and Technology to Combat Pests and Diseases

Progress as of 2018:

California Forest Pest Council – California Firewood Task Force

The California Firewood Task Force has focused on promoting the "Buy It Where You Burn It" campaign since 2011 in an effort to increase public awareness about the risks of spreading pests and diseases via long-distance firewood movement. The Task Force produces outreach materials that are disseminated to local, state, and federal partners as well as other interested parties. Task Force members staff outreach booths at numerous events each year, engaging the public, legislators, and professionals about the importance of acquiring locally sourced wood and not moving it from location to location, to help stop the spread of invasive species. For more information visit: http://www.firewood.ca.gov/.

Pest Reporting App

The pest reporting app provides the public with the ability to photograph and report suspected harmful pest to state and local agricultural officials. Using camera and Global Positioning System (GPS) technology, the app provides California Department of Food and Agriculture (CDFA) invasive species specialists with valuable visual information. The mobile app is connected to CDFA's "Report a Pest" database where an invasive species specialist can identify the pest and contact the citizen with information. Owners of iPads and iPhones can choose to use GPS coordinates to show the location of the find, allowing CDFA to respond quickly to invasive pest emergencies. For more information visit: http://www.cdfa.ca.gov/apps/reportapest.html.

Additional Insect Pests Hazard Mitigation Opportunities

CDFA is using USDA Specialty Crop Block Grants to leverage state and local efforts for research and public outreach programs.

9.1.2 AIR POLLUTION

Identifying Air Pollution Hazards

Although air pollution is rarely a single event as significant as flood, fire, or earthquake, cumulatively it is much more hazardous to the health of large numbers of Californians. Sources of air pollution are generally grouped into four major categories: stationary, mobile, area-wide, and natural sources.

Stationary sources include fixed facilities such as: power plants and landfills. Mobile sources of pollution are typically generated as a result of operation of vehicles such as cars, trucks, ships, and airplanes, and are often the largest source of emission in a region. Area sources of pollution may result from agriculture, construction grading, or unpaved roads. Natural sources of pollution can include plant pollens, biological decay, and windblown dust.

Air pollution from stationary (fixed) and mobile sources (e.g., factories and cars, respectively) is a complex mixture of gases, fumes, and particles released into the atmosphere from the combustion of fossil fuels and evaporation of solvents.

In addition to the cumulative impacts of air pollution, temporarily hazardous air conditions can occur as a result of natural and man-made hazards, including wildfires, high winds and dust, volcanic activities, stratospheric ozone intrusion, hazardous material accidents, structural fires, and fireworks.

Particulate Matter

Particulate matter (PM), one of six U.S. Environmental Protection Agency (EPA) criteria air pollutants, is a mixture that can include organic chemicals, dust, soot, and metals. Differences between $PM_{2.5}$ and PM_{10} are usually described as the difference between fine and coarse particles.

Particulate matter$_{2.5}$ or $PM_{2.5}$, consists of fine particles that are 2.5 micrometers (about 1 ten-thousandth of an inch) or less in diameter. This is less than the thickness of a human hair (typically 50 to 70 micrometers). These particles are typically combustion particles from motor vehicles, power plants, industrial processes and factories, wildfires, residential wood burning, agricultural burning, and other activities.

Particulate matter$_{10}$, or PM_{10}, consists of coarse particles that are 10 micrometers or less in diameter. These particles are larger than $PM_{2.5}$ particles, but are still less than the thickness of a human hair. PM_{10} includes mostly dust, pollen, and mold.

Ozone

Ozone is not directly emitted. It is a secondary pollutant produced from nitrogen oxides (NOx) and volatile organic compounds (VOC) (also called reactive organic compounds [ROG]) in the presence of sunlight. The main sources of the components of ground-level ozone are trucks, cars, planes, trains, factories, farms, construction, and dry cleaners. Ozone levels are typically highest in the afternoon and on hot days.

Studies of historical ozone levels find that increased daytime temperatures increase ozone concentrations.[240] Ground-level ozone increases the risk of disease and death from cardiovascular and respiratory conditions.[241]

Health Risks Resulting from Poor Air Quality

PM and ozone are two indicators of air pollution, that are closely linked to short- and long-term adverse health effects.[242]

[240] Kleeman, Michael J., Chen, Shu-Hua, and Harley, Robert A. Climate Change Impact on Air Quality in California: Report to the California Air Resources Board. June 2010. Available online at: https://www.arb.ca.gov/research/apr/past/04-349.pdf

[241] CalBRACE $PM_{2.5}$ Indicator narrative; https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHVIs/BRACE_PM25_776_Narrative_8-1-2017.pdf

[242] CalBRACE $PM_{2.5}$ Indicator narrative; https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHVIs/BRACE_PM25_776_Narrative_8-1-2017.pdf

$PM_{2.5}$ is an extremely small pollutant, and human exposure to it is linked to adverse health outcomes. The smaller the particles, the deeper they can move into the lungs when people breathe. $PM_{2.5}$ is capable of reaching deep into the lungs and causing a host of diseases including lung cancer, heart disease, respiratory disease, acute respiratory infections, and mortality. $PM_{2.5}$ is also linked to hospital emergency department admissions for pulmonary inflammation among asthmatic children and people with other respiratory conditions.[243]

PM_{10}, like $PM_{2.5}$, is an extremely small pollutant, and human exposure to it is also linked to adverse health outcomes. PM_{10} is linked to irritation of the eyes, nose, and throat. It can also cause reduced lung function, asthma, heart attacks, heart disease, and premature mortality.

Ozone is among the most widespread and significant air pollution health threats in California. Studies have shown that exposure to ozone is associated with decreased lung function, respiratory symptoms, hospitalizations for cardiopulmonary causes, emergency room visits for asthma, and premature death. At higher daily concentrations, ozone increases asthma attacks, hospital admissions, daily mortality, days of restricted activity, and school absences.[244] Besides harming human health, ground level ozone can harm crops, alter food quality and costs, and have harmful effects on sensitive vegetation and ecosystems.[245]

Profiling Air Pollution Hazards

Overview

Air pollution is a continuing problem, with the largest concentration of pollution in the most populated air basins: the San Francisco Bay Area, San Joaquin Valley, Sacramento Valley, San Diego, and the South Coast. Pollutants include smog, soot, and toxic air contaminants (TACs). However, some air toxic emissions in California are on the decline. Table 9.C shows the average quantities of emissions in tons per day from 2000 to 2015 as well as forecasts to 2035. Forecast emissions for future years take into account emissions data, projected growth rates, and future adopted control measures.

Table 9.C: Air Pollutant Emission Trends and Forecasts in California, 2000-2035

Pollutant	2000	2005	2010	2015	2020	2025	2030	2035
Volatile Organic Compounds (VOC)	2,902	2,261	1,943	1,624	1,561	1,554	1,568	1,574
Nitrogen Oxides (NO_X)	3,782	3,214	2,324	1,887	1,553	1,312	1,224	1,200
Sulfur Oxides (SO_X)	289	287	123	78	82	88	94	101
Diesel Particulate Matter (PM)	86	88	54	31	25	23	23	25
$PM_{2.5}$	661	524	447	410	414	419	434	441
PM_{10}	2,436	1,700	1,549	1,491	1,525	1,544	1,572	1,590
Ammonia (NH_3)	730	741	752	719	742	770	776	779

Source: California Air Resources Board (CARB), Background Material: Almanac of Emissions and Air Quality, 2013 Edition - Chapter 3 Statewide Trends and Forecasts.2013. https://www.arb.ca.gov/aqd/almanac/almanac13/chap313.htm

[243] CalBRACE $PM_{2.5}$ Indicator narrative; https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHVIs/BRACE_PM25_776_Narrative_8-1-2017.pdf
[244] CalBRACE Ozone Indicator narrative; https://www.cdph.ca.gov/Programs/OHE/CDPH%20Document%20Library/CHVIs/BRACE_Ozone_801_Narrative_11-8-2016.pdf
[245] California Department of Public Health. Public Health Impacts of Climate Change in California: Community Vulnerability Assessments and Adaptation Strategies. 2007 Retrieved on 9/4/2017 from http://cehtp.org/download/climate_change/public-health-impacts-of-climate-change-in-ca-report-no-1-heat-related-illness.

The 2013 Edition of the Almanac of Emissions and Air Quality, Chapter 3 – Statewide Trends and Forecasts, includes a detailed discussion of these trends and forecasts and can be downloaded from the California Air Resources Board (CARB) website at the following link: https://www.arb.ca.gov/aqd/almanac/almanac13/chap313.htm.

Most counties in California meet federal and state air quality standards for the pollutants summarized in Table 9.C; however, some counties are still working to attain the ozone, $PM_{2.5}$, and PM_{10} standards. Map 9.B indicates that 23 counties are in attainment, 12 are unclassified, and 23 are in non-attainment for $PM_{2.5}$ standards as of December 2015. Map 9.C indicates that 5 counties are in attainment, 3 are unclassified, and 50 are in non-attainment for PM_{10} standards as of December 2015. Map 9.D indicates there are 10 counties in attainment, 3 counties unclassified, and 45 counties in non-attainment for ozone standards as of December 2015.

These and other air pollutant maps for California can be downloaded from the CARB website at the following link: https://www.arb.ca.gov/desig/adm/adm.htm.

Climate Change and Air Pollution Hazard

Climate change is anticipated to modify long-term weather patterns in California, with direct consequences for air quality and public health. The air pollutants that cause climate change are a global focus for reduction. Many greenhouse gases, such as methane, also have public health consequences. In addition, indirect impacts of climate change, such as changes in weather patterns and increases in wildfire, can exacerbate existing air quality challenges and introduce new ones. For example, higher temperatures increase the production of ozone; with more wildfires comes an increase in particulate matter (PM); and increased drought and wind produce increased dust.

Ozone production increases with higher temperatures and greater penetration of ultraviolet (solar) radiation. Climate change increases the average temperature and, in many locations, reduces precipitation, which in turn increases solar exposure.[246] If ozone precursors (NOx and VOC) are present, climate change can increase ozone production. Even in areas where ozone production is low, wind can deliver ozone to areas less likely to generate it locally, such as higher altitude areas in California which tend to be low ozone-producing settings.[247] Increased ozone production will have consequences for many regions of California, regardless of the presence of precursors.

Climate change has the potential to worsen PM concentrations in California due to increased incidence of wildfire (see *Section 8.1*) as well as the increased temperature and reduced precipitation in many locations. Smoke and ash produced by fire increase PM concentrations. Similarly, dry, warm weather can result in greater amounts of dust being blown and suspended in air.

Among other issues, climate change threatens public health through a decline in the basic human life support system of air quality and increased extreme heat and wildfire events that will further affect air quality. The resulting human health impacts from climate change include increases in the risk and occurrence of asthma, allergies and other respiratory ailments, and cardiovascular disease.[248]

With the projected increasing temperatures, demand for electric power generation to run air conditioning will increase, potentially resulting in increased production of power plant air pollutants which may contribute further to poor air quality. It should also be noted that climate change magnifies existing health inequities including exacerbating health impacts on vulnerable populations due to poor air quality.

[246] IPCC. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. 2013. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 1535 pp.
[247] California Department of Public Health. Public Health Impacts of Climate Change in California: Community Vulnerability Assessments and Adaptation Strategies. 2007. Retrieved on 9/4/2017 from http://cehtp.org/download/climate_change/public-health-impacts-of-climate-change-in-ca-report-no-1-heat-related-illness
[248] Safeguarding California Plan: 2018 Update; http://resources.ca.gov/climate/safeguarding/

Map 9.B: Area Designation Map for $PM_{2.5}$



Source: California Air Resources Board https://www.arb.ca.gov/desig/adm/adm.htm

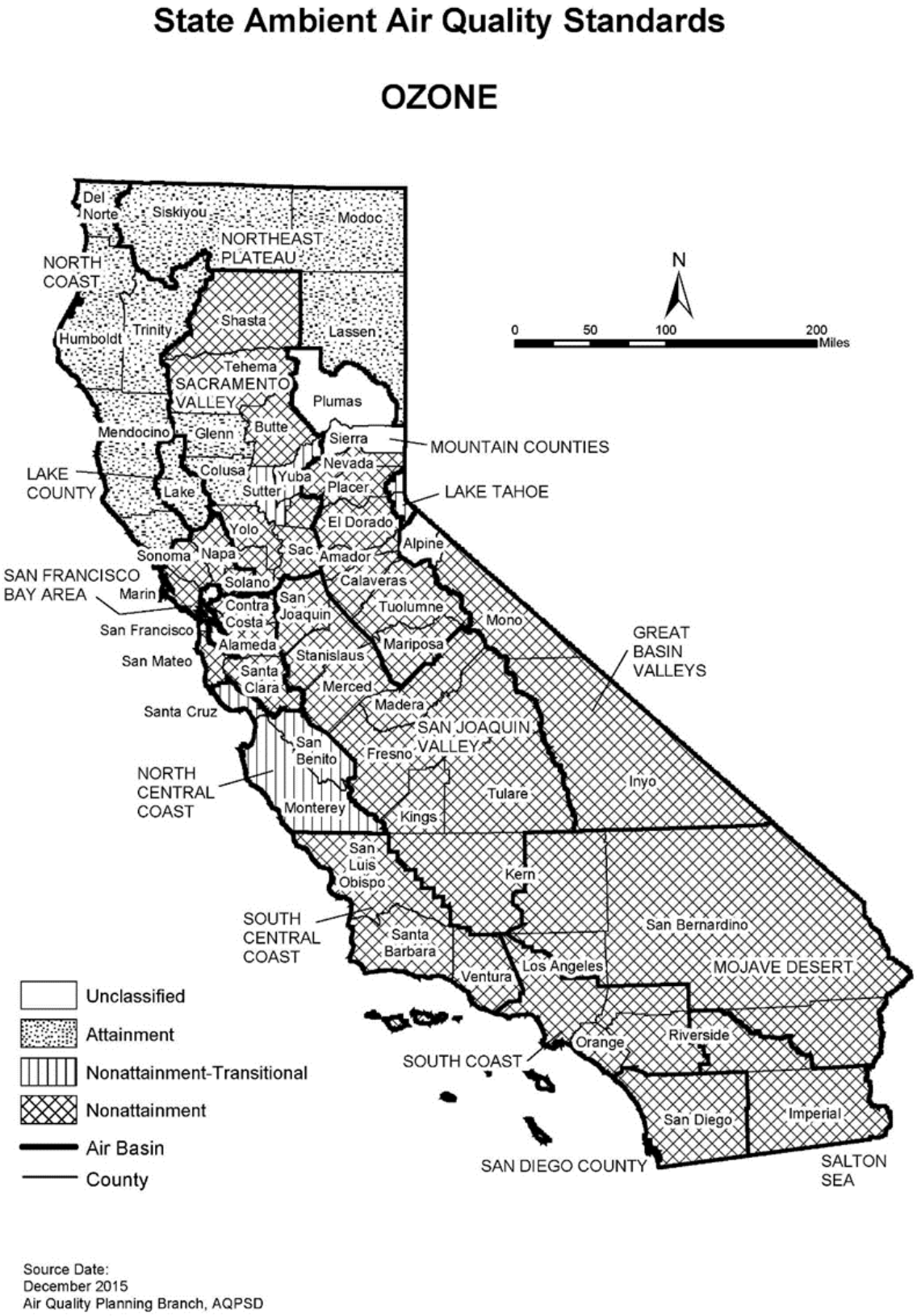
Map 9.C: Area Designation Map for PM_{10}



Source Date:
December 2015
Air Quality Planning Branch, AQPSD

Source: California Air Resources Board https://www.arb.ca.gov/desig/adm/adm.htm

Map 9.D: Area Designation Map for Ozone



Source: California Air Resources Board https://www.arb.ca.gov/desig/adm/adm.htm

State Vulnerability and Potential Losses

Densely populated and agricultural regions are the most exposed and vulnerable to severe air pollution. Negative public health impacts are considered a major risk resulting from air pollution hazards. Certain populations are more prone to illness from air pollution, due to location in proximity to emission sources, socio-economic status, race, occupation, age, or existing health issues.

The California Air Resources Board (CARB) has an active research program to investigate the health effects associated with air pollution exposure, particularly in citizens who may be more sensitive to air pollution effects, such as children and the elderly. Public health impacts are tracked and analyzed in multiple research studies. Health effects research information is available on the CARB website: https://www.arb.ca.gov/research/health/healthres.htm. An assessment of climate change impacts on the state's air quality was prepared for CARB in 2010. The assessment report can be downloaded at: https://www.arb.ca.gov/research/apr/past/04-349.pdf.

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment (OEHHA) produces and makes publicly available reports, notices, and documents about health risk assessments of chemical contaminants found in air, including those identified as toxic air contaminants (TACs) or on the list of chemicals under the "Hot Spots" Information and Assessment Act. Assessments include development of Cancer Potency Factors to assess the cancer risk from carcinogens in air, and development of Reference Exposure Levels to assess non-cancerous health impacts. OEHHA has developed and updates risk assessment guidance for use in site-specific risk assessments under the Air Toxics Hot Spots program. OEHHA also makes health-based recommendations to CARB for ambient air quality standards. Recent legislation, the Children's Environmental Health Protection Act, requires OEHHA to explicitly consider infants and children in evaluating health risks of air pollutants. OEHHA is evaluating current risk assessment methods for their adequacy to protect children.

OEHHA also conducts epidemiological investigations of the health effects of criteria air pollutants. Such investigations include health impacts on sensitive sub-populations such as children and the elderly. For example, OEHHA conducted an evaluation of the impacts of traffic-related pollutants on children. Specifically, the evaluation analyzed the relationship between respiratory health of children and proximity of their schools to heavily traveled roadways including measured exposure to traffic-related pollutants.

OEHHA also evaluates health effects of chemicals commonly found in indoor air. OEHHA participates in a number of inter-agency activities designed to evaluate indoor air quality health issues and to move California toward safer indoor air quality. OEHHA provides health-related assistance to CARB, air pollution control districts, local health officers, and environmental health officers.[249]

CalEnviroScreen

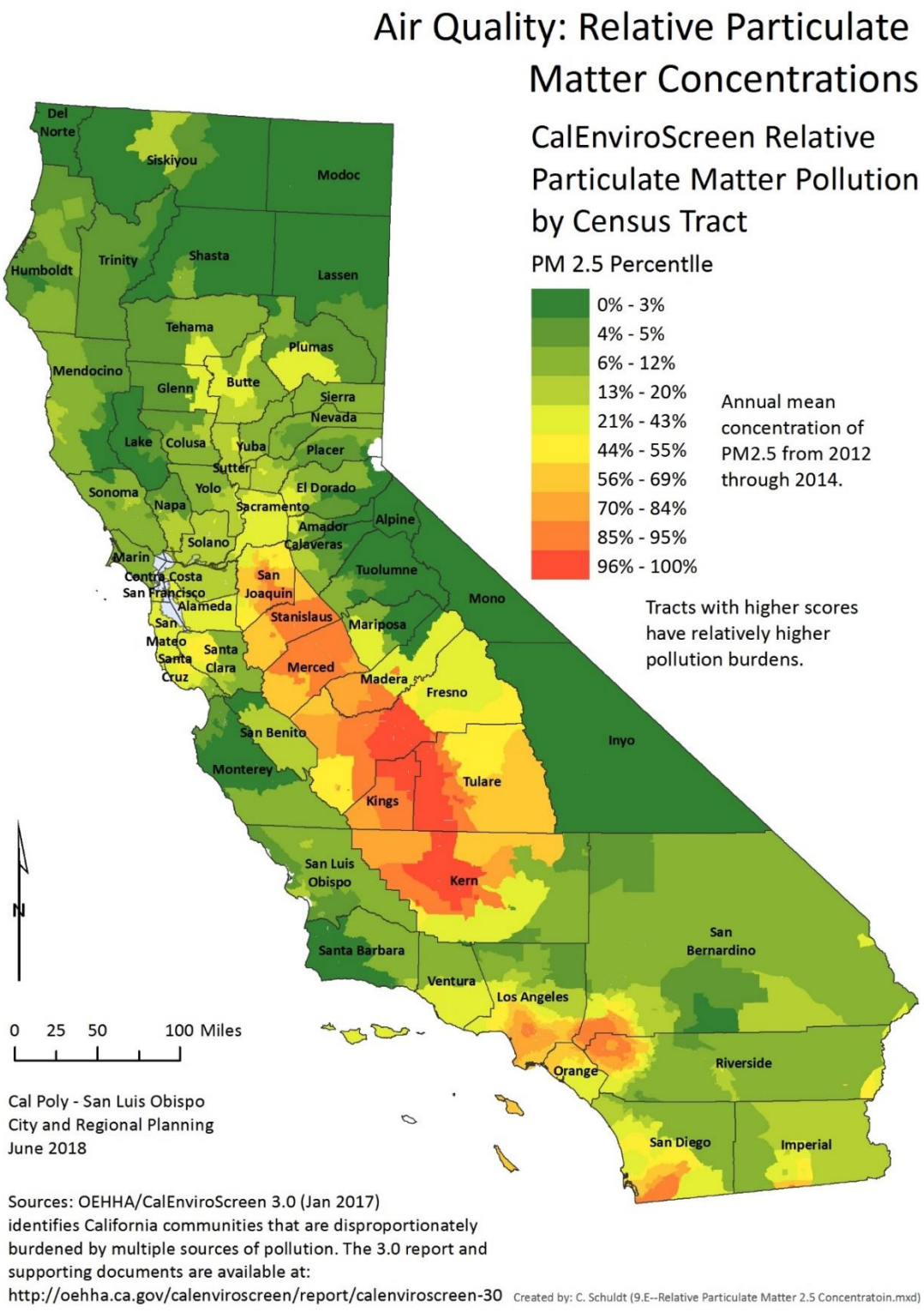
OEHHA developed and maintains the CalEnviroScreen mapping tool as a screening methodology that can be used to help identify California communities that are disproportionately burdened by multiple sources of pollution, including air pollution. "Air Quality: $PM_{2.5}$"and "Air Quality: Ozone" are two of seven pollution exposure indicators used to calculate "pollution burden," which is a factor in overall CalEnviroScreen scores for communities.[250]

Maps 9.E and 9.F present air quality and air pollution data available from CalEnviroScreen. For more information about CalEnviroScreen, see *Section 4.4.6* and also the program website: https://oehha.ca.gov/calenviroscreen.

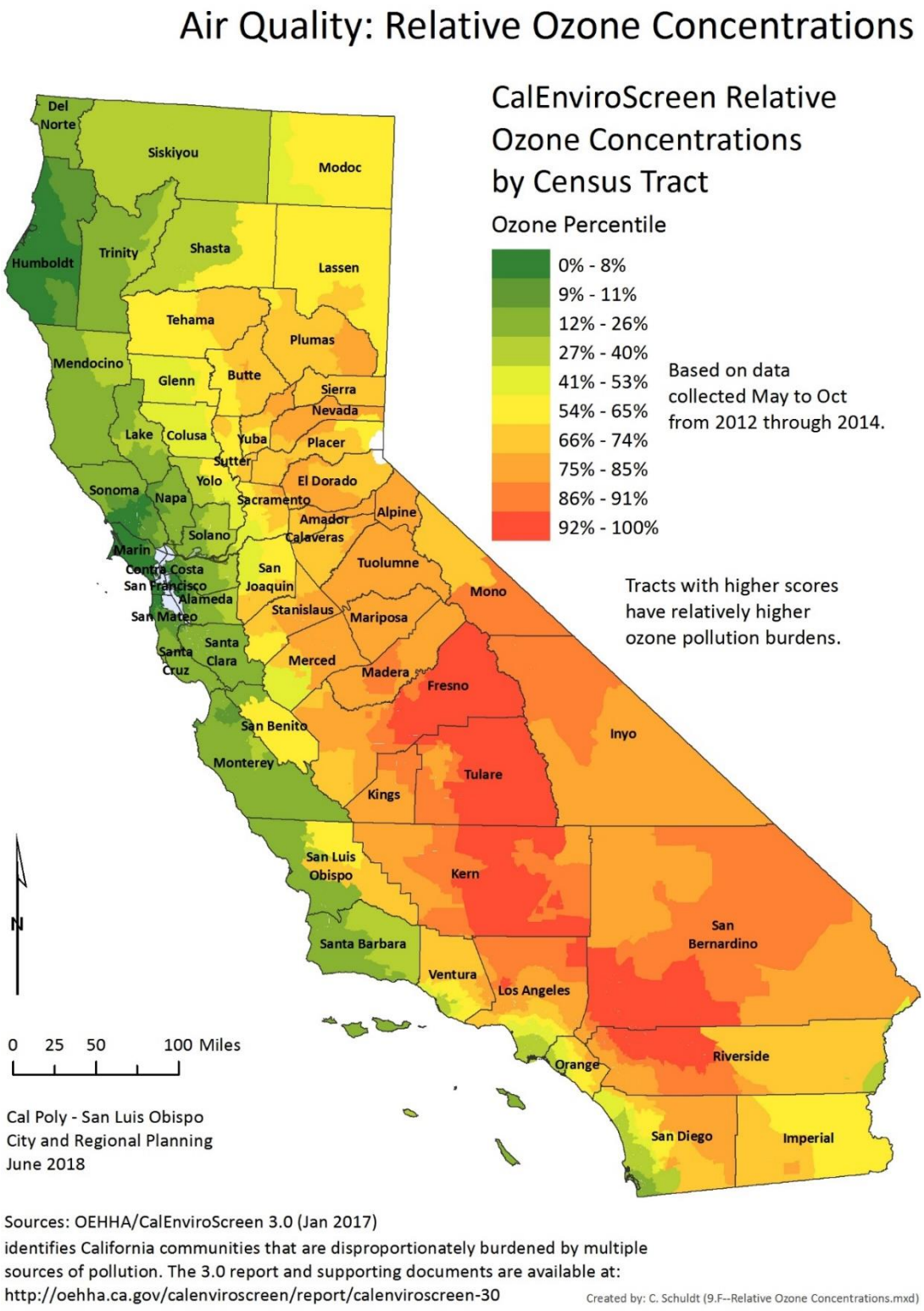
[249] https://oehha.ca.gov/air

[250] Pollution burden and population characteristics together are used to calculate the overall CalEnviroScreen score.

Map 9.E: Relative Particulate Matter Concentrations in California from CalEnviroScreen



Map 9.F: Relative Ozone Concentrations in California from CalEnviroScreen



California Building Resilience Against Climate Effects (CalBRACE)

The California Building Resilience Against Climate Effects (CalBRACE) program has developed data and narrative vulnerability reports for various indicators including air quality ($PM_{2.5}$ and ozone). The CalBRACE air quality indicator narratives describe certain populations that are prone to the impacts of worsened air quality exacerbated by climate change.

To download the CalBRACE air quality indicator data and narrative as well as the population sensitivity and adaptive capacity indicator data and narratives relevant to air quality, visit: https://www.cdph.ca.gov/Programs/OHE/Pages/CC-Health-Vulnerability-Indicators.aspx.

For more information about CalBRACE, visit the California Department of Public Health (CDPH) Health Equity Program webpage and follow the Climate Adaptation link to the CalBRACE program website: https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx.

California Environmental Health Tracking Program

The California Environmental Health Tracking Program (CEHTP) is a program of the Public Health Institute, in partnership with CDPH.

CEHTP conducts tracking and surveillance of environmental hazards and health outcomes in California, providing publicly available data to visualize and link environmental hazards and health and to explore possible associations between the environment and health outcomes. For more information visit: http://cehtp.org/page/main.

Progress Summary 9.B: Partnerships for Environmental Public Health: Imperial County Community Air Monitoring Project

Progress as of 2018: In 2017, the California Environmental Health Tracking Program, along with academic partners University of Washington, University of California, Los Angeles (UCLA), and George Washington University, partnered with Comité Cívico Del Valle Inc. to develop a community-engaged project aimed at reducing pollutant exposures to improve health of community members in Imperial County through development of a low-cost air quality monitoring network.

The project coordinated community input and assessment for the placement of portable air monitors, and the installation of air monitoring equipment was completed by Comité Cívico Del Valle Inc. staff. Real-time particulate matter (PM) air pollution data from the monitors are accessible on the Identifying Violations Affecting Neighborhoods (IVAN) Imperial website, a platform previously developed by the community to report violations involving toxic substances.

The IVAN Air Monitoring portion of the site provides air quality data in a map or list form and lets users sign up for alerts. To inform the design of the IVAN Air Monitoring site and the health messaging displayed there, the California Environmental Health Tracking Program conducted needs assessments and focus groups with residents and members of the Community Steering Committee.

Project collaborators are conducting analysis of the data from the monitors and intend to use this information to identify "hot spots" and to show how wind direction and transport of the pollutants affects PM levels. Analysis results can be used by the community to inform public health actions, such as developing new routes to school through less polluted areas.

To ensure accuracy and reliability of the low-cost monitoring equipment, project partners are exploring potential collocation of project monitors with regulatory monitors with the local air district, the California Air Resources Board, and the U.S. Environmental Protection Agency.

For more information, visit: https://ivan-imperial.org/air.

Local Vulnerability and Potential Losses

Local Hazard Mitigation Plans may provide information on vulnerability and potential losses associated with air pollution in a specific city or county. Local air district websites may also contain information about vulnerability and potential losses specific to that region.

Current Air Pollution Hazard Mitigation Efforts

There are numerous state and local regulations that mitigate or prevent air pollution from reaching unacceptable standards.

California Air Resources Board

The California Code of Regulations mandates that the California Air Resources Board (CARB) establish and monitor regulatory activity of the state's 35 local air districts, particularly as it relates to motor vehicles and public health. CARB also distributes a substantial amount of information regarding air quality standards, research, health, trends, and measurement methods on its website.

For more information on local, state, and federal statutes plus state and local regulations affecting air quality management in California visit the CARB Laws and Regulations web page: https://www.arb.ca.gov/html/lawsregs.htm.

Local Air Districts

Local Air Pollution Control Districts (APCDs) and Air Quality Management Districts (AQMDs) are responsible for controlling and monitoring stationary sources of air pollutants. Some districts have expanded their scope of activities to include education and incentive programs. Every district has its own website, which can be found by clicking on the district of interest on the following map provided by CARB: https://www.arb.ca.gov/capcoa/dismap.htm.

Senate Bill 1000 (2016), Disadvantaged Communities, and Pollution Reduction

Senate Bill (SB) 1000 (2016) requires cities and counties that have disadvantaged communities to incorporate environmental justice policies into their general plans, either by providing a separate environmental justice element or by integrating related goals, policies, and objectives into the other general plan elements.

New Government Code regulations stemming from SB 1000 (2016) require that, as part of their general plan updates, local jurisdictions with disadvantaged communities identify objectives and policies to reduce pollution exposure, including air pollution exposure.[251] The 2017 General Plan Guidelines include extensive discussion of general plan air quality element requirements and mitigation actions that local jurisdictions can take to address air pollution and improve air quality through their planning decisions. The General Plan Guidelines also examine air quality linkages to climate change and urban heat islands.

Strategic Growth Council – "Affordable Housing and Sustainable Communities Program"

California is a national leader in its efforts to protect natural resources, reduce greenhouse gas emissions, and move toward sustainable communities. In 2010, the Strategic Growth Council (SGC), created through adoption of SB 732, The Council's mission is to help make California's communities more sustainable. The Council defines sustainability holistically through: reducing greenhouse gas emissions; improving air and water quality; improving protection of natural resources and agricultural lands; increasing the availability of affordable housing; improving public health, improve transportation; encouraging sustainable land use plans and greater infill development; and revitalizing urban and community centers in a sustainable manner.

For more information regarding the SGCs grant program, see: http://sgc.ca.gov/programs/ahsc/vision/.

[251] Government Code section 65302(h)

9.1.3 AQUATIC INVASIVE SPECIES

Identifying and Profiling Aquatic Invasive Species

Non-indigenous species (NIS) are transported to new environments, both intentionally and unintentionally, through human activities. Ships transfer organisms to California waters from throughout the world. Once introduced, invasive species could become a permanent part of an ecosystem and may flourish, creating environmental imbalances, presenting risks to human health, and causing significant economic problems. The introduction of non-indigenous species into California's marine, estuarine, and freshwater environments can cause significant economic, human health, and ecological impacts. A non-indigenous species is considered an invasive species when it becomes established in a new geographic location, causing impacts.

Pathways for Introducing Aquatic Invasive Species

Nonindigenous species are introduced into aquatic habitats through multiple pathways, including aquaculture, aquarium trade, commercial shipping, live bait, live seafood trade/commercial fishing, marine debris, and recreational vessels. Each of these vectors contributes to aquatic invasive species introductions, but maritime transportation is the primary vector moving species around the globe. Vessels transport organisms through two primary mechanisms (vectors): ballast water and biofouling. Ballast water is taken on and later discharged by a vessel during cargo loading and unloading operations to maintain the vessel's trim and stability. Biofouling refers to the organisms or community of organisms that are directly attached to, or associated with, wetted hard surfaces of the vessel, such as the hull.

Climate Change and Aquatic Invasive Species

Climate change, which is warming marine waters and altering the water chemistry (such as changes to water salinity and pH), can also bolster invasive species populations and range. The changes in marine environment can weaken native species not accustomed to warmer temperatures or altered water chemistry. Non-indigenous species tend to be more tolerant and resilient to changes in their environment; therefore, shifts in species composition due to climate change events can favor invasive non-indigenous species over native species.

Assessment of State Vulnerability and Potential Losses

The marine, estuarine, and freshwaters environments of California are home to hundreds of invasive species. The San Francisco Bay Delta has more identified non-indigenous species present than any other estuary in North America, and perhaps the world. In aquatic environments, invasive species threaten aquaculture operations, recreational boating, agriculture, water conveyance, commercial and recreational fishing, marine transportation, and tourism, among other industries, all of which are essential to California's economy. In 2013, California's ocean-based economy employed roughly 500,000 people and accounted for almost $41 billion of California's total gross domestic product.[252]

In California's freshwater lakes, rivers, and reservoirs, zebra and quagga mussel infestations now pose a significant threat to the state's complex water conveyance system. As of 2016, more than $24 million has been spent on control and management of these species in California.[253] Water hyacinth, an invasive aquatic plant, has clogged the waterways of the California Delta. In 2014, shipping traffic to the Port of Stockton was restricted to daylight hours due to high densities of hyacinth in waterways. The Port spent $200,000 to mechanically remove the plant, and the shipping industry lost an estimated $300,000 due to delays in cargo operations.[254]

[252] NOEP 2016.
[253] Volkoff, M., pers. comm. 2016
[254] Wingfield, J., pers. comm. 2015

Assessment of Local Vulnerability and Potential Losses

All local aquatic environments are susceptible to aquatic invasive species, although the pathway of introduction may vary markedly from water body to water body. Information related to community vulnerability and loss assessments related to marine invasive species, if any, may be found in Local Hazard Mitigation Plans.

Current and Future Aquatic Invasive Species Hazard Mitigation Efforts

The Ballast Water Management for Control of Nonindigenous Species Act of 1999, as amended and reauthorized by the Marine Invasive Species Act of 2003, established California's program to prevent the introduction of nonindigenous species via vessel vectors (ballast water and biofouling). The Marine Invasive Species Act applies to all U.S. and foreign vessels that are 300 gross registered tons or more that arrive at California ports.[255] The Marine Invasive Species Act is implemented through integrated efforts by the following state agencies:

- California State Lands Commission, which is responsible for policy development, vessel tracking, compliance, enforcement
- California Department of Fish and Wildlife, which conducts species surveys
- State Water Resources Control Board, which consults on water quality issues
- California Department of Fee and Tax Administration, which collects fees from qualifying vessel arrivals to support the program

The California Department of Fish and Wildlife also houses the state's invasive species program. The goal of the invasive species program is to prevent, detect, and respond to species introductions when they occur and prevent the spread of species that have become established. The California Department of Fish and Wildlife is responsible for the state's Dreissenid Mussel Prevention Program. In 2016, the California Department of Fish and Wildlife adopted new regulations to prevent the spread of quagga and zebra mussels in California freshwater environments. The new regulations include provisions requiring vulnerability assessments, prevention programs, monitoring, and management of state reservoirs.

Progress Summary 9.C: Marine Invasive Species Act

Progress as of 2018: Under the Marine Invasive Species Act, vessels are required to submit a Ballast Water Management Report for each arrival at a California port or place and an Annual Vessel Reporting Form that requests information on vessel biofouling management practices and the use of ballast water treatment technologies. Between July 2014 and June 2016, over 96 percent of vessel arrivals complied with reporting requirements. According to the 2017 Biennial Report on the California Marine Invasive Species Program, between July 2014 and June 2016, almost 98 percent of the 122 million metric tons of vessel-reported ballast water carried into California water was managed in compliance with state law.

Furthermore, noncompliant ballast water has accounted for a smaller proportion of all ballast water discharges through the years, with slight variation, from 23.8 percent of the total volume of ballast water discharged in California in 2006 to 1.4 percent in the first half of 2016. These numbers signify a reduction in the risk of invasive species introduction from ballast water discharges to California waters. Furthermore, as of October 1, 2017, the California State Lands Commission has implemented the nation's first regulations to manage biofouling on the wetted surfaces of commercial vessels arriving at California ports. The state has thus made great strides to prevent species introductions from commercial vessel vectors.

[255] http://www.slc.ca.gov/Programs/MISP.html

Additional Aquatic Invasive Species Hazard Mitigation Opportunities

While the Marine Invasive Species Act addresses the threats of species introductions from commercial vessels, many of the other vectors of aquatic invasive species remain unregulated. In particular, the movement of biofouling species on recreational vessels, commercial fishing vessels, and mobile marine infrastructure (e.g., dredges, mobile offshore drilling units) in marine and estuarine environments remains almost entirely unregulated.

For more information, visit:
https://www.fws.gov/answest/coastal%20group/Final%20CC%20Biofouling%20White%20Paper%2011Apr17.pdf).

Furthermore, while the state is well poised to prevent new introductions and the spread of zebra and quagga mussels in freshwater, there has been limited planning and there is almost no funding available for rapid response and species management in the event of detections of new non-indigenous species in the state's marine and estuarine waters. For more information, visit: http://www.slc.ca.gov/Programs/MISP.html.

9.1.4 AVALANCHES

Identifying Avalanche Hazards

An avalanche is a mass of snow, ice, and rocks that fall down a mountainside, usually during heavy winter storms. Avalanches occur in the steep mountainous areas of the state that receive significant amounts of snow. Avalanches are weather-related threats to communities, residents, and visitors in the high mountain areas of the California.

Profiling Avalanche Hazards

Property Damage and Loss of Life

Avalanches have caused property damage and loss of life in California. As shown in Table 9.D, between 1996 and 2016, there were 14 deaths and property damage of $140,000 reported due to avalanches. There are no recorded avalanches between 1950 and 1996. Avalanches pose a threat in the Sierra Nevada range on the eastern side of the state and the Cascade Range in the north. Significant avalanches have damaged or destroyed ski resorts at Mt. Shasta and Lake Tahoe, as well as blocked and damaged roadways.

Table 9.D: Avalanches, 1950-2016

Period	Counties Affected (Number of Events)	Deaths
1996-2006	Amador (1), Alpine (1), Calaveras (1), El Dorado (2), Mono (3), Nevada (1), Placer (2), San Bernardino (1), San Diego (1), Sierra (1), Tuolumne (1)	2
2007-2016	Inyo (2), Nevada (1), Placer (6), San Bernardino (1), Siskiyou (3), Tulare (1),	12

Source: National Oceanic and Atmospheric Administration (NOAA) 2016

Climate Change and Avalanche Hazards

Warmer temperatures and/or rain weaken snowpack. These changes result from rainfall or warm spells weakening the snow pack or from formation of a crust due to early season rain (which is projected to increase due to climate change). These changes to the quality of snow cover lead to increased frequency and severity of avalanche events. Increased wind can also contribute to increased avalanche frequency.

State Vulnerability and Potential Losses

No known assessment of state vulnerability and potential losses is available at this time.

Local Vulnerability and Potential Losses

See Local Hazard Mitigation Plans for detailed information on local vulnerability to avalanches.

Current and Future Avalanche Hazard Mitigation Efforts

The California Department of Water Resources (DWR) monitors snowfall amounts and water content but does not actively monitor avalanche probability or occurrences. It does, however, provide a website link to the Avalanche Center, a 501(c)(3) organization that posts information on avalanche conditions for the United States. The organization is a partnership between the U.S. Forest Service and the private sector and relies heavily on private contributions and volunteer support. There are three Avalanche Centers operating in California that provide up-to-date information on snow conditions and avalanche danger levels:

- Eastern Sierra Avalanche Center – Inyo National Forest in Mammoth Lakes
- Central Sierra Avalanche Center – Tahoe National Forest in Truckee
- Shasta Avalanche Center - Shasta-Trinity National Forest in Mt. Shasta

The information and the avalanche warnings that the centers provide are geared to the general public who engage in snow-related recreational activities.

9.1.5 DROUGHTS AND WATER SHORTAGES

Identifying Droughts and Water Shortages Hazards

Drought is a gradual phenomenon. Normally, one dry year does not constitute a drought in California, but rather serves as a reminder of the need to plan for droughts. California's extensive system of water supply infrastructure (reservoirs, groundwater basins, and interregional conveyance facilities) generally mitigates the effects of short-term dry periods for most water users.

Drought can have secondary impacts. For example, drought is a major determinant of wildfire hazard, in that it creates greater propensity for fire starts and larger, more prolonged conflagrations fueled by excessively dry vegetation, along with reduced water supply for firefighting purposes. More recently, increased tree mortality, exacerbated by drought, has resulted in millions of dead trees around the state causing hazards to people, property, and infrastructure and creating a greater risk of wildland fires.

A significant secondary impact of drought due to the reduced availability of surface water is land subsidence caused by groundwater pumping from wells. Land subsidence is the phenomenon in which the earth's surface gradually settles or sinks due to sub-surface activities, primarily groundwater pumping, which compacts aquifer systems. Although pumping of groundwater occurs in both drought and non-drought years to support urban, rural, and agricultural water needs, it is greatly increased during dry years. Land subsidence due to groundwater pumping can permanently damage or collapse underground aquifers, increase flood risk in low-lying areas, and pose hazards to buildings, infrastructure, and water storage facilities.

Drought also amplifies the risk of loss of biodiversity and affects animal and plant species in the state. In March 2016, the California Department of Fish and Wildlife released an assessment report on the vulnerability of California wildlife affected by the 2012-2016 drought. It indicated that amphibian, reptile, bird, and mammal populations that depend on freshwater marsh, streamside habitat, and wet meadows struggle most to endure the drought. Impacts on salmon and trout hatcheries caused by decreased water supply, inferior water quality, and increased threat of water pathogens are also of concern, as are river conditions for native fish species. In addition to the physical implications of drought, significant economic impacts on California's agriculture industry can occur as a result of short- and long-term drought conditions. These include hardships for farmers, farm workers, packers, and shippers of agricultural products. In some cases, drought can also cause significant increases in food prices to the consumer due to shortages, and can result in lack of water and subsequent feed available to grazing livestock, potentially leading to risk of livestock death and resulting in losses to the state's agricultural economy.

Past experience with California droughts indicates that drought impacts are felt first by those most dependent on or affected by annual rainfall and snowpack, including agencies fighting forest fires, ranchers engaged in dryland grazing, farmers growing crops in arid zones, rural residents relying on wells in low-yield rock formations, or small water systems lacking a reliable water source.

Profiling Drought and Water Shortage Hazards

Drought has affected virtually every county in California at one time or another, causing over $5.1 billion in damages. Droughts exceeding three years are relatively rare in Northern California, the source of much of the state's water supply. The 1929-1934 drought, which affected the entire state, established the criteria commonly used in designing storage capacity and yield for large Northern California reservoirs. Significant droughts occurring within the past 50 years are briefly described below, followed by an in-depth discussion of the extended statewide drought that began in 2012 and ended in 2017.

The 1975-1977 Drought

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

The 1987-1992 Drought

From 1987 to 1992, California again experienced a serious drought due to low precipitation and runoff levels. The hardest-hit region was the Central Coast, roughly from San Jose to Ventura. In 1988, 45 California counties experienced water shortages that adversely affected about 30 percent of the state's population, much of the dry-farmed agriculture, and over 40 percent of the irrigated agriculture. Fish and wildlife resources suffered, recreational use of lakes and rivers decreased, forestry losses and fires increased, and hydroelectric power production decreased.

In February 1991, DWR and Cal OES surveyed drought conditions in all 58 California counties and found five main problems: extremely dry rangeland, irrigated agriculture with severe surface water shortages and falling groundwater levels, widespread rural areas where individual and community supplies were going dry, urban area water rationing at 25 to 50 percent of normal usage, and environmental impacts.

Storage in major reservoirs had dropped to 54 percent of average, the lowest since 1977. The shortages led to stringent water rationing and severe cutbacks in agricultural production, including threats to survival of permanent crops such as trees and vines. Fish and wildlife resources were in critical shape as well. Not since the 1928-1934 drought had there been such a prolonged dry period. In response to those conditions, the Governor established the Drought Action Team. This team almost immediately created an emergency drought water bank to develop a supply for four critical needs: municipal and industrial uses, agricultural uses, protection of fish and wildlife, and carryover storage for 1992.

The large-scale transfer program, which involved over 800,000 acre-feet of water, was implemented in less than 100 days with the help and commitment of the entire water community and established important links between state agencies, local water interests, and local governments for future programs.[256]

The 2007-2009 Drought

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

The greatest impacts of the 2007-2009 drought were observed in the CVP service area on the west side of the San Joaquin Valley, where hydrologic conditions combined with reduced CVP exports resulted in substantially reduced water supplies (50 percent supplies in 2007, 40 percent in 2008, and 10 percent in 2009) for CVP south of Delta agricultural contractors. Small communities on the west side highly dependent on agricultural employment were especially affected by land fallowing due to lack of irrigation supplies, as well as by factors associated with current economic recession. The coupling of the drought and economic recession necessitated emergency response actions related to social services, such as food banks and unemployment assistance.[257]

[256] California Department of Water Resources (DWR). "Preparing for California's Next Drought – Changes Since 1987-92." July 2000.
[257] (DWR, "California's Most Significant Droughts: Comparing Historical and Recent Conditions", February 2015)

The 2012-2017 Drought

Introduction

The statewide drought of 2012-2017 will be remembered as one of the most severe and costliest droughts of record in California. The drought that spanned water years 2012 through 2017 included the driest four-year statewide precipitation on record (2012-2015) and the smallest Sierra-Cascades snowpack on record (2015, with 5 percent of average). It was marked by extraordinary heat; 2014, 2015, and 2016 were California's first, second and third warmest years in terms of statewide average temperatures. By the time the drought was declared officially over in April 2017, the state had expended $6.6 billion in drought response and mitigation programs and had been declared a federal disaster area. The following discussion outlines the chronology of events and milestones reached during the drought as well as a summary of Executive Orders issued by the Governor, disaster assistance programs initiated, and grant programs designed to alleviate the impacts of the drought.

Chronology of the 2012-2017 Drought

Following the dry water years of 2007-2009, water years 2010-2011 marked a return to slightly wetter than average conditions for most of the state. Precipitation in 2011 improved statewide reservoir storage, mitigating the dry conditions that occurred across most of the state in 2012. Although Northern California experienced a series of late November/early December storms in 2013, a record dry January through May resulted in dryness for most of the state, particularly the San Joaquin Valley and Southern California. The impacts of dry years during 2012 and 2013 were notably felt in the agricultural sector, especially rangeland grazing.

With the advent of an exceptionally dry water year in 2014, Northern California began experiencing the significantly below-normal precipitation that had characterized the southern part of the state in the prior years. A blocking high pressure ridge diverted storms away from the state during the key winter precipitation months of December and January, resulting in record warmth and dryness. Some locations in Northern California experienced 50 consecutive days with no measurable precipitation during months that historically exhibited maximum precipitation for the year.

The Governor responded to the continuing drought conditions by forming a state interagency Drought Task Force in December 2013 to provide a coordinated assessment of the dry conditions and recommendations on state actions. The continuing absence of precipitation led to a Governor's proclamation of emergency in January 2014 that ordered state agencies to take specified actions and called on Californians to voluntarily reduce their water usage by 20 percent. In March, the Legislature enacted and the Governor signed measures to provide $687.4 million for drought relief, with the largest amount of that funding ($549 million) dedicated to accelerated expenditure of Proposition 84 and Proposition 1E bond funds for grants to local agencies for integrated regional water management projects.

Above normal late spring 2014 precipitation ameliorated some of the worst-case water supply scenarios that had been considered earlier in the year. Hydrologic conditions did not improve sufficiently, however, to avoid record low allocations for some Central Valley Project (CVP) and State Water Project (SWP) contractors: zero to the CVP's agricultural contractors both north and south of the Delta, zero to the CVP Friant Division contractors, and 5 percent to SWP contractors. Water year 2014 marked the first time that the U.S. Bureau of Reclamation's Friant Division contractors received a zero allocation of their Class 1 water. Reflecting the very dry hydrology, the State Water Resources Control Board (SWRCB) imposed widespread curtailments of diversions in locations including parts of the Sacramento-San Joaquin River watershed and the Eel and Russian River watersheds, another action that had not been taken since 1977.

Close coordination among the water project operating agencies (U.S. Bureau of Reclamation and DWR), and the regulatory agencies (SWRCB, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service) was employed throughout the hydrologically challenging winter-spring water year 2014 runoff season. Decisions were made to balance impacts and to reserve water in storage to be able to meet critical needs such as cold water for salmon and health and safety needs for urban water users.

As the summer of 2014 wore on, increasing numbers of small water systems, often located on unreliable fractured rock groundwater sources in rural areas, were experiencing water shortages, as were rural residents dependent on private wells. Bulk water haulage and distribution of bottled water were used to help some rural communities.

Early seasonal rainfall in November and December 2014, delivered only a third of what would be needed to end the prolonged drought but, combined with close coordination among federal and state agencies, allowed DWR to increase expected water deliveries for 2015 to most customers of the SWP from 10 to 15 percent of requested amounts. The SWRCB announced that the statewide urban water conservation rate climbed to 22 percent in December but declined steeply in during January 2015, which was considered the driest January since meteorological records have been kept. The March snowpack measurements taken by DWR indicated that the water content for the northern Sierra was 16 percent of average for the date. The central and southern Sierra readings were 20 percent and 22 percent of average, respectively. In response to the continuing dry winter, Governor Brown signed emergency legislation to fast track more than $1 billion in funding for drought relief and critical water infrastructure projects.

As the spring and summer of 2015 continued with little measurable precipitation, several new areas of drought response and mitigation were initiated, including construction of a temporary emergency barrier in the Sacramento-San Joaquin Delta to block saltwater from flowing into the central Delta and contaminating water supplies, and emergency actions designed to protect fisheries by releasing additional water into spawning rivers and relocating fish from threatened hatcheries. Additionally, the California Department of Housing and Community Development (HCD) and the California Building Standards Commission (CSBC) adopted new building codes to approve water efficiency requirements for both residential and non-residential construction, as well as schools and hospitals. Despite record-breaking heat in June and July, Californians continued to meet and surpass the Governor's 25 percent water conservation mandate, with a 27.3 percent reduction in water use in June and a 31.3 percent reduction in July.

Early predictions of an "El Nino" in water year 2016 led to a short-lived optimism that there might be a decline in the drought. Rain and snow levels this winter certainly improved from recent years, but not enough to draw the state out of the drought. Rain and snow levels during the winter varied significantly by region, with parts of Northern California receiving-higher-than average precipitation and most of Southern California receiving below-average precipitation.

As of mid-April, the automated snow sensors showed snowpack conditions across the state at 70 percent of normal. Regionally, the northern Sierra was at 75 percent of average, the central Sierra was at 76 percent of average, and the southern Sierra was at 60 percent of average. Reservoir levels had increased throughout the state. Californians continued to conserve water, generally meeting the Governor's mandated target of 25 percent, and saving 1.19 million acre-feet of water from June 2015 through February 2016. However, groundwater conditions had not improved, with approximately 2,180 wells statewide being identified as critical or dry, affecting an estimated 10,900 residents, mostly in the Central Valley.

Water year 2017 (October 1, 2016 to September 30, 2017) surpassed the wettest year of record (1982-1983) in the Sacramento River and San Joaquin River watersheds and was close to the wettest year in the Tulare Basin (set in 1968-1969). Mountain snowpack was well above the April 1 seasonal averages throughout the Sierra Nevada, with the southern Sierra at more than 200 percent of average for the year to date.

The plentiful winter rain and unprecedented water conservation prompted the Governor to end the drought state of emergency on April 7, 2017, for all California counties except Fresno, Kings, Tulare, and Tuolumne, where emergency drinking water projects will continue to help address diminished groundwater supplies. Water reporting requirements and prohibitions on wasteful practices, such as watering during or right after rainfall, hosing off sidewalks, and irrigating ornamental turf in public street medians, will remain in effect for all Californians. The goal is to make conservation a way of life in California. The state will also continue its work to coordinate a statewide response on the unprecedented bark beetle outbreak in drought-stressed forests that has killed millions of trees

across California.[258] Although the severely dry conditions that afflicted much of the state starting in the winter of 2011-2012 are gone, damage from the drought will linger for years in many areas. The drought reduced farm production in some regions, killed an estimated 100 million trees, harmed wildlife and disrupted drinking water supplies for many rural communities. Another serious consequence that of land subsidence due to groundwater pumping, is discussed later in this section.

Summary of California's Drought History

Table 9.E summarizes California droughts initially discussed in a July 2000 DWR report and brings the date forward to 2016. The 1976-1977 and 2012-2017 droughts were among the worst in California history.

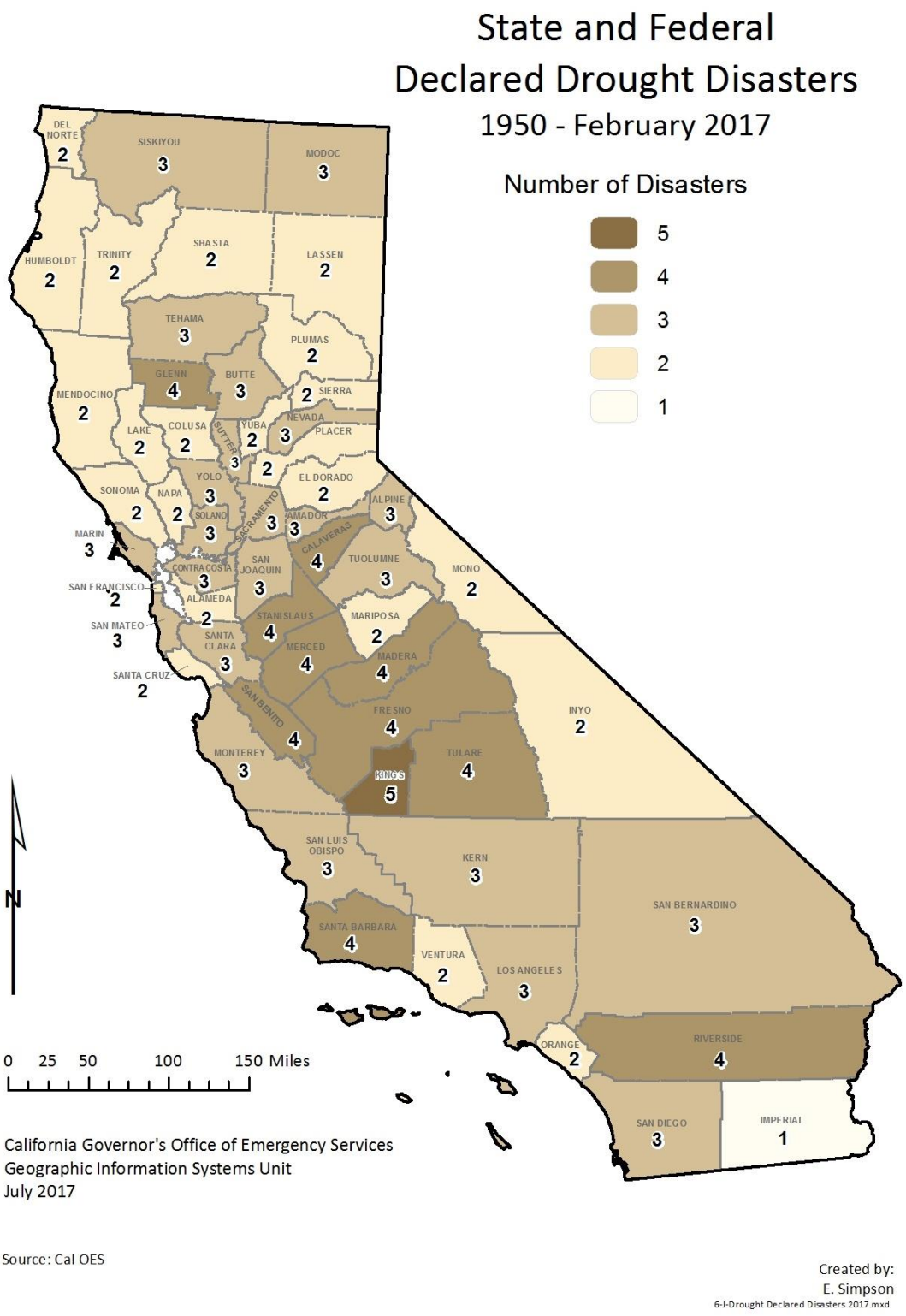
Table 9.E: Drought Incidents, 1972 to 2016

Year	Number of Incidents	Jurisdictions Affected (Counties, Unless Otherwise Noted)	Statewide Crop Damage
1972	1	Glenn, San Benito, Santa Clara	$8 million
1976-1977	1	Alpine, Calaveras, Colusa, Fresno, Glenn, Madera, Merced, San Diego, San Joaquin, Solano, Stanislaus, Sutter, Tuolumne, Alameda, Butte, Contra Costa, Kings, Los Angeles, Riverside, San Luis Obispo, Tulare, Yolo, Amador, Monterey, Napa, Nevada, San Benito, San Bernardino, Tehama, San Mateo, Marin	$2.67 billion
1988	1	Madera County location emergency was ratified every two weeks through 1991.	Not Available
1990	2	Santa Barbara(City and County)	0
1991	1	Alameda, Alpine, Colusa, Fresno, City of Orange Cove, Glenn, Kern, Kings, Lake, Madera, Marin, Mendocino, Monterey, Placer, Santa Barbara, City of Santa Barbara, Shasta, Siskiyou, Solano, Sonoma, Sutter, Tehama, Tulare, Tuolumne, and Yuba. Many of these emergencies continued through 1992.	U.S. Department of Agriculture - nationwide: $995 million for 1990-1991 crop loss. Additional $775 million in emergency funds for 1990-1992 crop losses.
2001	5	Del Norte, Modoc, Siskiyou, Inyo, Humboldt, Kern, Los Angeles, Ventura, Mono, Lassen, Plumas, San Bernardino, Santa Barbara, Sierra, Shasta, Trinity	Not Available
2002	3	Alpine, Amador, Calaveras, Imperial, Modoc, Nevada, Orange, Placer, Riverside, San Bernardino, Sierra, Stanislaus	$12,100
2007	1	Kings, Riverside	(data pending)
2008	1	Fresno, Kern, Kings, Madera, Merced, Sacramento, San Joaquin, Stanislaus, Tulare	(data pending)
2009	1	Fresno	(data pending)
2012	1	All counties	(data pending)
2013	1	All counties	(data pending)
2014	1	All counties	$810 million
2015	1	All counties	$900 million
2016	1	All counties	$921 million

Sources: Cooley et al. (2016), Howitt et al. (2015) http://pacinst.org/publication/impacts-of-californias-ongoing-drought-agriculture/, https://watershed.ucdavis.edu/files/biblio/Final_Drought%20Report_08182015_Full_Report_WithAppendices.pdf, Cal OES Individual Assistance Section, SBA Declarations/USDA Designations database; Cal OES Origins and Development- A Chronology 1917- 1999

[258] Governor's Press Release April 7, 2017. Available at https://www.gov.ca.gov/2017/04/07/news19747/

Map 9.G: State and Federal Declared Drought Disasters, 1950-February 2017



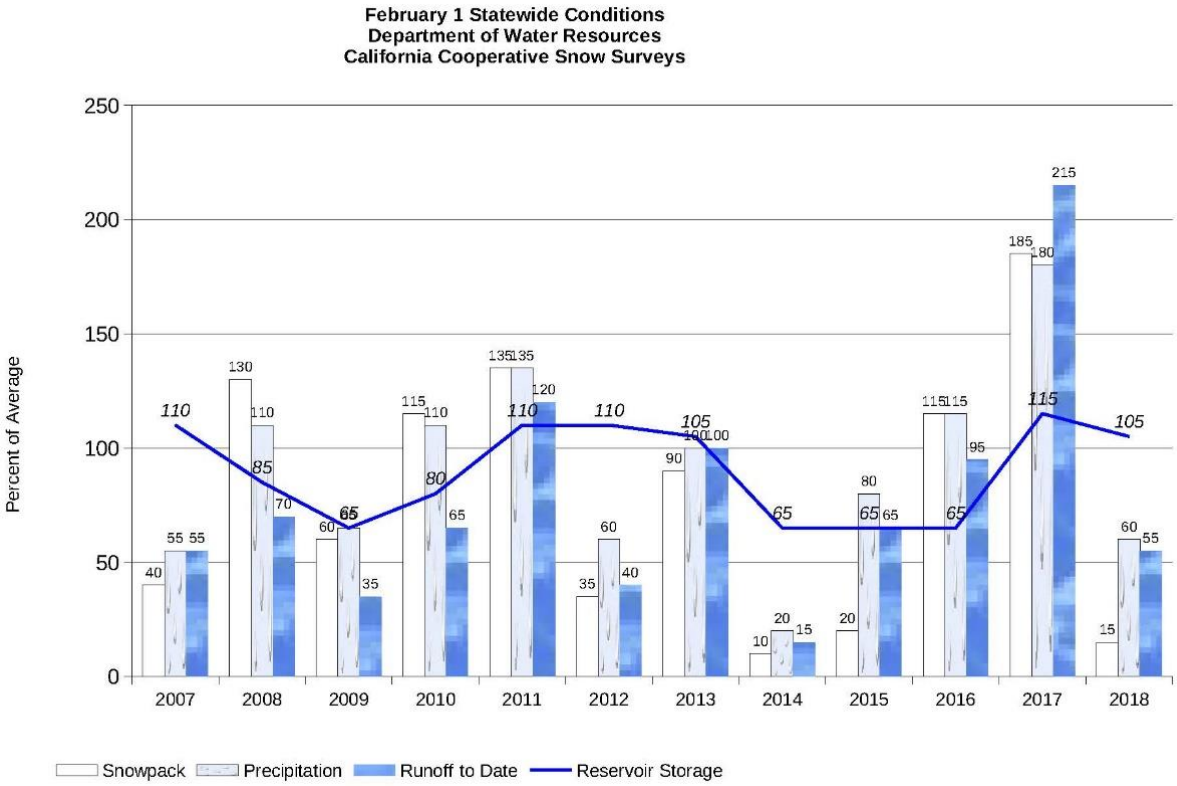
Map 9.G shows the pattern of drought-declared disasters in California over the past 67 years. While heaviest concentrations are centered in the Central Valley area, no part of the state is immune from drought disaster.

Tracking Water Conditions

Chart 9.A illustrates several indicators commonly used to evaluate water conditions in California. The percent of average values are determined by measurements made in each of the ten major hydrologic regions. The chart describes water conditions in California between 2005 and 2018. The chart illustrates the cyclical nature of weather patterns in California.

Snow pack and precipitation increased in 2006, decreased sharply in 2007 through 2009, recovered somewhat in 2010-2011, again dramatically declined in 2012, reached average levels in 2013, and again decreased for 2014-2015, with average levels again reached in 2016. In 2017 precipitation, snowpack, and runoff, were significantly above average (resulting in other hazard events such as flooding), but 2018 follows with rainfall and snowpack well below average.

Chart 9.A: Water Supply Conditions, 2005 to 2018



Source: Department of Water Resources, https://cdec.water.ca.gov/snow/bulletin120/FebHistory.pdf

Drought and Land Subsidence

Subsidence due to groundwater pumping historically has occurred in seven main areas within Central and Southern California, Sacramento Valley, Antelope Valley, Oxnard Plain, greater Los Angeles, the Mojave Desert, Yucaipa and Coachella Valleys, and the San Joaquin Valley. Each is described briefly below, with more focus placed on the San Joaquin Valley.

Sacramento Valley
The Sacramento Valley has seen elevation losses from ranging from 0.73 to 3.9 feet since 1949, which has caused damage to irrigation wells and increased the extent of flooding in certain areas. Although the Sacramento Valley has a large supply of surface water, drought periods have led communities to rely more heavily on groundwater.

Antelope Valley
Although the spatial extent is much less than the San Joaquin Valley, land subsidence due to excessive groundwater pumping has occurred at striking levels in the Antelope Valley as well. Groundwater level declines of more than 270 feet in some parts of the groundwater basin have resulted in an increase in pumping lifts, reduced well efficiency, and land subsidence of more than 6 feet in some areas. Future urban growth and limits on the supply of imported water may increase reliance on groundwater.

Oxnard Plain
While the amount and areal extent of subsidence in the basin from each contributing source remain unknown, groundwater withdrawal and oil and gas production are probably major causes in the Oxnard Plain Sub-Basin, and tectonic activity is likely a minor cause. Water-level declines in this coastal basin have induced land subsidence that was first measured in 1939. Subsidence occurred primarily in the upper-aquifer system prior to 1959; some subsidence also occurred in the lower-aquifer system during 1959-1993, owing to an increase in groundwater extraction.

Greater Los Angeles
Because tectonic deformation, oil field operations, and groundwater extraction and injection occur in overlapping proximity within the greater Los Angeles metropolitan area, it is difficult to determine the cause of observed deformations using standard surveying techniques. However, separate cases of subsidence within the basin have been attributed to a variety of activities, including groundwater pumping, oil extraction, and tectonic movement. Given the expansive infrastructure and population density in this region, the effects of land subsidence are potentially catastrophic; however, the rate of subsidence is presently not high enough to cause major concern.

Mojave Desert
Land subsidence has been ongoing in the dry lakebeds throughout the Mojave and Morongo groundwater basins since the 1960s.

Yucaipa and Coachella Valleys
Land subsidence in these two valleys is primarily due to excessive groundwater pumping, as neither region has adequate surface water to support its domestic and non-domestic uses.

San Joaquin Valley
The most striking case of land subsidence is in the San Joaquin Valley, such that it is considered "the greatest human alteration of Earth's surface."[259] The San Joaquin Valley is the largest and most productive agricultural region in California, but it does not have sufficient surface water to support farming or domestic uses. Beginning around the 1920s, farmers relied upon groundwater for water supply. Over time, over-pumping caused groundwater level declines and associated aquifer system compaction and land subsidence that resulted in permanent aquifer-system storage loss. By 1970, significant land subsidence (more than 1 foot) had occurred in about half of the San Joaquin Valley, or about 5,200 square miles, and locally some areas had subsided by as much as 28 feet.

[259] USGS, 2017

Physical Signs of Subsidence



Source: U.S. Geological Survey (USGS) California Water Science Center, https://ca.water.usgs.gov/land_subsidence/

Reduced surface-water availability during 1976-1977, 1986-1992, 2007-2009, and 2012-2016 caused groundwater pumping increases in the San Joaquin Valley, declines in water levels to near or beyond historic lows, renewed aquifer compaction, and resulting increased subsidence. This suggests that subsidence becomes a larger risk factor during drought events but is more broadly linked to ongoing groundwater management issues.

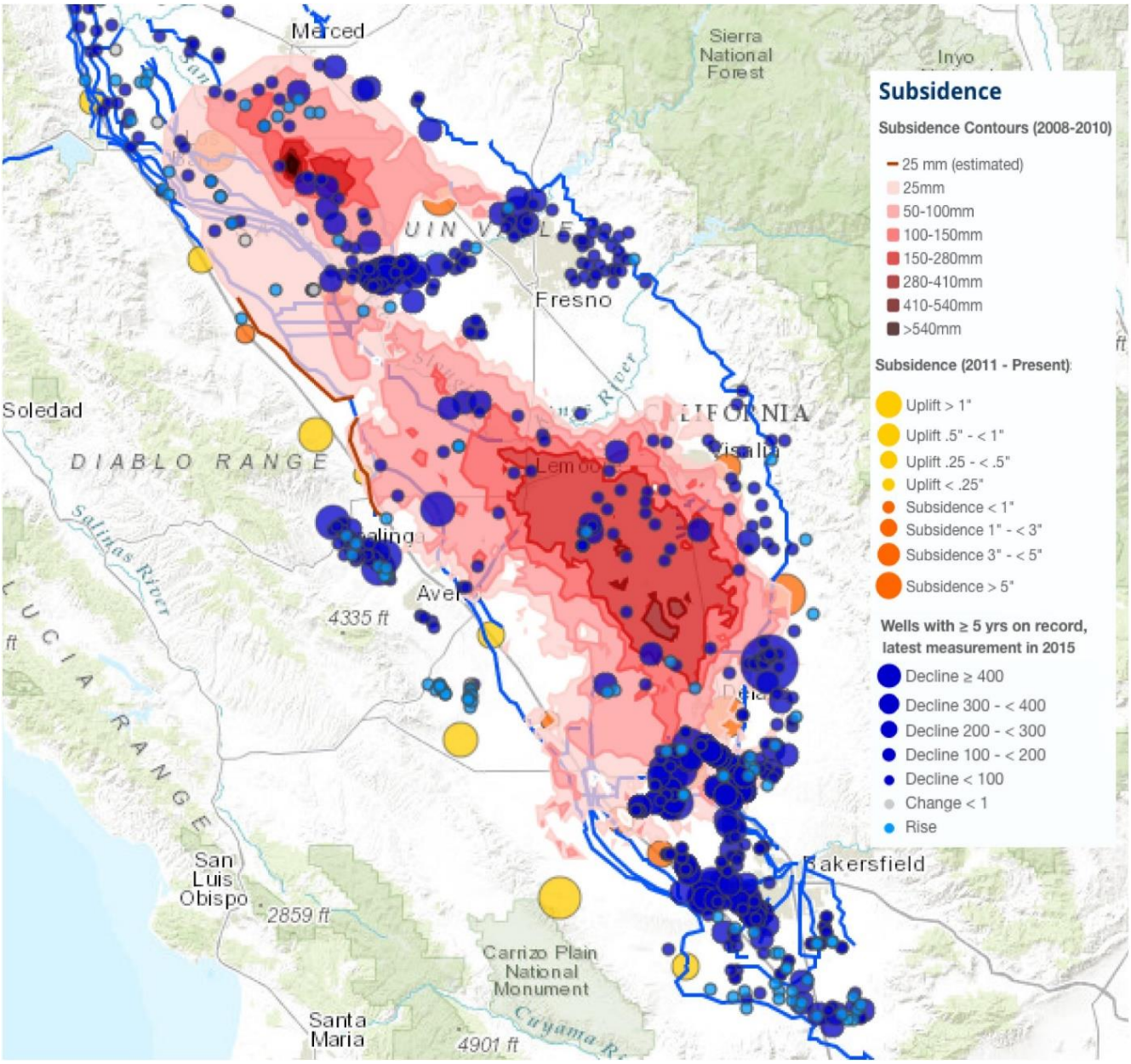
The resulting land subsidence has reduced the freeboard and flow capacity of the Delta-Mendota Canal, as well as the California Aqueduct and other canals that transport floodwater and deliver irrigation water, requiring expensive repairs.

Interferometric Synthetic Aperture Radar (InSAR)[260] analyses in 2017 show that two large areas in the San Joaquin Valley are subsiding substantially. These areas are a large (2,700 square mile) swath of subsidence west of Tulare and east of Kettleman City, and an area about half the size (1,200 square miles), but still very large near El Nido (south of Merced and west of Madera).

Map 9.H shows the areas of subsidence along with occurrences of well decline since 2011 (with the latest well measurement in 2015). Map 9.I shows critically overdrafted groundwater basins as of January 2016.

[260] https://ca.water.usgs.gov/land_subsidence/california-subsidence-measuring.html

Map 9.H: Drought Indicators Map from U.S. Geologic Survey Showing Well Decline Along with Subsidence in the San Joaquin Valley



Source: USGS California Water Science Center, https://ca.water.usgs.gov/land_subsidence/

Map 9.I: Critically Overdrafted Groundwater Basins in the San Joaquin Valley



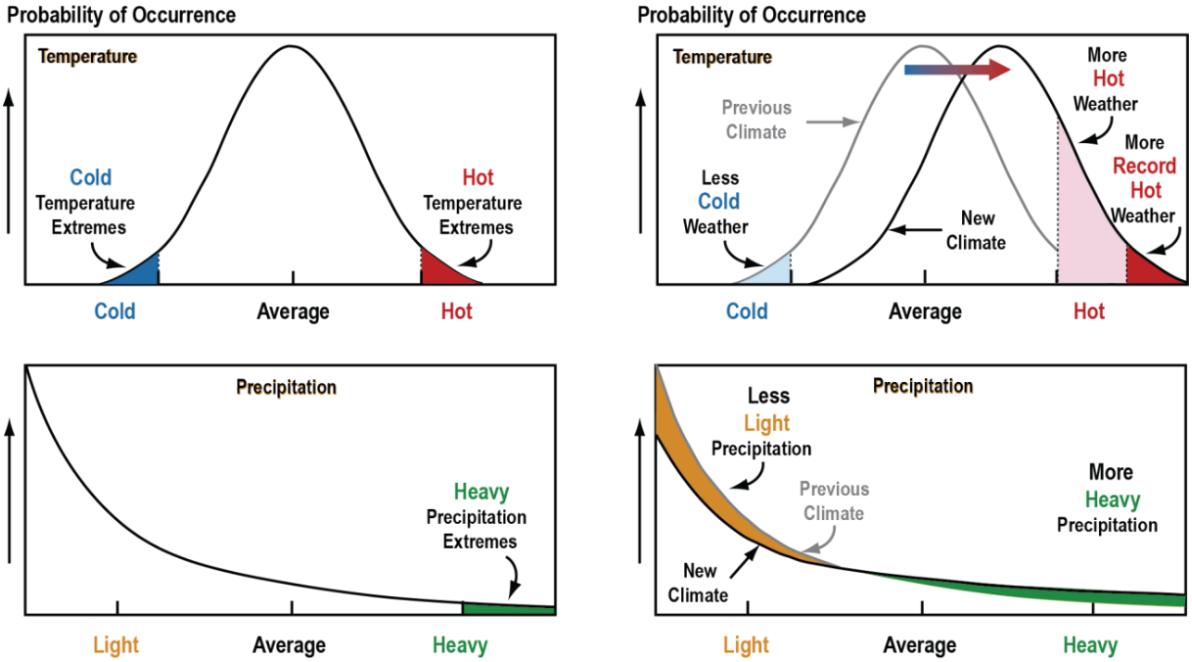
Source: Department of Water Resources, http://www.water.ca.gov/groundwater/sgm/pdfs/GW_basinsCriticalOverdraft_SCentralRegion.pdf

Climate Change, Drought, and Water Shortage Hazards

Climate scientists studying California find that drought conditions are likely to become more frequent and persistent through the 21st century due to climate change. The experiences of California during recent years underscore the need to examine more closely the state's water storage, distribution, management, conservation, and use policies.

As summarized in *Chapter 4: Profiling California's Setting, Section 4.3*, climate change not only alters the annual amount of precipitation and seasonal distribution, but also changes seasonal variability, which is projected to increase the severity and frequency of drought events. Combined with higher temperature, which increases water demand and loss of water due to evaporation, these events can lead to water shortage. In addition to creating water shortages, drought increases wildfire risk, and wildfires in turn increase demand for water. Prolonged periods of drought can result in detrimental changes in the vegetative structure and health of forests, making them more vulnerable not only to pest outbreaks but also to fire.[261] The loss of forests due to distressed health, pests, or fire can produce increased risk of other hazards due to reduced ability to retain runoff during heavy rainfall events. Figure 9.A illustrates the relationships between temperature and precipitation.

Figure 9.A: Graphical Illustration of extreme Events for Temperature and Precipitation



Source: CCSP. Weather and Climate Extremes in a Changing Climate. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [Thomas R. Karl, Gerald A. Meehl, Christopher D. Miller, Susan J. Hassol, Anne M. Waple, and William L. Murray (eds.)]. 2008. Department of Commerce, NOAA's National Climatic Data Center, Washington, D.C., USA, 164 pp.

The 2018 Safeguarding California Plan, an update to the 2009 Climate Adaptation Strategy, stresses the need for public policy development addressing long-term climate change impacts on water supplies. Droughts are expected to increase in frequency, duration, and intensity, and drought affects all sectors, including public health, biodiversity, agriculture, and the economy. During droughts, groundwater use will likely intensify, potentially resulting in increased overdraft and subsidence (which can result in permanent loss of storage and damage to overlying infrastructure, including flood management and transportation facilities), and further stressing groundwater-dependent ecosystems. Agriculture relies extensively on the state's aquifers; groundwater is the only source of water for much of California's most productive farmland, and agricultural water needs are likely to be heightened during prolonged hot and dry periods. Groundwater is also often the only source of water for small, rural water

[261] US EPA Region 9 & CA DWR. (2011). Climate Change Handbook for Regional Water Planning. Sacramento: author, 200p.

systems and households, which may lack the technical, managerial, and financial capacity to respond to drought conditions.[262]

California's snowpack has historically stored about 15 million acre-feet of water and this amount of naturally occurring water storage has been an integral part of California's water supply systems. Snow has traditionally added about 35 percent to the reservoir capacity available to water managers in the state, carrying water over from California's winter wet season to the summer dry season. The water management community has invested in, and depends upon, a system based on historical conditions. Scientists project a loss of at least 25 percent of the Sierra snowpack by 2050.

Assessment of State Vulnerability and Potential Losses

Although no definitive assessment of state vulnerability or potential long-term losses due to drought and water shortages exists, the cyclical occurrence of drought and documentation of past and current losses point to the strong probability that California will continue to be vulnerable to short- and longer-term drought impacts.

Agricultural Vulnerability

Table 9.F shows the economic loss impacts of the 2015 California drought on agriculture.

Table 9.F: Summary of Impacts of 2015 California Drought

Description	Impact
Drought-related idle land	540,000 acres
Crop revenue losses	$900 million
Dairy and livestock revenue losses	$350 million
Costs of additional pumping	$590 million
Direct costs	$1.8 billion
Total economic impact	**$2.7 billion**
Direct job losses	10,100 jobs
Total job losses	21,000 jobs

Source: Howitt et al., "Economic Analysis of the 2015 Drought for California Agriculture," 2015.https://watershed.ucdavis.edu/files/biblio/Final_Drought%20Report_08182015_Full_Report_WithAppendices.pdf

Subsidence Vulnerability

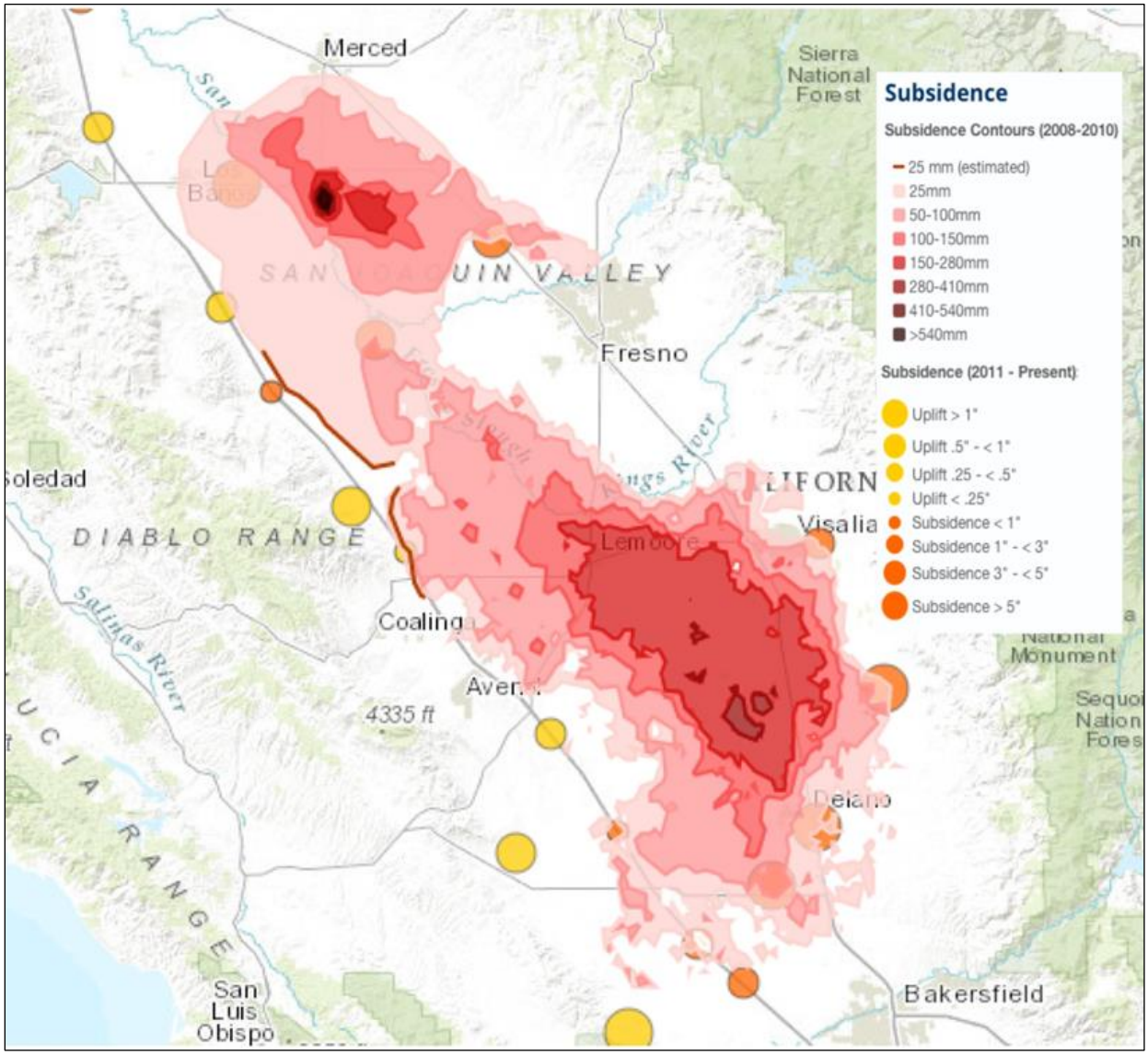
Land subsidence in the San Joaquin Valley and Sacramento-San Joaquin Delta, illustrated in Map 9.J, accounts for the greatest statewide vulnerability and potential loss due to groundwater pumping. The San Joaquin Valley is home to the largest and most economically significant agricultural land in the state. The long-term impacts of subsidence on water storage capacity and flood risk threaten the well-being of the people, property, and the economy. The current drought and cropping patterns that have changed from row crops and rangeland to tree and other permanent crops have again forced reliance on groundwater in the San Joaquin Valley for agricultural irrigation supplies.

The existing and potential economic impacts of land subsidence in the San Joaquin Valley are not well known. Damages directly related to subsidence have been identified, and some have been quantified. Other damages indirectly related to subsidence, such as flooding and long-term environmental effects, merit additional assessment. Some of the direct damages have included decreased storage in aquifers, partial or complete submergence of canals and associated bridges and pipe crossings, collapse of well casings, and disruption of collector drains and irrigation ditches.

[262] Safeguarding California Plan: 2018 Update, http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

Costs associated with these damages have been conservatively estimated at $25 million. These estimates are not adjusted for changing valuation of the dollar, and do not fully account for the underreported costs associated with well rehabilitation and replacement. When the costs of lost property value due to condemnation, regrading of irrigated land, and replacement of irrigation pipelines and wells in subsiding areas are included, the annual costs of subsidence in the San Joaquin Valley soar to $180 million per year in 1993 dollars.[263]

Map 9.J: Subsidence Contours in the Central Valley



Source: U.S. Geological Survey California Water Science Center https://ca.water.usgs.gov/land_subsidence/

The subsided islands of the Sacramento-San Joaquin Delta are perpetually at risk of flooding in the event of levee breaks or overtopping and many have flooded in the past, causing millions of dollars in damage. As subsidence progresses, the levees must be regularly maintained and periodically raised and strengthened to support the increasing stresses on their banks. Delta island flooding can also interfere with freshwater exports from the Delta.[264] The statewide water-transfer system in California is so interdependent that decreased water quality in the Delta might lead to accelerated subsidence in other areas. Both the Santa Clara and San Joaquin Valleys rely, in part, on

[263] (USGS, 1999
[264] USGS, 2017

imported water from the Delta to augment local supplies and thereby reduce local ground-water extraction and arrest or slow subsidence. Degradation of the Delta source water could result in increased groundwater use and renewed subsidence.[265]

Social Vulnerability

According to a study conducted by the Pacific Institute, the most vulnerable communities are those considered disadvantaged (characterized by a medium household income less than 80 percent of the state median) and "cumulatively burdened" (according to combined environmental and socio-economic indicators of vulnerability). The 2012-2017 drought adversely affected at least one public water system in 39 out of 58 of the state's counties, but the most impacts were seen in the San Joaquin Valley, North Coast, and Central Coast regions. Among 92 drought-affected water systems, two-thirds served a disadvantaged community and almost one-third served a cumulatively burdened community.

Dry household wells were a major issue within vulnerable communities. Dry household wells were also a major problem for vulnerable communities. In Tulare County, for example, two-thirds of the approximately 1,600 reported dry wells were in a disadvantaged community, and nearly 90 percent were in a cumulatively burdened community. Additionally, 50 percent of state emergency food assistance was distributed to Tulare County residents.[266]

Physical, Mental, and Financial Vulnerability

While many aspects of drought are well understood, very little research has been conducted to discover the extent of public health impacts associated with extended droughts. In an attempt to further explore the potential vulnerability of populations exposed to drought conditions, the California Department of Public Health partnered with two highly drought affected counties (Tulare and Mariposa) to conduct Community Assessments for Public Health Emergency Response. The rapid assessments were conducted in October and November 2015 to evaluate household water access, acute stressors, exacerbations of chronic diseases, behavioral health issues, and financial impacts.

Depending on assessment area, household impact results ranged from 3 to 12 percent of households reporting not having running water, 25 to 39 percent reporting impacts on finances, 39 to 54 percent reporting impacts on property, 10 to 20 percent reporting impacts on health, and 33 to 61 percent reporting impacts on peace of mind. Additionally households reported worsening conditions for the following: 16 to 46 percent for chronic disease, 8 to 26 percent for acute stress, and 14 to 34 percent who considered moving. Impacts on finances or property were each associated with impacts on health, peace of mind and acute stress levels. Other issues related to personal hygiene that could lead to personal health issues included the decrease in frequency or duration of handwashing which ranged from 58 to 68 percent.

Additional information may be found at:
https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/Pages/Emergency-Preparedness-Team.aspx.

Assessment of Local Vulnerability and Potential Losses

In April 2017, Governor Brown declared an end to the drought emergency, although four California counties were still deemed to lack of safe drinking water at that time.

Additional information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

[265] USGS, 1999
[266] Feinstein et al., "Drought and Equity in California", 2017. http://pacinst.org/publication/drought-equity-california/

Current Drought Hazard Mitigation Efforts

The state has deployed numerous resources—fiscal, logistical, and personnel—in response to the impacts of the 2012-2017 drought. These include Proposition 1, which was passed by a 67 percent majority of California voters in 2014. It authorized $7.5 billion in general obligation bonds to fund ecosystem and watershed protection and restoration, along with water supply infrastructure projects, including surface and groundwater storage and drinking water protection. Assembly Bill 2480, approved by the Governor in 2016, officially acknowledges that source watersheds are an integral component of California's water infrastructure and are eligible for the same forms of financing as other water collection and treatment infrastructure.

Since 2014, the state has appropriated $6.6 billion for drought response in five primary categories, as shown in Table 9.G.

Table 9.G: Drought Response Funding Since 2014, by Category

Response Measure	Amount Appropriated
Flood Improvements	$737 million
Conservation and Drought Relief	$246.5 million
Human Assistance	$164.4 million
Public Safety	$376.8 million
Environmental Protection	$95.7 million

Source: http://www.drought.ca.gov/

2012-2017 Drought Response, Recovery, and Mitigation Programs

The five-year drought prompted a multitude of response, recovery, and mitigation programs and actions led by Governor Brown and the Drought Task Force and implemented by state and local agencies as well as the general public. The following sections summarize many of the actions taken and the program delivery mechanisms.

Emergency Proclamations and Disaster Declarations

On January 17, 2014, Governor Brown proclaimed a State of Emergency and directed state officials to take all necessary actions to prepare for the drought conditions, to assist farmers and communities economically affected by dry conditions, and to ensure that the state could respond if Californians faced drinking water shortages. On April 25, 2014, the Governor issued a proclamation of continued State of Emergency.

An additional State of Emergency was declared on October 30, 2015, in response to the tree mortality epidemic worsened by the drought. As of March 30, 2017, 55 local emergency proclamations were issued by local governments (22 counties, 10 cities, 11 tribes, and 12 special districts). The U.S. Department of Agriculture included all of California's counties in its drought disaster designations at various times over the course of 2012-2017, either as primary counties or contiguous counties.

Governor's Executive Orders

California's ongoing response to the drought conditions was guided by a series of executive orders issued by Governor Brown. A brief summary of each executive order is listed in Table 9.H.

Table 9.H: 2012-2017 Drought Executive Orders

Executive Order Number	Issue Date	Provisions
B-21-13	May 20, 2013	Directed the California Department of Water Resources (DWR) and State Water Resources Control Board (SWRCB) to expedite review and processing of voluntary transfers of water and water rights.
B-26-14	September 19, 2014	Directed DWR, SWRCB, the Governor's Office of Emergency Services (Cal OES), and the Governor's Office of Planning and Research (OPR) to assist local governments with identification of

Executive Order Number	Issue Date	Provisions
		acute drinking water shortages and to work with local agencies in implementing solutions to shortages. Authorized Cal OES to use California Disaster Assistance Act (CDAA) funds to provide temporary water supplies to households without water for drinking or sanitation.
B-27-14	October 6, 2014	Directed state agencies to assist local governments with wildfire response during the drought conditions.
B-28-14	December 28, 2014	Extended provisions within the State of Emergency Proclamation issued on January 17, 2014.
B-29-15	April 1, 2015	Ordered the SWRCB to impose restrictions to achieve a 25 percent reduction in potable urban water usage, directed state agencies (DWR and California Energy Commission [CEC]) to implement water saving programs including turf replacement and appliance rebate programs, streamlined the state's drought response, and encouraged new drought-resilient technologies.
B-36-15	November 13, 2015	Extended B-26-14, B-28-14, and B-29-15. Called for additional actions to build on the ongoing drought response and assist recovery efforts from 2015 wildfires. Also extended emergency conservation regulations and streamlined permitting for stormwater capture.
B-37-16	May 9, 2016	Established a new water efficiency framework for the state, including measures to achieve longer-term water conservation, reduce urban water use, reduce system leaks, eliminate wasteful practices, strengthen urban drought contingency plans, improve agricultural water management, and improve drought planning for small water providers and rural communities.
B-40-17	April 7, 2017	Lifted the drought emergency in all California counties except Fresno, Kings, Tulare, and Tuolumne. Continued emergency drinking water projects in those counties to address diminished groundwater supplies.

Drought Disaster Assistance Programs

As noted earlier, the state has deployed numerous resources—fiscal, logistical, and personnel—in responding to the impacts of the drought. Table 9.I describes assistance programs designed to mitigate various types of drought impacts.

Table 9.I: Drought Disaster Assistance Programs

Agency	Program	Description	Allocation
California Governor's Office of Emergency Services (Cal OES)	California Disaster Assistance Act	Funding for local government assistance to provide emergency drinking and sanitation water supplies to households.	$20.1 million
Department of Food and Agriculture (CDFA)	State Water Efficiency and Enhancement Program (SWEEP)	Grants to provide financial incentives for California agricultural operations to invest in water irrigation systems that reduce greenhouse gas emissions and save water.	$40 million (Fiscal Year 2015-2016)
California Department of Social Services (CDSS)	Drought Food Assistance Program	Food assistance to affected communities that suffer high levels of unemployment from the drought.	$18.4 million
California Department of Community Services	Migrant and Seasonal Farmworker Drought Assistance Program	Assistance in employment training and placement services to migrant and seasonal	$400,000

Agency	Program	Description	Allocation
and Development (CSD)		farmworkers suffering job loss or reduced employment due to the drought.	
	Utility Assistance	Financial assistance to help low-income families pay their water utility bills.	$1.2 million under the federally funded Community Services Block Grants
	Migrant and Seasonal Farm Worker Drought Emergency Assistance Program	Emergency relief and support services to drought-affected, low-income workers in industries ancillary to agriculture	$7.5 million
California Department of Housing and Community Development (HCD)	Housing Assistance	Emergency rental assistance program in cooperation with La Cooperativa	$10 million
	Drought Housing Assistance	Funding to Tulare, Yolo, Tuolumne, Fresno, and Kings Counties for persons moving from current residences that do not have reasonable access to potable water.	$1.7 million
California Department of Water Resources (DWR)	Turf Replacement Rebate Program	A rebate program for removing turf and replacing it with landscapes that require little water at California single-family residences to support the state's drought response.	$21.8 million
Labor Workforce Development Agency (LWDA)	Employment Assistance	Administration of federally funded Drought Temporary Jobs program for six months of employment on drought-related public works projects.	$18 million funded through the U.S. Department of Labor's National Dislocated Worker Grant Program.
State Water Resources Control Board (SWRCB)	Cleanup and Abatement Account Interim Emergency Drinking Water Program and Public Water System Drought Emergency Response Program	Technical and funding assistance to communities facing drinking water shortages, and monitoring of water systems across the state.	$15 million funded through Cleanup and Abatement Account (Senate Bill 826)

Drought Grant Programs

In addition to the disaster assistance programs outlined above, a number of grant programs were initiated to provide drought relief and to stimulate drought mitigation activities. These programs are listed in Table 9.J.

Table 9.J: Drought Grant Programs

Agency/Department	Program	Description	Available Funding [Finalize these amounts]
California Energy Commission	Energy and Water Saving Research	Demonstration of water and energy saving technologies that promise to make the water, industrial, and agricultural sectors more efficient.	$16 million
California Department of Fish and Wildlife	Fisheries Restoration Grant Program	Removal of barriers to fish migration, restoration of riparian habitat, and creation of a more resilient and sustainably managed water resources system that can better withstand drought conditions.	$16.7 million
California Department of Food and Agriculture (CDFA)	State Water Efficiency and Enhancement Program	Competitive grants to implement irrigation systems that reduce greenhouse gases and save water at agricultural operations.	$18 million (3.75 million for 2017)
California Department of Forestry and Fire Protection (CAL FIRE)	Tree Mortality	Local fire protection grants focused on the removal of dead and dying trees in order to reduce the wildfire threat around homes.	$2 million
California Department of Water Resources (DWR)	High Efficiency Toilet Retrofit Program	Designed to install very low-flush volume toilets in disadvantaged communities.	$6 million funded by Proposition 1
	Turf Replacement Rebate Program	Removal of turf at single-family residences, replacing it with landscapes that require little water.	$21.8 million
	Integrated Regional Water Management	Support for projects and programs to meet California's long-term water management needs, including delivery of safe drinking water, enhancement of recycled water, water conservation, flood risk abatement, watershed protection, ecosystem restoration, and groundwater management.	$232 million

Best Practices Highlight 9.A: A Permanent Solution to Water Shortage in East Porterville, Tulare County

Residents of East Porterville in Tulare County, often called drought's "ground zero," now can turn on their taps and be confident a sustainable, safe-to-drink stream of water will flow.

Imagine losing access to a potable water supply in your own home—not for days, but for years. That happened in East Porterville as California's five-year drought reduced surface water supplies, increased the Central Valley's reliance on groundwater, and dropped the water table below the reach of many wells in the community. Hundreds of wells went dry in unincorporated East Porterville, which has no water distribution system.

Since 2014, the California Governor's Office of Emergency Services (Cal OES) has assisted with water deliveries to temporary holding tanks installed at East Porterville homes at a monthly cost of more than $650,000. Volunteers and non-governmental organizations delivered bottled water during the crisis.

The California Department of Water Resources (DWR) conducted the East Porterville Water Supply Project Feasibility Study, which concluded that the most practical solution among the several options analyzed was to connect East Porterville homes to the City of Porterville's water system. The study was a critical piece because it helped convince residents that the proposed arrangement with the City of Porterville would work. It also established the governance of the new water distribution system to achieve efficient operations. DWR employees designed the new system, negotiated with Tulare County and Porterville officials to achieve necessary agreements, and met numerous times with residents to explain the project.

New water lines were laid along East Porterville streets to expand the City of Porterville's system, which eventually will provide service to up to 1,100 East Porterville homes whose wells are dry or contaminated.

DWR employees worked on a daily basis with their colleagues in the other state agencies and in local government. The State Water Resources Control Board exercised its powers to facilitate the consolidation of East Porterville's unincorporated community with the existing Porterville water system.

DWR also collaborated with East Porterville non-profit organizations that are committed to ensuring social justice for the community's drought victims. Public meetings with simultaneous interpretation services for Spanish speakers helped East Porterville residents understand the project. [267]

Best Practices Highlight 9.B: State Water Efficiency and Enhancement Program (SWEEP)

The State Water Efficiency and Enhancement Program (SWEEP) is a competitive grant program initiated in 2014 in response to California's historic five-year drought. The program provides grant funds on a matching fund basis to agricultural operations in the state to support projects that both save water and reduce greenhouse gas emissions. Agricultural operations are defined as row, vineyard, field and tree crops, commercial nurseries, nursery stock production, and greenhouse operations. The awarded projects can combine multiple strategies to achieve the required water savings and emissions reductions. Eligible system components include soil moisture monitoring, drip systems, switching to low pressure irrigation systems and installing renewable energy to reduce on-farm water use and energy.

Administered by the California Department of Food and Agriculture, in collaboration with the Department of Water Resources and the State Water Resources Control Board, the program is funded as part of California Climate Investments, a statewide program that puts billions of cap-and-trade dollars to work reducing greenhouse gas emissions, strengthening the economy, and improving public health and the environment—particularly in disadvantaged communities. The SWEEP provides a unique opportunity for government and private enterprise to work together to provide long-term solutions aimed toward reducing agricultural water use.

[267] Department of Water Resources Magazine, fall 2016

Since the SWEEP was launched in 2014, it has funded 587 projects totaling more than $62 million. For funding year 2017, 58 awards covering 19 different counties were made, totaling $4,992,509 in grant funds with $6,782,535. Cumulative benefits are estimated at 958,000 acre-feet of water savings—enough to fill more than two million swimming pools—along with greenhouse gas emission reductions of 741,000 metric tons of carbon dioxide equivalent over 10 years, the equivalent of removing more than 20,000 vehicles from roads.

For additional information go to: https://www.cdfa.ca.gov/oefi/sweep/.

Drought Mitigation Plans and Programs

California develops, maintains, and implements various plans related to drought and water management activities. Each is briefly outlined below. Additional information and details may be found at the weblinks provided.

Drought Contingency Plan

In response to the 2007-2009 drought, Governor Arnold Schwarzenegger issued Drought Proclamations and Executive Orders in 2008 and 2009 directing state agencies to take immediate actions to manage the crisis. DWR responded, with strong support from Cal OES and other agencies, by developing a Drought Contingency Plan. In response to the 2012-2017 drought, the 2016 Drought Contingency Plan directed operations of the State Water Project (SWP) and Central Valley Project (CVP)—two fundamental water supply projects in the state—for February through November 2016. The 2016 Drought Contingency Plan builds on the foundation of the planning work by state and federal agencies over the previous three years and fulfills the condition of the order adopted by the State Water Resources Control Board (SWRCB) on December 15, 2015. The goals of the 2016 Drought Contingency Plan are the following: [268]

- Ensure, as a first priority, that the CVP and SWP will meet essential human health and safety needs, by supplying adequate water supplies throughout their service areas for drinking, sanitation, and fire suppression
- Manage the intrusion of salt water into the Sacramento-San Joaquin Delta through operations of the CVP and SWP
- Provide and maintain adequate protections for state and federal endangered and threatened species and other fish and wildlife resources
- Seek and consider water management flexibilities to maximize the benefit of limited water supplies

2013 California Water Plan and 2018 Update

The most recent California Water Plan was adopted in 2013 and supports the implementation of the Governor's Water Action Plan. The objectives of the California Water Plan are the following:[269]

- Strengthen integrated regional water management planning
- Use and reuse water more efficiently
- Expand conjunctive management of multiple supplies
- Protect and restore surface water and groundwater quality
- Practice environmental stewardship
- Improve flood management using an integrated water management approach
- Manage the delta to achieve the coequal goals for California
- Prepare prevention, response, and recovery plans
- Reduce the carbon footprint of water systems and water uses
- Improve data, analysis, and decision support tools
- Invest in water technology and science
- Strengthen tribal/state relations and natural resources management
- Ensure equitable distribution of benefits
- Public access to waterways, lakes, and beaches

[268] DWR, 2016, "2016 Drought Contingency Plan For Water Project Operations February – November 2016", http://www.water.ca.gov/waterconditions/docs/2016-DroughtContingencyPlan-CVP-SWPOperations-Feb-Nov_1.19.16-FINAL.pdf

[269] DWR, 2013, "California Water Plan Update 2013", https://www.water.ca.gov/Programs/California-Water-Plan

- Strengthen alignment of land use planning and integrated water management
- Strengthen alignment of government processes and tools
- Improve integrated water management finance strategy and investments

As an update to the 2013 California Water Plan, DWR is in the process of developing the 2018 Water Plan to incorporate progress of existing strategies and new strategies in support of the Governor's 2016 Water Action Plan. The purpose of the 2018 Water Plan is to assess the effectiveness of current water actions (programs and projects) in advancing sustainable water management in California.

2016 Water Action Plan

The Governor's Water Action Plan was updated in 2016 and includes the following objectives:[270]

- Make conservation a way of life in California
- Invest in integrated water management and increase regional self-reliance
- Achieve the coequal goals for the Delta
- Protect and restore important ecosystems
- Manage and prepare for dry periods
- Expand water storage capacity and improve groundwater management
- Provide safe drinking water and secure wastewater systems to all communities
- Increase flood protection
- Improve operational and regulatory efficiency
- Identify sustainable and integrated financing opportunities

State Water Resources Control Board Activities

Division of Drinking Water. To help mitigate the hazard of lack of drinking water during emergencies and increased resiliency, the State Water Resources Control Board (SWRCB) Division of Drinking Water has been promoting and implementing consolidation of challenged public water systems. The Division of Drinking Water has encouraged the establishment of interconnections among public water systems, updates of vulnerability assessments and emergency response plans, and review of development of recycled water projects and desalination projects. The Division of Drinking Water also encourages public water systems to engage with county emergency services to be included in local hazard mitigation planning, specifically with recognition of and calling attention to the human right of access to water. For more information, visit: https://www.waterboards.ca.gov/water_issues/programs/hr2w/

Safe Drinking Water Plan for California. Originally developed by the California Department of Health (CDPH) in 1993, the Safe Drinking Water Plan for California is required to be periodically updated in accordance with Senate Bill (SB) 1307, passed in 1996. During the preparation of the 2014 draft update, responsibility for the plan was transferred from CDPH to the SWRCB. The current update of the Safe Drinking Water Plan for California, submitted to the Legislature in June 2015, focuses on how the SWRCB proposes to improve access to reliable and healthy drinking water for communities throughout the state. The plan focuses on the nearly 8,000 public water systems that are under the purview of the Division of Drinking Water. The plan includes recommendations to effectively support and provide resources to the water systems that serve the 2 percent of consumers who do not receive safe drinking water.

The Safe Drinking Water Plan identifies the improvements needed to bring the smaller systems into compliance with a secure and reliable supply. Some of the key areas addressed in the report include:

- Obtaining water in a drought
- Providing safe drinking water for disadvantage communities
- Increasing and sustaining capacity development of systems
- Identifying shared solutions to supplying safe drinking water, including the consolidation of systems
- Developing cheaper and effective treatment and analytical methods
- Building better emergency preparedness and response protocols for small systems

[270] CNRA, 2016, "California Water Action Plan", http://resources.ca.gov/california_water_action_plan/

The plan may be found at:
https://www.waterboards.ca.gov/publications_forms/publications/legislative/docs/2015/sdwp.pdf

Urban and Agricultural Water Management Plans
The Governor's drought declaration also called upon local urban water suppliers and municipalities to implement their local water shortage contingency plans immediately in order to avoid or forestall outright restrictions that could become necessary later in the drought season. Furthermore, the Governor directed local water agencies to update their legally required Urban and Agricultural Water Management Plans, which can help plan for extend drought conditions.

Progress Summary 9.D: California Groundwater and the Sustainable Groundwater Management Act of 2014

Progress as of 2018: In September 2014, Governor Jerry Brown signed a historic three-bill package known as the Sustainable Groundwater Management Act of 2014 (SGMA) into law. Intended to strengthen local control and management of California's groundwater basins, the SGMA collectively commits California to local management of groundwater supplies with the goal of achieving sustainable management of groundwater basins through development and implementation of groundwater sustainability plans (GSPs) by local agencies within 20 years.

The SGMA provides the following timeline for the state, counties, and local agencies to provide tools and technical assistance to empower local entities to achieve groundwater sustainability:

- ACTION 1: Local agencies must establish groundwater sustainability agencies (GSAs) for all medium- and high-priority basins by June 30, 2017.
- ACTION 2: GSAs for medium- and high-priority basins must develop and begin implementation of GSPs by January 31, 2020 for those in critical condition of overdraft and by January 31, 2022 for all other medium- and high-priority basins.
- ACTION 3: After the development of GSPs, agency implementation of the GSP must occur over the following 20 years. GSPs must include measurable objectives and milestones to show progress toward sustainability goals.

To guide the implementation of the SGMA, the California Department of Water Resources (DWR) is tasked with several actions. DWR's next objectives include completing regulations for changing basin boundaries and establishing content for and review of GSPs, updating basin priorities (low, medium, or high), and conducting groundwater assessments into the next decade.

To date, DWR has identified basins subject to critical conditions of overdraft and held public meetings on the topic. DWR posts notifications for GSA formation on its web page and provides a graphical summary of the SGMA's timeline.

The SGMA also required DWR to develop Best Management Practices (BMPs) that provide technical assistance for GSAs to develop GSPs. As of 2016, DWR published the following BMPs, which include assistance for monitoring and modeling land subsidence in addition to the sustainable management of groundwater:

- BMP 1: Monitoring Protocols, Standards, and Sites
- BMP 2: Monitoring Networks and Identification of Data Gaps
- BMP 3: Hydrogeologic Conceptual Model
- BMP 4: Water Budget
- BMP 5: Modeling

For more information regarding the GGMA and progress toward implementation, visit DWR's Sustainable Groundwater Management web page (https://www.water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management) or the U.S. Geological Survey's Sustainable Groundwater Management Act web page: https://ca.water.usgs.gov/sustainable-groundwater-management/

Countywide Drought and Water Shortage Contingency Plans

In May 2016, Governor Brown issued Executive Order B-37-16 that included drought hazard and planning-related actions. Directive 10 from the order specified that, "For areas not covered by a Water Shortage Contingency Plan, the Department shall work with counties to facilitate improved drought planning for small water suppliers and rural communities."

In the April 2017 final report titled "Making Water Conservation a California Way of Life," state agencies identified the following efforts as a pathway to developing recommendations: improved engagement with cities, counties, and stakeholders; state agencies' commitment to develop initial data collection and outreach; engagement of stakeholders through a public process to develop drought plan recommendations; and incorporation of drought planning into county hazard mitigation plans.

Since issuance of Directive 10, the California Department of Water Resources (DWR) has been working with a diverse group of stakeholders to develop a framework for improved drought planning, for areas not covered by Urban Water Management Plan Water Shortage Contingency Planning that could be incorporated by counties into their hazard mitigation and land use planning efforts and documents. The framework would allow counties to demonstrate preparation, planning, and response strategies to water shortages—especially shortages resulting from prolonged droughts and climate change.

Assembly Bill 1668 pending legislation (as amended May 3, 2018) would require DWR, in coordination with the State Water Resources Control Board (SWRCB), to identify small water suppliers and rural communities that may be at risk of water shortage vulnerability and develop recommendations for countywide drought and water shortage contingency planning to address the planning needs of small systems and rural communities.

The current draft of the countywide drought preparedness framework will be made available on DWR's website at: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Conservation-As-a-Way-of-Life.

Additional Drought Hazard Mitigation Opportunities

Sub-Seasonal to Seasonal (S2S) Precipitation Forecasting

Improved National Weather Service (NWS) forecasts at the sub-seasonal to seasonal (S2S) timescale are sorely needed for improving California's drought preparedness, response, and mitigation capabilities. Such forecasts can answer questions such as "will the next six weeks be wet or dry?" or "will this winter be wet or dry?" Having longer lead times as a result of better forecasting allows for more timely response actions and better operation of water infrastructure. DWR is working through the Western States Water Council and the National Oceanic and Atmospheric Administration (NOAA) to identify proposed actions for improving forecasting. Additional background on S2S forecasting is available at: http://www.westernstateswater.org/wp-content/uploads/2016/05/A2227_precip-forecasting-brochure_v6_FINAL.pdf.

California Statewide Groundwater Elevation Monitoring (CASGEM) Program

The California Statewide Groundwater Elevation Monitoring (CASGEM) Program tracks seasonal and long-term groundwater elevation trends in groundwater basins statewide as mandated by the November 4, 2009 Water Code amendment with Senate Bill x7-6 (2009). In accordance with this amendment to the Water Code, DWR developed the CASGEM Program. The amendment requires collaboration between local monitoring entities and DWR to collect groundwater elevation data.

DWR has completed the 2015 CASGEM Status Report, prepared for the Governor and the Legislature as required by the Water Code (Section 10920 et seq.). This report describes the significant number of CASGEM Program accomplishments achieved during calendar years 2012 through 2015. Collection and evaluation of such data on a statewide scale is an important fundamental step toward improving management of California's groundwater resources. CASGEM groundwater elevation data are necessary for determining groundwater elevation and storage trends and the effectiveness of groundwater management measures, including those implemented under

Sustainable Groundwater Management Act (SGMA). For more information on the CASGEM Program, visit the program website: https://www.water.ca.gov/Programs/Groundwater-Management/Groundwater-Elevation-Monitoring--CASGEM.

Promoting Continued Efficient Water Use

Collaborative water conservation campaigns such as "Save our Water" provide educational resources to the public to facilitate personal water conservation practices. For more information, visit: http://saveourwater.com.
A top priority of the Water Action Plan is to "Make Conservation a California Way of Life." As a result of Executive Order B-37-16, the SWRCB will permanently prohibit wasteful practices, such as hosing off sidewalks, driveways, and other hardscapes; washing automobiles with hoses not equipped with a shut-off nozzle; and watering lawns in a manner that causes runoff. DWR and the SWRCB will also work to eliminate leaks in water systems across the state. Figure 9.B is a graphic summary of recommended conversation actions outlined in the report. To view the full report, go to:
http://www.water.ca.gov/wateruseefficiency/conservation/docs/20170407_EO_B-37-16_Final_Report.pdf

Figure 9.B: "Make Conservation a California Way of Life" Report Actions Summary

Table ES-1. Actions and Recommendations Summarized in this Report

Chapter Section and Title where Item is Addressed	Executive Order Items: Use Water More Wisely			Eliminate Water Waste				Strengthen Local Drought Resilience			Improve Agricultural Water Use Efficiency & Drought Planning			Within Existing Authorities (Chapter 2)	Requires New Authority (Chapter 3)
	1	2	3	4	5	6	7	8	9	10	11	12	13		
2.1 Emergency Water Conservation Regulations for 2017	●													✓	
2.2 Permanent Prohibition of Wasteful Practices			●	●										✓	
2.3 Reduced Water Supplier Leaks and Water Losses					●	●								✓	
2.4 Certification of Innovative Technologies for Water Conservation and Energy Efficiency							●							✓	
3.1 New Water Use Targets Based on Strengthened Standards		●				●									✓
3.2 Water Shortage Contingency Plans						●		●	●						✓
3.3 Drought Planning for Small Systems & Rural Communities										●					✓
3.4 Agricultural Water Management Plans						●					●	●	●		✓

Source: Make Conservation a California Way of Life Implementation Report, page iv
http://www.water.ca.gov/wateruseefficiency/conservation/docs/20170407_EO_B-37-16_Final_Report.pdf

9.1.6 ENERGY SHORTAGE AND ENERGY RESILIENCY

Identifying Energy Shortage Hazards

The California energy system includes the following elements: energy extraction, transport, and conversion (such as combusting natural gas in power plants to generate electricity or producing gasoline and diesel from crude oil in refineries); energy consumption for services (such as electricity for lighting, natural gas use in homes and buildings for space and water heating, and gasoline and diesel to fuel cars and trucks); and use of electricity from out-of-state plants serving California.

California gets its electric power from a number of sources.[271] Most in-state electrical generation is derived from natural gas (49.9 percent). Even when combined with imports from other regions, natural gas remains dominant at 36.5 percent. Hydro-generation provides 12.31 percent of California's electric power, with the balance coming from fossil fuels, nuclear, and renewable sources. Renewables comprise 27.9 percent of in-state electrical generation and the percentage is very similar (25.5 percent) when combined with imports.

Renewable energy sources include wind (6.8 percent), solar (10.0 percent), geothermal (5.8 percent), biomass (3.0 percent), and small hydroelectric (2.3 percent). In-state electrical generation is 68.2 percent (198,227 gigawatt hours [GWh]) of the total (290,567 GWh), with the remaining being provided through southwest and northwest imports. Coal, provided primarily from imports, makes up only 4 percent of California's electrical generation. About 97 percent comes from out-of-state power plants. Imports of coal-fired generation are expected to become zero by the end of 2025.

Natural gas continues to play an important and varied role in California. Nearly 45 percent of the natural gas burned in California is used for electricity generation, and much of the remainder is consumed in the residential (21 percent), industrial (25 percent), and commercial (9 percent) sectors. California continues to depend upon out-of-state imports for nearly 90 percent of its natural gas supply.

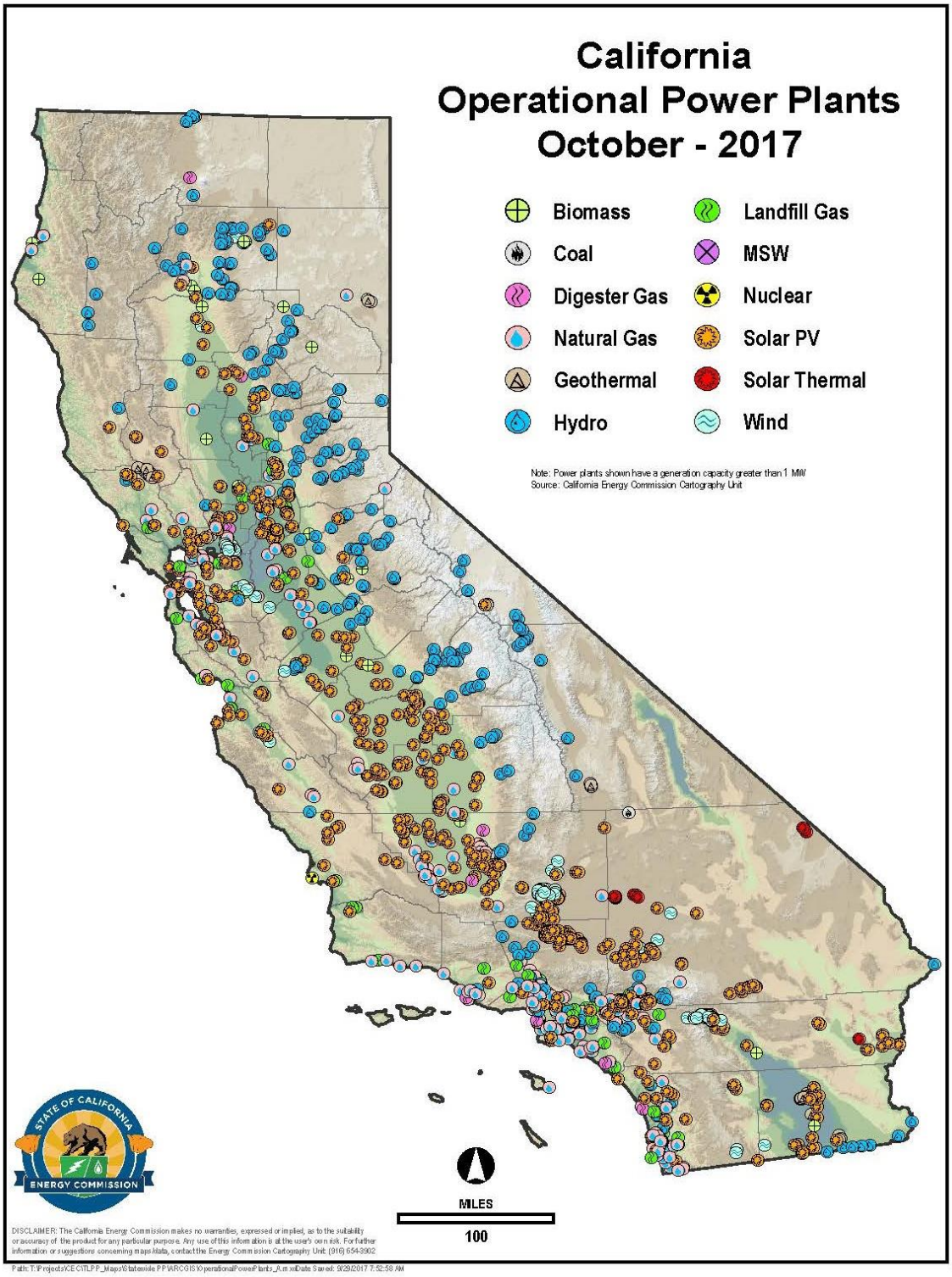
Transportation accounts for a major portion of California's energy budget and has a significant impact on air quality. It is also the single largest source of the state's greenhouse gas emissions. Gasoline is the most used transportation fuel in California, with 97 percent of all gasoline being consumed by light-duty cars, pickup trucks, and sport utility vehicles. In 2015, 15.1 billion gallons of gasoline were sold, according to the State Board of Equalization. Gasoline sold in California at retail is made up of 90 percent petroleum-based gasoline (as specified by the California Air Resources Board) and 10 percent ethanol.

Diesel fuel is the second largest transportation fuel used in California, representing 17 percent of total fuel sales behind gasoline. According to the State Board of Equalization, in 2015 4.2 billion gallons of diesel, including off-road diesel, were sold. Since 2003, natural gas use for transportation in California has more than doubled from under 80 million gallons to 160 million gallons of gasoline equivalent. It is estimated that 88 percent of this value is used in medium and heavy-duty vehicles.[272]

Additional information and resources on energy disruptions or emergencies can be found at: http://www.energy.ca.gov/emergencies/.

[271] California Energy Commission, http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html
[272] California Energy Commission Almanac, http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html

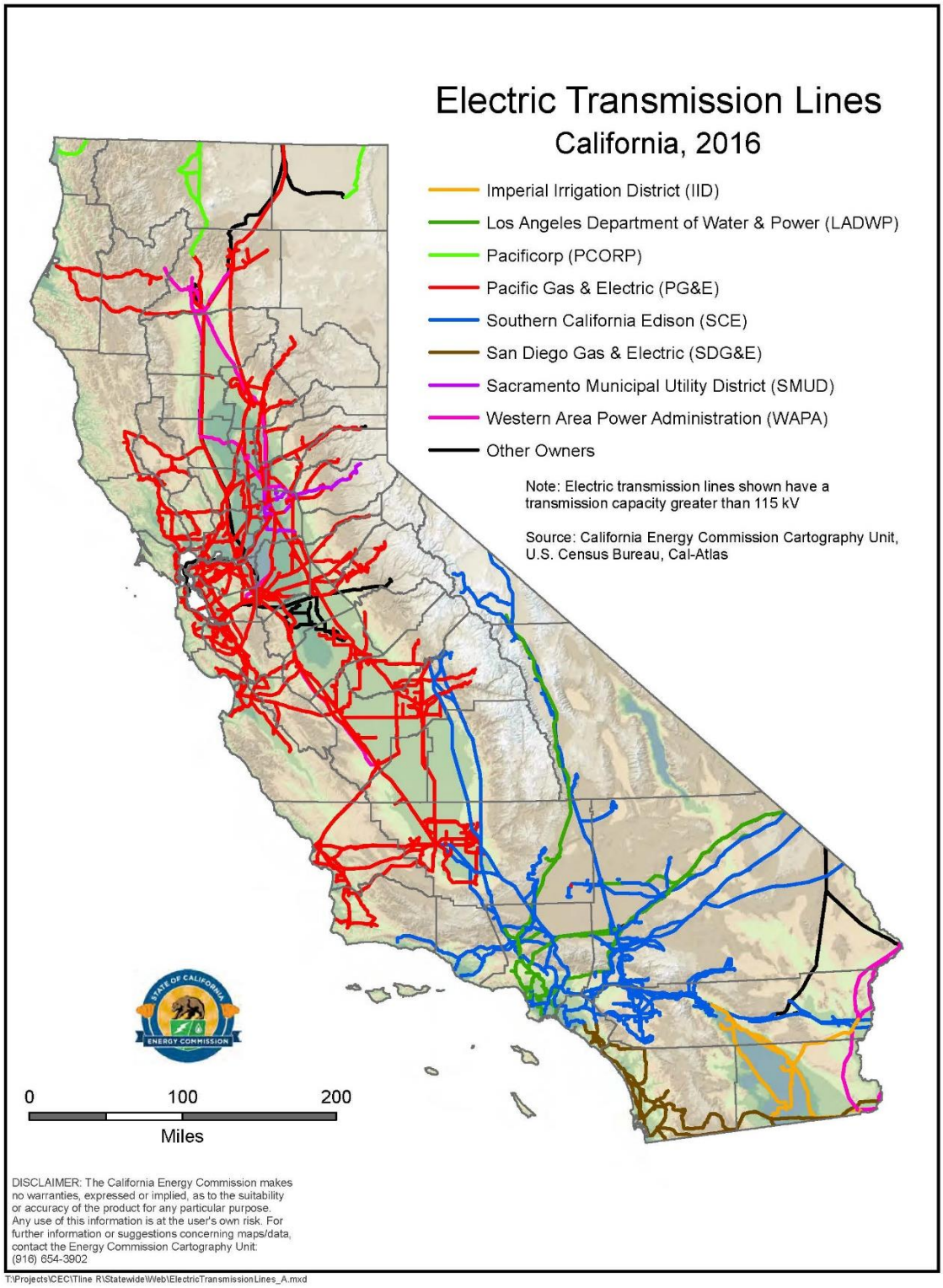
MAP 9.K: California's Operating Power Plants



Source: California Energy Commission, http://www.energy.ca.gov/maps/

Map 9.K shows the location and type of California power plants in operation as of 2017.

Map 9.L: California's Electric Transmission Grid



Source: California Energy Commission, http://www.energy.ca.gov/maps/

Map 9.L illustrates the extent and complexity of California's electrical transmission system.

Profiling Energy Shortage Hazards

Electric Power Disruptions

The electric power industry does not have a universal agreement for classifying disruptions. Nevertheless, it is important to recognize that different types of outages are possible so that plans may be made to handle them effectively. Electric power disruptions can be generally grouped into two categories: intentional and unintentional.

There are four types of intentional disruptions:

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

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

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

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

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

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

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

A July 2006 heat storm event affected the entire state as well as most of the West, producing record energy demand levels in California. The state was able to avoid rotating outages due to a combination of favorable factors that included no major transmission outages, lower than typical generator outages, significant customer response to pleas for energy conservation, high imports from the Pacific Northwest despite unusually high loads, outstanding cooperation among western control area operators, and prompt response to fires that potentially threatened major interties. However, the event brought to light the vulnerability of the electric distribution system, as over 3,500

distribution transformers failed, leaving over two million customers without power at various times over the ten-day event, many for several hours and a small minority for up to three days.

On the afternoon of September 8, 2011, an 11-minute system disturbance occurred in the Pacific Southwest, leading to cascading outages and leaving approximately 2.7 million customers without power. The outages affected parts of Arizona, Southern California, and Baja California, Mexico. All of the San Diego area lost power, with nearly 1.5 million customers losing power, some for up to 12 hours. The disturbance occurred near rush hour, on a business day, snarling traffic for hours. Schools and businesses closed, some flights and public transportation were disrupted, water and sewage pumping stations lost power, and beaches were closed due to sewage spills. Millions went without air conditioning on a hot day.[273]

Gas Hazards

On October 23, 2015, Southern California Gas Company discovered a leak in one well within its Aliso Canyon storage field in the northern San Fernando Valley. The company stores natural gas underground at this storage field until it is pumped up and delivered to its customers. This storage field and others in California help meet peak seasonal demand for natural gas in the state during the winter months. Attempts to plug, or kill, the leaking well failed in November and December 2015. During that time actions were taken to reduce the amount of gas leaking from the facility, including withdrawing gas to reduce the gas pressure, and curtailing injections of gas into the storage facility. Recognizing that the storage field could be out of service or available only at reduced capacity for an extended period, the California Energy Commission (CEC), California Public Utilities Commission (CPUC), Department of Conservation Division of Oil, Gas, and Geothermal Resources (DOGGR), Cal OES, and other state agencies, as well as CAISO and the Los Angeles Department of Water and Power (LADWP), began assessing the potential impacts on natural gas and electricity reliability.

Although the levels of methane gas escaping from the leak were too low to raise flammability concerns, the additive odorant called Scentinel® T-50 was shown to cause limited short-term eye and skin irritation to residents of Porter Ranch, the closest community to the Aliso Canyon facility. The California Department of Public Health published a fact sheet on its website to educate residents on the public health impacts and to inform residents that Southern California Gas Company would temporarily relocate residents who were experiencing health effects.

On February 18, 2016, state officials announced that the leak was permanently plugged after 119 days. Although the well had stopped leaking, the DOGGR maintained the moratorium prohibiting Southern California Gas Company from injecting natural gas for storage at the facility until completion of a comprehensive safety review. This safety review required all 114 wells at the Aliso Canyon storage facility to be either thoroughly tested for safe operation or removed from operation and isolated from the underground reservoir. The Natural Gas Storage: Moratorium 2015-2016 (SB 380) codified this directive.

On July 19, 2017, state regulators confirmed the safety of the Aliso Canyon natural gas storage facility and cleared Southern California Gas Company to resume limited injections at the field to help prevent energy shortages, once certain conditions were met. That same day, the CEC issued a letter to the California Public Utilities Commission (CPUC) urging it to plan for the permanent closure of the facility within 10 years.

Climate Change and Energy Shortage

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

[273] FERC/NERC Staff Report on the September 8, 2011 Blackout

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

With climate warming, higher costs from increased demand for cooling in the summer are expected to outweigh the decreases in heating costs in the cooler seasons. Hotter temperatures in California will mean more energy (typically measured in "cooling-degree days") needed to cool homes and businesses both during heat waves and on a daily basis, during the daytime peak of the diurnal temperature cycle. During future heat waves, historically cooler coastal cities (e.g., San Francisco and Los Angeles) are projected to experience greater relative increases in temperature, such that areas that never before relied on air conditioning will experience new cooling demands.[274]

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

Assessment of State Vulnerability and Potential Losses

The CEC provides full forecasts for electricity and natural gas demand every two years as part of the Integrated Energy Policy Report (IEPR) process. The CEC uses detailed models for each economic sector (such as residential, commercial, industrial, and transportation) to project electricity consumption and demand for the full IEPR energy demand forecast. For details on how these forecasts are calculated, go to: http://www.energy.ca.gov/2016_energypolicy/.

California's energy infrastructure is designed to cope with the state's highly variable conditions and frequent disruptions from wildfires, storms, and floods. Generally, power outages caused by these events are short-term and limited to regional impacts. Of more concern are system-wide outages or shortages caused by a major disruption in supply or transmission, such as the recent Aliso Canyon gas leak. During the 18-month period when the facility was shut down, gas flow to meet hourly energy demands in the Los Angeles area was affected, creating uncertainty about the reliability of energy system operations in the area.[275]

The Governor's 2016 emergency proclamation on the Aliso Canyon leak called for an assessment of the long-term viability of all natural gas storage facilities in California. This assessment is well underway and is being conducted by an independent team of scientists organized by the California Council on Science and Technology. It is scheduled to be completed by the end of 2017, and will inform the state's rethinking of all natural gas storage facilities in California.

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

[274] California Climate Change Center 2009
[275] Source: CEC, IEPR

Current Energy Shortage Hazard Mitigation

Overview

There are a variety of measures California takes to mitigate energy shortages and promote energy resilience. Balancing energy supply and demand on a constant and continuing basis by CAISO helps to ensure that the flow of energy into and within the state meets the energy needs of business, industry, government, and residents in the most reliable and economic way.

Siting of energy system elements away from natural hazards through state and local regulatory mechanisms such as zoning, codes, standards, and environmental review helps to reduce the impacts of earthquake, flood, and fire events.

Energy efficiency standards help to eliminate the least efficient products (such as appliances) and practices (such as in the building industry) from continued use. California utilities energy efficiency programs since the 1970s offer some of the lowest-cost energy resource options and help meet California's energy and climate policy objectives. Still, more action is needed to reduce energy consumption in existing buildings as the energy used in them accounts for more than one quarter of all greenhouse gas emissions in California.

In 2015, the CEC adopted the Existing Buildings Energy Efficiency Action Plan to help meet the Governor's goal to double the efficiency savings of existing buildings by 2030 and adopted the first update in December 2016. Further updates are expected every three years. SB 350 (2015) requires the CEC to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a doubling of energy efficiency savings from buildings and retail end uses by 2030.

Local governments have the authority to adopt energy efficiency codes that exceed the State 2016 Building Energy Efficiency Standards. Examples include standards developed in Marin County and the City of Santa Monica, which were approved by the CEC in March 2017.

All electric power companies develop projections of long-term demand as a starting point for planning the expansion of electric power generation, transmission, and distribution facilities. Projections are made for a range of planning horizons (from 1 to 20 years) and for a range of geographical resolutions (for the entire system to individual distribution sub-stations and feeder lines). In general, the shorter the planning horizon and the larger the geographic resolution used, the more likely the demand forecast will be reasonably representative of the actual situation.

Energy-Specific Strategies from the California Climate Adaptation Strategy

The 2017 California Climate Adaptation Strategy included a list of energy-specific strategies along with near-term recommended actions for immediate implementation and longer-term recommended actions that require state agency collaboration and support. These energy-specific strategies are:

1. Continue to support climate research for the energy sector to better inform climate adaptation and mitigation strategies.
2. Use common climate scenarios in all energy research and planning, and work to help standardize climate scenarios across state government planning and investment.
3. Continue incorporating implications of climate change into all energy sector planning and decision-making.
4. Support local adaptation planning efforts and increase outreach about available analytical tools.
5. Investigate means to provide long-term support for Cal-Adapt advancement, maintenance, and expansion.

Information on current programs and implementation actions, as well as proposed next steps, can be found at the California climate change portal website: http://www.climatechange.ca.gov/adaptation/strategy/index.html.

Progress Summary 9.E: California Solar Initiative

Progress as of 2018: In January 2007, California began a $3.3 billion ratepayer-funded effort to install new solar facilities capable of generating 3,000 megawatts (MW) of energy over the next decade and transform the market for solar energy by reducing the cost of solar generating equipment. The California Public Utilities Commission's portion of the solar effort is known as the California Solar Initiative (CSI) program. The CSI program goal was to install 1,940 MW of customer-sited solar capacity by the end of 2016 and, along with other statewide solar programs, transition the solar industry to a point where it can be self-sustaining without subsidies.

The CSI program has two funding streams, depending upon whether the rebated technology displaces electricity or natural gas. The electric portion of the CSI program has a 10-year budget of $2.4 billion, collected from electric ratepayers as authorized by Senate Bill (SB) 1. Assembly Bill (AB) 217, passed in 2013, extended the CSI low-income programs with $108 million in new funding, to continue until the incentives are claimed or 2021, whichever is earlier. The natural gas-displacing portion of the CSI program, known as CSI Thermal, is funded by AB 1470, which authorized $250 million in incentives for solar thermal technologies to be collected from gas ratepayers through 2017.
The CSI program has several components:

- The CSI General Market Solar Program provides incentives for residential and non-residential systems from 1 kilowatt (kW) to 1 MW.
- The CSI Single-Family Affordable Solar Homes (SASH) Program provides solar incentives to qualifying single-family low-income households.
- The CSI Multifamily Affordable Solar Housing (MASH) Program provides solar incentives to multi-family low-income housing facilities.
- The CSI Research, Development, Demonstration and Deployment Program provides grants to develop and deploy solar technologies that can advance the overall goals of the CSI program, including achieving targets for capacity, cost, and a self-sustaining solar industry in California
- The CSI Thermal Program provides incentives to eligible solar thermal technologies such as gas or electric-displacing solar water heating systems.

By the end of 2014, residential solar system costs had decreased by 53 percent. By the end of 2015, California had installed over 3,886 MW of solar capacity at over 488,541 customer sites, including approximately 76 MW installed at single- and multi-family low-income properties.

Additional information about the California Solar Initiative may be found at:
http://www.cpuc.ca.gov/General.aspx?id=6043

Source: California Public Utilities Commission, California Solar Initiative Annual Program Assessment. June 2016.

Progress Summary 9.F: California Public Utilities Commission Solar Programs Invest In Disadvantaged Communities

Progress as of 2018: The California Public Utilities Commission (CPUC), in its ongoing efforts to help improve air quality and economic conditions in disadvantaged communities, adopted three programs in June 2018 to promote the installation of solar energy to serve customers in disadvantaged communities:

1. The Disadvantaged Communities – Single-family Solar Homes (DAC-SASH) program will provide up-front financial incentives towards the installation of solar systems for low income homeowners.
2. The Disadvantaged Communities – Green Tariff (DAC-Green Tariff) program will provide a 20 percent bill discount to customers in disadvantaged communities. This will allow customers to choose clean energy options without the need to own their home and without the cost of installing their own solar systems.
3. The Community Solar Green Tariff program is similar to the DAC Green Tariff program, and will also provide a 20 percent bill discount. This program will allow primarily low income customers in disadvantaged communities to benefit from the development of solar generation projects located in or near their communities.

For more details about the programs, visit: http://www.cpuc.ca.gov/discom/.

Progress Summary 9.G: Clean Energy Progress Tracking

Progress as of 2018: Energy efficiency advancements provide the same or better level of energy service (including all the ways people use energy such as for lighting, heating, and air conditioning), while using less energy. Energy efficiency is a critical element of the state's energy policy that can reduce the need for new electricity generation. Energy efficiency efforts in California have reduced greenhouse gases, made businesses more competitive, and allowed consumers to save money, improve health, and increase comfort.

Combining efficiency gains from standards and guidelines, efficiency programs, and market and price effects, the cumulative annual efficiency and conservation savings for electricity were estimated to surpass 95,000 gigawatt hours (GWh) by 2016. This amount of energy savings is equivalent to the annual carbon dioxide emissions produced by more than 7 million automobiles and equivalent to the amount of energy produced annually by more than 31,500-megawatt (MW) power plants. For more information, go to: http://www.energy.ca.gov/renewables/tracking_progress/

Statewide Energy Demand: Since the mid-1970s, per capita consumption has remained relatively constant in California but continues to grow in the U.S. overall. Californians consume 40 percent less electricity per person because of factors ranging from climate and household size to fuel and industry mixes and the state's aggressive energy policies.

Zero-Emission Vehicles and Infrastructure: On September 8, 2016, Governor Brown signed Senate Bill 32, putting into law a statewide goal to reduce greenhouse gas emissions 40 percent below 1990 levels by 2030. Previously, he established the foundation to support 1.5 million zero-emission vehicles (ZEV) by 2025 and published a ZEV Action Plan. As part of its work on ZEV, the California Energy Commission (CEC) provides funding for plug-in electric vehicle charging and hydrogen refueling stations, along with guidance on plug-in electric and hydrogen vehicle infrastructure deployment.

Reliance on Coal: Coal-fired electricity served about 11 percent of California's electricity demand in 2000 but has steadily declined; it served less than 6 percent by the end of 2015 and is expected to decline to zero by the middle of the next decade.

Renewable Energy: Installed capacity of renewable energy in California has more than tripled from 6,800 MW in 2001 to 26,300 MW as of October 31, 2016. Most of the growth in renewable energy resources has come from wind and solar. The addition of utility-scale solar photovoltaic power plants and residential solar installations accounts for the majority of the increase. The state has surpassed the goal of installing 3,000 MW of solar energy systems on new and existing structures by 2017, which was set in response to Senate Bill 1.

The Desert Renewable Energy Conservation Plan is a multi-agency comprehensive effort to identify the most appropriate areas for large-scale renewable energy development within 22 million acres of public and private desert landscape while protecting and conserving desert ecosystems and cultural resources. In September 2016, the U.S. Secretary of the Interior approved Phase I of the plan, covering 10.8 million acres of public lands managed by the U.S. Bureau of Land Management in the California desert.

Once-Through Cooling (OTC): The goal of the once-through cooling (OTC) policy is to reduce the inflow of ocean and estuarine water for power plant cooling. Generators must eliminate or reduce use of coastal or estuarine waters for OTC on a schedule established by the State Water Control Resources Board that considers both environmental goals and the need to maintain electrical reliability. Some generators have proposed alternative dates for specific units, groups of units, or whole facilities.

As water is an increasingly precious resource in California, the state has worked to reduce water consumption associated with electricity generation and the impacts on aquatic environments. Over the past decade, the fossil-fueled power plant fleet in California has become more water-efficient, resulting in a relatively modern fleet of thermal power plants that consume little water. Energy production accounts for less than 1 percent of all consumptive water use in California, but the use can affect the water supply of local communities. The total amount of freshwater used for cooling has not increased in the last decade, despite the addition of numerous thermal power plants. The increased use of dry-cooling technologies and the use of recycled water have significantly increased the water efficiency of power plants in California. For more detailed information, go to: http://www.energy.ca.gov/renewables/tracking_progress/documents/once_through_cooling.pdf.
Source: California Energy Commission: http://www.energy.ca.gov/renewables/tracking_progress/index.html

Progress Summary 9.H: California Clean Energy Jobs Act

Progress as of 2018: The California Clean Energy Jobs Act (Proposition 39) was approved on November 6, 2012, by the voters of California. The initiative makes changes to corporate income taxes and provides for the annual transfer of funds from the General Fund to the Clean Energy Job Creation Fund for five fiscal years, beginning with the 2013-2014 fiscal year. The funds are appropriated by the Legislature annually to fund eligible projects that create jobs in California while improving energy efficiency and expanding clean energy generation.

The 2017-2018 budget allocates $827 million of Proposition 39 revenue to school districts, charter schools, county offices of education (collectively referred to as local educational agencies [LEAs]), and community colleges to support energy efficiency projects. Various aspects of the Proposition 39 program are administered by the following California agencies: the California Energy Commission, the Department of Education, Conservation Corps, Workforce Development Board, and the Community Colleges Chancellor's Office.

The California Energy Commission administers three components of the California Clean Energy Jobs Act: a grant program (Proposition 39 K-12 Program), a revolving loan program (Energy Conservation Assistance Act – Education Subaccount Program), and a technical assistance program (Bright Schools Program). As of June 30, 2016, nearly $827 million in expenditures has been approved—$154 million for energy planning and $673 million for energy projects.

In February 2017, the California Energy Commission released a progress report entitled "Proposition 39: California Clean Energy Act, K-12 Program and Energy Conservation Assistance Act 2015-2016 Progress Report," which documents project status covering the period from December 2013 through June 2016. Projects have already been completed in 52 school districts around the state, representing $27 million in Proposition 39 funding. These projects are projected to save the annual energy consumption equivalent of more than 2,000 homes and save school districts nearly $2.5 million in annual energy costs. An additional 74 school districts, representing $104 million have completed their projects and are in the data documentation phase, which must be done once the project is completed and the school gathers 12 months of energy use data. Another 733 energy projects are still in the construction phase, using $151 million in Proposition 39 funds.

The report also highlights information on the California Energy Commission's zero interest loan program, known as the Energy Conservation Assistance Act, which includes the Education Subaccount Program and the Bright Schools Program, both of which complement the K-12 Program and are appropriated through Proposition 39.

Additional program details may be found at: http://www.energy.ca.gov/efficiency/financing/.
Source: California Energy Commission

Progress Summary 9.I: Regional Efforts

Progress as of 2018: The Bay Area Regional Energy Network (BayREN) is a collaboration of the nine counties that make up the San Francisco Bay Area. Led by the Association of Bay Area Governments (ABAG), BayREN implements effective energy-saving programs on a regional level and draws on the expertise, experience, and proven track record of Bay Area local governments to develop and administer successful climate, resource, and sustainability programs. BayREN is funded by California utility ratepayers under the auspices of the California Public Utilities Commission. One of only two Regional Energy Networks in the state, BayREN represents 20 percent of the state's population. Highlights of the BayREN program are listed below.

Single-Family Residential:

- Provides a Home Upgrade Advisor unit that offers free step-by-step technical assistance to consumers and contractors.
- Administers the Energy Upgrade California® Home Upgrade program in the nine Bay Area counties.
- Provides an additional $300 rebate for whole-home energy audits for homeowners who have participated in the Advanced Home Upgrade program.
- Recruits, trains, and qualifies Specialty Contractors for program participation.
- Provides regional and local marketing, education and outreach activities for customers and contractors.

Multi-Family Residential:

- Offers rebates of $750 per unit for multi-family building upgrades.
- Targets outreach to multi-family property owners to promote energy upgrades.
- Offers comprehensive technical assistance to multi-family property owners to identify and prioritize energy upgrades, qualify for rebates, and find appropriate programs.

Codes and Standards:

- Promotes an integrated, measurement-driven management process for enhancing energy code compliance.
- Establishes code compliance baselines for select jurisdictions in the nine-county Bay Area.
- Offers targeted training based upon identified baselines to institutionalize regular, actionable feedback to local officials.
- Organizes bi-monthly regional forums addressing high-level program policy and program design issues on energy efficiency and energy code compliance.

Financing Portfolio Subprogram:

- Develops and launches a regional public agency led financing portfolio.
- Offers multiple financing options to help diverse consumers undertake energy projects, such as the Multifamily Capital Advance Program, Pay-as-you-Save, and Commercial Property Assessed Clean Energy (PACE).

Additional program details can be found at: https://www.bayren.org/.

Additional Energy Shortage Hazard Mitigation Opportunities

In addition to monitoring energy supply and planning for production, conservation is an important element of energy policy. Reducing the energy consumption and demand per capita can offset the growth in supply needed to keep pace with population growth and urban development.

Of the energy used in the transportation sector, a large percentage is consumed by gasoline-powered vehicles. There are a number of measures that can be taken to reduce energy consumption for gasoline-powered vehicles, including continuing development of alternative energy vehicles and changing work commute patterns through telecommuting or land use policies that encourage mixed-use development. Development and production of alternative energy vehicles combined with a reduction in vehicle trips will result in both reduced reliance on fossil fuels and reduced carbon emissions to lessen the impacts of global warming and climate change.

More work is needed to decarbonize California's overall energy system. The advancements in the state's electricity system demonstrate that California is capable of transforming its energy system in a relatively short time frame. However, much more work is needed to reduce greenhouse gases to 40 percent below 1990 levels by 2030. California must dramatically reduce emissions even as its population is expected to grow from about 38 million today to more than 44 million by 2030. The rapid growth in California's renewable resources has brought new challenges for grid operators trying to maintain reliability while managing swings in wind and solar generation.

Best Practices Highlight 9.C: San Francisco Solar and Energy Storage for Resiliency

San Francisco's Solar+Storage for Resiliency project (Solar Resilient) aims to expand the solar market by serving as a national model for integrating solar and energy storage into the city's emergency response plans. Viewing disaster preparation and resiliency through the lens of on-going sustainability is fairly new in the emergency response arena. Like other cities working on issues at the intersection of sustainability and emergency preparation, the City and County of San Francisco faces the challenge of being unable to use its sustainable energy resources when the electric grid goes down.

As of 2018, all of the pieces to implement a "Solar+Storage" solution are available in the marketplace. However, no one project has put the pieces together to create a comprehensive plan to allow a Solar+Storage solution to be implemented in disaster preparedness plans around the country. Solar+Storage offers an opportunity to systematically bolster emergency preparedness not only in San Francisco, but in the more than 19,000 municipal governments nationwide. By disseminating a plan for increasing solar and energy storage deployment, the project will advance Solar+Storage market and financing mechanisms.

Goals and Objectives: The primary goals of the project are to accelerate the deployment of photovoltaics (PV) nationwide and create a roadmap for using PV as a viable tool for energy security in the event of an emergency. The key elements of the project are:

- Research San Francisco's current disaster preparedness plans with respect to electricity needs of buildings.
- Facilitate stakeholder engagement through the formation and management of a working group.
- Identify Disaster Preparedness Zones in San Francisco, outlined in a series of Geographic Information Systems (GIS) maps detailing building power needs and feasible microgrid locations.
- Address technical and economic barriers and outline solutions in a road map.
- Identify or develop an emergency load assessment tool.
- Develop an approach to use existing solar systems during an outage.
- Disseminate a plan, including a Best Practices Manual, to regional, state, and national networks.

Organization and Partners: Peer review, research support, and dissemination will be provided by: Sandia National Laboratories, Lawrence Berkeley National Laboratory, Pacific Gas & Electric, the San Francisco Public Utilities Commission, the San Francisco Department of Public Health, the San Francisco Department of Emergency Management, the County of Alameda, the Neighborhood Empowerment Network, the Neighborhood Emergency Response Team, Renewable Funding, Clean Coalition, Cal-Charge, and the Urban Sustainability Directors Network.

Funding: This project is funded by the U.S. Department of Energy's SunShot Initiative through the Solar Market Pathways Program in the amount of $1,321,200.

For additional information, go to: https://sfenvironment.org/solar-energy-storage-for-resiliency.

9.1.7 EPIDEMIC/PANDEMIC/VECTOR BORNE DISEASE

Identifying Epidemic/Pandemic/Vector-Borne Disease

Pandemic Influenza

California faces a variety of natural and human-caused hazards that can threaten the lives, health, safety, and property of individuals and communities, and negatively affect California's environment, economy, and infrastructure. The California Department of Public Health (CDPH) has identified influenza as a specific hazard that would have a significant impact throughout the state.

Seasonal Influenza

Seasonal influenza, also known as the flu, is a disease that attacks the respiratory system (nose, throat, and lungs) in humans. Seasonal influenza occurs every year. In the U.S. the influenza season typically extends from October through May, peaking in January or February with yearly epidemics of varying severity. Although mild cases may be similar to a viral "cold," influenza is typically much more severe. Influenza usually comes on suddenly; may include fever, headache, tiredness (which may be extreme), dry cough, sore throat, nasal congestion, and body aches; and can result in complications such as pneumonia. Persons aged 65 and older, those with chronic health conditions, pregnant women, and young children are at the highest risk for serious complications, including death.

Pandemic Influenza

A pandemic influenza occurs when a new influenza virus, for which there is little or no human immunity, emerges and spreads on a worldwide scale, infecting a large proportion of the human population. The 20th century saw three such pandemics, and a fourth one occurred in the 21st century. The most notable pandemic was the 1918 Spanish influenza pandemic that was responsible for 20 million to 40 million deaths throughout the world.

As demonstrated historically, pandemic influenza has the potential to cause serious illness and death among people of all age groups and have a major impact on society. These societal impacts include significant economic disruption that can occur due to death, loss of employee work time, and costs of treating or preventing the spread of influenza.

Vector-Borne Diseases

The Vector-Borne Disease Section (VBDS) of CDPH protects the health and well-being of Californians from diseases transmitted to people from insects and other animals. VBDS conducts prevention, surveillance, and control of vector-borne diseases, including Hantavirus pulmonary syndrome, plague, Lyme disease, West Nile virus (WNV), and other tick-borne and mosquito-borne diseases. VBDS also performs surveillance and advises on control for introduction of exotic vector species that may harbor human pathogens.

Vector-borne diseases and exotic vectors that cause a significant risk to people are discussed further in this section. These include WNV and invasive *Aedes* mosquitoes. Natural disasters such as flooding, fires, and earthquakes may create mosquito-breeding habitat that must be assessed and surveyed. The devastating 2015 wildfires in Lake County resulted in exposed structures, particularly septic systems that became important mosquito-breeding sources, particularly for *Culex* spp. mosquitoes (vector of WNV). Damaged structures from earthquakes may also have new potential to hold water that can serve as mosquito-breeding sources.

Additional information about other vector-borne diseases can be found at the CDPH website: https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/VBDS.aspx.

Profiling Epidemic/Pandemic/Vector-Borne Disease

Pandemic Influenza

In 2009 a pandemic of H1N1 influenza, popularly referred to as the swine flu, resulted in many hospitalizations and deaths. Pandemic H1N1 influenza is spread in the same way as seasonal influenza, from person to person through coughing or sneezing by infected people.

Avian Influenza, commonly referred to as "Bird Flu," remains a looming pandemic threat. Avian Influenza primarily spreads from birds to birds and rarely to humans. Public health experts continue to be alert to the possibility that an avian virus may mutate or change so that it can be passed from birds to humans, potentially causing a pandemic in humans. Some strains of the Avian Influenza could arise from Asia or other continents where people have very close contact with infected birds. Examples are poultry farmers or visitors to live poultry markets who had been in very close contact with infected birds and contracted fatal strains of Avian Influenza.

Thus far, Avian Influenza viruses have not mutated and have not demonstrated easy transmission from person to person. However, if Avian Influenza viruses were to mutate into a highly virulent form and become easily transmissible from person to person, the public health community would be very concerned about the potential for an influenza pandemic. Such a pandemic could disrupt all aspects of society and severely affect the economy.

Vector-Borne Disease

Mosquito-Borne Viruses

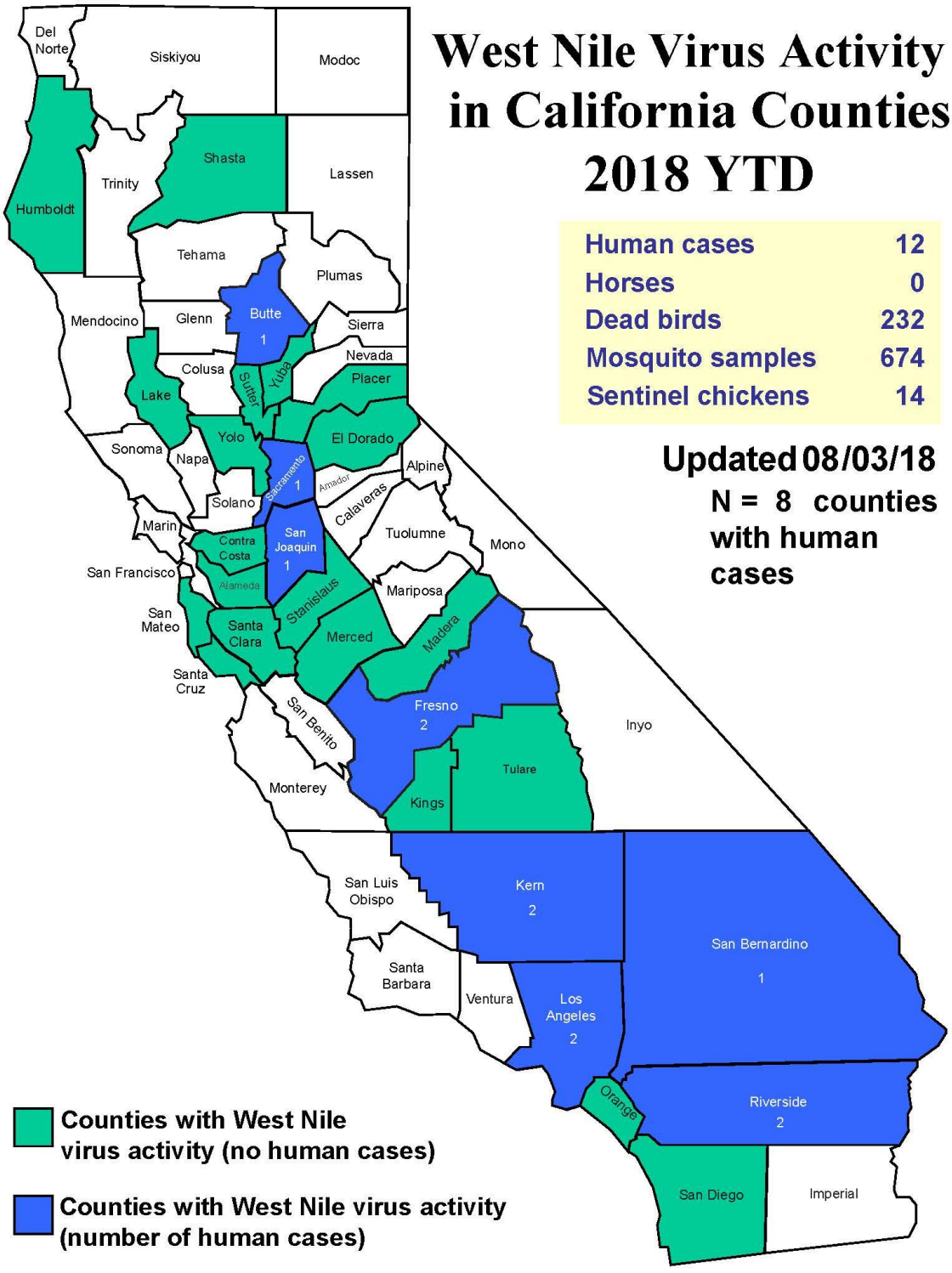
Mosquito-borne viruses belong to a group of viruses commonly referred to as arboviruses (for arthropod-borne). Although 12 mosquito-borne viruses are known to occur in California, only West Nile virus (WNV), western equine encephalomyelitis virus (WEE), and St. Louis encephalitis virus (SLE) are significant causes of human disease. WNV continues to seriously affect the health of humans, horses, and wild birds throughout the state. Since 2003, there have been over 6,000 WNV human cases with 248 deaths, and over 1,200 equine cases. Consequently, the California Arbovirus Surveillance Program emphasizes forecasting and monitoring the temporal and spatial activity of WNV, WEE, and SLE. These viruses are maintained in wild bird-mosquito cycles that do not depend upon infections of humans or domestic animals to persist. Surveillance and control activities focus on this maintenance cycle.

WNV first appeared in the United States in 1999 in New York and rapidly spread across the country to California in subsequent years. California has historically maintained a comprehensive mosquito- borne disease surveillance and control program including the Mosquito-borne Virus Surveillance and Response Plan,[276] which is updated annually in consultation with local vector control agencies. Timely information on WNV activity in mosquitoes, humans, and birds can be found at: www.westnile.ca.gov.

Map 9.M illustrates WNV activity around the state as of mid-2018.

[276] http://westnile.ca.gov/resources.php3

Map 9.M: West Nile Virus Activity in California Counties



Source: www.westnile.ca.gov

Table 9.K summarizes WNV activity for the period of 2003 to 2016. In 2016, 19 fatal human cases of WNV were recorded, down from the previous year. Current information on incidence of WNV is available on the website maintained by CDPH at: www.westnile.ca.gov.

Table 9.K: West Nile Virus Activity, 2003-2016

							Number of Cases By Year								
Element	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	***Total***
Human cases (fatal)	3[1] (0)	779 (29)	880 (19)	278 (7)	380 (21)	445 (15)	112 (4)	111 (6)	158 (9)	479 (20)	379 (15)	801 (31)	782 (53)	442 (19)	*6,029 (248)*
Horses	1[2]	540	456	58	28	32	18	19	15	22	13	0[3]	0[3]	0[3]	*1,202*
Dead birds	96	3,232	3,046	1,446	1,396	2,569	515	416	688	1,644	1,251	2,442	1,349	1,352	*21,442*
Mosquito samples	32	1,136	1,242	832	1,007	2,003	1063	1305	2087	2,849	2,528	3,340	3,329	3,528	*26,281*
Sentinel chickens	70	809	1,053	640	510	585	443	281	391	540	485	443	449	343	*7,042*
Squirrels	-	49	48	32	26	32	10	24	24	23	0[3]	0[3]	0[3]	0[3]	*276*

[1] Plus 20 imported human cases. [2] Plus three imported horse cases. [3] No longer monitored
Source: www.westnile.ca.gov

Exotic Aedes Mosquitoes

Two invasive (non-native) mosquito species have been found since 2011 in numerous California cities, and there is a potential for them to continue to spread into other areas of California. The two species are Aedes *aegypti* (the yellow fever mosquito) and *Aedes albopictus* (the Asian tiger mosquito). As of 2017, these mosquitoes are found in 12 counties, primarily in Central and Southern California. For more information, visit: https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/AedesDistributionMap.pdf.

Unlike most native mosquito species, *Aedes aegypti* and *Aedes albopictus* bite during the day. Both species are small black mosquitoes with white stripes on their back and on their legs. They can lay eggs in small artificial or natural containers that hold water.

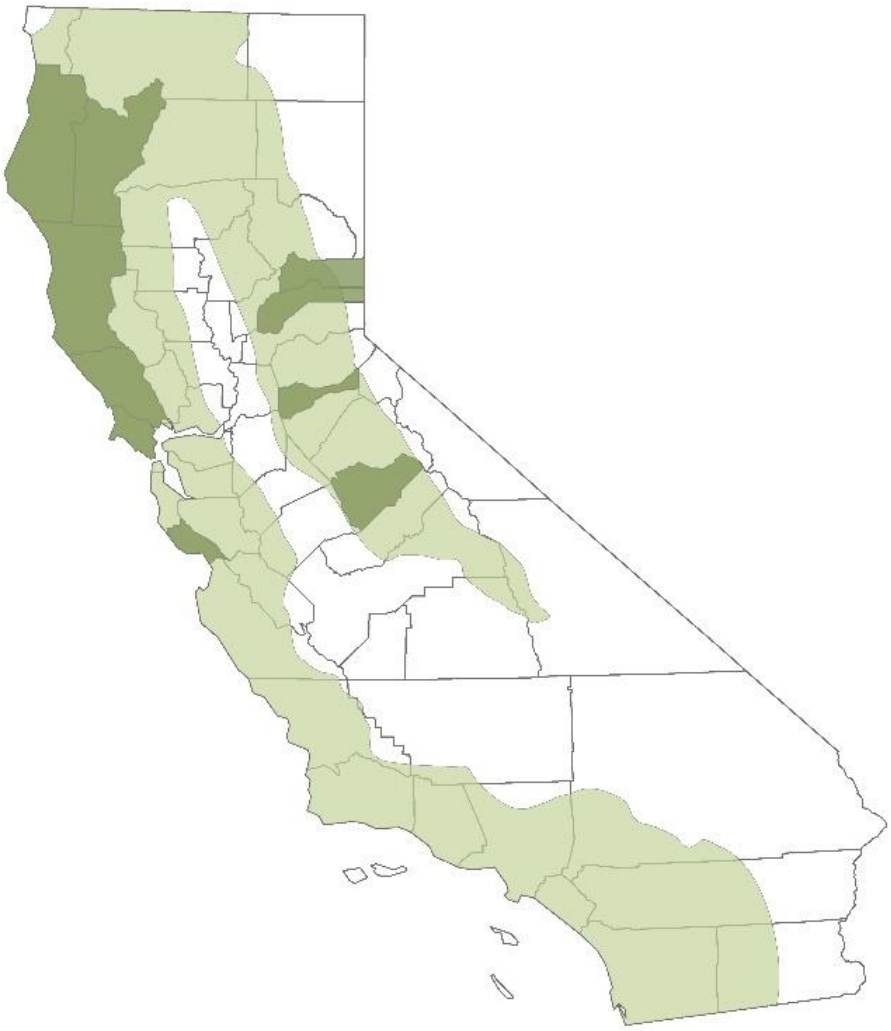
Aedes aegypti and *Aedes albopictus* have the potential to transmit several viruses, including Zika, dengue, chikungunya, and yellow fever. None of these viruses is known to be transmitted within California, but thousands of people are infected with these viruses in other parts of the world, including in Mexico, Central and South America, the Caribbean, and Asia, and recent local transmissions of dengue and Zika in Florida and Texas highlight the need for vigilance. The presence of *Aedes aegypti* and *Aedes albopictus* mosquitoes in California poses a threat that Zika, dengue, and chikungunya viruses can be transmitted in infested areas if the virus is acquired from returned infected travelers.

VBDS has developed a document titled "Guidance for Surveillance of and Response to Invasive *Aedes* Mosquitoes and Dengue, Chikungunya, and Zika in California" to address local issues that may arise with the introduction of these exotic mosquitoes. Updated information on *Aedes* mosquitoes can be found at: https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-*aegypti*-and-Aedes-*albopictus*-mosquitoes.aspx.

Lyme Disease

Lyme disease is caused by a spirochete (a corkscrew-shaped bacteria) called *Borrelia burgdorferi* and is transmitted by the Western black-legged tick. Lyme disease was first described in North America in the 1970s in Lyme, Connecticut, the town for which it was then named. Though the tick has been reported from 56 of the 58 counties in California, the highest incidence of disease occurs in the northwest coastal counties and northern Sierra Nevada counties with western-facing slopes. Ticks prefer cool, moist areas and can be found in wild grasses and low vegetation in both urban and rural areas.

Map 9.N: Western Black-legged Tick and Lyme Disease Incidence in California



Source: California Department of Public Health

Map 9.N shows Western black-legged tick and Lyme disease incidence in California. The Western black-legged tick is commonly found in all green areas shown on the map; dark green areas on the map show where reported Lyme disease cases most often had exposure.

Additional information about Lyme disease may be found at:
https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Tick-Borne-Diseases.aspx.

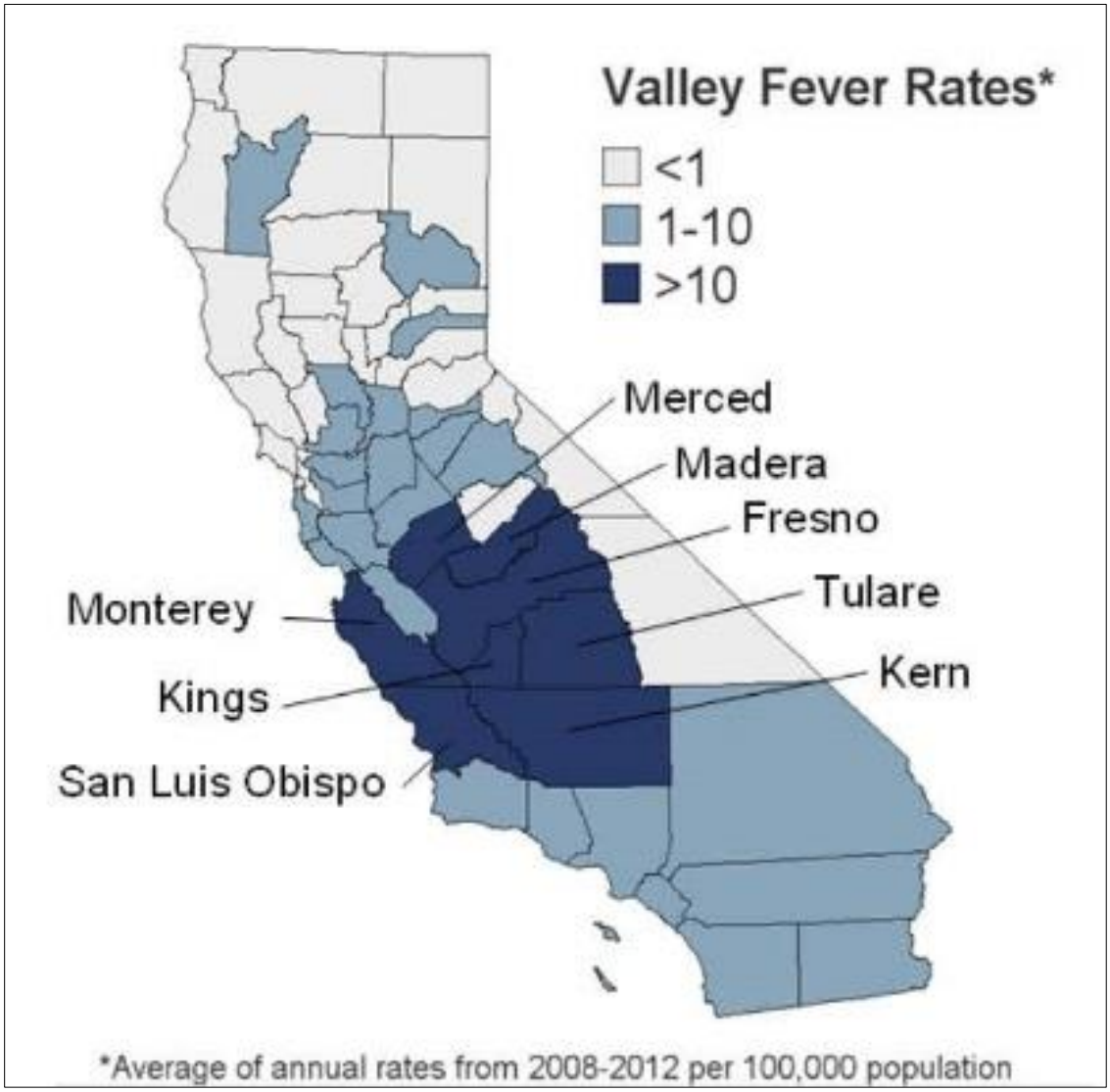
Valley Fever

Valley Fever is caused by *Coccidioides*, a fungus that lives in the soil in the southwestern United States and parts of Mexico, Central America, and South America. Inhaling the airborne fungal spores can cause an infection called coccidioidomycosis, which is also known as "cocci" or "Valley Fever."

Most people who are exposed to the fungus do not get sick, but some people develop flu-like symptoms that may last for weeks to months. In a very small proportion of people who get Valley Fever, the infection can spread from the lungs to other parts of the body and cause more severe conditions, such as meningitis or even death. Valley Fever cannot spread from person to person.

Most cases of Valley Fever in the U.S. occur in people who live in or have traveled to the southwestern United States, especially Arizona and California. Map 9.O shows the areas where the fungus that causes Valley Fever is thought to be endemic, or native and common in the environment. The full extent of the current endemic areas is unknown and is a subject for further study.

Map 9.O: Valley Fever Average Annual Rates by California County



Source: http://www.cdc.gov/features/valleyfever/

A March 2013 Morbidity and Mortality Weekly Report published by the federal Centers for Disease Control and Prevention (CDC) notes that more than 20,000 cases of Valley Fever are reported each year in the United States, but many more cases likely go undiagnosed. Some researchers estimate that each year the fungus infects more than 150,000 people, many of whom are sick without knowing the cause or have symptoms so mild they are not recognized.

The annual number of cases has been increasing in recent years, possibly because of higher numbers of people exposed to the fungus or because of changes in the way cases are being detected and reported.

Anyone, including children, can get Valley Fever, but it is most common among older adults, particularly those 60 and older. Several groups of people are at higher risk for developing the severe forms of Valley Fever; these groups include African Americans, Filipinos, women in their third trimester of pregnancy, and people with weak immune systems, including those with an organ transplant or who have HIV/AIDS.

Additional information about Valley Fever may be found at: http://www.cdc.gov/features/valleyfever/.

Climate Change and Epidemic/Pandemic/Vector-Borne Disease

Climate change will likely affect vector-borne disease transmission patterns. Changes in temperature and precipitation can influence seasonality, distribution, and prevalence of vector-borne diseases. A changing climate may also create conditions favorable for the establishment of invasive mosquito vectors in California.

For most Californians, WNV poses the greatest mosquito-borne disease threat. Above-normal temperatures are among the most consistent factors associated with WNV outbreaks. Mild winters are associated with increased WNV transmission due, in part, to less mosquito and resident bird mortality. Warmer winter and spring seasons may also allow for transmission to start earlier. Such conditions also allow more time for virus amplification in bird-mosquito cycles, increasing the potential for mosquitoes to transmit WNV to people.

The effects of increased temperature are primarily through acceleration of physiological processes within mosquitoes, resulting in faster larval development and shorter generation times, more frequent mosquito biting, and shortening of the incubation period time required for infected mosquitoes to transmit WNV. During periods of drought, especially in urban areas, mosquitoes tend to thrive more due to changes in stormwater management practices. Mosquitoes in urban areas can reach higher abundance due to stagnation of water in underground stormwater systems that would otherwise be flushed by rainfall. Runoff from landscape irrigation systems mixed with organic matter can also create ideal mosquito habitat. Drought conditions may also force birds to increase their utilization of suburban areas where water is more available, bringing these WNV hosts into contact with urban vectors.

The emergence of new infectious diseases associated with invasive species, such as the invasive *Aedes* in California, can be influenced by a number of factors, including land use changes (e.g., agriculture and urbanization), the introduction of new hosts and climate change. Vector-borne disease transmission can be influenced by such factors as adaptations and changes in pathogens, the availability of hosts, human behavior (for example time spent indoors), and the actions of mosquito and vector control programs.

Assessment of State Vulnerability and Potential Losses

The impact of an actual epidemic, pandemic, or vector-borne disease outbreak cannot be predicted precisely, as it will depend on the virulence of the virus, the speed at which the virus spreads, the availability of vaccines and antivirals, and the effectiveness of medical and non-medical containment measures.

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

Current Epidemic/Pandemic/Vector-Borne Disease Hazard Mitigation Efforts

Pandemic Influenza

The California Department of Public Health (CDPH) takes the lead on planning for pandemic outbreaks in the state. CDPH will coordinate the public health response to a pandemic with the Emergency Medical Services Authority (EMSA), the Department of Health Care Services (DHCS), the California Health and Human Services Agency, Cal OES, local health departments, tribal entities, the health care community, the federal government, and other key partners.

In 2009, in response to the H1N1 pandemic influenza, the Governor established a Cabinet Pandemic Influenza Working Group that met monthly to report on H1N1 activity and review the state's response until the pandemic ended. Since that time period, CDPH has continued statewide planning efforts to meet the Centers for Disease Control and Prevention (CDC) cooperative agreement requirements to benchmark the level of state agency preparedness. Each local health department has a pandemic preparedness plan, including a section on community mitigation. Each year, CDPH reviews the pandemic response planning activities of local health departments as required by the CDC cooperative agreement.

Within CDPH, the Center for Infectious Diseases (CID) Division of Communicable Disease Control (DCDC) provides statewide leadership in communicable disease surveillance, laboratory confirmation, and vaccine management. DCDC provides recommendations for community mitigation strategies as needed for both routine and emergency public health infectious disease control activities.

Year-round, DCDC works closely with other programs within CDPH and external stakeholders including the CDC and other partners in addition to local health departments to protect Californians from the effects of pandemic influenza. DCDC has an internal plan, the DCDC Pandemic Influenza Operational Plan (PIOP), revised in 2016, which provides operational guidance for DCDC's lead response to a pandemic influenza within California, specifically in the areas of Epidemiology and Surveillance, Laboratory, Vaccine Management, and Non-Pharmaceutical Interventions (Community Mitigation).

The DCDC PIOP identifies potential mitigation actions that can be taken to reduce the impacts of the pandemic, including:

- Ensuring rapid and early detection of a novel virus
- Confirming the identity or type of a novel virus by laboratory identification
- Identifying the exposure source of the outbreak and the population at risk
- Controlling and containing the spread of influenza through pharmaceutical and non-pharmaceutical community containment strategies, including isolation, quarantine, infection control, antiviral treatment and prophylaxis, and, if available, vaccination
- Managing and disseminating accurate information for scientific, resource, and policy decisions in public health and healthcare delivery settings

The DCDC PIOP is an annex to the CDPH Emergency Operations Response Plan (EORP) of 2013. The CDPH EORP provides a department-level multi-hazard framework for comprehensive public health and environmental health emergency management to support the needs of California's residents, communities, government, and businesses. The DCDC PIOP is consistent with all CDPH principles and guidelines, to include those identified in the California Public Health and Medical Emergency Operations Manual (EOM). The PIOP also conforms to the California State Emergency Plan, the Standardized Emergency Management System, and the Incident Command System standards.

In addition to CDPH's pandemic planning, Cal OES has a Statewide Concept of Operations Plan for Pandemic Influenza that discusses communication and coordination at the local, state, and federal government levels. At the local level, the Statewide Concept of Operations includes checklists to assist with local government pandemic influenza preparedness, including alert and warning considerations and suggested response actions. At the federal level, the Statewide Concept of Operations describes the established federal role in managing the Strategic National Stockpile, which is vital to pandemic influenza response planning and State Operations Center coordination.

The Statewide Concept of Operations emphasizes that all events begin at the local level and recommends that each local agency prepare a pandemic influenza operations plan. At the state level, the plan outlines 27 preparedness, response, and recovery objectives under three strategic goals as established by the CDC and identifies the agencies that have plans and procedures for each objective. The plan also includes a State Agency Responsibilities Matrix that lists the state agencies that have lead and support roles for each CDC objective.

For more information, see:
http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/StatewideConOpsforPandemicInfuenza%202009.pdf.

Vector-Borne Diseases

The Vector-Borne Disease Section (VBDS) protects the health and well-being of Californians from diseases transmitted to people from insects and other animals. VBDS conducts prevention, surveillance, and control of vector-borne diseases, including Hantavirus pulmonary syndrome, plague, Lyme disease, WNV, and other tick-borne and mosquito-borne diseases. VBDS also performs surveillance and advises on control for introduction of exotic vector species that may harbor human pathogens.

VBDS staff, located in four regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease prevention, surveillance, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Coordinate preparedness activities for detection and response to introduced vectors and vector- borne diseases, such as WNV, Zika, chikungunya, dengue, and invasive *Aedes* mosquitoes
- Provide laboratory and proficiency testing for vector-borne disease agents in arthropods and vertebrates and testing for pesticide resistance in mosquitoes
- Conduct emergency vector control when disease outbreaks occur
- Advise local agencies on public health issues related to vector-borne diseases
- Advise local agencies on regulatory issues pertaining to mosquito and vector control
- Oversee the Cooperative Agreement (HSC 116180) between CDPH and local vector control agencies
- Oversee the Vector Control Technician Certification and Continuing Education programs
- Provide information, training, and educational materials to governmental agencies, the medical community, and the public
- Maintain the San Francisco Bay Area U.S. Army Corps of Engineers general permit, which allows local vector control agencies to conduct abatement activities
- Oversee Special Local Need permits on restricted use of public health pesticides

Progress Summary 9.J: Updates for Two Vector-Borne Disease Plans

Progress as of 2018: The California Mosquito-Borne Virus Surveillance and Response Plan was developed by the California Department of Public Health, Vector-Borne Disease Section, in conjunction with the Mosquito and Vector Control Association of California and the University of California, Davis. Updated annually to accommodate surveillance and ecology information from previous years, the plan has been updated for 2017 and is designed to enhance the surveillance and response program for mosquito-borne viruses in California.

Specifically, the plan:

- Provides guidelines and information on the surveillance and control of mosquito-borne viruses in California, including West Nile, St. Louis encephalitis, and western equine encephalomyelitis viruses;
- Incorporates surveillance data into risk assessment models;
- Prompts surveillance and control activities associated with virus transmission risk level;
- Provides local and state agencies with a decision support system; and
- Outlines the roles and responsibilities of local and state agencies involved with mosquito-borne virus surveillance and response.

The California Mosquito-Borne Virus Surveillance and Response Plan provides statewide guidelines that can be modified to meet local or regional conditions. The complete plan may be found at: http://westnile.ca.gov/downloads.php?download_id=3744&filename=2017 CA Response Plan.

"Guidance for Surveillance of and Response to Invasive Aedes Mosquitoes and Dengue, Chikungunya, and Zika in California" was developed by the California Department of Public Health, Vector-Borne Disease Section in conjunction with local health departments, local vector control agencies and the University of California, Davis.

This document was developed to guide local vector control agencies and health departments in preparing for, conducting surveillance of, and responding to the detection of invasive *Aedes* mosquitoes and human cases of dengue, chikungunya, Zika, or other exotic mosquito-borne viral infections potentially transmitted by these mosquitoes. Mosquito species of immediate concern are *Aedes aegypti* and *Aedes albopictus*, both of which recently have been detected and become established in some California counties. Although locally acquired human infection with dengue, chikungunya, or Zika has not been detected in California to date, this is an ongoing low risk as travelers return and visitors come from areas with known disease transmission. Latest updates to this document reflect geographic expansion of the mosquitoes and changes in Zika case definition.

The plan may be found here: https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Aedes-*aegypti*-and-Aedes-*albopictus*-mosquitoes.aspx

Additional Epidemic/Pandemic/Vector Borne Disease Hazard Mitigation Opportunities

The Operational Plan for Emergency Response to Mosquito-Borne Disease Outbreaks describes coordination between the California Department of Public Health (CDPH) and partner agencies in responding to a mosquito-borne disease emergency. It serves as a supplemental document to the California Mosquito-Borne Virus Surveillance and Response Plan (Response Plan) and is consistent with the CDPH Emergency Plan, Departmental Administrative Order, and State Emergency Plan. This document expands on the roles of the agencies mentioned in the Response Plan and provides the policy basis for mosquito-borne disease outbreak planning, response, recovery, and mitigation actions. The plan may be found here:
www.westnile.ca.gov/downloads.php?download_id=2737&filename=2013%20Op%20Plan%20Mosquito%20Disease%20Emergency.pdf

The document includes the following information:

- Description of how CDPH and federal, state, and local agencies function together in a coordinated escalating emergency response
- The progression from normal to emergency operations
- The emergency management structure [Standardized Emergency Management System (SEMS) organization chart for CDPH response], notification system, responsibilities for the various agencies involved in the response, and anticipated agency roles at each jurisdictional (federal, state, local) level

Similarly, an Operational Checklist for Local Health Departments, Local Vector Control Agencies, and California Department of Public Health In the Event of Local Dengue, Chikungunya, or Zika Transmission was developed to provide a summary of roles and responsibilities of local and state California agencies that would be involved should local transmission of dengue, chikungunya, or Zika be detected.

The checklist may be found here:
https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/OperationalChecklistLocalTXZika.pdf.

9.1.8 EXTREME HEAT

Identifying Extreme Heat Hazards

In most areas of the state, summer temperatures are expected to be warm; during certain periods, however, temperatures can rise much higher, to the point of being considered severe or possibly dangerous. Severe heat conditions are much warmer than average for a particular time and place. Severe heat conditions may also include increased humidity. Three or more consecutive severe heat days is referred to as an extreme heat event. Heat wave activity is on the rise in California and humid heat waves, particularly, are becoming more prevalent.[277,278] Heat ranks as among the deadliest of all natural hazards.[279] Even though heat-related deaths and illnesses are largely preventable, many people annually succumb to extreme and especially humid heat.

Heat-Related Illness

Heat-related illness includes a spectrum of illnesses ranging from heat cramps to severe heat exhaustion and life-threatening heat stroke. Heat-related illness results from the "body's inability to dissipate heat produced by metabolic activity, often as a result of increased ambient temperature".[280,281]

Heat related illnesses include:

- Heat cramps
- Heat exhaustion
- Heat stroke

Heat cramps and heat exhaustion can be painful and may progress to heat stroke rapidly if not addressed. Heat exhaustion occurs when the body is dehydrated, resulting in an imbalance of electrolytes. Symptoms include headache, nausea, dizziness, cool and clammy skin, pale face, cramps, weakness, and profuse perspiration. First aid involves moving to a cooler spot and drinking water with a small amount of salt added (one teaspoon per quart). Without intervention, heat exhaustion can lead to collapse and heat stroke.

Heat stroke is a severe and life-threatening failure of the body's ability to cool (e.g., sweating ceases), with core temperature generally over 104°F. Heat stroke ensues when perspiration cannot occur and the body overheats. Symptoms include headache, nausea, face feeling flushed, hot and dry skin, no perspiration, body temperature over 101°F, chills, and rapid pulse. Heat stroke includes severe mental status changes, seizures, loss of consciousness, kidney failure, and abnormal cardiac rhythm.

Heat stroke is an extreme medical emergency that, if not promptly treated, frequently results in death or permanent neurological impairment. First aid involves cooling the person immediately; moving to shade or indoors; wrapping the person in a cool, wet sheet; and getting medical assistance. Without intervention, heat stroke can lead to confusion, coma, and death. With prompt and appropriate emergency medical treatment, survival can approach 100 percent.

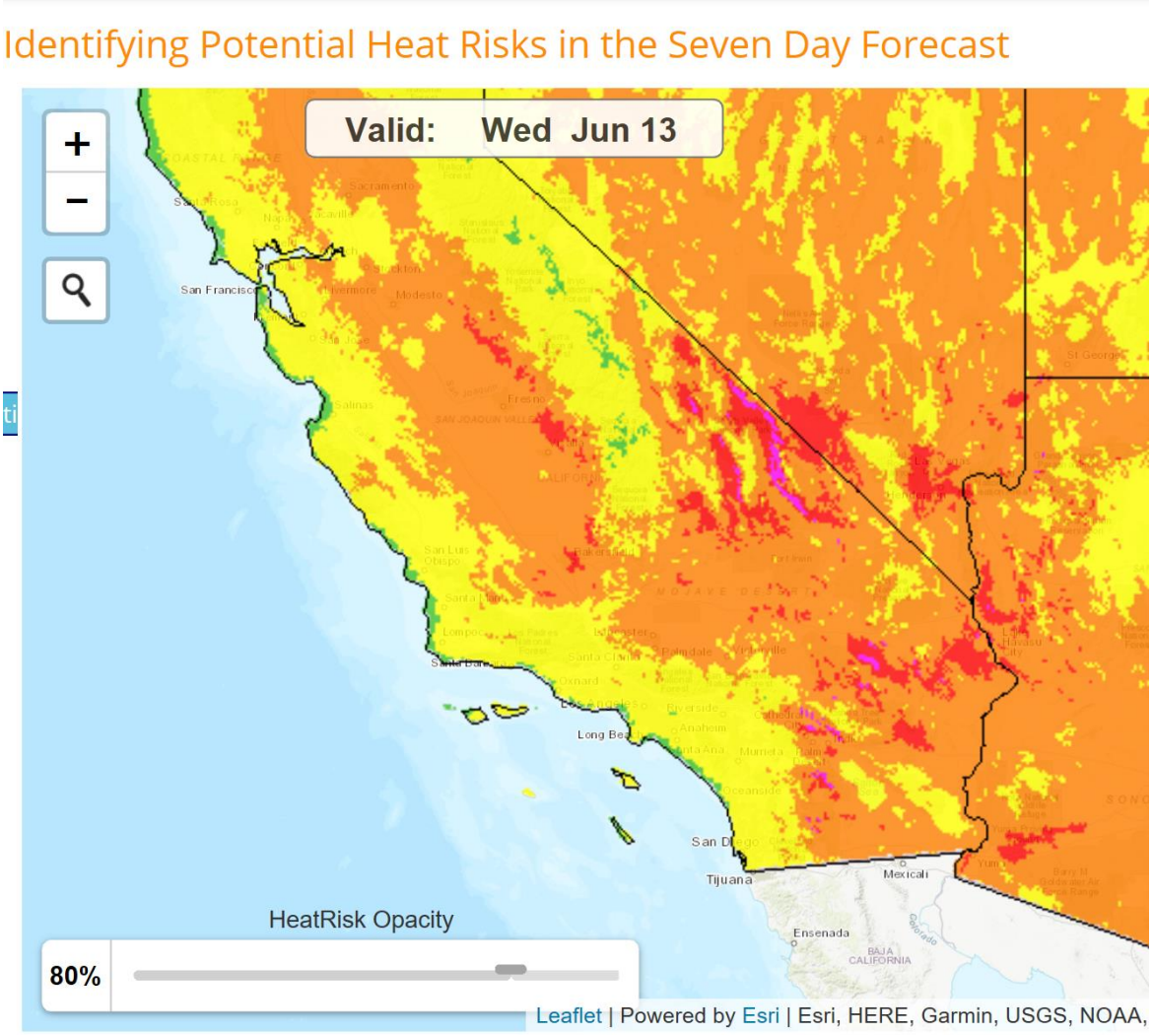
[277] Gershunov, A., D. Cayan and S. Iacobellis, 2009: The great 2006 heat wave over California and Nevada: Signal of an increasing trend. Journal of Climate, 22, 6181–6203.
[278] Gershunov A. and K. Guirguis, 2012: California heat waves in the present and future. Geophysical Research Letters, 39, L18710, doi:10.1029/2012GL052979.
[279] Borden et al, 2008
[280] Preparing California for Extreme Heat: Guidance and Recommendations, October 2013; http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf
[281] Wexler, 2002

National Weather Service HeatRisk Forecast

Heat affects everyone differently. In order to better address heat risk and prepare for upcoming heat events, the National Weather Service (NWS) developed the experimental HeatRisk forecast. The NWS experimental HeatRisk forecast is an online mapping tool that provides daily guidance on potential heat risks out to seven days. Map 9.P is an example screenshot from the HeatRisk mapping tool.

The NWS HeatRisk forecast provides a quick view of heat risk potential over the upcoming seven days. The heat risk is portrayed in a numeric (0-4) scale and a color (green/yellow/orange/red/magenta) scale, similar in approach to the Air Quality Index or the Ultraviolet Index. Table 9.L summarizes the heat risk color scale categories. The scale provides one value each day that indicates the approximate level of heat risk concern for any location, along with identifying the groups who are most at risk. This product is supplementary to the official NWS heat watch/warning/advisory program and is meant to provide continuously available heat risk guidance for decision-makers and heat-sensitive populations who need to take actions at levels that may be below current NWS heat product levels.

Map 9.P: National Weather Service (NWS) Experimental HeatRisk Forecast Mapping Example from NWS Website



Source: National Weather Service, NWS Experimental HeatRisk forecast tool; https://www.wrh.noaa.gov/wrh/heatrisk/, retrieved 06/11/18

Table 9.L: HeatRisk Categories by Color

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

Source: National Weather Service, http://www.nws.noaa.gov/om/heat/heat_index.shtml

The NWS issues Excessive Heat Watches, Excessive Heat Warnings, and Heat Advisories to warn of an extreme heat event (a "heat wave") within the next 36 hours. If NWS forecasters predict an excessive heat event beyond 36 hours, the NWS will issue messaging in the form a Special Weather Statement, partner emails, and social media during the a three to seven day time frame. In 2017, the NWS transitioned to using NWS experimental HeatRisk forecast output to determine if Excessive Heat Watches, Excessive Heat Warnings, or Heat Advisories are warranted. This risk is assessed by comparing the official NWS temperature forecast to local thresholds, which change through the year based on climatology.

For more information, visit: https://www.wrh.noaa.gov/wrh/heatrisk/.

Profiling Extreme Heat Hazards

Heat waves do not cause damage or elicit the immediate response that floods, fires, earthquakes, and other disasters do. However, they have claimed many more lives when compared with other disasters.

The worst single heat wave event in Southern California for loss of life occurred in 1955, when an eight-day heat wave is said to have resulted in 946 deaths. The summer 2006 heat wave in California caused the deaths of about 650 people over a 13-day period.[282] In comparison, other types of disasters, such as recent earthquakes and fires, have caused in fewer deaths. For example, the 1989 Loma Prieta Earthquake resulted in 63 deaths, while the 1992 Northridge Earthquake was responsible for the loss of 55 lives. The catastrophic 2003 Southern California firestorms resulted in 24 deaths.

The California Climate Adaptation Strategy, citing a California Energy Commission study of San Diego, states that "over the past 15 years, heat waves have claimed more lives in California than all other declared disaster events combined."[283] Despite this history, however, few heat events were proclaimed at the state level or declared as a federal disaster between 1960 and 2009.[284] Though no formal explanation exists for this seeming contradiction, scholars have written about the exclusion of heat events as declared disasters. Klinenberg, author of an account of a heat wave that killed 739 people in the Chicago in July 1995, suggests that the hidden nature of social vulnerability combined with the inconspicuous nature of heat events (unlike earthquakes, floods, wildfires, tornados, etc.)

[282] Safeguarding California: Reducing Climate Risk, An Update to the 2009 California Climate Adaptation Strategy, July 2014; http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf

[283] California Natural Resources Agency, California Climate Adaptation Strategy, December 2009, p. 32; Messner, Steven, Sandra C. Miranda, Karen Green, Charles Phillips, Joseph Dudley, Dan Cayan, Emily Young. Climate Change Related Impacts in the San Diego Region by 2050. PIER Research Report, CEC-500-2009-027-D, Sacramento, CA: California Energy Commission. 2009.

[284] Guirguis, K., A. Gershunov, A. Tardy and R. Basu, 2014: The Impact of Recent Heat Waves on Human Health in California. Journal of Applied Meteorology and Climatology, 53, 3-19.

prevent them from being declared as legitimate disasters.[285] Further, an evaluation of hospitalizations in California found that heat events in cooler months (due to less acclimatization to heat) and those with above average humidity resulted in greater heath impacts.[286]

According to Safeguarding California: Reducing Climate Risk, An Update to the 2009 California Climate Adaptation Strategy, it is anticipated that extreme heat events in urban centers such as Sacramento, Los Angeles, and San Bernardino could cause two to three times more heat-related deaths then occurred in 2006. Additionally, Safeguarding California notes that urban areas are more likely to experience "heat Island" effects (see discussion below).

Urban Heat Islands

Large urban areas often experience higher temperatures, greater pollution, and more negative health impacts during hot summer months, when compared to more rural communities. This phenomenon is known as the urban heat island. Heat islands are created by a combination of heat-absorptive surfaces (such as dark pavement and roofing), heat-generating activities (such as engines and generators), and the absence of vegetation (which provides evaporative cooling). Heat island effects can occur in urban areas when natural surfaces and materials such as grass, trees, and soil, which dissipate heat, are replaced by road and buildings with materials that increase absorption (and reduce dissipation) of heat. As a result of building and road construction and other human activities, more heat is generated and retained, and air temperatures in urban heat island areas are consistently higher than in surrounding areas.

Increased temperatures also add to the heat load of buildings in urban areas and exacerbate existing urban heat islands adding to the risk of high ambient temperatures. In certain urban settings where conditions create "heat islands," occupants face a greater risk of heat-related diseases.

Treating Heat as a "Legitimate Hazard"

Historic losses due to extreme heat events raise several issues. First, since the primary goal of the SHMP is to significantly reduce the loss of life and injuries in California, heat is considered a legitimate disaster type. The number of people killed by extreme heat underscores the importance of mitigating its impacts. Second, heat events highlight the importance of thoughtful social vulnerability analyses. While changes to the built environment can greatly alter vulnerability to different hazards, social vulnerability and resiliency are especially important during heat events. For example, socially isolated elderly persons are especially vulnerable. Any mitigation efforts aimed at reducing heat losses will focus on ways to reduce social isolation, as well as changes to the built environment. Third, heat events illustrate how seemingly unrelated phenomena combine to create disaster. For example, the increased use of air conditioners during heat waves can lead to power outages, which makes extreme heat events even more deadly. Upgrading water and power infrastructure, then, is a form of extreme heat disaster mitigation.

Situational and physical characteristics help to identify vulnerable populations that may not comfortably or safely gain access to and use disaster resources. Specifically, when discussing heat-related emergency preparedness, the following groups could be considered vulnerable or at greater risk in a heat emergency:

- People with a developmental/intellectual disability, i.e., a severe and chronic disability that is attributable to a mental or physical impairment that begins before an individual reaches adulthood. These disabilities include cerebral palsy, epilepsy, and autism.
- People who are blind or have low vision.
- People who are deaf or hard of hearing.
- People with limited mobility.
- People with injuries from auto accidents, falls, sports, and/or war. These injuries can cause damage to the brain, spinal cord, hearing, and sight, and limit mobility.

[285] Heat Wave: A Social Autopsy of Disaster in Chicago, The University of Chicago, 2002

[286] Guirguis, K., A. Gershunov, A. Tardy and R. Basu: The Impact of Recent Heat Waves on Human Health in California. 2014. Journal of Applied Meteorology and Climatology, 53, 3-19.

- People with chronic conditions such as diabetes, arthritis, dialysis, asthma, and epilepsy.
- Older adults who have age-related limitations (e.g. slow movement, sight, and hearing limitations, etc.).
- Children who may dependent on others, not only for care, but for decision-making. Because children process information and trauma differently than adults, they may be unable to articulate their needs and, may decompensate faster than adults. They are also generally more susceptible to thirst, hunger, and temperature than adults.

Animals, including domestic pets, livestock, and poultry, are also susceptible to extreme heat. For example, dogs and cats are in danger of heat stroke in temperatures of 110°F. The heat wave of 2006 resulted in 15 reported pet deaths and more than 25,000 cattle and 700,000 fowl heat-related deaths. Heat wave impacts on livestock can lead to financial losses in California's agricultural economy.

Climate Change and Extreme Heat

Average temperatures are rising around the world and across the United States, and the western portion of the U.S, including California, is experiencing more warming than other parts of the country. In addition to overall warming, the U.S is experiencing an increase in extreme heat events, with hotter-than-usual days and nights becoming more common.[287]

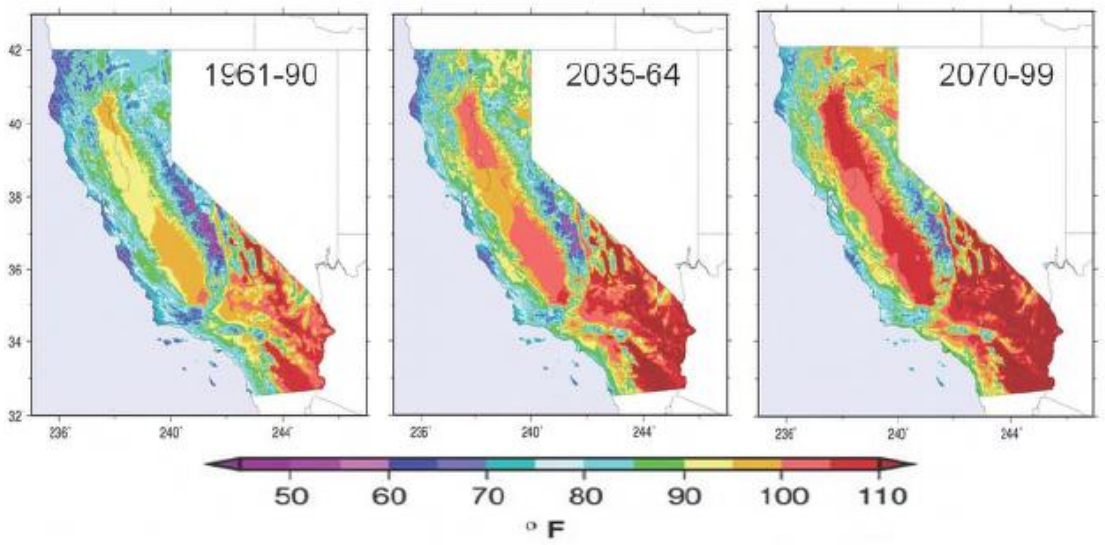
According to the U.S. Environmental Protection Agency (EPA), climate change caused by greenhouse gas emissions is a pattern of change in average weather, such as increases in temperatures that is occurring over many years. Increases in global temperatures have led to other changes such as increases in extreme heat events. Extreme heat events are likely to occur more often, with greater severity, and for longer periods of time. In California, this trend is accentuated specifically for humid heat waves, which are expressed very strongly in nighttime temperatures.[288,289] In California, this trend is accentuated specifically for humid heat waves, which are expressed very strongly in nighttime temperatures.[290,291]

Climate change has the potential to increase the number of communities facing recurrent extreme heat events, particularly in urban settings where extreme heat events will be exacerbated by urban heat islands. Without appropriate preparation, communities unaccustomed to repeated heat events will be unprepared to address the health consequences of extreme heat. The State of California provides a web tool, Cal-Adapt (http://cal-adapt.org/) that projects climate change-influenced heat wave frequency to aid communities in preparing for projected impacts.

According to the 2018 Safeguarding California Plan: California's Climate Adaptation Strategy, California is getting warmer, leading to increasing frequency, intensity, and duration of heat waves, and increased mortality and morbidity associated with increased healthcare costs. Map 9.Q illustrates the statewide temperature increase trend.

[287] Climate change and Extreme Heat: What You Can Do to Prepare, https://www.epa.gov/sites/production/files/2016-10/documents/extreme-heat-guidebook.pdf
[288] Gershunov, A., D. Cayan and S. Iacobellis, 2009: The great 2006 heat wave over California and Nevada: Signal of an increasing trend. Journal of Climate, 22, 6181–6203.
[289] Gershunov A. and K. Guirguis, 2012: California heat waves in the present and future. Geophysical Research Letters, 39, L18710, doi:10.1029/2012GL052979
[290] Gershunov, A., D. Cayan and S. Iacobellis, 2009: The great 2006 heat wave over California and Nevada: Signal of an increasing trend. Journal of Climate, 22, 6181–6203.
[291] Gershunov A. and K. Guirguis, 2012: California heat waves in the present and future. Geophysical Research Letters, 39, L18710, doi:10.1029/2012GL052979.

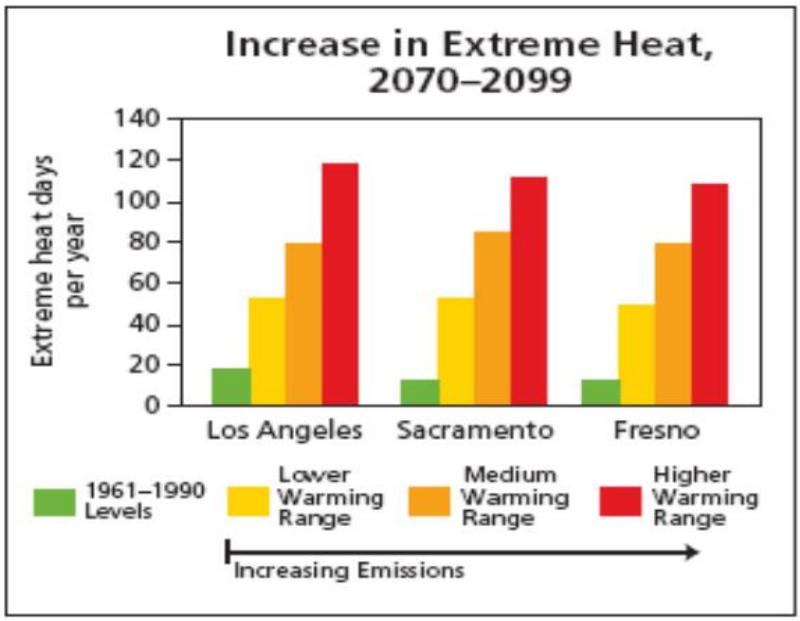
Map 9.Q: California Historical and Projected Temperature, 1961-2099



Source: Dan Cayan; California Climate Adaptation Strategy

As temperatures rise, Californians will face greater risk of death from dehydration, heat stroke/exhaustion, heart attack, stroke, and respiratory distress caused by extreme heat, leading to greater risk of hospitalizations. By mid-century, extreme heat events in urban centers could cause two to three times more heat-related deaths than occur today.[292] By 2100, hotter temperatures are expected throughout the state, with an increase of 3°F to 5.5°F under the lower emissions scenario and 8°F to 10.5°F under the higher emissions scenario. If temperatures rise to the higher warming range, there could be up to 100 more days per year with temperatures above 90°F in Los Angeles and above 95°F in Sacramento, as shown in Chart 9.B. Future heat wave activity, however, will not, increase uniformly and will depend in large part on the local climate (e.g., coast vs. inland valleys, deserts, and mountains).[293]

Chart 9.B: Projected Increase in Extreme Heat, 2070-2099



[292] California Climate Change Center 2006, 2009

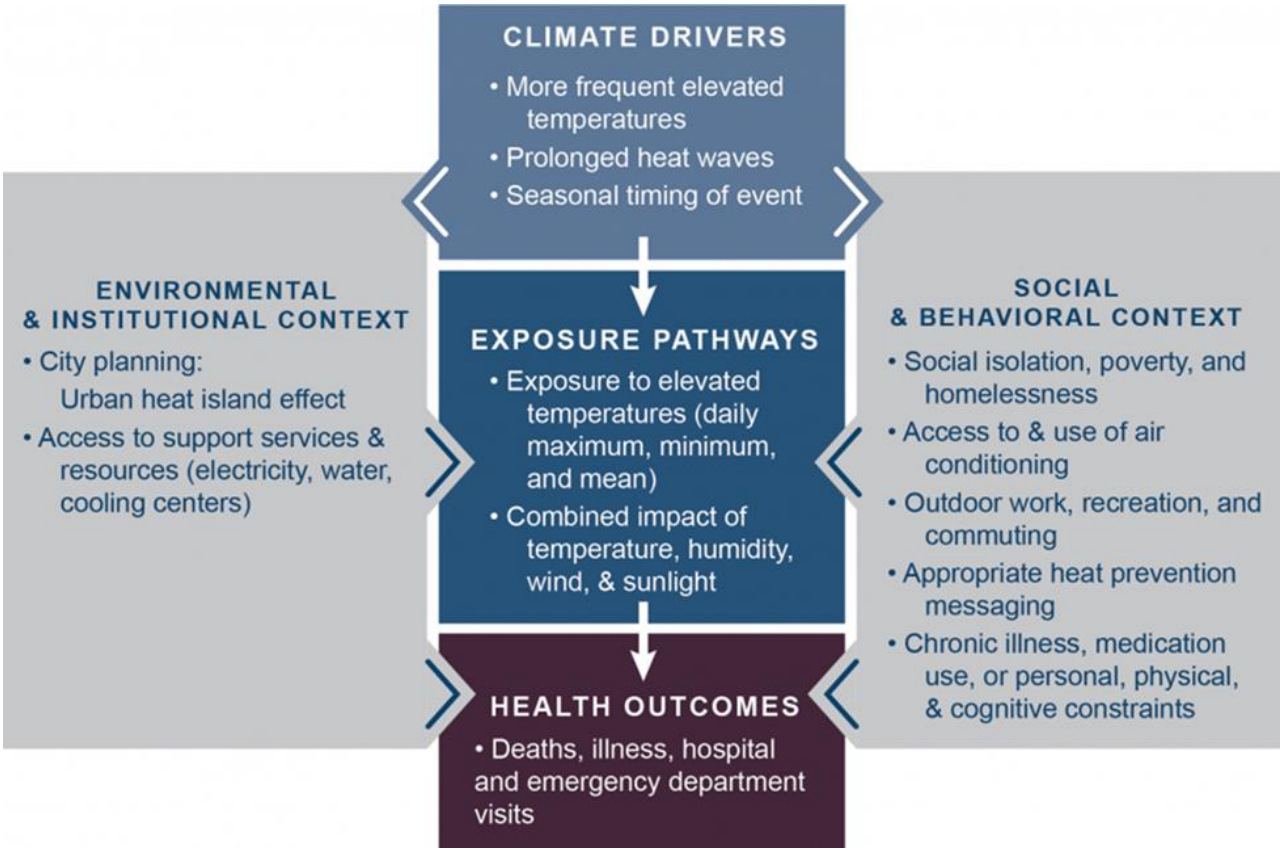
[293] Guirguis, K., A. Gershunov, D.R. Cayan and D. Pierce. Heat wave probability in the changing climate of the Southwest US. 2017. Climate Dynamics, DOI: 10.1007/s00382-017-3850-3.

Other Health Impacts Resulting from Climate Change and Extreme Heat

Climate change is projected to result in an increase in the frequency and severity of extreme heat events. Climate change-influenced heat events (temperature and humidity) may also create a conducive environment for vector-borne diseases. Extended heat events result in the emergence of vectors that can carry infectious diseases, like dengue, Zika, yellow fever, and chikungunya, in areas within California that have not historically experienced their occurrence.

As a result of the increase in vectors due to heat events, spread of disease is rising. The surge in Zika and dengue fever infections is one example. For these two pathogens, the increase in temperature causes mosquitoes to 1) feed more frequently, 2) breed more prolifically, and 3) live longer, which ultimately results in their ability travel farther than ever before.

Figure 9.C: Linking Climate Change, Extreme Heat, and Public Health



Source: https://health2016.globalchange.gov/temperature-related-death-and-illness

Figure 9.C shows a conceptual diagram prepared by the U.S. Global Change Research Program that is a useful illustration of the key pathways by which climate change influences human health during an extreme heat event. The U.S. Global Change Research Program website states as follows: "Key factors that influence vulnerability for individuals are shown in the right box, and include social determinants of health and behavioral choices. Key factors that influence vulnerability at larger scales, such as natural and built environments, governance and management, and institutions, are shown in the left box. All of these influencing factors can affect an individual's or a community's vulnerability through changes in exposure, sensitivity, and adaptive capacity and may also be affected by climate change."[294]

[294] U.S. Global Change Research Program website, retrieved on 8/2/2017. https://health2016.globalchange.gov/temperature-related-death-and-illness

Assessment of State Vulnerability and Potential Losses

As noted *in Safeguarding California: Reducing Climate Risk, (July* 2014 update), not all communities and not all members of a community are equally vulnerable to climate events. Underlying health status ("sensitivity") and socio-economic conditions may vary, and access to information, services, and resources affects how impacts are experienced.

Research on Climate Exposure and Socio-Economic Vulnerability of California Communities

The Third California Climate Change Assessment featured a number of studies on the exposure and vulnerabilities of California communities to climate impacts. These studies assessed particular communities, such as Fresno and San Luis Obispo, and developed a climate vulnerability index to identify the areas of the state most vulnerable to climate impacts. The climate vulnerability index combined 19 indicators into one overall climate vulnerability score and includes factors specifically related to climate impacts, such as air conditioner ownership, percentage of tree cover, and workers in outdoor occupations.

Preparing California for Extreme Heat: Guidance and Recommendations, October 2013, notes that certain populations are more vulnerable to extreme heat. Heat-related illness can be classified as "classic" or "exertional," and different populations are at risk for each type.

The majority of non-working victims who tend to suffer from classic heat-related illness during heat waves come from the following groups: young children, elderly persons, pregnant women, persons who are socially isolated, and persons with access and functional limitations.

Exertional heat-related illness tends to affect persons involved with vigorous physical activities that cause the body to generate more heat—typically workers, outdoor athletes, and military personnel. For workers, exertional heat illness occurs across a wide age range and in numerous industries and occupations, including agriculture, construction, firefighting, warehousing, delivery, and service work.

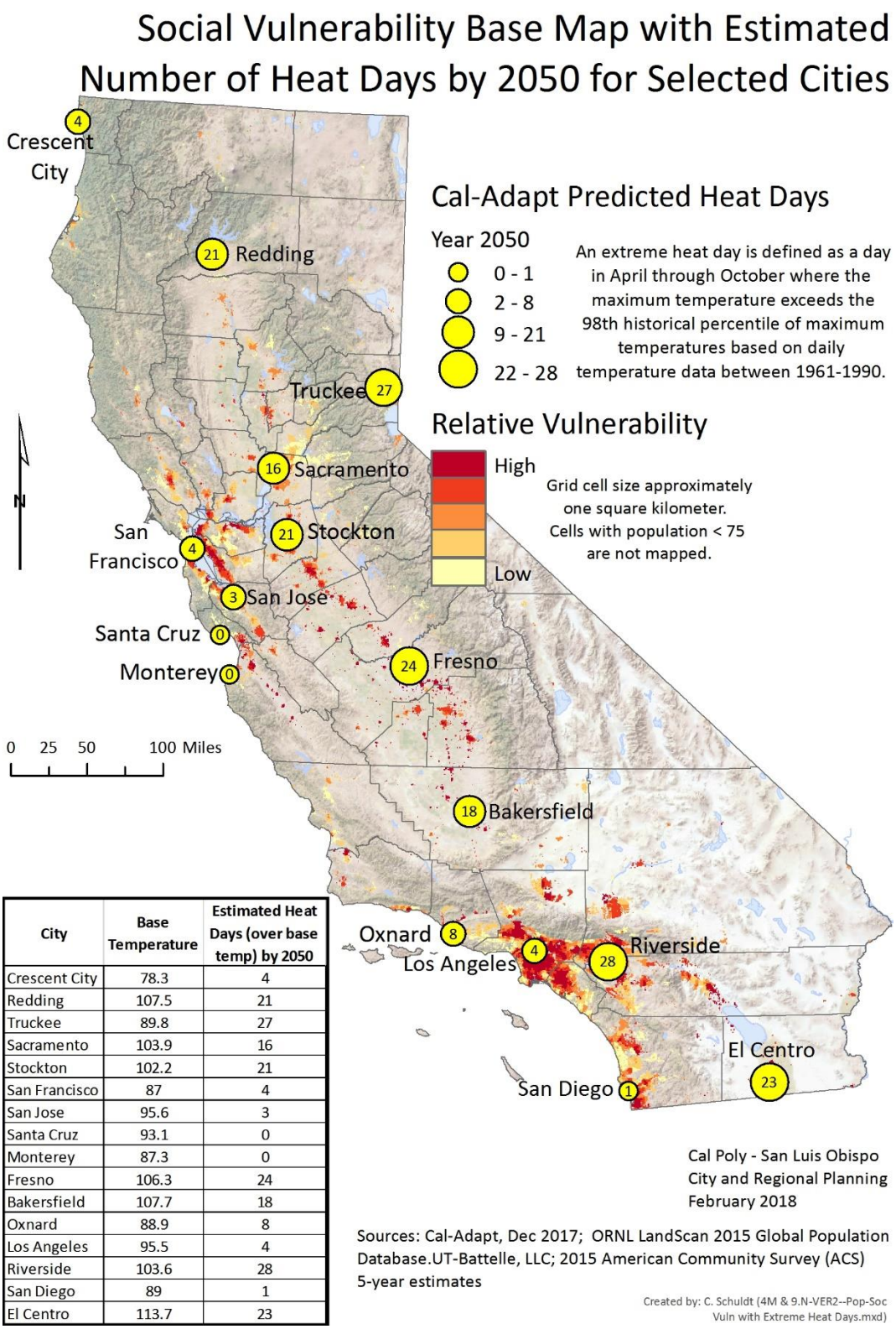
California Building Resilience Against Climate Effects (CalBRACE)

The CalBRACE program has developed data and narrative vulnerability reports for various indicators, including extreme heat. The CalBRACE extreme heat indicator narrative describes certain populations that may have greater difficulty preparing for extreme heat. To download the CalBRACE extreme heat indicator data and narrative, as well as the population sensitivity and adaptive capacity indicator data and narratives relevant to extreme heat events, visit: https://www.cdph.ca.gov/Programs/OHE/Pages/CC-Health-Vulnerability-Indicators.aspx.

For more information about CalBRACE, visit the CDPH Health Equity Program webpage and follow the Climate Adaptation link to the CalBRACE program website: https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx.

Map 9.R shows moderate to high concentrations of population/social vulnerability (based on the index described in *Appendix N*) in selected cities at risk of increased extreme heat days.

Map 9.R: Social Vulnerability and Extreme Heat



City	Base Temperature	Estimated Heat Days (over base temp) by 2050
Crescent City	78.3	4
Redding	107.5	21
Truckee	89.8	27
Sacramento	103.9	16
Stockton	102.2	21
San Francisco	87	4
San Jose	95.6	3
Santa Cruz	93.1	0
Monterey	87.3	0
Fresno	106.3	24
Bakersfield	107.7	18
Oxnard	88.9	8
Los Angeles	95.5	4
Riverside	103.6	28
San Diego	89	1
El Centro	113.7	23

Assessment of Local Vulnerability and Potential Losses

In July 2012, the California Energy Commission's Climate Change Center published a White Paper, prepared by the University of California (UC), Berkeley, entitled "Mapping Climate Change Exposures, Vulnerabilities, and Adaptation to Public Health Risks in the San Francisco Bay and Fresno Regions." The study first reviewed available frameworks for climate change adaptation in the public health arena and then proposed a conceptual framework and procedure to assess climate change vulnerabilities. The study identified and modeled heat stress, along with environmental, social, and health factors related to climate change and vulnerability. The study also provided a measure of small-scale variations in the urban heat island. The study determined that downtown urban areas in both Fresno County and the San Francisco Bay Area showed a cumulatively higher vulnerability score than more outlying areas (with the exception of the western portion of Fresno County).

More jurisdiction-specific information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

Current Extreme Heat Hazard Mitigation Efforts

State of California: Preparing California for Extreme Heat: Guidance and Recommendations

In 2017, in the wake of the hottest July ever recorded in the United States, the State of California released a plan to deal with extreme heat caused by climate change. This broad guidance document was developed by the Heat Committee of the Public Health Workgroup in the Climate Action Team and provides recommendations for incorporating extreme heat projections into planning and decision-making in California.

An important companion to this plan is the state's latest climate change and heat guidance entitled "Preparing California for Extreme Heat: Guidance and Recommendations" produced by the Heat Adaptation Work Group of the Climate Action Team's Public Health Workgroup and coordinated by the California Department of Public Health and the California Environmental Protection Agency (CalEPA).

This document provides an overview of climate change projections for increasing temperature and extreme heat events through 2100, evaluates the health risks associated with these changes, and presents recommendations to guide the state's actions to reduce human health risks in the face of a warming climate in California and promote more heat resilient communities.

To download "Preparing California for Extreme Heat: Guidance and Recommendations," visit:
http://www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf.

Contingency Plan for Excessive Heat Emergencies.

In June 2014, Cal OES issued a revised version of the Contingency Plan for Excessive Heat Emergencies, as a supporting document to the State Emergency Plan. The Contingency Plan was originally published in 2010.

Although primarily designed to guide preparedness and response activities, the Contingency Plan also identifies mitigation actions to prevent life loss, including:

- Identifying the location of vulnerable populations
- Establishing cooling centers
- Issuing advisories and warnings
- Conducting pre-season public information campaigns
- Promoting and expanding urban greening and the use of green infrastructure as part of cooling strategies in public and private spaces

Details regarding the Contingency Plan for Excessive Heat Emergencies are available at the following link:
http://www.caloes.ca.gov/PlanningPreparednessSite/Documents/ExcessiveHeatContingencyPlan2014.pdf.

California Adaptation Planning Guide.

The California Adaptation Planning Guide: Identifying Adaptation Strategies document presents potential strategies for adapting to climate change, including some strategies addressing heat events. Communities are encouraged to use these strategies to meet adaptation needs. The Adaptation Planning Guide can be found at the following link: http://resources.ca.gov/climate/safeguarding/local-action/.

Protecting Vulnerable Populations at Work

Since 2005, California employers have been required to provide basic elements to protect outdoor workers—adequate water, shade, rest breaks, training, and emergency procedures.[295] In 2010, the standard was strengthened to include a high heat provision that must be implemented by five industries (agriculture, construction, landscaping, oil and gas extraction, and transportation or delivery of agricultural products, construction material, or other heavy materials) when temperatures reach 95°F.

These enhancements included mandates to remind employees to drink water more frequently, to observe employees for signs and symptoms of heat illness, to ensure effective communications to summon help if needed, and to provide close supervision of new employees.

Best Practices Highlight 9.D: Kern County Cooling Centers

Kern County, located in the southern Central Valley, already experiences extreme heat events, and the frequency of these events is projected to increase due to climate change. For community members who do not have access to a setting with temperature control (e.g., air conditioning), cooling centers have been established to provide places to escape the heat. The opening of these centers is tied to a set of temperature triggers that vary by location.

The temperature triggers for opening the cooling centers, based on the National Weather Service forecast as of the previous day, are as follows:

- San Joaquin Valley / Kern River Valley Centers: 105 degrees Fahrenheit (°F)
- Mountain Center(s): 95°F
- Desert Centers: 108°F

Cooling centers include a wide range of community facilities, such as senior centers, parks and recreation facilities, community centers, police departments, and veterans' centers. When the centers have opened, announcements are made via TV, radio, and the Internet. In addition, transportation is available for community members who do not have a way to travel to one of the centers.

Sources: Reported in the California Climate Adaptation Planning Guide; https://www.kerncounty.com/pio/coolingcenters.aspx

California Heat Assessment Tool

California Natural Resources Agency under the California Fourth Climate Change Assessment is sponsoring the California Heat Assessment Tool project. The project, which is projected to launch in 2018, is a decision-support tool for city, county, and state practitioners involved in public health and local planning efforts to better prepare extreme heat events, by supporting their inclusion of extreme heat and its impact on human health in long-term policy and planning decisions. The tool will be available at www.cal-heat.org beginning in late 2018.

[295] California Code of Regulations, Title 8, Section 3395. Heat Illness Prevention, (http://www.dir.ca.gov/title8/3395.html)

Progress Summary 9.K: Urban Heat Island Index for California

Progress as of 2018: Concentration of heat in urban areas is a concern because it creates health risks from heat exposure and the increased formation of air pollutants, particularly ground-level ozone or smog. It also affects energy consumption through additional air conditioning needed to counter-balance the higher temperatures. The urban heat island effect is projected to increase with climate change.

Until now, there has been no way to quantify the extent and severity of an urban heat island for individual cities in California. There was no consistent "index" to define urban heat islands, and no maps to show where and how intensely they manifest at a local scale.[296] To address that gap, in 2012 the California Legislature required that the California Environmental Protection Agency (CalEPA) develop an Urban Heat Island Index (Assembly Bill 296, Chapter 667, Statutes of 2012) and to design it so that "cities can have a quantifiable goal for heat reduction."

Creating the Index

In 2015, CalEPA released a study entitled "Creating and Mapping an Urban Heat Island Index for California." It defines and examines the characteristics of the urban heat island and, for the first time, creates an Urban Heat Island Index to quantify the extent and severity of urban heat islands for individual cities. The index assigns a score for each census tract in and around most urban areas throughout the state. The scores are based on atmospheric modeling over two three-month-long summer seasons, 2006 (the year of a major heat wave) and 2013 (the most recent year for which data were available).

The study also produced Urban Heat Island Interactive Maps showing the urban heat island effect for each census tract in and around most urban areas throughout the state.

Study Findings

Among the study's findings:

- Hotter parts of California do not necessarily have the most intense urban heat islands. For example, the heat island effect in Fresno averages 4 degrees Fahrenheit (°F), a relatively modest increase over the already high average summer temperature of about 84°F. In contrast, the average summer temperature in Ontario is about 78°F, while the heat island effect is greater, averaging around 9°F.
- Wind and topography can shift the urban heat island effect. In major coastal cities, cool ocean air blows heated urban air inland, where it gets trapped against mountain ranges. As a result, urban heat generated in one area tends to move inland to blanket other areas with the overheated air. A similar phenomenon occurs with ozone air pollution.
- Heat island effects are related to the size of the urban area. Large urban areas have average daily summer temperature increases up to 9°F compared with non-urban regions, while smaller cities average an increase of up to 5°F. The largest effect is in Southern California, where the urban heat islands blur together to form an "urban heat archipelago" with temperatures up to 19°F higher than average in the Riverside-San Bernardino region at the eastern end of the basin.

Uses of the Index

The index may have a variety of uses. Urban heat islands may be priority areas for public health education and preparedness for extreme heat. Along with other environmental studies, such as CalEnviroScreen, this research can also help identify vulnerable areas across the state and set priorities for mitigation by providing another indicator of climate change impacts. Local governments may be interested in the maps of individual cities as a tool for identifying areas for activities such as urban greening and projects focused on cooler roofs and pavements. Over time, it may be possible to track changes in the index that result from climate change or mitigation efforts.

To download the maps or for information on how the index is calculated, visit the CalEPA Urban Heat Island Interactive Maps program website: https://calepa.ca.gov/climate/urban-heat-island-index-for-california/urban-heat-island-interactive-maps/.

[296] The closest tool that exists is U.S. EPA's Mitigation Impact Screening Tool (MIST), which provides qualitative assessments of the likely impacts of heat island mitigation strategies averaged at the city-scale. http://www.epa.gov/heatisld/resources/index.htm

Additional Extreme Heat Hazard Mitigation Opportunities

Additional opportunities to prevent or mitigate the impacts of climate change and extreme heat exist in the form of the ongoing climate change science studies and the Cal-Adapt online resource sponsored by the California Energy Commission (CEC).

For more information, visit the CEC's Environmental Research Energy Related Global Climate Change Issues webpage: http://www.energy.ca.gov/climatechange/.

9.1.9 FREEZE

Identifying Freeze Hazards

Sustained temperatures below freezing in California's generally mild weather regions can cause life loss and health risks to vulnerable populations. Although infrequent, freezes can severely affect California agriculture. Freezing temperatures occurring during winter and spring growing seasons can cause extensive crop damage.

Secondary impacts of freeze disasters can include major economic impacts on farmers, farm workers, packers, and shippers of agricultural products. Freezes can also cause significant increases in food prices to the consumer due to shortages.

Freezing spells are likely to become less frequent in California as climate temperatures increase; if emissions follow higher pathways, freezing events could occur only once per decade in a sizable portion of the state by the second half of the 21st century. While fewer freezing spells would decrease cold-related health effects, too few freezes could lead to increased incidence of disease as vectors and pathogens do not die off (CNRA 2009).

Profiling Freeze Hazards

Overview

Map 9.S shows the pattern of declared freeze disasters in California since 1950. Greatest concentrations are in the Central Valley, followed by areas north and south of the San Francisco Bay Area and portions of Southern California. Table 9.M lists freeze disasters that have occurred in the state since 1950.

Climate Change and Freeze

Similar to severe weather discussed in the following section, extremely cold periods below freezing, may also occur due to the increase in variance caused by climate change. While the global average temperature is rising, the increase in variance means that extreme events at the lower end of the historic temperature range remain a possibility.

In addition, periods of freeze intermixed with unusually warm periods may result in layering of snowpack that increases avalanche risk. This is particularly true if the freeze occurs in the fall and following a late-season rainfall event on snow, resulting in a layer of ice as part of the snowpack. At lower elevations, freezing temperatures can disrupt agricultural productivity, as some products are sensitive to freezing temperatures.

Map 9.S: State and Federal Declared Freeze Disasters, 1950-February 2017

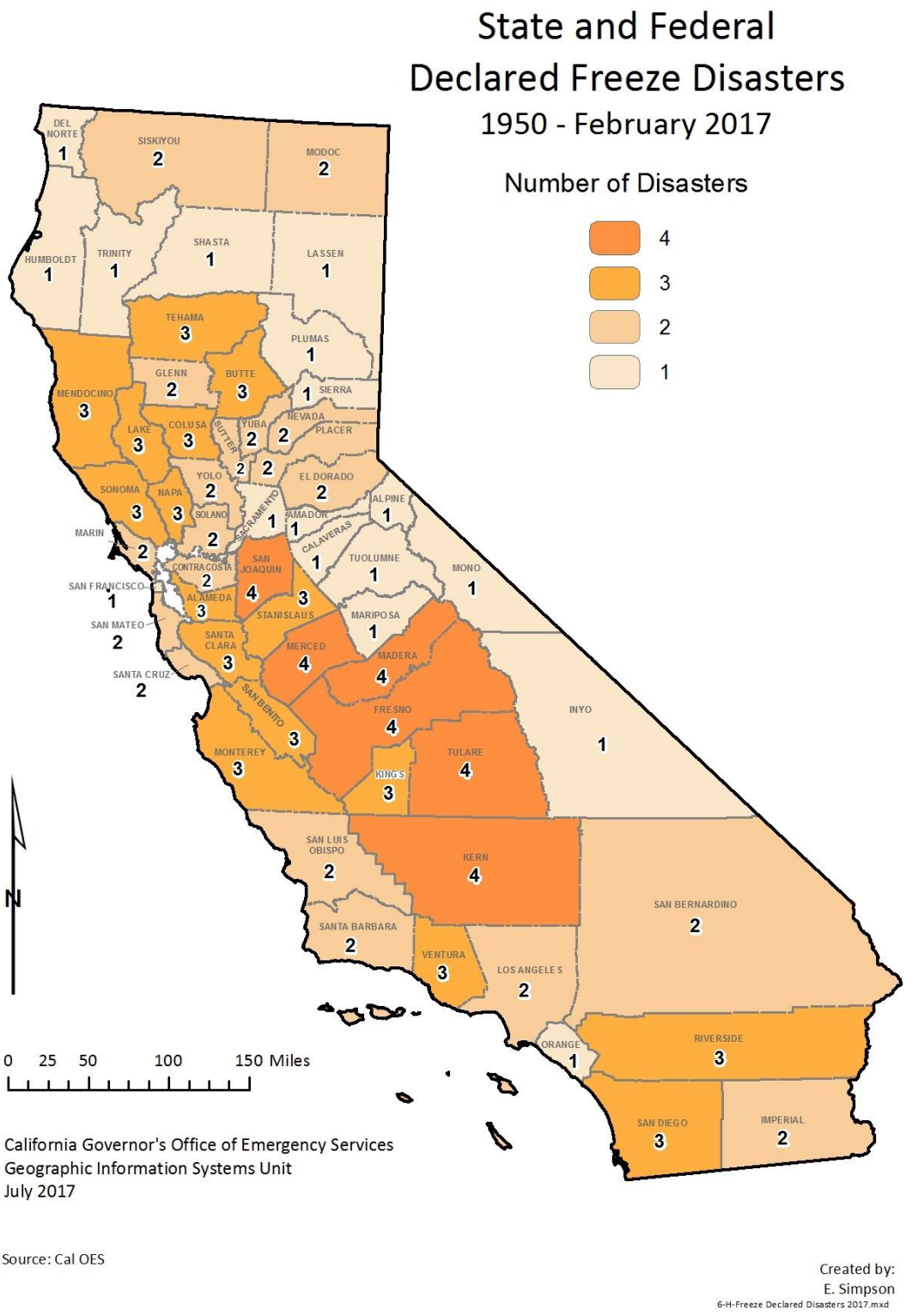


Table 9.M: Freeze Disasters, 1950 to Present

Year*	Number of Incidents	Counties Affected	Crop Damage
1969	1	San Diego	$10 million
1972	2	Colusa, El Dorado, Fresno, Kern, Kings, Lake, Madera, Merced, Modoc, Nevada, Placer, San Benito, San Joaquin, Santa Clara, Stanislaus, Siskiyou, Tehama, Tulare	$113.5 million
1973	1	Alameda, Contra Costa	$8-$10 million
1990	1	Alameda, Butte, Colusa, Fresno, Glenn, Imperial, Kern, Los Angeles, Madera, Marin, Merced, Mendocino, Monterey, Napa, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tulare, Ventura, Yolo, Yuba	$852.4 million
1998-99	1	Fresno, Kern, Kings, Madera, Merced, Monterey, Tulare, Ventura	N/A
2001	3	Butte, Colusa, Fresno, Glenn, Madera, Mariposa, Merced, Plumas, Sutter, Tehama, Tuolumne, Yuba	N/A
2002	5	Butte, Colusa, Glenn, Lake, Marin, Mendocino, Napa, Orange, Riverside, Sacramento, Shasta, Sonoma, Tehama, Trinity	N/A
2007	1	Alameda, Amador, Calaveras, El Dorado, Fresno, Glenn, Imperial, Kern, Kings, Lake, Los Angeles, Madera, Marin, Mendocino, Merced, Monterey, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Solano, Stanislaus, Tulare, Ventura, Yolo, Yuba	$1.3 billion
2008	11	Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Marin, Mariposa, Merced, Modoc, Napa, Nevada, Placer, Sacramento, San Joaquin, San Mateo, Santa Clara, Shasta, Siskiyou, Stanislaus, Solano, Sonoma, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba	$137,000
2009	15	Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Marin, Mariposa, Merced, Modoc, Napa, Nevada, Placer, Sacramento, San Joaquin, San Mateo, Santa Clara, Shasta, Siskiyou, Stanislaus, Solano, Sonoma, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba	N/A
2010	9	Fresno, Kern, Kings, Madera, Mariposa, Merced, Modoc, Siskiyou, Tulare	N/A
2011	10	Del Norte, Fresno, Humboldt, Kern, Kings, Madera, Marin, Mariposa, Mendocino, Merced, Modoc, Napa, Siskiyou, Sonoma, Trinity, Tulare	$300.44 million
2012	12	Fresno, Kern, Kings, Madera, Mariposa, Merced, Modoc, Siskiyou, Tulare	N/A

Year*	Number of Incidents	Counties Affected	Crop Damage
2013	19	Fresno, Imperial, Kern, Kings, Madera, Mariposa, Merced, Modoc, Riverside, San Bernardino, Siskiyou, Tulare	$440.35 million
2014	12	Fresno, Kern, Kings, Madera, Mariposa, Merced, Modoc, Siskiyou, Tulare	N/A
2015	14	Fresno, Imperial, Kern, Kings, Madera, Mariposa, Merced, Modoc, Riverside, San Bernardino, Siskiyou, Tulare	N/A
2016	6	Kern, Modoc, Siskiyou	N/A

Sources: Cal OES Individual Assistance Section, 2001 & 2002 SBA Declarations/ USDA Designations database; Cal OES Origins and Development - A Chronology 1917-1999; NOAA Storm Events Database, 2008-2016

Assessment of State Vulnerability and Potential Losses

Freeze can cause substantial damage to crops in California. Table 9.M shows some of the most detrimental periods of freeze in terms of crop damage dollar losses. As shown in the table, a six-day period of freeze in December 2013 caused more than $440 million in damage to citrus crops.[297] Citrus crops tend to be the most vulnerable to freeze; they accounted for a vast majority of reported damage between 1972 and 2016.

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

Current Freeze Hazard Mitigation Efforts

Freeze damage is another economic hazard. Mitigation measures for frost include:

- Warning systems
- Selective planting
- Crop insurance
- Frost-fighting equipment
- Biological ice nucleation[298]

For specific mitigation ideas related to extreme temperatures, see "Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards" (January 2013), prepared by the Federal Emergency Management Agency (FEMA), and available on the FEMA website: http://www.fema.gov/library/viewRecord.do?id=6938.

Additional Freeze Hazard Mitigation Opportunities

There are no additional opportunities identified at this time to prevent or mitigate the impacts of freeze hazards.

[297] NOAA, 2013 and California Citrus Mutual
[298] FEMA Region IX Mitigation Division, Mitigation Strategy Report, FEMA-DR-1267-Ca, The California Freeze of 1998.

9.1.10 SEVERE WEATHER AND STORMS

As pointed out in the discussion of climate change earlier in this chapter as well as in *Chapter 4, Section 4.3*, more extreme weather and severe storms are expected among the future natural hazards challenges in California due to climate change. Increases in severe weather, winter storms, flooding, temperature extremes, and other meteorological effects are anticipated.

Severe weather, what the Intergovernmental Panel on Climate Change refers to as extreme weather, describes a variety of events that are beyond or near the ends of the range of observed weather patterns and behavior.[299] These can include extreme rainfall events, heat waves, storms, unusually cold temperatures, and wind events.

A key theme in the California Climate Adaptation Strategy is the likelihood of more extreme weather-related events requiring planning for adaptation. Because the science is so new, however, little is yet known about certain possible weather effects of climate change. For example, among potential weather-related effects not dealt with in depth in the California Adaptation Strategy is the possibility of increasing numbers and intensities of windstorms, a variable having substantial local impacts and affecting future building code provisions, landscape design and maintenance, and power line and pole design, among other things.

Therefore, although this sub-section focuses primarily on tornadoes and to a lesser degree on hurricanes, it is intended to serve as a placeholder for future assessment of other weather-related hazards representing a broader variety of manifestations in this classification of extreme weather. The severe weather hazards of extreme heat and freeze and are addressed under separate sections within *Chapter 9, Section 9.1*.

Identifying Storm Hazards

A storm disaster is generally defined as a violent atmospheric disturbance occurring over land and/or water and is distinguished by its strength, characteristics, and the scale of the resulting damage. Storms can represent a major potential threat to the state's population because of their frequency, the size of areas devastated and the population affected, and the scale of the potential resulting damage. Storms in California also have historically caused flooding, mudflows, landslides, electrical outages, and other impacts.

There are different types of storms including thunderstorms and winter storms, both of which can produce hazardous conditions. Thunderstorms can produce damaging winds, tornadoes, large hail, flooding and flash flooding. Winter storms can include freezing rain, sleet, heavy snow, and strong winds.

Severe thunderstorms are officially defined as storms that are capable of producing large hail (inch or larger) and/or wind gusts over 58 miles per hour. Hail this size can damage property such as plants, roofs, and vehicles. Wind this strong is able to break off large branches, knock over trees, or cause structural damage to trees. Thunderstorms also produce tornadoes and dangerous lightning; heavy rain can cause flash flooding.

El Nino and La Nina storms are two types of storms that affect the state often. The term El Niño refers to the large-scale ocean-atmosphere climate phenomenon linked to a periodic warming in sea-surface temperatures across the central and east-central equatorial Pacific. La Nina refers to the periodic cooling of ocean surface temperatures in the central and east-central equatorial Pacific that occurs every 3 to 5 years or so. During an El Nino or La Nina, the changes in Pacific Ocean temperatures affect the patterns of tropical rainfall from Indonesia to the west coast of South America, a distance covering approximately one-half way around the world. These changes in tropical rainfall affect weather patterns throughout the world.[300]

[299] IPCC. Intergovernmental Panel on Climate Change. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. 2012. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

[300] http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensofaq.shtml#NINO

Following are other various types of storms that have historically affected the state:

- *Coastal storm:* large wind waves and/or storm surge that strike the coastal zone.
- *Wind storm:* marked by high wind with little or no precipitation.
- *Hailstorm:* a type of storm that precipitates round chunks of ice. Hailstorms usually occur during regular thunderstorms.
- *Ice storm:* Ice storms are one of the most dangerous forms of winter storms. When surface temperatures are below freezing, but a thick layer of above-freezing air remains aloft, rain can fall into the freezing layer and freeze upon impact into a glaze of ice. In general, 8 millimeters (0.31 inch) of accumulation is all that is required, especially in combination with breezy conditions, to start downing power lines as well as tree limbs. [3] Ice storms also make unheated road surfaces too slick to drive on. Ice storms can vary in time range from hours to days and can cripple small towns and large urban centers alike.
- *Snowstorm:* A heavy fall of snow accumulating at a rate of more than 5 centimeters (2 inches) per hour that lasts several hours. Snowstorms, especially ones with a high liquid equivalent and breezy conditions, can down tree limbs, cut off power, and paralyze travel over a large region.
- *Thunderstorms and winter storms* (both discussed later in *Section 9.1.10*)

Identifying Hurricane Hazards

No hurricanes have hit California in recorded history because tropical storm winds generally blow from east to west. California is affected by heavy rain resulting from tropical winds that blow north from Mexico and become colder by the time they hit California.[301]

In the future, monitoring is needed to determine whether present patterns of movement of such storms continue or are modified by the warming of waters off the Pacific Coast due to climate change.

Identifying Tornado Hazards

While California has tornadoes, such storms represent a relatively low risk for most areas, compared to states in the Midwestern and Southern United States where risk exposure is severe and many lives and millions of dollars are lost annually due to this hazard.

Wind speeds in tornadoes range from values below that of hurricane speeds to more than 300 miles per hour. Unlike hurricanes, which produce wind speeds of similar values over relatively widespread areas (when compared to tornadoes), the maximum winds in tornadoes are often confined to extremely small areas and vary substantially over very short distances, even within the funnel itself.

Tornados are measured by the Fujita Tornado Scale which classifies tornadoes by intensity categories (F0-F12), based on the maximum winds occurring within the funnel. Table 9.N describes the Fujita Tornado Scale.

Table 9.N: Fujita Tornado Scale

Category	Wind Speed	Description
F0	40-72 miles per hour	Gale Tornado. Light Damage: Some damage to chimneys; breaks twigs and branches off trees; pushes over shallow-rooted trees; damages signboards; some windows broken; hurricane wind speed begins at 73 miles per hour.
F1	73-112 miles per hour	Moderate Tornado. Moderate Damage: Peels surfaces off roofs; mobile homes pushed off foundations or overturned; outbuildings demolished; moving autos pushed off the roads; trees snapped or broken.
F2	113-157 miles per hour	Significant Tornado. Considerable Damage: Roofs torn off frame houses; mobile homes demolished; frame houses with weak foundations lifted and

[301] The USA TODAY Weather Book by Jack Williams

Category	Wind Speed	Description
		moved; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	158-206 miles per hour	Severe Tornado. Severe Damage: Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forests uprooted; heavy cars lifted off the ground and thrown; weak pavement blown off roads.
F4	207-260 miles per hour	Devastating Tornado. Devastating Damage: Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and disintegrated; large missiles generated; trees in forest uprooted and carried some distance away.
F5	261-318 miles per hour	Incredible Tornado. Incredible Damage: Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 300 feet (100 meters); trees debarked; incredible phenomena will occur.
F6-12	Greater than 319 miles per hour	The maximum wind speeds of tornadoes are not expected to reach the F6 wind speeds.

Source: http://www.spc.noaa.gov/faq/tornado/f-scale.html

Profiling Storm Hazards

The information in Table 9.O extends back to 1993 because that is the year that Cal OES began tracking disaster recovery history information. The 1993 storm was the first federally declared flood disaster since Stafford Act implementation began in 1988.

Table 9.O: Federally Declared Storm Disasters Since 1993 (as of February 2018)*

Disaster #[1]	Date[1]	# of Counties Affected[2]	# of Deaths	Damage in $[2]
DR-979	Jan-Mar 1993	20	20	$175,734,172
DR-1046	Feb-Apr 1995	41	17	$110,327,382
DR-1044	Jan-Feb 1995	33	11	$143,991,187
DR-1155	Dec 1996-Apr 1997	47	8	$174,408,427
DR-1203	Feb-Apr 1998	43	17	$367,638,469
DR-1577	Dec 2004-Jan 2005	7	0	$258,456,701
DR-1585	Feb 2005	7	0	$77,765,373
DR-1628	Dec 2005-Jan 2006	13	0	$155,861,541
DR-1646	Mar-Apr 2006	17	0	$35,332,696
DR-1884	Jan-Feb 2010	6	2	$28,328,920
DR-1952	Dec 2010-Jan 2011	12	0	$75,384,562
DR-4301	Jan 2017	34	[a]	$78,667,600
DR-4302	Jan 2017	Hoopa Valley Tribe	[a]	$3,296,420
DR-4305	Jan 20147	22	[a]	$39,993,640
DR-4308	Feb 2017		[a]	$199,828,031
DR-4312	Feb 2017	Resighini Rancheria	[a]	$269,935
TOTAL				**$2,112,685,689**

[a] Information regarding number of deaths from storm related disasters is not available as of February 2018
Source: [1] https://www.fema.gov/disasters; [2] Cal OES disaster database (Oracle) tracks the amount of obligated funds (Public Assistance and California Disaster Assistance Act [CDAA] funds)

Profiling Tornado Hazards

As shown in Table 9.P, between 1950 and 2017, 354 tornadoes occurred in California, resulting in 87 injuries and more than $103 million in property damage, as well as $267,000 in reported crop damage. No known deaths occurred as a result of California tornadoes, however, and the state has never proclaimed a state of emergency or had a federal disaster declared as the result of a tornado event.

Of the 354 tornadoes that occurred in California between 1950 and 2017, only 2 reached F3; 23 were F2, 93 were F1, and the remaining 236 were at F0. Based on the number of events within the recorded period, in the 67 years between 1950 and 2017, the average recurrence interval of an F0 tornado was about 3.7 per year; the interval for an F1 tornado was about 1.5 per year, the interval for an F2 tornado was approximately once every 2 years, and the interval for an F3 tornado was once every 28 years. However, both F3 tornadoes occurred within a five-year period (1973-1978). The biggest risks of tornadoes in California include light to moderate damage to homes, destruction of mobile homes, and injuries caused by light object projectiles.

Table 9.P: Tornado Losses, 1950-2017

Magnitude	Number	Injuries*	Property Damage*	Crop Damage*
F0	236	8	$38 million	$212,000
F1	93	26	$18 million	$55,000
F2	23	47	$45 million	N/A
F3	2	6	$2.5 million	N/A

Source: The Tornado Project (www.tornadoproject.com), NOAA national climate data center
**2013-2017 updates pending*

Climate Change and Severe Storms

Climate change increases the variance of weather patterns (described in *Section 4.3.2*) which means the occurrence of events at the edges of the observed range increases. This increase in extreme events or severe weather must be anticipated and planned for.

While a specific event is difficult to project for a particular location, planners should be familiar with local weather patterns and be able to identify which events meet or go beyond the historically observed range that would pose the greatest risk to a community. This could be intense rainfall, wind, heat, powerful hurricanes, or any other climate change-influenced event. Communities should include the potential for these events in their planning process. For example, severe coastal storms may increase in frequency and severity. This potential should be incorporated into coastal community plans for land use and emergency response.

Assessment of State Vulnerability and Potential Losses

No known current assessment of state vulnerability or potential losses due to tornado hazards is available at this time.

Assessment of Local Vulnerability and Potential Losses

Information related to community vulnerability and loss assessments may be found in Local Hazard Mitigation Plans.

Current Severe Weather and Storms Hazard Mitigation Efforts

Voters passed a $4 billion disaster preparedness and flood control bond in 2006, Proposition 1E, that has allowed the state to help local agencies protect homes and lives from levee failures, flash floods, and mudslides. Proposition 84, also passed by voters in 2006, which included $800 million for flood control. Since their passing, those bond dollars have gone to hundreds of safeguarding and mitigation projects such as strengthening the levees that protect Central Valley populations; replacing a 114-year-old dam in Escondido; building stormwater detention basins that improve flood control, create habitat and naturally treat urban runoff; and constructing a five-mile pipeline that will enable Los Angeles County to use stormwater to recharge a groundwater basin.

Tornado mitigation is achieved through the enforcement of wind engineering design and construction codes and standards. Tornado watch and warning announcements are issued to local emergency management agencies and to the media through the Emergency Disaster Information System (EDIS), based on information provided by National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service.

Additional Severe Weather and Storm Hazard Mitigation Opportunities

Storm-related mitigation activities that occur during storm season include winterizing by clearing culverts, marshaling heavy equipment, training crews in flood-fighting techniques, and sharing information with the public on weather-related information.

In addition to maintaining California existing reservoirs and improving groundwater management, California is looking to make major new investments to build the state's water storage capacity through construction of new reservoirs and/or groundwater storage systems. California voters passed Proposition 1 in November 2014 that included $2.7 billion to pay for new water storage projects.

The state and federal governments are also working to modernize the water conveyance system in the Sacramento-San Joaquin Delta to improve the movement of water across the state. California WaterFix is a state and federal proposal to build three new tunnels to allow for a more natural flow of water, reduce dependence on the existing pumping plants, and safeguard a critical water delivery system from catastrophic failure by earthquake, flood, or levee collapse.

9.1.11 TREE MORTALITY

Identifying Tree Mortality Hazards

Tree mortality can create dangerous conditions for people who work in, live in, and/or visit affected areas. High levels of tree mortality increase fuel loads, create hazardous conditions for wildland firefighting personnel, decrease production rates of fireline construction, pose risk of injury from falling branches or trees, and create financial burdens for property owners. Most notable is the high number of hazard trees in or around roads, trails and power lines, administrative sites, campgrounds and communities. Hazard trees require felling and removal to ensure public safety, which may limit access to public lands. Some areas may see a reduction in tourism due to the impact of tree mortality on aesthetics. Additionally, mitigation of hazard trees might alter employee responsibilities and planned forest management activities.

Factors contributing to tree mortality include drought-induced water stress, bark beetles, and high tree density. During water deficit periods, trees become suitable host material for bark beetles. High tree density exacerbates stress on individual trees. In particularly dry areas, trees are dying solely from drought conditions regardless of tree competition; however, tree mortality is largely due to drought conditions coupled with high tree density and/or bark beetles.[302]

Profiling Tree Mortality Hazards

Overview

In California, drought is a recurring event and a catalyst for thousands of acres of stressed trees, bark beetle outbreaks, and extremely high levels of tree mortality.[303] Due to the drought, tree mortality levels have substantially increased in forests in California over the past several years. An estimated 29 million trees covering three million acres died in 2015 alone. From 2010 through the fall of 2017, approximately 129 million trees died on 8.9 acres.[304]

Tree mortality is occurring statewide but is particularly dramatic on the west side of the southern Sierra Nevada range and in parts of the Transverse range. As of 2017, there are over one million acres with high levels of tree mortality across the Stanislaus, Sierra, and Sequoia National Forests. Forest managers are recording 50 percent to greater than 75 percent conifer mortality between 3,000 to 6,000 feet elevation. See Map 9.T.

Climate Change and Tree Mortality

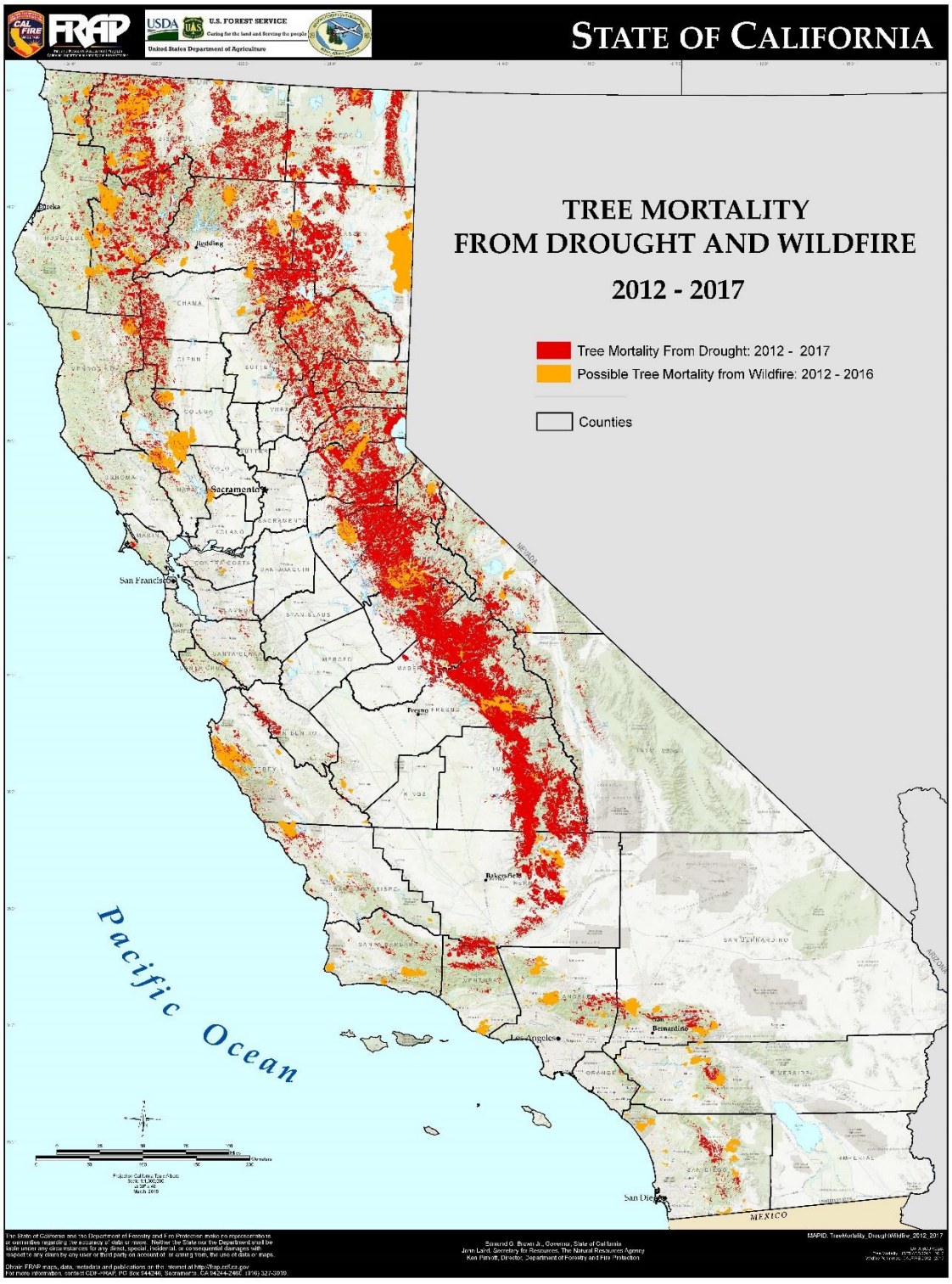
Climate change has the potential to bolster tree mortality by affecting drought and insect populations. Climate change is projected to result in increased frequency and severity of drought events. In addition, changes in seasonal patterns for temperature and precipitation can allow pest populations, such as bark beetles, to increase with limited population reductions in the winter.

Potential repeated and increasingly severe drought events in the future, as well as increases in pest populations stemming from climate changes, may result in additional tree mortality and associated hazards. The potential for increasing incidence of events that cause tree mortality should be incorporated into local and regional mitigation plans.

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[302] USDA, https://www.fs.fed.us/psw/topics/tree_mortality/index.shtml, https://www.fs.usda.gov/CATreeMortality
[303] USDA, https://www.fs.fed.us/psw/topics/tree_mortality/index.shtml
[304] USFS Tree Mortality Team/CAL FIRE News Release, December 12, 2017; https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd566303.pdf

Map 9.T: Tree Mortality from Drought and Wildfire, 2012-2017



Source: Tree Mortality Task Force reports and deliverables webpage; http://www.fire.ca.gov/treetaskforce/reports#Maps-Data

Map 9.T identifies all tree mortality recorded between 2012 and 2017 throughout the state.

Assessment of State Vulnerability and Potential Losses

Federal, state, and local agencies are working to increase their capacity to mitigate and respond to the impacts of tree mortality on both public and private lands. California's wood processing infrastructure has been declining for decades, limiting state and local capacity to capture the value of the wood in the dead and dying trees. Lack of adequate infrastructure limits the options for quickly removing dead trees. With limited ability to sell the trees, private landowners, and public land managers may need assistance with on-site treatment or transportation of wood to temporary disposal areas.[305]

Map 9.U shows state vulnerability to tree mortality by delineating hazard zones and high priority counties. The High Hazard Zones are those areas designated by the State of California as being in greatest need of dead tree removal due to severe tree mortality levels caused by five years of drought and subsequent bark beetle infestations. Hazard zones are represented in two tiers, representing both potential direct threat to people, buildings and infrastructure from falling trees (Tier 1), and broader fire risk and forest health considerations (Tier 2).

Findings from the Centers for Disease Control and Prevention (CDC) "Community Assessment for Public Health Emergency Response (CASPER) – Mariposa County, 2016," addressing the California drought, indicate that negative impacts of drought on households include financial impacts of dead and dying trees on the properties.

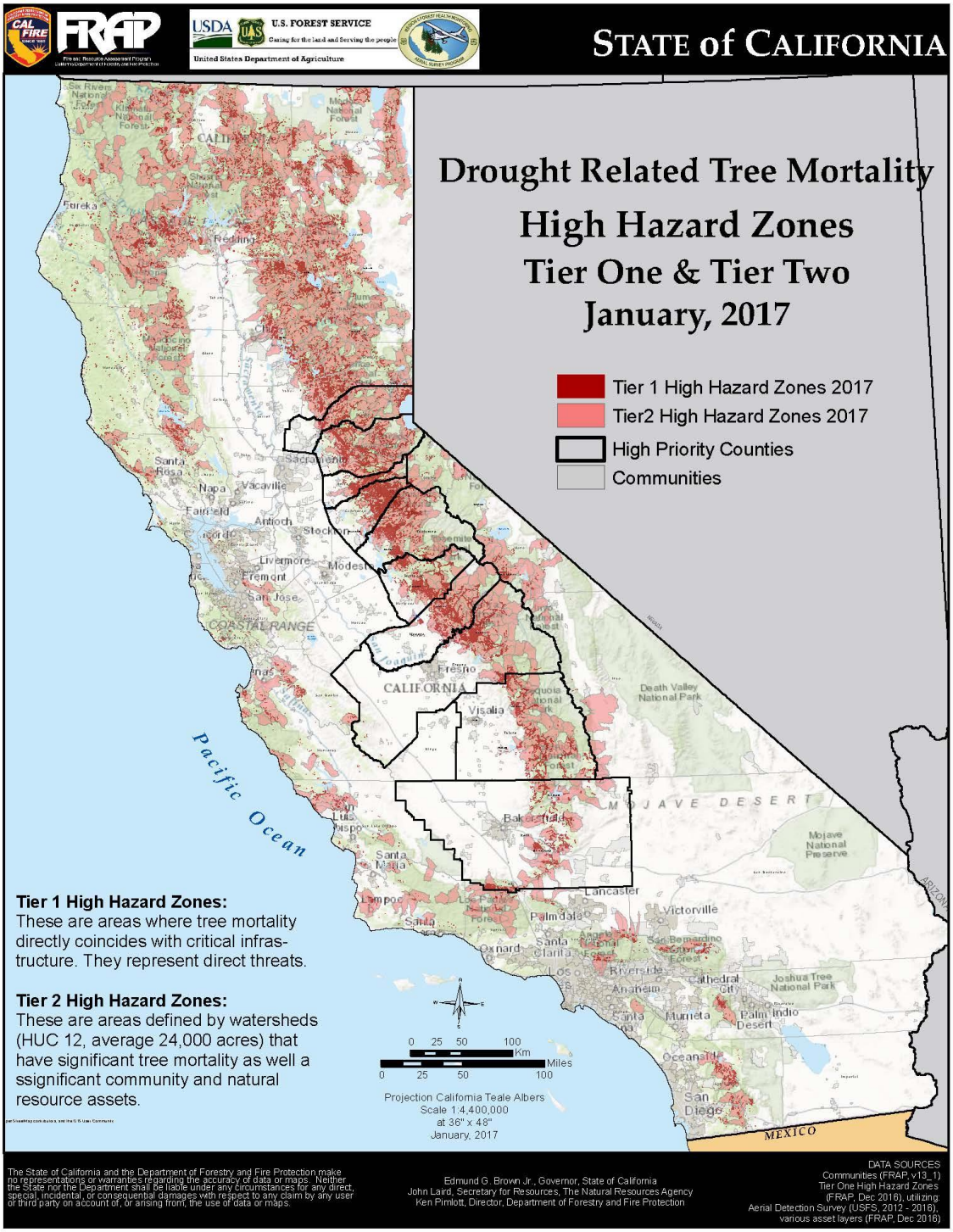
Specifically, the report found that households reported that drought negatively affected their property (40.1 percent) and finances (19.7 percent), and that 62.4 percent of households had dead or dying trees on their property. Almost two-thirds of these households (63.6 percent) have had the dead or dying trees felled, with the cost of felling trees ranging from $0 to $60,000. Of the households that felled trees, 38.1 percent reported no cost, 23.2 percent spent $100 to $999, 14.6 percent spent $1,000 to $4,999, and 8.3 percent spent $5,000 or more.[306]

Assessment of Local Vulnerability and Potential Losses

CAL FIRE identified the following counties as high hazard zones: Amador, Calaveras, El Dorado, Fresno, Kern, Madera, Mariposa, Placer, Tulare, and Tuolumne. Tree mortality threatens forest health, infrastructure, and public safety, and increases risk of wildfire, regardless of the region. For more information on local vulnerability and potential losses, see the jurisdictions' hazard mitigation plan and/or tree removal plan.

[305] USDA, https://www.fs.fed.us/psw/topics/tree_mortality/index.shtml
[306] https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/CDPH%20Document%20Library/Mariposa%202016%20CASPER%20report.pdf

Map 9.U: Tree Mortality (per acre) and High Hazard Zones



Map 9.U identifies tree mortality around the state with the highest concentrations occurring in the central Sierra Nevada range. This map can be downloaded from the Tree Mortality Task Force web page: http://www.fire.ca.gov/treetaskforce/downloads/HighHazardZones_Tier1_Tier2_8x11.pdf

Current Tree Mortality Hazard Mitigation Efforts

Forest Management Task Force (formerly named the Tree Mortality Task Force)

In October 2015, Governor Brown issued an Emergency Proclamation that supplemented his January 17, 2014 Executive Order; the Emergency Proclamation addressed tree mortality and established the Tree Mortality Task Force. The Task Force is comprised of more than 80 state and federal agencies, local governments, utilities, and other stakeholders working together to address public safety hazards associated with epidemic levels of tree mortality driven by California's fifth year of drought. All high-hazard counties have their own disaster declarations and task forces as well.

The objectives of the Tree Mortality Task Force are the following:

- Provide for public health and safety of persons and property in identified high hazard zones.
- Ensure efforts associated with implementation of the directives contained in the Governor's Emergency Proclamation remain coordinated.
- Ensure continuous communication among state, federal, and local governments, as well as with other non-governmental organizations assigned to the task force.
- Provide consistent and coordinated messaging between task force member agencies and the public.
- Manage projects and programs in a financially responsible and efficient manner.

Since its inception, the Tree Mortality Task Force has made significant progress on the 19 directives set forth in the Governor's Executive Order. The progress made on each directive is summarized in Table 9.Q.

Table 9.Q: Progress of Tree Mortality Task Force Directives, through June 2018

Executive Order Directive	Progress
1. The California Department of Forestry and Fire Protection (CAL FIRE), the California Natural Resources Agency, Caltrans, and the California Energy Commission will identify areas of the state that represent high-hazard zones for wildfire and falling trees.	A tree mortality map viewer is now available on the Tree Mortality Task Force website and will be updated as mortality expands.
2. State agencies, utilities, and local governments will undertake efforts to remove dead or dying trees in these high hazard zones that threaten power lines, roads, other evacuation corridors and critical infrastructure.	Ongoing.
3. CAL FIRE shall identify potential storage locations for removed trees across impacted areas in partnership with federal agencies and local jurisdictions.	Completed, and will be updated as mortality expands.
4. Caltrans will seek emergency federal funding to clear hazard trees that threaten state highways and roads.	Completed.
5. The Department of General Services will identify state facilities and Caltrans shall identify highway and road corridors where woodchips produced from dead trees can be used as mulch.	Completed.
6. State agencies will make available portable equipment such as large volume masticators, chippers, and portable sawmills in high hazard zones to aid local entities in tree removal efforts.	Completed.
7. The California Air Resources Board and CAL FIRE shall work together with federal land managers and the U.S. Environmental Protection Agency to expand the practice of prescribed burns and increase the number of allowable days on a temporary basis to burn tree waste that has been removed in high hazard zones.	Completed.
8. The California Public Utilities Commission (CPUC) will utilize its authority to extend contracts on existing forest bioenergy facilities receiving feedstock from high hazard zones.	Completed.

Executive Order Directive	Progress
9. The CPUC will increase capacity for forest biomass generation by expediting actions for qualifying facilities in two of its biomass-oriented programs, BioMat and ReMAT.	Partially completed.
10. The CPUC will work to reduce delays between utilities and facilities in reaching agreement on interconnection terms for new and expanded biomass energy facilities.	Ongoing.
11. The California Energy Commission will prioritize grant funding from the Electric Program Investment Charge for woody biomass-to-energy technology development and deployment, consistent with direction from the CPUC.	Ongoing.
12. CAL FIRE, the California Energy Commission, and other appropriate agencies will work with land managers to estimate biomass feedstock availability, storage locations, and volumes that may be available for use as bioenergy feedstock at existing and new facilities	Partially completed.
13. CAL FIRE and the California Energy Commission will work with bioenergy facilities that accept forest biomass from high-hazard zones to identify potential funds to help offset higher feedstock costs.	Partially completed.
14. Cal Recycle and CAL FIRE will work with affected counties and existing wood products markets to determine feasibility of expanded wood products markets in California.	Ongoing.
15. For purposes of carrying out Directives 1, 2, and 5 through 8, Division 13 (commencing with Section 21000) of the Public Resources Code and regulations adopted pursuant to that division are hereby suspended	Completed, with updates as needed.
16. In order to ensure that equipment and services necessary for emergency response can be procured quickly, state contracts, including, but not limited to, advertising and competitive bidding requirements, are hereby suspended as necessary	Completed.
17. For purposes of this Proclamation, Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of the Government Code is suspended for the development and adoption of regulations or guidelines needed to carry out the provisions in this Order.	Completed, with updates as needed.
18. The Office of Emergency Services shall provide local government assistance as appropriate under the authority of the California Disaster Assistance Act, and California Code of Regulations.	Ongoing.
19. State agencies shall actively monitor tree removal efforts directed by this Proclamation to assess their effectiveness in protecting forest health and strengthening forest resilience.	Ongoing.

Source: CAL FIRE Tree Mortality Task Force, Two Year Review and Status of Executive Order Directives 2015-2017, http://www.fire.ca.gov/treetaskforce/downloads/TMTFMaterials/Factsheet_TMTF2yearreview111317FINAL.pdf

In response to Governor Brown's 2015 Emergency Proclamation, an Incident Action Plan was developed by the Task Force. The Incident Action Plan identifies areas of the state that represent high hazard zones for wildfire and falling trees associated with elevated tree mortality and a corresponding threat to public safety, community assets, and related infrastructure. Guidelines were developed to assist in the implementation of dead and dying tree removal in high hazard zones underscoring the legal and regulatory basis for the project.

In 2018, the Tree Mortality Task Force was absorbed into the Forest Management Task Force as its own working group. The Forest Management Task Force objectives expand the Tree Mortality Task Force efforts to support the broader goals of the 2018 Forest Carbon Plan. The Forest Management Task Force, which is a cooperative effort between state, federal, and local governments, will respond to the overarching need for better management of California's forests and forested watersheds.

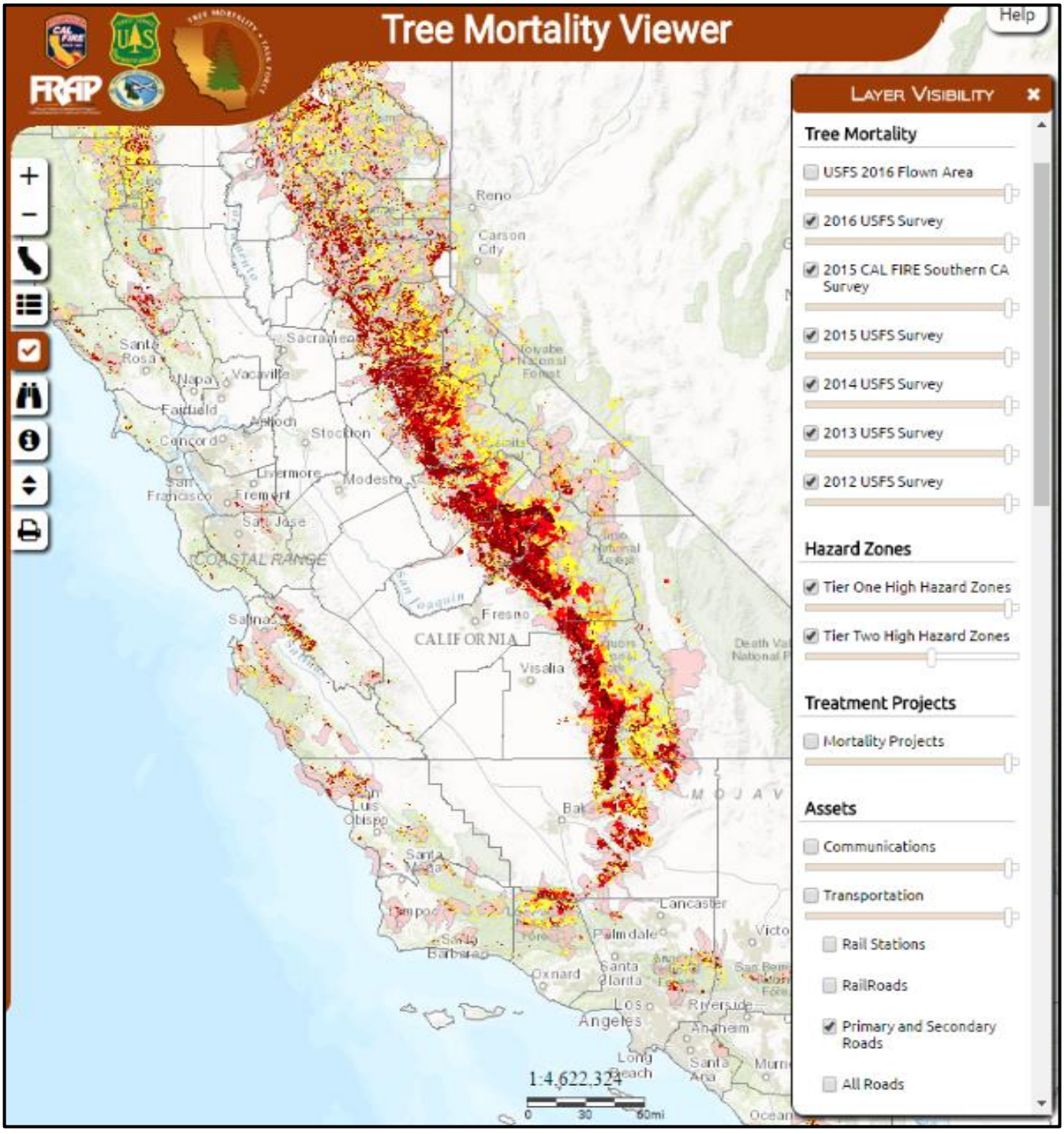
The new Task Force will continue efforts on tree mortality, but will also focus on carrying out the directives contained in the Governor's Executive Order B-52-18, including promoting forest health and vegetation reduction, streamlining permitting for forest health and fuel reduction activities on private property, and promoting use of forest products.

Tree Mortality Map Viewer

Tree Mortality Task Force Directive 1 resulted in the creation of the Tree Mortality Map Viewer, which allows individuals and agencies to view and export a variety of spatial information related to tree mortality. Some of the available data layers are recorded tree mortality, hazard zones, tree removal projects, utility lines, recreational facilities, and fire threat levels. The Tree Mortality Viewer is maintained by the CAL FIRE "Fire and Resource Assessment Program" (FRAP), the U.S. Forest Service, and the Tree Mortality Task Force.

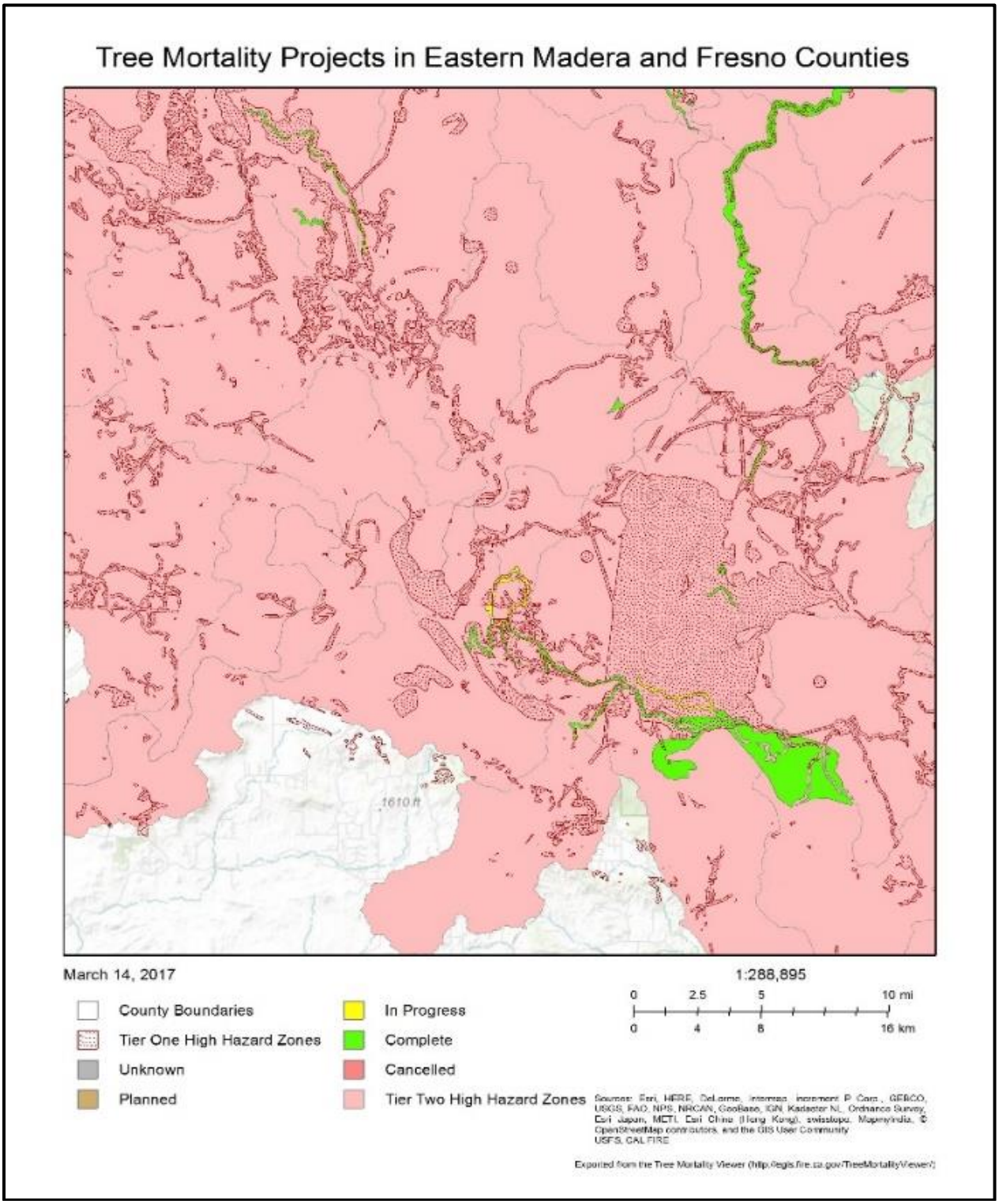
The tree mortality layer consists of results of annual 2012-2016 aerial tree mortality surveys. The map viewer also includes a layer identifying locations of state and local assets. The Tree Mortality, Assets, and Hazard Zones are updated periodically based on local review and the availability of new data.

Map 9.V: Screen Shot of Tree Mortality Viewer



Map 9.V illustrates how the map viewer can be used to watch the worsening progression of tree die-off from 2012 to 2016. To access the viewer, visit: http://www.fire.ca.gov/treetaskforce/

Map 9.W: Tree Mortality Viewer Example of Map Export



Map 9.W is an example of the map views available from the viewer. As shown in Map 9.W, the viewer includes a layer with treatment projects related to the removal of dead trees. This layer is updated every other month with submitted projects. For more information about the Tree Mortality Task Force or to use the tree mortality viewer, go to: http://www.fire.ca.gov/treetaskforce/.

Executive Order B-52-18 Addressing Tree Mortality and Wildfire

In the face of the worst wildfires in California's history, Governor Brown issued an Executive Order on May 10, 2018 to combat dangerous tree mortality, increase the ability of forests to capture carbon, and systematically improve forest management. The issuance of Executive Order B-52-18 coincides with the release of the California Forest Carbon Plan prepared jointly by CAL FIRE, the California Environmental Protection Agency (Cal EPA), and the California Natural Resources Agency (CNRA). The plan's intent is to provide a detailed implementation plan for the forest carbon goals embodied in the California Air Resources Board (CARB) 2030 Target Scoping Plan Update, which outlines strategies to achieve the 2020 greenhouse gas emissions reduction goals.

Key elements of the Executive Order include:

- Doubling the land actively managed through vegetation thinning, controlled fires and reforestation from 250,000 acres to 500,000 acres.
- Launching new training and certification programs to help promote forest health through prescribed burning.
- Boosting education and outreach to landowners on the most effective ways to reduce vegetation and other forest-fire fuel sources on private lands.
- Streamlining permitting for landowner-initiated projects that improve forest health and reduce forest-fire fuels on their properties.
- Supporting the innovative use of forest products by the building industry.
- Expanding grants, training, and other incentives to improve watersheds.

Executive Order B-52-18 will improve the health of the state's forests and help mitigate the threat and impacts of deadly and destructive wildfires, which hinder the state's progress toward its climate goals. Forests serve as the state's largest land-based carbon sink, drawing carbon from the atmosphere and storing it in trees and shrubs and in forest soils. But even a single wildfire can immediately cancel all those benefits.[307]

To support implementation of Executive Order B-52-18 and the Forest Carbon Plan, a Forest Management Task Force will be convened, and $96 million is allocated to these efforts in the Governor's May 2018 budget revision. For more information about the California Forest Carbon Plan: Managing our Forest Landscapes in a Changing Climate, visit: http://fire.ca.gov/fcat/.

US Forest Service Activities

In addition, the U.S. Forest Service is undertaking the following actions to address tree mortality:

- Removing hazardous trees near communities, along roads and power lines, and in recreation sites.
- Re-assessing areas for new hazards as tree mortality continues.
- Compiling a toolbox of tools and resources for federal, private, and state landowners and managers to assist in managing affected areas and support decision-making on the best course forward.
- Providing public education via a number of media (both print and electronic) and acting as a key participant in the Governor's Tree Mortality Task Force.
- Assessing California's wood processing capacity and helping to develop biomass energy markets that are responsive to changing needs.
- Reducing tree density and restoring resilience against forest pests and wildfires.

Caltrans Tree Mortality Program

As part of its participation in the Tree Mortality Task Force, Caltrans is identifying dead and dying hazardous trees that could affect the safety of the traveling public along highways and marking trees for removal. The 2017 Incident Action Plan of the Tree Mortality Task Force identified ten high hazard zones (in the counties of Kern, Tulare, Fresno, Madera, Mariposa, Tuolumne, Calaveras, Amador, Placer, and El Dorado), where tree mortality directly coincides with critical infrastructure. The Tree Removal Program is underway in counties in high hazard areas in Northern and Central California.

[307] https://www.gov.ca.gov/2018/05/10/governor-brown-issues-executive-order-to-protect-communities-from-wildfire-climate-impacts/

Since marked trees along highways may be on federal, state, county, or private property, Caltrans is in the process of obtaining written permission from all affected landowners to perform tree removal work. As part of this effort, Caltrans has mailed "permission to enter" forms to land owners and established an electronic "permission to enter" process online.

Caltrans has created a website that provides project maps, regulatory background, and public outreach information: http://www.dot.ca.gov/treemortality/.

CAL FIRE State Responsibility Area Fire Prevention Fund and Tree Mortality Grant Program

CAL FIRE awarded over $15 million in grants under the State Responsibility Area Fire Prevention Fee (SRAFPF) and Tree Mortality Grant Program for 2016 to 2017. Local entities receiving the grants include local governments, fire districts, community services districts, water districts, and special districts with State Responsibility Areas (SRAs) within their jurisdiction, along with local conservation corps, Fire Safe Councils, and other non-profit organizations. The grants support local efforts to remove dead and dying trees that pose a threat to public health and safety and projects that reduce the wildfire threat to habitable structures within SRAs.

Fire Safe Council Risk Reduction Activities Grants

The California Fire Safe Council selected 21 local projects in at-risk communities for the 2017 Grants Clearinghouse State Fire Assistance Program. These projects received $2.1 million in federal grant funds to support wildfire risk reduction activities and hazardous fuels reduction projects, including removal of dead and dying trees.

9.2 SOCIOTECHNICAL/TECHNOLOGICAL HAZARDS

Sociotechnical or technological hazards are events caused by either human error in controlling technology or a malfunction of a technology system.

9.2.1 HAZARDOUS MATERIALS RELEASE

Identifying Hazards Due to Release of Hazardous Materials

A hazardous material is defined in California's State Hazardous Materials Incident Contingency Plan (1991) as "a substance or combination of substances which, because of quantity, concentration, physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in deaths or serious illnesses; and/or pose a substantial present or potential hazard to humans or the environment."[308] Hazardous materials are one or more of the following: flammable, corrosive or an irritant, oxidizing, explosive, toxic (poisonous or infectious), thermally unstable or reactive, or radioactive. See *Section 9.2.4* for discussion of radiological accidents.

Hazardous materials are ubiquitous in modern society and may be found at all stages of production, consumption, and disposal. Federal and state laws permit the intentional release of some hazardous materials into the environment, typically in quantities, in a form, and/or in locations such that the risk to human health and the environment is thought to be acceptable. However, sometimes releases are unintentional, resulting from leaks, accidents, or natural hazards. This section focuses on accidental or unintentional releases. Deliberate sabotage or terrorism are not covered here; see instead *Section 9.3.1, Terrorism*.

During the past two decades or so, increasing attention has been given to hazardous materials releases resulting from natural disasters. The term "natech" (an abbreviation for "natural disaster that triggers a technological accident") is generally used to refer to such releases. As pointed out by various authors including Lindell and Perry (1996), Young, Balluz, and Malilay (2004), and Steinburg, Sengul, and Cruz (2008), natechs are of particular concern because:

- They may have a simultaneous effect on many industrial facilities, overwhelming the capacity for response.
- Mitigation measures may fail (e.g., an outer containment system constructed to contain a release from within may itself be damaged so badly that it allows the hazardous material to escape).
- There may be cascading disasters, resulting in a "domino effect" (e.g., a fire in one facility may cause an explosion in a neighboring facility, which in turn damages a third facility, and so on).
- Response personnel typically focus on search and rescue first and give attention to the presence of hazardous materials only secondarily, if at all.
- Response may be hindered by a disaster's impact on the physical environment (e.g., roadways may be cut or blocked; power lines and communication towers may be toppled).
- Determining the appropriate response may be difficult (e.g., it may not be obvious whether, following an earthquake, people should shelter in place for protection against a chemical release or be evacuated to avoid being harmed by aftershocks).

Profiling Hazardous Materials Release and Toxic Substance Hazards

Accidental hazardous materials releases occur many times during any given day. Most incidents are minor, but some do cause significant impacts such as injuries, evacuation, and the need for cleanup.

For example, in Roseville, California, on April 28, 1973, a railroad accident focused national attention on the hazards of munitions involved in fires. A hot brake shoe ignited the oak-wood floor of a Department of Defense boxcar carrying 250-pound bombs filled with Tritonal (TNT/aluminum). The bombs were being transported from the Naval

[308] Note that the term "toxic substance" is sometimes used interchangeably with "hazardous material." However, toxicity is only one of many characteristics that may cause a material to be hazardous. In this section, the more general term "hazardous material" will be used except where reference to toxicity in particular is intended.

Ammunition Depot in Hawthorne, Nevada, to the ship load-out port facility at the Naval Weapons Station in Concord, California. The train had just entered the yard in Roseville when a fire was observed coming from one of the boxcars. The fire department was summoned but, before they could act, a large explosion demolished a boxcar and spread the fire. Over a period of approximately 32 hours, 18 boxcars exploded in succession. The railroad yard was essentially destroyed.

Fortunately, no one was killed; however, later local newspaper reports suggest that about 100 people were injured. There was about $24 million in property damage to the railroad yard and the surroundings. The litigation that followed lasted for several years and cost the government millions of dollars.

For more information about the Roseville explosion, see: http://www.oesnews.com/month-cal-oes-history-1973-railroad-explosion/.

More recently, on August 6, 2012, following a leak and the subsequent ignition of diesel fuel, a series of explosions and fires occurred at Chevron's refinery in Richmond, California. Thousands of East Bay residents were ordered to stay in their homes (shelter in place) with the windows and doors closed. Fortunately, there were no fatalities, but one refinery worker suffered burns to his wrist and was treated at the onsite clinic.

Much of the knowledge about the occurrence and impacts of natechs is anecdotal, although information has been reported with greater regularity in recent years, especially in relation to events involving earthquakes and tsunamis. Precise data can be difficult to obtain, as company managers may be reluctant to divulge the nature and extent of releases. Table 9.R lists examples of what has been reported by various authors.

While not related to natechs, a recent release of methane gas in Aliso Canyon, California illustrates the vulnerabilities of gas storage and risk to residential areas.

Table 9.R: Examples of Hazardous Materials Releases Triggered by Natural Disasters

Date	Location	Disaster	Reported Releases of Hazardous Materials	Citation(s)
1964	Alaska	Earthquake (magnitude 9.2) and tsunamis	Standard Oil Company's storage tanks toppled; break in hose connections to tanker loading diesel fuel; fire; rail cars exploded; Texaco bulk oil storage yard ignited.	Lindell and Perry, 1996
1971	San Fernando	Earthquake (magnitude 6.6)	100 natural gas leaks responded to by fire departments; one-third caused fires; also 18 hazardous materials leaks, 12 of which caused fires.	Perkins and Wyatt, 1990; Lindell and Perry, 1996
1983	Coalinga	Earthquake (magnitude 6.7)	Many natural gas line breaks; at least nine hazardous materials releases, including a spill of strong acids and bases at a community college; one caused a fire.	Ibid.
1987	Whittier Narrows	Earthquake (magnitude 6.1)	1,411 natural gas line breaks, 3 of which caused fires; 30 hazardous materials releases.	Ibid.
1989	Loma Prieta	Earthquake (magnitude 6.7)	Hundreds of natural gas leaks; over 300 releases of hazardous materials, including asbestos.	Ibid.

Date	Location	Disaster	Reported Releases of Hazardous Materials	Citation(s)
1994	Northridge	Earthquake (magnitude 6.8)	More than 15,000 natural gas leaks; over 200 fires; hazardous materials problems at 134 locations; 60 incidents requiring offsite hazardous materials response; fires and hazardous materials releases at California State University (CSU) Northridge science laboratory complex.	Lindell and Perry, 1996; Lindell and Perry, 1997
1999	Kocaeli, Turkey	Earthquake (magnitude 7.4)	Eight percent of facilities handling hazardous materials suffered earthquake-triggered releases of hazardous materials.	Cruz and Steinberg, 2005
2002	Czech Republic	Floods	Release of over 400 kilograms of chlorine from Spolana Chemical Works Company at Neratovice, north of Prague.	European Commission, 2002; Cruz and Okada, 2008
2004	Sumatra, Indonesia	Earthquake (magnitude 9.1) and tsunami	Leakage of 8,000 cubic meters of oil from Pertamina oil depot in Banda Aceh.	UNEP, 2005; Cruz and Okada, 2008
2008	Sichuan (Wenchuan), China	Earthquake (magnitude 8.0)	Leaks of ammonia, sulphuric acid, and other substances; also fires and explosions.	Krausmann, Cruz, and Affeltranger, 2010
2011	Tohoku, Japan	Earthquake (magnitude 9.0) and tsunami	Extensive damage to facilities handling hazardous materials; several documented major fires, explosions, spills.	Krausmann and Cruz, 2013
2012	East Coast, United States	Superstorm Sandy (80 to 90 mile-per-hour winds and sea-levels more than 14 feet above normal)	Diesel spill at the Motiva Refinery in Sewarren, New Jersey; biodiesel spill at the Kinder Morgan terminal in Carteret, New Jersey; fuel oil spill at the Phillips 66 Refinery in Linden, New Jersey; and smaller spills throughout New Jersey and New York.	National Oceanic and Atmospheric Administration (NOAA)– Office of Response and Restoration, 2012
2013	Estancia, Philippines	Super Typhoon Haiyan (Yolanda)	850,000 liters of bunker oil leaked onto coastline near Estancia after tanker pushed ashore during typhoon. 1,042 families at risk.	World Health Organization, 2013

Source: Multiple sources listed in "References" Appendix P.

Public Health Concerns Related to Hazardous Materials Releases

Hazardous materials released during and following industrial accidents and natural disasters pose risks to first responders, the impacted community, and the environment. While many of these incidents may be of a localized nature, they can cause both short- and long-term health and environmental impacts. Recent California examples include the 2016 Aliso Canyon methane gas leak, which caused evacuation of nearby residents, many of whom experienced temporary health problems such as difficulty breathing and eye irritation; and the 2016 Fruitland metal recycle plant fire in Maywood, which released heavy metals such as lead, magnesium, copper, aluminum, antimony, calcium, iron, sulfur, tin, potassium, and zinc. Other chemicals including bromine and chlorine were also released during the Maywood fire. Health effects from exposure to these metals included short-term symptoms such as irritation to the eyes, nose, throat, and lungs. This incident prompted a notice regarding "Health Related Information for First Responders and Workers" to be issued jointly by the U.S. EPA and Los Angeles County, including the county public health and county fire departments.

Implications of Hazardous Materials Releases Resulting from Primary Hazard Events

Natural disasters, including earthquake, flood, and fire also pose risks to public health and the environment. For example, following the Northridge Earthquake, California State University (CSU) Northridge laboratories and chemical storage rooms experienced multiple chemical spills. Such incidents, triggered by a natural disaster, pose a significant risk to students, faculty, staff, and first responders. Any educational institution with a science lab might be at risk for a chemical spill leading to adverse health outcomes.

In a severe flood event, floodwaters are often contaminated with hazardous materials posing a threat to public and animal health, groundwater, and other parts of the environment. These hazardous materials may be released from damaged or flooded underground tank sites (e.g., gas stations or chemical storage facilities), propane tanks, manure or human waste handling facilities, fertilizer and pesticide storage, agricultural sites, and household hazardous waste.

Following the October 2017 Northern California firestorms, which destroyed approximately 6,000 residences and burned entire neighborhoods to the ground, public health concerns delayed the initial steps of fire recovery, including reopening burned areas to residents and initiating debris removal activities. As part of the daily fire briefings held in Sonoma and Napa Counties, residents were advised of the public health issues related to post-fire cleanup, specifically the dangers of coming into contact with toxic substances due to the presence of synthetic and hazardous materials. In Sonoma County, the Public Health Officer and Environmental Health Director issued a local health emergency proclamation for debris removal. A "toxic sweep" managed by CalEPA identified and removed hazardous materials from all burned residential properties.

Employers performing cleanup and other work in areas damaged or destroyed by fire are required to identify and evaluate these hazards, correct any unhealthful conditions and provide training to employees. For worker safety and health during fire cleanup, information provided by California Division of Safety and Health includes guidelines related to:

- Safety hazards (fire and fire byproducts, electricity, flammable gases, unstable structures, demolition, sharp or flying objects, excavations)
- Health hazards (carbon monoxide ash, soot and dust; asbestos; hazardous liquids; other hazardous substances; heat illness)
- Confinement hazards

Details can be found at http://www.dir.ca.gov/dosh/wildfire/Worker-Health-and-Safety-During-Fire-Cleanup.html.

Assessment of State Vulnerability and Potential Losses

There is no comprehensive statewide vulnerability assessment available at this time. Validated historical data on which to base a model of vulnerability and potential losses from natechs (for example) are scarce, although a PC-compatible diskette of nearly 400 hazardous materials problems in 32 past earthquakes, including over 150 problems

from the Loma Prieta Earthquake, was made available in 1990 by the Association of Bay Area Governments (ABAG). It is likely that many such hazardous materials releases have received little attention in the past because public authorities, the media, and the public have overlooked them in the rush to address and recover from immediate disaster threats.[309] Furthermore, responsible parties may have an incentive to understate the extent of releases or not to report them at all.

With regard to earthquakes, as pointed out by Lindell and Perry (1997), historically there appears to have been no correlation between earthquake magnitude and the number of earthquake-triggered hazardous materials releases reported. Such releases depend not only on event magnitude but also on soil conditions, the number and structural characteristics of hazardous materials facilities in the area, and the seismic resistance of building contents. Lindell and Perry point out that "the Northridge experience establishes that (releases) may occur even when structural damage is minimal or absent, which indicates that chemical containment systems are more fragile than the buildings in which they are housed."

Assessment of Local Vulnerability and Potential Losses

Information related to vulnerability and loss assessments for California communities may be found in Local Hazard Mitigation Plans.

Current Hazardous Materials Release and Toxic Substance Mitigation Efforts

Many federal and state laws regulate hazardous materials in terrestrial, aquatic, and atmospheric environments. At the federal level, these laws include (as amended) the Clean Air Act; the Occupational Safety and Health Act; the Clean Water Act; the Hazardous Materials Transportation Act; the Resource Conservation and Recovery Act; the Toxic Substances Control Act; the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund); and others. Brief descriptions of some of the most relevant federal and state legislative and regulatory provisions are provided below.

Emergency Planning and Community Right-to-Know Act

Title III of the federal Superfund Amendments and Reauthorization Act, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), was established to encourage and support emergency planning efforts at the state and local levels and to provide the public and local governments with information concerning potential chemical hazards present in their communities in the wake of the Bhopal Disaster in India in 1984. The 2013 explosion of a fertilizer plant in West Texas that killed 15 people (including 12 first responders), injured 100s, and demolished buildings within a five-block radius, serves as a reminder of the importance of EPCRA. There was a lack of knowledge within the first responder community and among the nearest neighbors about what was being stored at the West Texas facility. The U.S. Chemical Safety and Hazard Investigation Board investigation report can be found at: http://www.csb.gov/file.aspx?DocumentId=732.

The law requires facilities to furnish information about the quantities and health effects of chemicals that they use and to promptly notify local and state officials whenever a significant release of hazardous materials occurs. Broadly representative Local Emergency Planning Committees (LEPCs) have been appointed for each of six Emergency Planning Districts, which have the same boundaries as the Mutual Aid Regions. There is one LEPC for each of the more than 3,000 designated local emergency planning districts. Membership of these committees, at a minimum, must include elected officials; emergency services professionals; environment, transportation, and hospital officials; facility representatives; and representatives from community groups and the media.

In carrying out the community right-to-know requirements of EPCRA, the committees provide a forum for emergency management agencies, responders, industry and the public to work together to evaluate, understand, receive training on, coordinate, and communicate chemical hazards in the community and develop regional hazardous materials emergency plans. Local plans, developed with stakeholder participation, are reviewed annually and provide information about chemicals in the community to citizens, government agencies, and emergency

[309] Breslin, 1993; Young, Balluz, and Malilay, 2004

responders. For more information on LEPCs, visit: https://www.epa.gov/epcra/local-emergency-planning-committees and http://www.caloes.ca.gov/FireRescueSite/Pages/Local-Emergency-Planning-Committee.aspx.

California's Unified Program

California law established the Unified Program, which consolidates, coordinates, and makes consistent the administrative requirements, permits, inspections, and enforcement activities of the following environmental and emergency response programs: the Aboveground Petroleum Storage Act (APSA) Program, Area Plans for Hazardous Materials Emergencies, the California Accidental Release Prevention (CalARP) Program, the Hazardous Materials Release Response Plans and Inventories (Business Plans), Hazardous Material Management Plan (HMMP) and Hazardous Material Inventory Statement (HMIS) requirements (California Fire Code), the Hazardous Waste Generator and Onsite Hazardous Waste Treatment (tiered permitting) Programs, and the Underground Storage Tank Program.

The state agencies responsible for these programs include the California Environmental Protection Agency (CalEPA), the Department of Toxic Substances Control (DTSC), the California Governor's Office of Emergency Services (Cal OES), the CAL FIRE Office of the State Fire Marshal, and the State Water Resources Control Board. These agencies set the standards for their programs while local governments implement and enforce the standards. CalEPA oversees the implementation of the Unified Program as a whole (California Code of Regulations, Title 27, Division I, Subdivision 4, Chapter 1, Sections 15100-15620).

The Unified Program is implemented at the local level by government agencies certified by the Secretary of CalEPA. These Certified Unified Program Agencies (CUPAs) have typically been established as a function of a local environmental health or fire department. Some CUPAs also have contractual agreements with one or more other local agencies, "participating agencies" (PAs) that implement one or more program elements under the oversight of the CUPA. Members of the California CUPA Forum, a partnership between CUPAs and PAs, have established the Unified Program Administration Advisory Group (UPAAG). The UPAAG addresses policy decisions, education, and problem solving. The goals and objectives of the UPAAG are listed in the UPAAG Strategic Plan, available on the CalEPA web page: http://calepa.ca.gov/cupa/about/.

At the state level, Hazardous Materials Business Plans/Emergency Response Plans (California Health and Safety Code, Chapter 6.95) seek to prevent or minimize the damage to public health and safety and the environment from a release or threatened release of hazardous materials and to satisfy community right-to-know laws. This is accomplished by requiring businesses that handle hazardous materials in quantities equal to or greater than 55 gallons, 500 pounds, or 200 cubic feet of gas or extremely hazardous substances above the threshold planning quantity (40 Code of Federal Regulations [CFR], Part 355, Appendix A) to:

- Inventory their hazardous materials;
- Develop an emergency plan; and
- Implement a training program for employees.

Most hazardous materials facilities in the state are regulated by a Hazardous Materials Business Plan. The state contains many such the Cal OES Hazardous Materials Business Plan program, visit: http://www.caloes.ca.gov/cal-oes-divisions/fire-rescue/hazardous-materials/hazmat-business-plan.

Map 9.X shows locations of certified hazardous material teams in California.

Map 9.X: Certified Hazardous Materials Teams in California



California Accidental Release Prevention (CalARP) Program

The California Accidental Release Prevention (CalARP) Program is intended to prevent accidental releases of substances that can cause serious harm to the public and the environment, to minimize the damage if releases do occur, and to satisfy community right-to-know laws. This is accomplished by requiring businesses that handle more than a threshold quantity of a regulated substance listed in the regulations to develop a Risk Management Plan (RMP). An owner or operation or a stationary source that has more than a threshold quantity of a regulated substance (listed in Tables 1-3 of Title 19 Section 2770.5) in a process may have to complete and submit an RMP. An RMP is a detailed engineering analysis of the potential accident factors present at a business and the mitigation measures that can be implemented to reduce this accident potential. The RMP may address:

- Regulated substances held onsite at the stationary source
- Offsite consequences of an accidental release of a regulated substance
- The accident history at the stationary source
- The emergency response program for the stationary source
- Coordination with local emergency responders
- Hazard review or process hazard analysis
- Operating procedures at the stationary source
- Training of the stationary source's personnel
- Maintenance and mechanical integrity of the stationary sources physical plant
- Accident investigation

Various mitigation efforts relating to the transport of hazardous materials are required and implemented as the result of federal and state regulations. The CalARP Program ensures that businesses carry out mitigations required by federal and state regulations for transport of hazardous materials, including the following:

- Placards and labeling of containers
- Proper container established for material type
- Random inspections of transporters
- Safe-handling policies and procedures
- Hazard communications
- Training for handlers
- Permitting
- Transportation flow studies (e.g., restricting the transportation of hazardous materials over certain routes)

California's Source Reduction Requirement

California's Hazardous Waste Source Reduction and Management Review Act of 1989, also known as Senate Bill 14, requires hazardous waste generators to seriously consider source reduction as the preferred method of managing hazardous waste. Source reduction is preferable to recycling and treatment options because source reduction avoids waste generation costs and management liability. Source reduction also provides the best protection for public health and the environment. Facilities generating more than 12 kilograms of hazardous waste or 12 kilograms of extremely hazardous waste are required to do source reduction planning. Hazardous waste generators subject to Senate Bill 14 are required to prepare various documents, including a Source Reduction Evaluation Review and Plan.

Additional Hazardous Materials Release and Toxic Substance Hazard Mitigation Opportunities

Mitigating Natech Risks

Steinberg, Sengul, and Cruz (2008) have identified several approaches to mitigating the risks posed by natechs. Similar approaches may be used to mitigate hazardous materials risks more generally. The identified approaches are:

- Design criteria (e.g., more stringent building codes so that structures containing hazardous materials are better protected against earthquakes and other likely hazards)
- Chemical process and facility safety measures (e.g., consideration of potential natural disaster-triggered process failures in safety management and planning for chemical processing plants, required every five years by the U.S. Occupational Health and Safety Administration – 29 CFR Section 1910.119)
- Land use planning (e.g., restriction of development in high risk areas, relocation of exposed elements, etc.)
- Local hazard mitigation planning (e.g., consideration of natechs in Local Hazard Mitigation Plans)
- Adoption of sustainable industrial processes (e.g., substitution of less hazardous raw materials and intermediate products for those that are more hazardous)

The authors acknowledge that California is ahead of many other states in the extent to which action has already been taken to address natechs and other hazardous materials releases. For example, the CalARP Program, mentioned above, specifically requires industry to analyze seismic events in the hazard review. Nevertheless, it is evident that much more could be done in this area.

Refinery Safety

Following the 2012 fire at Chevron's Richmond refinery, an Interagency Working Group on Refinery Safety was formed, composed of 13 state agencies and departments and the Governor's office. The working group met over eight months to examine ways to improve public and worker safety through enhanced oversight of refineries, and to strengthen emergency preparedness in anticipation of any future incident. Regular internal meetings were informed by meetings with a wide variety of stakeholders, including those from industry, labor, community and environmental groups, academic institutions, and local emergency response units. The working group's draft report, issued in July 2013, includes an assessment of the current state of refinery safety with input from stakeholders, a study by the RAND Corporation, and findings by the Division of Occupational Safety and Health (Cal/OSHA), the U.S. Chemical Safety Board, and Chevron's own internal investigation. As of 2017, two significant regulations regarding refinery safety have been changed: 1) the California Accidental Release Prevention (CalARP) Program administered through the California Governor's Office of Emergency Services (Cal OES), and 2) the Process Safety Management (PSM) regulations administered through Cal/OSHA, within the Department of Industrial Relations (DIR). The PSM regulations are largely focused on minimizing risks to employees, and the CalARP Program is designed to protect the safety and health of the community.

Recommendations of the working group most relevant to mitigation include 1) the creation of an Interagency Refinery Task Force, housed within CalEPA, to coordinate agencies' activities and carry out the recommended actions; 2) the strengthening of existing regulations, and the development of new regulations and practices to address the underlying causes of safety problems, including but not limited to creating inherently safer systems requiring periodic assessments of safety culture, completing root-cause analysis after significant accidents or releases, and accounting for "human factors" to manage and reduce error; and 3) enhanced enforcement and increased worker involvement in improving the methods and culture of safety at refineries.

The Interagency Refinery Task Force has since been established and met for the first time in August 2013. Although initially it will address safety issues relating to refineries, members have agreed that its focus should subsequently be expanded to other high risk facilities, including but not limited to those covered by the CalARP Program.

Other Opportunities

There are many other opportunities for enhanced mitigation of hazardous materials releases in California. Increased research into the potential risks associated with various hazardous materials, coupled with greater public awareness, may lead to additional regulatory requirements and personal choices regarding the use of certain chemicals and other substances identified as potentially harmful themselves or manufactured from (or using) other materials that are hazardous.

Product designers often have opportunities to minimize impacts on human health and the environment long before products reach the marketplace. California's proposed Safer Consumer Products Regulation, nearing adoption at the time of this writing, would create a predictable process for reducing toxic ingredients in products. In its simplest terms, the regulation would require manufacturers whose consumer product contains a toxic ingredient to ask: "Is this ingredient necessary? Is there a safer alternative? Is that alternative ingredient feasible?" In addition, by listing the chemicals that the State of California will be examining in consumer products, the regulation would give manufacturers the opportunity to "design out" the use of those chemicals ahead of time.

9.2.2 OIL SPILLS

Identifying Oil Spill Hazards

An oil spill is a release of liquid petroleum into the environment due to human activity that results in pollution of land, water, and air. Oil releases also occur naturally through oil seeps either on land or under water. Oil spills can result from the release of crude oil from offshore oil platforms, drilling rigs, wells, pipelines, tank trucks, and marine tank vessels (tankers). Refined petroleum products such as gasoline, diesel, and heavier fuels such as bunker fuel used by cargo ships are also sources of potential oil spill releases. According to NOAA, oil spills can be caused by people making mistakes or being careless, by equipment breaking down, by natural disasters, and by deliberate acts of terrorism, vandals, or illegal dumpers.[310]

During and oil spill, the oil floats on saltwater and often floats on freshwater. Depending on the type of oil, oil can sink in freshwater but usually, oil spreads out across a large area and is called an oil slick. As the oil slick spreads and convers a larger area, it becomes thinner and is called an oil sheen.[311] Depending on the origin, size, and duration of the release, an oil spill can have serious impacts on air and water quality, public health, plant and animal habitat, and biological resources. Spill clean-up and remediation activities may cost millions of dollars and impacts can last for years. The California Department of Fish and Wildlife Office of Spill Prevention and Response (OSPR) (Oiled Wildlife Division) treats countless thousands of oiled birds and other wildlife annually. Oil slicks and spills (as well as naturally occurring oil plumes) have a devastating impact on wildlife. Together with University of California Davis, the OSPR operates the Oiled Wildlife Care Network, which works to identify wildlife impacts and wildlife response needs.[312]

In 2014, OSPR's mission was expanded by Governor Brown to cover all state surface water at risk to oil spills from any source. These sources may include pipelines, production facilities, and shipments of oil transported by railroads.[313] The mission of the OSPR is to provide best achievable protection of California's natural resources by preventing, preparing for, and responding to spills of oil and other deleterious materials, and by restoring and enhancing affected resources. OSPR staff participated in Deepwater Horizon oil spill among many others. For more information about the OSPR, visit: http://www.dfg.ca.gov/ospr/.

The environmental impacts of oil spills contribute to short- and long-term effects on economic activities in the affected areas. Moratoriums may be temporarily imposed on fisheries, and tourism may decline in beach communities, resulting in economic hardship on individuals dependent on those industries for their livelihood and on the economic health of the community as well.

Profiling Oil Spill Hazards

The complex array of petroleum-related industries and distribution networks throughout California makes the majority of the state vulnerable to oil spills. As of early 2018, there are 26 production platforms, 1 processing platform, and 6 artificial oil and gas production islands located in the waters offshore of California. Of the 27 platforms, 4 are located in state waters offshore of Santa Barbara and Orange Counties, and 23 are located in federal waters offshore of Santa Barbara, Ventura, and Los Angeles Counties. There are 31 marine terminals in state waters and numerous land-based oil production, transportation, and storage facilities. In 2017, it was announced that that Platform Holly, located offshore of Santa Barbara County, will be dismantled and will be the first to be removed in over 20 years, leaving 26 offshore oil platforms remaining offshore of California (source). An executive order issued by President Trump in April 2017 mandates the United States Secretary of the Interior and cabinet members to review federal rules and regulations regarding offshore oil drilling. This action could open areas off the coast of California to drilling, increasing the oil spill risk.

[310] https://response.restoration.noaa.gov/training-and-education/education-students-and-teachers/how-do-spills-happen.html
[311] https://response.restoration.noaa.gov/training-and-education/education-students-and-teachers/how-do-spills-happen.html
[312] https://www.wildlife.ca.gov/OSPR/About
[313] https://www.wildlife.ca.gov/OSPR/About

The platforms and artificial islands off California each have multiple wells, the number of which varies from fewer than 10 to more than 50. The amount of oil produced by each structure varies from a few hundred to more than 20,000 barrels per day. According to the California Division of Oil, Gas, and Geothermal Resources (DOGGR), a total of 28 counties in California produce oil, and offshore oil production accounts for 16.3 percent of the state's total production.[314]

Platforms in federal waters are regulated by the U.S. Department of the Interior's Minerals Management Service (MMS). Facilities located in state waters less than 3 nautical miles from shore are regulated by the California State Lands Commission and the DOGGR, which under the jurisdiction of the California Department of Conservation. As of 2017, the DOGGR was updating its Renewal Plan for Oil and Gas Regulation. The first Renewal Plan was released in 2015, and the update will highlight the DOGGR's progress in the regulatory overhaul of California's oil and gas industry. More information on the Renewal Plan can be found at: http://www.conservation.ca.gov/dog/Documents/renewal-plan2017-onesheet.pdf.

A report prepared by the now dissolved U.S. Department of the Interior MMS in 2003 states that "based on the amount of offshore oil expected to be produced in California over the next 28 years and the number of spills that have occurred in the past, the risk of a spill of 1,000 bbl (oil barrel unit) or greater occurring during that period is estimated at 41.2 percent for federal operations and 8.4 percent for state operations."

Under the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, the State Lands Commission exercises oversight for the prevention of oil spills from offshore oil platforms and onshore and offshore marine oil terminals. At these marine facilities, large oceangoing tank vessels and smaller barges transfer oil between shore and the tank vessel. Due to numerous interfaces and interactions, there is great propensity for human-caused oil spills, fire, and/or explosion. Government Code Section 8670.28 requires the operator of each marine facility to conduct hazard and operability studies to identify hazards associated with operations of the facility, due to operating error (organizational factors), equipment failure, and external events like natech (a natural disaster that triggers a technological accident). These studies form the basis for permitted operations of oil production, handling, transportation, and preparedness for contingencies.

The DOGGR maintains data sets on the number, location, owner/operator, lease, and other characteristics of oil and gas wells. As of 2017, the data catalog has information on nearly 190,000 oil, geothermal, and gas wells in California.

The following is a discussion of historic oil spills that have either occurred in California or have contributed to environmental legislation and regulatory requirements for the oil industry. A summary of significant oil spills is included in Table 9.S at the end of this section.

Kern County

Known as the Lakeville Gusher, this incident involved an oil well that blew out on March 15, 1910. The oil well was being drilled at 2,440 feet below the surface in Kern County between the towns of Taft and Maricopa. The well was drilled into a high-pressure oil-bearing zone. The uncontained oil blew much of the steel casing out of the well and resulted in an estimated 9 million barrels of crude oil pouring from the ground. This was considered the largest documented oil spill in history and has only recently been surpassed by the Deepwater Horizon Oil Spill in the Gulf of Mexico.

To mitigate the spread of oil, workers circled the well with sandbags and built an earthen dam 20 feet high and 50 feet thick in the canyon mouths above the well to prevent flash flooding from further dispersing the oil. The well ultimately caved in and sealed itself on September 9, 1911, nearly 18 months after it blew. The site is designated as California Historical Landmark Number 485.

[314] http://www.conservation.ca.gov/dog/Pages/statistics.aspx#2004_offshore_production

Santa Barbara

In 1953, Congress enacted legislation authorizing the federal leasing of submerged Outer Continental Shelf (OCS) lands. The first lease sale was conducted in 1966 and resulted in the installation of the first platform in federal waters offshore of Santa Barbara County in 1967. Additional lease sales were conducted the following year; in September 1968, Union Oil Platform A was installed in 188 feet of water approximately 5 miles offshore of Summerland. By January 1969, four wells had been drilled and work began on a fifth well. Union Oil asked the U.S. Geological Survey to waive various well casing requirements and the waiver was approved.

Drilling began on January 14 and continued for two weeks until January 28 when drilling was halted for evaluation and maintenance. Pressure built up in the 3,500-foot-deep well as a pipe was being extracted. A burst of natural gas blew out the drilling mud that was being pumped into the well, split the steel casing, and caused cracks to form in the sea floor surrounding the well. The large volume of oil and gas being released caused a "blowout" of the well, releasing approximately three million gallons of oil over an 11-day period. Workers pumped chemical mud down the 3,500-foot shaft at a rate of 1,500 barrels an hour. It was then topped by a cement plug. Although capped, gas continued to escape and another leak sprung up weeks later, releasing oil for several more months. Union Oil drilled a relief well and pumped cement into a leaking well bore, thereby killing it. However, small amounts of oil continue to leak from fractures in the sea floor to this day. Platform A is still in operation.

The cause of the blowout and spill was attributed to the inadequate protective casing allowed by the U.S. Geological Survey waiver. Investigators postulated that more steel pipe sheathing inside the drilling hole would have prevented the rupture.

The incident received international attention and was a major catalyst in the development of modern environmental law in the United States. The spill influenced the passage of major state and federal legislation, such as the National Environmental Policy Act (NEPA), Clean Water Act, California Environmental Quality Act (CEQA), California Coastal Initiative in 1972 (Proposition 20), and California Coastal Act of 1976. Pursuant to these and other statutes, development permits for onshore or offshore oil and gas facilities cannot be issued without provisions to protect terrestrial, marine, visual, recreational, and air resources.

Exxon Valdez

Although the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska did not directly affect the California environment or economy, it is significant for several reasons. First, it highlights the interconnectivity of oil production and distribution systems. The Exxon Valdez was en route from the Alyeska Pipeline Terminal to Long Beach, California when it ran aground, rupturing 8 of the 11 cargo tanks holding crude oil. Secondly, although in size the spill is no longer listed in the top 50 international oil spills, it is still considered to be one of the largest in terms of environmental damage. Finally, because of the environmental impacts, the Exxon Valdez oil spill resulted in landmark environmental legislation and more rigorous oil industry regulations.

American Trader

On February 7, 1990, off Huntington Beach, California, the oil tanker American Trader ran over its anchor, puncturing its hull and spilling an estimated 416,598 gallons of crude oil. An estimated 3,400 birds and an unknown number of fish were killed, and recreational beach use was seriously disrupted. The biological component of the resulting litigation was settled out of court for $3.45 million for bird- and fish-related injuries, plus an additional $360,000 for water monitoring projects, while the recreational component was eventually settled, following a jury trial, for $11.6 million. For more information, visit: https://www.wildlife.ca.gov/OSPR/NRDA/american-trader.

Guadalupe Dunes

The Guadalupe Dunes oil spill typifies another variety of oil spill that can occur in California. The Guadalupe-Nipomo Dunes, located along the southern coast of San Luis Obispo County, is one of the largest dune complexes along the California coast, measuring approximately 15,500 acres.

Oil exploration and production began in the area in the late 1940s. By 1953, Unocal Corporation was producing up to 2,000 barrels of oil per day from 34 wells. Oil field operations continued until March 1990 with gradual expansion to 215 wells producing approximately 4,500 barrels per day. Because of the highly viscous nature of the oil being extracted from the field, diluent (a diesel-like crude oil thinner) was introduced in the 1950s to assist in the production and transportation of the heavy crude. A 145-mile network of pipelines was built across the dunes to carry the diluent. Over the years, the pipelines rusted and became buried in the shifting sands, where they sprang leaks in 80 to 90 places, releasing as much as 12 million gallons of diluent into the dunes, beach, groundwater, and the Pacific Ocean.

The spill came to the attention of state officials when an oily sheen was noticed by surfers and sea lions and seals began washing up dead on the shore. On March 23, 1994, a lawsuit was filed by the California State Attorney General, the California Department of Fish and Wildlife, the California Regional Water Quality Control Board Central Coast Region, the California Department of Toxic Substances Control, and the Coastal Conservancy against Union Oil Company of California. The state plaintiffs alleged in this action that on numerous occasions since Unocal began using diluent at the Guadalupe oil fields, oil had leaked from the pipelines and storage tanks at numerous locations into the groundwater, surface water, and marine water. An agreement was reached between the parties in July 1998, for $43,800,000, of which $9 million was allocated for dune restoration activities. Six state and federal agencies now oversee the cleanup activities. Unocal has dismantled and removed the pipelines, storage tanks, and other infrastructure related to the oil field operations.

Cosco Busan

This San Francisco oil spill occurred on November 7, 2007, as a result of a container ship, the M/V Cosco Busan, striking the fender surrounding a footing of the western span of the San Francisco Bay Bridge. The collision caused no substantial damage to the bridge and the ship hull ruptured, causing medium-grade fuel oil to leak from its tank. Unlike oil tankers, container and cargo ships are not required to have double hulls, a regulation that was adopted following the Exxon Valdez oil spill discussed earlier.

Numerous local jurisdictions border the bayfront coastline and were affected by the oil spill. Local proclamations were issued by the counties of Alameda, Contra Costa, Marin, San Francisco, San Mateo, Solano, and Sonoma; the cities of Albany, Berkeley, and Oakland; and the East Bay Regional Park District. The Governor's proclamation covered the City and County of San Francisco and the counties of Alameda, Contra Costa, Marin, San Mateo, Solano, and Sonoma. The incident period for the event closed nearly one year following the oil spill on October 31, 2008.

Numerous state and federal agencies were involved in the oil spill response, cleanup, and subsequent investigations, including the United States Coast Guard (USCG), California Department of Fish and Wildlife Office of Oil Spill Prevention and Response (OSPR), and California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA). The 226 identified affected shoreline sites were ranked based on spill specifics such as the location of the release, nature of the release, volume of the release, and other established criteria. (For details on the oil spill response organization and activities, please see the Cosco Busan San Francisco Bay Area Oil Spill After Action/Corrective Action Report published by the California Emergency Management Agency, now Cal OES.)

Two new response and cleanup initiatives were developed as a result of this oil spill: the Department of Fish and Wildlife developed Shoreline Cleanup and Assessment Techniques (SCAT) teams to oversee beach and shoreline cleanup, and, OSPR has taken a lead role in expanding its convergent volunteer program to include opportunities outside of wildlife rehabilitation.

Gulf of Mexico

The Deepwater Horizon oil spill occurred in the Gulf of Mexico on April 20, 2010, as a result of an explosion that killed 11 platform workers and injured 17 others. It is the largest offshore marine oil spill in United States history. After releasing approximately 4.9 million barrels of crude oil, the leak was stopped by capping the wellhead. The spill caused extensive damage to marine and wildlife habitats as well as the Gulf's fishing and tourism industries.

While a six-month moratorium on offshore drilling was imposed after the explosion, the moratorium was lifted shortly thereafter by the United States District Court. Investigations into the causes of the explosion and spill were conducted by the United States Coast Guard (USCG), Minerals Management Service (MMS), National Academy of Engineering, National Commission on the BP Deepwater Oil Spill and Offshore Drilling, United States House Committee on Energy and Commerce, and others.

Table 9.S: Summary of California and Other Significant Oil Spills

Spill	Date	Area Affected	Estimated Amount	Wildlife Impacts (including estimated deaths)	Estimated Costs
Lakeville Gusher - Kern County	May 14, 1910–September 1911	Not available	378,000,000 gallons (9,000,000 barrels)	Unknown	Unknown
Santa Barbara	January 28, 1969–February 8, 1969	35 miles mainland coastline;800-square mile slick	3,000,000 gallons (102,620 barrels)	3,600 birds, seals, dolphins, fish, intertidal invertebrates	$17 million in lawsuit settlements for property damage
Exxon Valdez	March 24, 1989	1,300 miles of shoreline	11,000,000 gallons (257,000 barrels)	250,000 seabirds, 2,800 sea otters, 300 harbor seals, 250 bald eagles,33 killer whales, billions of salmon and herring eggs	$2.1 billion for clean-up by Exxon
American Trader	February 7, 1990	About 13 miles of coastline plus offshore area	416,598 gallons	3,400 birds; fish	$3.45 million settlement for bird and fish-related injuries; $360,000 for water monitoring projects; $11.6 million for recreational damage
Guadalupe Oil Field - San Luis Obispo	1950s–1994	2,700 acres	9,000,000-12,000,000 gallons (212,570 barrels)	Soil and water contamination; impacts on dune habitat, wetlands, groundwater, intertidal habitat	$44 million in penalties to Unocal, including $9 million for restoration
Cosco Busan - San Francisco Bay	November 7, 2007	200 miles of coastline	58,000 gallons (1,375 barrels)	2,225 birds, seals, herring eggs	$2.1 million for ship damage, $1.5 million for bridge damage, $70 million for cleanup
Deepwater Horizon - Gulf of Mexico	April 20, 2010–July 15, 2010	2,500-square-mile slick	180,000,000 gallons (4,900,000 barrels)	4,642 birds, 540 sea turtles, 75 mammals, (as of August 22, 2010)	To be determined; $20 billion response fund established by BP
Refugio Oil Spill – Plains All America Pipeline	May 19, 2015	Approximately 7 miles of coastline	123,000 gallons	202 birds, primarily brown pelican, common murre, and Pacific loon; 99 mammals, primarily California sea lion	$150 million in cleanup cost

Source: Multiple sources listed in "References" Appendix P.

Refugio

On May 19, 2015, a 24-inch subterranean pipeline owned and operated by Plains All America Pipeline ruptured on the Gaviota Coast, west of Refugio State Park. Much of the crude oil spilled ran down a storm drain and into a ravine under the freeway and entered the ocean. The size of the spill ranged from 100,000 to 140,000 gallons, covering the Santa Barbara County coastline and extending nearly 9 miles out into the ocean. Various agencies, including local, county, state, and federal partners, were involved in response and recovery efforts, with the participation of approximately 1,300 field and 325 incident command post personnel. Notifications from the county to state and federal partners were aligned with the Santa Barbara Operational Area Oil Spill Contingency Plan and Los Angeles-Long Beach Area Contingency Plan. The incident command post remained operational for the first 13 days of the incident.

Interagency field teams conducted a National Resource Damage Assessment to document dead fish, invertebrates, and other wildlife in the oiled areas following the spill. NOAA and its state and federal natural resource co-trustees investigated the extent to which the incident may have caused harm to birds (brown pelicans, common murres, Pacific loons, snowy plovers), marine mammals (including California sea lions), fish (especially surf perch and grunion), and marine invertebrates along with their habitats. The spill also shut down fisheries, closed multiple beaches, and affected recreational uses such as camping, non-commercial fishing, and beach visits.

Nearly one year after the spill, Plains All America Pipeline was indicted by the Santa Barbara County grand jury on 46 criminal counts related to the spill, after which the county filed criminal charges. Another three years elapsed before the trial date was set for February 5, 2018, with jury selection beginning in April 2018. The outcome of the trial will not be known for several months.

Three bills were signed into law in response to the spill. Under a new law, the California Fire Marshal will be required to review the oil pipelines conditions every year, while federal regulations only mandate a review every five years. Another new law provides for making oil spill response times faster and more effective. The third will force intrastate pipelines to use the best-known technology such as automatic shut-off valves.

Assessment of State Vulnerability and Potential Loss to Oil Spill Hazards

In his testimony to the U.S. House of Representatives Natural Resources Committee on May 27, 2010, California Congressman John Garamendi stated that the coastal environment of California provides $22 billion in annual economic activity and employs 369,000 people. According to the California Ocean Protection Council (OPC), California's ocean economy is valued at more than $40 billion per year and supports a multi-billion-dollar tourist industry. This is in addition to the immeasurable wealth and value that are difficult to quantify relative to the coastal environmental assets, including land, water, wildlife, and habitat. While even a catastrophic oil spill such as the recent Deepwater Horizon explosion and spill in the Gulf of Mexico would affect only a portion of these economical and aesthetic assets, the potential impacts could be sizeable and long-lasting.

Current Oil Spill Hazard Mitigation Efforts

The 1969 oil spill off the coast of Santa Barbara was a pivotal event in the history of offshore oil safety. Since 1969, a number of preventive measures have been initiated, including stringent regulations covering OCS operational and environmental safety, a rigorous MMS inspection program in the Pacific OCS Region, continuous evaluation, and improvement in OCS facilities' oil spill response, and the development of a highly organized oil spill response structure.

Following the Exxon Valdez oil spill in Alaska in 1989, both the United States and California governments enacted laws to prevent oil spills. The International Safety Management Code, enforced since 1998, requires ships entering U.S. ports to meet certain standards, including procedures for reporting accidents and requiring qualified crew. In 1990, the U.S. enacted the Oil Pollution Act, which requires that oil tankers be double-hulled and that existing single-hull tankers be phased out (see: https://www.epa.gov/laws-regulations/summary-oil-pollution-act). A double hull further protects a ship from damage to its cargo tank, reducing the risk of oil spilling during an accident. California

enacted the Lempert-Keene Seastrand Oil Spill Prevention and Response Act in 1990, which established the Office of Spill Prevention and Response (OSPR) within the (now) California Department of Fish and Wildlife (see: https://www.wildlife.ca.gov/OSPR). The OSPR is authorized to direct spill response, cleanup, and natural resource damage assessment activities, as well as regulate all private vessels over 300 gross tons (672,000 pounds) that enter California ports. The act also gave oversight of all marine oil terminals in the state to the California State Lands Commission, with the mandate to protect the public health, safety, and the environment by preventing spills at these facilities.

The OSPR also is tasked with preparation of the California State Oil Spill Contingency Plan. The latest (2017) version of this plan addresses discharges of oil to all marine or inland surface waterways of California and spills on land. State and local agencies must carry out spill response activities consistent with this plan and other applicable federal, state, or local spill response plans.

Non-tanker vessels (like the container ship that spilled oil in San Francisco) have their own regulations, which are less stringent than those for tanker vessels. California requires a Non-Tank Vessel Contingency Plan and Certificate of Financial Responsibility, which means vessels must prove to the OSPR that they have a plan in case of an oil spill and that they carry an insurance policy to cover the cost of a spill. Non-tank vessels over 300 gross tons must carry $300 million of insurance, while the requirement for tanker vessels is $1 billion.

The State Lands Commission has prevention programs for exercising the oversight at all oil platforms and oil terminals under the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act. Under the authority of this act, the State Lands Commission exercises oversight over the oil production operation on oil platforms and oil transfer operations between the ships and the shore. Each production activity generates its risk to the public and the environment. The State Lands Commission is charged with oversight responsibility under the act. The oversight is exercised by the Commission staff on oil production work, to ensure adequate precautions are taken by industry. This is done through a comprehensive regulatory framework of performance standards. The Commission staff periodically inspects and regularly monitors the operations at oil platforms and in marine oil terminals for conformance to performance standards.

Oil Spill Response Plans and Procedures

Local Marine Oil Spill Contingency Plans

Local Marine Oil Spill Contingency Plans are developed by local governments that have marine waters within their borders. A local government may develop or update a Local Oil Spill Contingency Plan, consistent with state policy, as a supplement to its Area Plan. Although not required, most local governments have undertaken this planning process.

Harbor Safety Plans

Harbor Safety Plans are created pursuant to California Government Code Section 8670.23.1. Harbor Safety Committees were created in each of the major active port areas in the state to address oil spill prevention issues in those regions. The plans created by the committees are designed to ensure safe navigation and operation of vessels within each harbor. The California Department of Fish and Wildlife Office of Spill Prevention and Response (OSPR) is charged for developing regulations for the plans, which are found in 14 California Code of Regulations (CCR) Section 802.

Region IX Mainland Regional Contingency Plan

The Region IX Mainland Regional Contingency Plan is designed to coordinate timely and effective responses by various federal and state agencies and other organizations to discharges of oil and releases of hazardous substances, pollutants, and contaminants to protect public health, welfare, and the environment. It is meant to ensure that the roles and responsibilities of federal, state, local, and other responders are clearly defined. The plan also describes the Regional Response Team (RRT) organization and its relationship to other contingency plans. The RRT oversees the response operations and removal and remedial actions for hazardous substances, the use of chemical countermeasures such as dispersants and surface washing agents, state-specific response information, notification

procedures, and natural resource trustee contacts. The Region IX Mainland Regional Contingency Plan is supplemented by marine area plans and inland sub-area plans, which provide detailed information on areas of environmental or special economic importance. The plan also identifies the minimum components of an Inland Area Contingency Plan that best support first responders. (See discussion of marine and inland area planning below.)

Marine Contingency Plans
Marine Contingency Plans are required by Section 311(j) of the federal Clean Water Act. They are developed and maintained by Area Committees comprised of qualified personnel of federal, state, and local agencies. Area Committees, under the direction of a Federal On-Scene Coordinator, are responsible for preparing Marine Contingency Plans as described in National Contingency Plan (NCP) Section 300.210(c). Although Area Plans are "owned" by their Area Committees, the lead federal agency for marine area plans is the United States Coast Guard (USCG) and for inland area plans it is the U.S. Environmental Protection Agency (EPA). Area Committees are also responsible for working with appropriate federal, state, and local officials to enhance the contingency planning of those officials and to assure pre-planning of joint response efforts.

In California, there are six geographical marine areas and Area Committees along the coast and three Area Contingency Plans. Each Area Committee, chaired by the USCG and co-chaired by the OSPR, is comprised of a diverse group of participants from federal, state, and local agencies with expertise in environmental and response issues, as well as industry representatives and special interest groups.

Inland Geographic Response Plans
Inland Geographic Response Plans are updated and developed by the OSPR in collaboration with other federal, state, and local government, industry, and other partners for priority inland waters of the state with high oil spill risk. Inland Geographic Response Plans are also vetted through regional Local Emergency Planning Committees (LEPCs) that are made up of industry representatives; federal, state, and local government agencies; public health agencies; tribal representatives; and other stakeholders.

The California Oil Spill Contingency Plan
The California Oil Spill Contingency Plan is the state oil spill and marine oil spill contingency plan required pursuant to California Government Code Sections 8574.1 and 8574.7. The OSPR combined the California State Oil Spill Contingency Plan and the Marine Oil Spill Contingency Plan into one plan.
The latest 2017 version is available from the OSPR website at: https://www.wildlife.ca.gov/OSPR/Contingency

National Oil, Hazardous Substances, Pollutants, and Contaminants Contingency Plan
The National Oil, Hazardous Substances, Pollutants, and Contaminants Contingency Plan (NCP) is the nation's main hazardous materials emergency response plan. It is promulgated in Title 40, CFR, Part 300. The NCP is designed to provide for efficient, coordinated, and effective action to minimize adverse impact from oil discharges and hazardous substance releases. The NCP contains the national response strategy that provides the framework for notification, communication, logistics, and responsibility for response to discharges of oil, including worst-case discharges, and discharges that pose a substantial threat to the public health or welfare of the United States. The NCP is supported by the Region IX Regional Contingency Plan and Marine and Inland Area Contingency Plans.

Industry Contingency Plans – Marine and Inland
Effective September 2015, emergency regulations governing the development of oil spill contingency plans and financial responsibility for inland facilities, pipelines, refineries, and railroads became effective. Industry members affected by the regulations had until January 2016 to submit facility contingency plans and Certificates of Financial Responsibility to ensure compliance with inland regulations.

Oil Spill Technical Advisory Committee (TAC)

The Oil Spill Technical Advisory Committee (TAC) was established to provide public input and independent judgment of the actions of the OSPR Administrator. The TAC consists of 14 appointed members, 8 of whom are appointed by

the Governor, 3 by the Speaker of the Assembly, and 3 by the Senate Rules Committee. These appointees must have experience, knowledge, and expertise in the following areas:

- Public representation
- Marine transportation
- Local government
- State government
- Petroleum industry
- Oil spill response and prevention programs
- Environmental protection and the study of ecosystems
- Dry cargo vessel
- Railroad
- Oil production

The TAC meets as often as necessary, but at least twice a year. The TAC has the following responsibilities:

- The TAC provides recommendations to the OSPR Office of the Administrator, State Lands Commission, California Coastal Commission, San Francisco Bay Conservation and Development Commission, the DOGGR, Office of the State Fire Marshal, and California Public Utilities Commission on any provision of the act, including the promulgation of rules, regulations and policies according to Government Code Section 8670.54-8670.56.1.
- The TAC may study, comment, or evaluate any aspect of oil spill prevention and response in the state, coordinated with ongoing studies by the federal government, the OSPR Administrator, State Lands Commission, State Water Resources Control Board (SWRCB), and other state and international entities.
- The TAC may attend any drills, or any oil spills pursuant to Government Code Section 8670.10
- The TAC reports biennially to the Governor and the Legislature on its evaluation of oil spill response and preparedness programs within California. It may prepare and send any additional reports it determines to be appropriate to the Governor and the Legislature.

Progress Summary 9.L: Management and Control of Risks in Marine Oil Transportation System

Progress as of 2018: Tank ships calling at California ports must comply with the International Safety Management Code (ISM Code) in accordance with the international regulations in Chapter 9 of the International Maritime Organization's Safety of Life at Sea Conventions. The ISM Code requires ship operators to ensure that tank ships comply with the international regulation. The ISM Code requires ship owners to have an effective safety management system that addresses systemic risks attributable to catastrophic oil spills, petroleum fires, and/or explosions when ships are berthed at marine terminals. In accordance with Title 2, California Code of Regulations, Section 2340(c)(19), operators of marine terminals must verify that tank ships are compliant.

The international regulations do not apply to domestic tank barges. The tank barges are now required by the United States Coast Guard to manage systemic risks and demonstrate compliance with 46 Code of Federal Regulations (CFR) Subchapter M, Parts 136-144. This federal regulation requires tank barges owners to adopt and show compliance with a Towing Vessel Safety Management System. During oil transfer, the terminal and the ship or barge must form a temporary unified system for safe conduct of oil cargo operations.

There is no equivalent regulatory requirement for shoreside marine oil terminals, where ships and barges berth to transfer petroleum products and crude oil. This is a residual risk in the maritime oil transportation system.

The 2015-2020 Strategic Plan of the California State Lands Commission (Strategy 1.5) has a goal that requires the commission staff to develop regulatory requirements for identifying systemic risks at marine oil terminals in California ports. In 2017, the safety management system is the best achievable technology for controlling and mitigating systemic risks in marine oil terminals. The Oil Companies International Marine Forum developed guidelines ("Marine Terminal Management and Self-Assessment") as an industry initiative to control systemic risks. These guidelines have a four-stage maturity model for organizational development and control of risks.

Additional Opportunities for Oil Spill Hazard Mitigation

Oil Spill Prevention – Loss of Containment

West Coast Ocean Protection Act

In response to the Deepwater Horizon oil spill in the Gulf of Mexico in 2010, Senators Barbara Boxer and Dianne Feinstein from California joined senators from Oregon and Washington to introduce a bill known as the West Coast Ocean Protection Act that would prohibit offshore oil and gas drilling off the West Coast of the United States. The bill was a companion to a House bill introduced by California Representative John Garamendi. The 2010 bills were not enacted; however, after another unsuccessful attempt in 2011, Senators Boxer and Feinstein re-introduced their bill once again in 2013. The 2013 bill was again not enacted, but Senator Feinstein re-introduced the bill once again in 2017. The bill is a companion to a House bill introduced by California Representative Jared Huffman. In 2017, the West Coast Ocean Protection Act was reintroduced in the Senate to amend the Outer Continental Shelf Lands Act to prohibit the Bureau of Ocean Energy Management from issuing a lease for exploration, development, or production of natural gas in any area of the Outer Continental Shelf, specifically in California, Oregon, or Washington. The bill has been referred to the Committee on Energy and Natural Resources. For more information, visit: https://www.congress.gov/bill/115th-congress/senate-bill/31/all-info.

The future of mitigation efforts in preventing catastrophic oil spills lies in the oil industry adopting systems safety approaches to build a culture of safety, which in turn would build organizational resilience to withstand and manage these catastrophic events. The systems safety approach balances production goals with public expectation of risk management as a result of that production. It encompasses managing the socio-technical risks at the interfaces of human beings, organization, and engineered systems. In the recommendations of the Deepwater Horizon incident of April 2010, the National Academy of Engineers and the National Research Council (Recommendation 5.5) stated that "…Industry should foster an effective safety culture through consistent training, adherence to principles of human factors, system safety, and continued measurement through leading indicators."

Removal of Structures from the Surf Zone

The surf zone along the coastline of Santa Barbara and Ventura Counties contains many hazards that are caused by the remnants of past oil and gas development and/or are the result of development along the coastline. These hazards consist of old oil pier remnants, H-beam piles, and old oil well caissons. The remnants are generally sharp, protruding spikes that can cause severe injury to the beach users. As the underlying fee owner with exclusive jurisdiction over sovereign lands of the state, the California State Lands Commission is responsible for structures located on tidal and submerged lands pursuant to Public Resources Code Section 6301 et seq. Failure to provide for public safety exposes the state to tort liability in the event of an accident involving injury or death resulting from public use of the facility. A single loss could exceed the cost of repairs. The state is aware of the hazard and the fact that failure to remediate could result in a determination of negligence. These lands are held in trust to be used for public purposes such as commerce, navigation, fishing, recreation, and environmental open space and habitat. The hazards represent derelict structures that impede these uses and pose a potential threat to public health and safety.
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9.2.3 NATURAL GAS PIPELINE HAZARDS

Identifying Natural Gas Pipeline Hazards

The United States is heavily dependent on transmission pipelines to distribute energy and fuel sources. Virtually all natural gas, which accounts for about 29 percent of energy consumed annually, is transported by transmission pipelines according to the U.S. Energy Information Administration.[315] Energy demand in the United States continues to increase. Although California is a leader in exploring and implementing alternative energy sources such as wind and solar, the expansion of traditional energy sources, such as natural gas, continues. Increased urbanization is resulting in more people living and working closer to existing gas transmission pipelines that were placed prior to government agencies adopting and implementing land use and other pipeline safety regulations.

Compounding the potential risk is the age and gradual deterioration of the gas transmission system due to natural causes. Significant failure, including pipe breaks and explosions, can result in loss of life, injury, property damage, and environmental impacts. Causes of and contributors to pipeline failures include construction errors, material defects, internal and external corrosion, operational errors, control system malfunctions, outside force damage, subsidence, and seismicity. Growth in population, urbanization, and land development near transmission pipelines, together with addition of new facilities to meet new demands, may increase the likelihood of pipeline damage due to human activity and the exposure of people and property to pipeline failures.

Profiling Natural Gas Pipeline Hazards

California's Natural Gas Pipeline System

Most of the natural gas used in California comes from out-of-state natural gas basins. It is delivered to California via the interstate natural gas pipeline system. In 2016, natural gas accounted for 49.86 percent of in-state energy generation and 36.48 percent of California's power mix. Natural gas contributed 105,992 gigawatt hours (GWh) to the state's energy mix.[316]

Natural gas transported via the interstate pipelines, and some of the California-produced natural gas, is delivered into the Pacific Gas and Electric Company (PG&E) and Southern California Gas (SoCal Gas) intrastate natural gas transmission pipeline systems (commonly referred to as California's "backbone" natural gas pipeline system). Natural gas on the utilities' backbone pipeline systems is then delivered into the local transmission and distribution pipeline systems, or to natural gas storage fields. PG&E and SoCal Gas own and operate several natural gas storage fields that are located in Northern and Southern California.[317]

Map 9.Y shows the location and ownership of the natural gas pipeline system. Many of the pipelines are located in areas with high seismic activity, crossing the San Andreas and other active faults. To view in more detail, download a PDF copy of this map at: http://www.energy.ca.gov/maps/infrastructure/Natural_Gas_Pipelines.pdf.

Generally speaking, transmission lines are large-diameter steel pipes carrying natural gas at high pressure and compressed to provide higher carrying capacity. Transmission lines are both interstate and intrastate, with the latter connecting to smaller distribution lines delivering gas directly to homes and businesses.

Data compiled by the Pipeline and Hazardous Materials Safety Administration (PHMSA) report a total of 212,621 miles of gas pipelines in California, of which 12,416 miles are classified as gas transmission lines, 161 miles are gas-gathering lines, and the majority, 200,045 miles, are for gas distribution.

[315] https://www.eia.gov/energyexplained/index.cfm?page=natural_gas_use
[316] California Energy Commission, http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html
[317] California Public Utilities Commission, http://www.cpuc.ca.gov/natural_gas/

Map 9.Y: California Natural Gas Pipelines



Source: California Energy Commission, http://www.energy.ca.gov/maps/infrastructure/Natural_Gas_Pipelines.pdf

Incidents and Losses from Pipeline Accidents

Overview

PHMSA tracks significant incidents and losses as a result of pipeline accidents occurring on gas transmission lines and gas distribution lines. Significant incidents are those reported by pipeline operators with either 1) a fatality or injury requiring in-patient hospitalization, or 2) $50,000 or more in total costs, measured in 1984 dollars.

From 2013 to 2017, a total of 85 incidents were reported on California distribution lines, resulting in a total of six fatalities, seven injuries, and $53,010,856 in property damage. For that same period, a total of 43 incidents were reported on gas transmission lines, resulting in two fatalities, 15 injuries, and $28,563,740 in property damage.[318] These incidents are summarized in Table 9.T.

Table 9.T: Gas Distribution and Local Transmission Line Incidents, 2013 to 2017

Year	Number of Incidents	Fatalities	Injuries	Total Cost of Damages
Gas Distribution Lines				
2013	14	0	0	$3,490,587
2014	18	2	2	$18,683,512
2015	14	2	2	$1,546,593
2016	16	0	1	$3,061,979
2017	23	2	2	$26,228,185
Total Gas Distribution Line Incidents	***85***	***6***	***7***	**$53,010,856**
Gas Transmission Lines				
2013	6	0	0	$2,324,207
2014	13	0	0	$10,344,591
2015	9	2	15	$9,633,537
2016	6	0	0	$2,052,778
2017	9	0	1	$4,208,740
Total Gas Transmission Line Incidents	**43**	**2**	**15**	**$28,563,853**

Source: Pipeline and Hazardous Materials Safety Administration, https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Portalpages

San Bruno Gas Transmission Line Explosion

Given the extensive gas transmission and distribution systems in place in California, annual average losses of approximately $1 million may not seem of concern. However, the potential for serious damage and loss of life from a single pipeline explosion can be substantial. On September 9, 2010, a 30-inch steel natural gas transmission pipeline owned and operated by PG&E ruptured and exploded in a residential neighborhood in San Bruno, California. The rupture produced a crater about 72 feet long by 26 feet wide. The section of pipe that ruptured, which was about 28 feet long and weighed about 3,000 pounds, was found 100 feet south of the crater. PG&E estimated that 47.6 million standard cubic feet of natural gas was released. The released natural gas ignited, resulting in a fire that destroyed 38 homes and damaged 70. There were eight confirmed deaths and 66 reported injuries. Cal OES has identified preliminary damage estimates at $15.4 million, including $2.5 million for debris removal, $10.2 million for protective measures, $2.1 million for roads and bridges, and $0.6 million for utilities and other facilities.

A report issued by the National Transportation Safety Board (NTSB) in August 2011 determined that the probable cause of the accident was PG&E's 1) inadequate quality assurance and quality control in 1956 during its Line 132 relocation project, which allowed the installation of a substandard and poorly welded pipe section with a visible seam weld flaw that over time grew to a critical size, causing the pipeline to rupture during a pressure increase stemming from poorly planned electrical work at the Milpitas Terminal; and 2) an inadequate pipeline integrity management program, which failed to detect and repair or remove the defective pipe section.

[318] Pipeline and Hazardous Materials Safety Administration, https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Portalpages, Data retrieved March 6, 2018

Contributing to the accident were the California Public Utilities Commission (CPUC) and the U.S. Department of Transportation (US DOT) exemptions of existing pipelines from the regulatory requirement for pressure testing, which likely would have detected the installation defects. Also contributing to the accident was the CPUC's failure to detect the inadequacies of PG&E's pipeline integrity management program. Contributing to the severity of the accident were the lack of either automatic shutoff valves or remote control valves on the line and PG&E's flawed emergency response procedures and delay in isolating the rupture to stop the flow of gas.

The NTSB report included a series of recommended actions to be undertaken by federal and state government agencies and PG&E. These recommendations and resulting legislation are discussed in subsequent sections.

Assessment of State Vulnerability and Potential Losses

No comprehensive statewide seismic hazard vulnerability inventory for pipeline networks exists in California. However, it can be logically assumed that any state facility in close proximity to a natural gas transmission pipeline is at risk. This risk is heightened if the facility is also located in an area of high seismicity, where multiple gas line failures and resulting fires can be expected.[319]

In 2017, the California Energy Commission's Climate Change Center conducted research assessing the state's natural gas pipeline vulnerability to climate change and hazards resulting from climate change. The study used modeling to assess the potential for damage to California's natural gas transmission system by inundation that may occur as a result of sea-level rise. The CEC assessment report is available at: http://www.energy.ca.gov/2017publications/CEC-500-2017-008/CEC-500-2017-008.pdf.

Assessment of Local Vulnerability and Potential Losses

Individual Local Hazard Mitigation Plans may include information on pipeline vulnerability pertinent to their communities, if this information is known. Earthquake planning scenarios produced by the California Geological Survey and others are the best source of information on potential disruptions, length of outages, and estimates of post-earthquake fire. For a discussion of vulnerability of gas and other pipelines to earthquake, see *Chapter 6, Section 6.1.4.2* under the heading "Pipeline Networks – Oil and Natural Gas."

Specific information on pipeline vulnerability is maintained by owners/operators such as PG&E and SoCal Gas. This information is not always readily available to local government planners. PG&E monitors system status in real time on a 24-hour basis and regularly conducts leak inspections, surveys, and patrols of all its natural gas transmission pipelines to identify issues to be addressed immediately. PG&E also uses the data it collects to help plan and set priorities for future work. One of the tools PG&E uses is a risk management program that inventories and evaluates each of the 20,000 segments within PG&E's natural gas transmission pipeline system. A pipeline segment may be identified for further study and long-range planning based on any of the following factors:

- Potential for third-party damage
- Potential for corrosion
- Potential for ground movement
- Physical design and characteristics
- Overall, did not score high in any one factor, but scored moderately high in more than one factor

PG&E also considers proximity to high-density populations, potential reliability impacts, and environmentally sensitive areas. Based on these factors, PG&E determines which segments warrant further evaluation, monitoring, or other future action. PG&E also creates a list of the "Top 100" segments to help inform future work plans. As conditions change from year to year, PG&E reevaluates the segments included on the list.[320]

[319] NTSB Number: PAR-11-01
[320] Gas Transmission Pipeline Long Range Planning http://www.pge.com/myhome/customerservice/response/pipelineplanning/

As a result of the 2010 San Bruno gas pipeline explosion, PG&E has launched a website application with an interactive map that individuals can use to learn more about the gas pipelines in their neighborhoods. The website can be found at: https://www.pge.com/en_US/safety/how-the-system-works/natural-gas-system-overview/gas-transmission-pipeline/gas-transmission-pipelines.page.

Current Gas Pipeline Hazard Mitigation Efforts

Mitigation for gas pipelines is accomplished primarily through federal regulation and safety standards. The federal government establishes minimum pipeline safety standards under 44 CFR, Title 49 "Transportation," Parts 190-199. The Office of Pipeline Safety (OPS), within the U.S. Department of Transportation (US DOT), Pipeline and Hazardous Materials Safety Administration (PHMSA), has overall regulatory responsibility for hazardous liquid and gas pipelines under its jurisdiction in the United States. The Natural Gas Pipeline Safety Act of 1968 as amended (NGPSA) authorizes US DOT to regulate pipeline transportation of natural (flammable, toxic, or corrosive) gas and other gases.

State and Federal Regulatory Activities

In 2015, PHMSA and FEMA released a new hazard mitigation guidance document titled "Hazard Mitigation Planning: Practices for Land Use Planning and Development Near Pipelines." This document outlines best practices to reduce risk from pipeline incidents, including those caused by natural hazards. This document is available through the FEMA website at: https://www.fema.gov/media-library-data/1422297186422-e43ce828d6821027c258e96eae10fd6d/PIPA_Hazard_Mitigation_Primer_Final.pdf.

Through certification by OPS, the State of California regulates and inspects facilities and enforces intrastate gas and liquid pipeline safety requirements. By signed agreement with OPS, the State of California also enforces interstate liquid pipeline safety requirements. The California Office of the State Fire Marshal (OSFM) performs this work. State of California regulations can be found at: http://osfm.fire.ca.gov/pipeline/pipeline.

The California Public Utilities Commission (CPUC) regulates natural gas utility service for approximately 10.7 million customers that receive natural gas from PG&E, SoCal Gas, San Diego Gas & Electric (SDG&E), Southwest Gas, and several smaller natural gas utilities. The CPUC also regulates independent storage operators Lodi Gas Storage and Wild Goose Storage. The CPUC regulates the California utilities' natural gas rates and natural gas services, including in-state transportation over the utilities' transmission and distribution pipeline systems, storage, procurement, metering, and billing. The CPUC has regulatory jurisdiction over utility-owned natural gas pipelines, which transported 82 percent of the total amount of natural gas delivered to California's gas consumers in 2012.[321]

Operator compliance with state and federal pipeline safety regulations is monitored through a comprehensive inspection and enforcement program. The program is comprised of field inspections of operations, maintenance, and construction activities; programmatic inspections of operator procedures, processes, and records; incident investigations and corrective actions; and direct dialogue with operator management.

The OSFM and CPUC work in partnership with the federal Pipeline and Hazardous Materials Safety Administration (PHMSA) to assure pipeline operators are meeting requirements for safe, reliable, and environmentally sound operation of their facilities. Data on probable violations discovered and compliance actions taken are reported annually by the state to PHMSA. Information on enforcement actions taken by PHMSA is available at the Pipeline Safety Enforcement Program homepage: http://primis.phmsa.dot.gov/comm/reports/enforce/Enforcement.html?nocache=7044.

OPS is authorized to reimburse a state agency up to 80 percent of the actual cost for carrying out its pipeline safety program, including the cost of personnel and equipment. The actual amount of federal reimbursement depends upon the availability of appropriated funds and state program performance. OPS also provides grant funding to state partners to improve communication among excavators and owners of underground facilities. The PIPES Act of

[321] California Public Utilities Commission http://www.cpuc.ca.gov/natural_gas/

2006 also authorizes grants to state authorities, designated by the Governor, to create or augment effective state damage-prevention programs. For more information, go to Grants to States for One-Call and Damage Prevention.

Guidance for Local Land Use Planning

To reduce risk to public safety posed by natural gas transmission lines, local governments rely on zoning ordinances and control of easements. To better understand issues related to land use planning, PHMSA, in conjunction with the Federal Energy Regulatory Commission (FERC), sponsored a comprehensive study of land use practices, zoning ordinances, and preservation of environmental resources on transmission pipeline rights-of-way.

In an October 2004 report, the Transportation Research Board (TRB) recommended that PHMSA "develop risk-informed land use guidance for application by stakeholders." In response, the Pipelines and Informed Planning Alliance (PIPA), representing a wide spectrum of stakeholders, developed recommended practices related to protecting communities and pipelines. Approximately 130 stakeholder participants undertook the work to develop the PIPA recommended practices.

The final report, "Partnering to Further Enhance Pipeline Safety In Communities Through Risk-Informed Land Use Planning," was released in November 2010. The report includes recommended practices for local governments, property developers and owners, transmission pipeline operators, and real estate boards to be aware of and to implement as appropriate. PHMSA plans to continue working with stakeholders to ensure that a sound implementation strategy is developed and that the PIPA recommended practices are communicated to and understood by those that need to adopt them.

Lessons learned from implementation of these practices are expected to lead to improvement and expansion of the practices. The most current version of this information will be available on PHMSA's Pipeline Safety Stakeholder Communications website.

Gas Pipeline Safety Laws

Three gas pipeline safety bills were introduced into the California legislature as a result of the 2010 San Bruno gas pipeline explosion. On September 23, 2010, all three were signed into law by Governor Jerry Brown. A brief description of each bill is outlined below. Full text of the laws can be found at: http://leginfo.legislature.ca.gov/.

AB 578 (2010)
This bill requires the California Public Utilities Commission (CPUC) to adopt gas pipeline safety recommendations made by the National Transportation Safety Board (NTSB). If the CPUC opts not to adopt the standards, it must submit reasons for that decision in writing.

AB 861 (2010)
This bill prohibits a public utility from either cutting spending on operations and maintenance or increasing rates to recover expenses that were used to pay executive bonuses.

AB 1546 (2010)
This bill requires the CPUC to adopt performance metrics for pipeline safety and evaluate the state's gas utilities against those metrics. The bill allows the CPUC to levy penalties on the utility for poor performance.

Gas Safety Action

The California Public Utilities Commission (CPUC) created a comprehensive, high-level, Gas Safety Action Plan to guide and promote the CPUC's shift in culture from the traditional compliance model to a regulatory structure that sets, monitors, and enforces rules for regulated utilities based on risk assessment and risk management. The Gas Safety Action Plan also tracks the CPUC's implementation of improvements responsive to recommendations made by the Independent Review Panel and the National Transportation Safety Board (NTSB) in response to the PG&E San Bruno pipeline explosion that occurred on September 9, 2010. As part of the plan, the CPUC engages in an in-depth review of its current practices and procedures to seek areas for improvement in gas pipeline safety.

The Gas Safety Action Plan categorizes the efforts of the CPUC into four basic goals that embrace the elements of the CPUC's overall mission to protect the public and utility workers from unsafe practices and events involving gas pipeline facilities in California:

1. Ensuring the safety of the existing gas system
2. Upgrading and replacing the gas system to make it safer
3. Reforming the CPUC, making safety its first priority
4. Instilling safety culture in gas operators

To accomplish these goals, the plan's focus is to:

- Proactively identify, evaluate, and mitigate risks
- Verify compliance with rules, standards, and risk mitigation measures
- Propose and litigate enforcement actions
- Develop policies and procedures to assess the safety culture of natural gas pipeline operators
- Educate operators to promote the elements of the plan
- Review and improve CPUC policies, practices, and procedures

The Gas Safety Action Plan is designed to be a living document that will drive the CPUC's overarching strategies to improve its Gas Pipeline Safety Program. This "safety action plan" concept will not be limited to the CPUC's Gas Pipeline Safety Program, as the CPUC is also in the process of developing similar plans for the Electric and Railroad Safety Programs with innovative safety measures and methods with the goal of instilling a culture that inspires the values of utility safety and reliability throughout California, and the nation.

The Natural as Safety Action Plan can be viewed at: http://www.cpuc.ca.gov/General.aspx?id=2496.

Progress Summary 9.M: Pacific Gas and Electric Pipeline Safety

Progress as of 2018: Pacific Gas and Electric Company (PG&E) validated the safe operating pressure of an additional 194 miles of natural gas transmission pipeline in 2012, through hydrostatic pressure testing and rigorous records validation. These activities were completed in areas throughout Northern and Central California as part of PG&E's Pipeline Safety Enhancement Program (PSEP) Since PSEP projects were launched in 2011, PG&E has successfully tested a total of 409 miles of gas transmission pipeline.

In late 2013, PG&E completed construction on a state-of-the-art gas control center at its new gas operations headquarters in San Ramon, California. The control center serves as a central location from which PG&E will monitor the safe and reliable operation of its 7,000 miles of transmission pipeline and 42,000 miles of smaller-diameter distribution mains, enabling PG&E to more quickly assess and resolve gas system issues.

In 2017, PG&E developed a Gas Safety Plan that reports on the progress PG&E makes in assessing threats to energy assets, setting priorities for addressing risks, ensuring safety for employees and contractors, and resourcing the workload for future demand. The plan is available at: http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Safety/Natural_Gas_Pipeline/Plans_and_Reports/2017%20Gas%20Safety%20Plan.pdf.

Additional Gas Pipeline Hazard Mitigation Opportunities

The NTSB's Pipeline Accident Report for the San Bruno gas pipeline explosion resulted in a series of recommendations to improve the nation's and California's gas pipeline safety practices. At the federal level recommendations were made to the U.S Secretary of Transportation, the Pipeline and Hazardous Materials Safety Administration, the American Gas Association (PHMSA) and the Interstate Natural Gas Association of America. Additional details regarding NTSB's recommended actions to these agencies can be found at: https://www.ntsb.gov/investigations/AccidentReports/Pages/PAR1101.aspx.

Recommendations specific to the State of California, quoted directly from the NTSB report, were as follows:

To the Governor of the State of California:

- Expeditiously evaluate the authority and ability of the pipeline safety division within the California Public Utilities Commission to effectively enforce state pipeline safety regulations, and, based on the results of this evaluation, grant the pipeline safety division within the California Public Utilities Commission the direct authority, including the assessment of fines and penalties, to correct noncompliance by state regulated pipeline operators

To the California Public Utilities Commission:

- With assistance from the Pipeline and Hazardous Materials Safety Administration, conduct a comprehensive audit of all aspects of Pacific Gas and Electric Company operations, including control room operations, emergency planning, record-keeping, performance-based risk and integrity management programs, and public awareness programs
- Require the Pacific Gas and Electric Company to correct all deficiencies identified as a result of the San Bruno, California, accident investigation, as well as any additional deficiencies identified through the comprehensive audit, and verify that all corrective actions are complete
- Develop an implementation schedule for the requirements of safety recommendations to Pacific Gas and Electric Company (PG&E) and ensure, through adequate oversight, that PG&E has aggressively and diligently searched documents and records relating to pipeline system components, such as pipe segments, valves, fittings, and weld seams, for PG&E natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing as outlined in safety recommendations to PG&E. These records should be traceable, verifiable, and complete; should meet your regulatory intent and requirements; and should have been considered in determining maximum allowable operating pressures for PG&E pipelines
- If such a document and records search cannot be satisfactorily completed, provide oversight to any spike and hydrostatic tests that Pacific Gas and Electric Company is required to perform
- Through appropriate and expeditious means, including posting on your website, immediately inform California intrastate natural gas transmission operators of the circumstances leading up to and the consequences of the September 9, 2010, pipeline rupture in San Bruno, California, and the National Transportation Safety Board's urgent safety recommendations to Pacific Gas and Electric Company so that pipeline operators can proactively implement corrective measures as appropriate for their pipeline systems

To the Pacific Gas and Electric Company:

- Revise your work clearance procedures to include requirements for identifying the likelihood and consequence of failure associated with the planned work and for developing contingency plans
- Establish a comprehensive emergency response procedure for responding to large-scale emergencies on transmission lines; the procedure should (1) identify a single person to assume command and designate specific duties for supervisory control and data acquisition staff and all other potentially involved company employees; (2) include the development and use of trouble-shooting protocols and checklists; and (3) include a requirement for periodic tests and/or drills to demonstrate the procedure can be effectively implemented

- Equip your supervisory control and data acquisition system with tools to assist in recognizing and pinpointing the location of leaks, including line breaks; such tools could include a real-time leak detection system and appropriately spaced flow and pressure transmitters along covered transmission lines.
- Expedite the installation of automatic shutoff valves and remote control valves on transmission lines in high consequence areas and in class 3 and 4 locations, and space them at intervals that consider the factors listed in Title 49 Code of Federal Regulations 192.935(c)
- Revise your post-accident toxicological testing program to ensure that testing is timely and complete
- Assess every aspect of your integrity management program, paying particular attention to the areas identified in this investigation, and implement a revised program that includes, at a minimum, (1) a revised risk model to reflect the Pacific Gas and Electric Company's actual recent experience data on leaks, failures, and incidents; (2) consideration of all defect and leak data for the life of each pipeline, including its construction, in risk analysis for similar or related segments to ensure that all applicable threats are adequately addressed; (3) a revised risk analysis methodology to ensure that assessment methods are selected for each pipeline segment that address all applicable integrity threats, with particular emphasis on design/material and construction threats; and (4) an improved self-assessment that adequately measures whether the program is effectively assessing and evaluating the integrity of each covered pipeline segment
- Conduct threat assessments using the revised risk analysis methodology incorporated in your integrity management program, as recommended in safety recommendations, and report the results of those assessments to the California Public Utilities Commission and the Pipeline and Hazardous Materials Safety Administration
- Develop, and incorporate into your public awareness program, written performance measurements and guidelines for evaluating the plan and for continuous program improvement
- Aggressively and diligently search for all as-built drawings, alignment sheets, and specifications, and all design, construction, inspection, testing, maintenance, and other related records, including those records in locations controlled by personnel or firms other than Pacific Gas and Electric Company, relating to pipeline system components, such as pipe segments, valves, fittings, and weld seams for Pacific Gas and Electric Company natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing. These records should be traceable, verifiable, and complete.
- Use the traceable, verifiable, and complete records located by implementation of Safety Recommendation P-10-2 (Urgent) to determine the valid maximum allowable operating pressure, based on the weakest section of the pipeline or component to ensure safe operation, of Pacific Gas and Electric Company natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing
- If you are unable to comply with safety recommendations to accurately determine the maximum allowable operating pressure of Pacific Gas and Electric Company natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing, determine the maximum allowable operating pressure with a spike test followed by a hydrostatic pressure test
- Require your control room operators to notify, immediately and directly, the 911 emergency call center(s) for the communities and jurisdictions in which your transmission and/or distribution pipelines are located, when a possible rupture of any pipeline is indicated.

9.2.4 RADIOLOGICAL ACCIDENTS

This hazard risk assessment covers only accidental or unintentional radiological events. Intentional radiological/nuclear threats are discussed in the terrorism hazard risk assessment *in Section 9.3.1*.

Identifying Radiological Accident Hazards

Overview

The wide use of radioactive and nuclear material in research, education, medicine, and industry, as well as the potential for terrorism, requires all levels of government to be prepared for response, mitigation, and recovery efforts should a radiological or nuclear emergency occur.

Radioactive materials are routinely transported in California. These materials include the medical and industrial sources described below, as well as wastes that have radioactive components. Many of the radioactive waste shipments come from research and cleanup efforts at national laboratories and military bases undergoing the BRAC process. Other radioactive waste shipments are generated from the oil and gas industry.

Examples of potential radiological releases include:

- Releases or loss of control at facilities that handle radioactive materials;
- Releases during the transportation of radiological materials;
- Discovery of uncontrolled, unlicensed, or unidentified radiological materials;
- Nuclear power plant incidents; or
- Terrorist acts involving radiological or nuclear materials e.g. radiological dispersion device (RDD) or an improvised nuclear device.

Nuclear Power Plants in California

Diablo Canyon Power Plant in San Luis Obispo County is the only operating nuclear power plant in California. Pacific Gas and Electric Company (PG&E) has submitted a joint proposal to phase out nuclear power production at the plant. Under the proposal, which is pending approval by the California Public Utilities Commission (CPUC), Diablo Canyon Power Plant would be retired in 2025 at the end of its current Nuclear Regulatory Commission operating licenses, which expire in 2024 and 2025.

California is home to three decommissioning nuclear power plants: San Onofre Nuclear Generating Station in San Diego County, Humboldt Bay Power Plant in Humboldt County, and Rancho Seco Nuclear Generating Station in Sacramento County. These sites are non-operational but have spent fuel stored onsite.

The accidental or intentional release of radiological materials or radiation may threaten public health, property, and the environment.

Profiling Radiological Accident Hazards

Radiological accidents that result in the release of radioactive materials may result in long-term health risks and contamination of the state resources, including air, water supply, groundwater, and agricultural lands.

Due to strict regulation of nuclear power plants in the United States, significant nuclear power incidents that can cause harm to the public have low probability of occurrence, and none have occurred to date in California. The probability of a catastrophic event involving a nuclear power plant is low and these plants are extremely well protected. However, as evidenced by the March 2011 events at the Fukushima Daiichi plant in Japan, caused by the Tohoku Earthquake and Tsunami, the consequences of a severe accident or a successful terrorist attack on a nuclear power plant that results in a release of radioactive materials could be very significant.

State and local governments having jurisdiction within Emergency Planning Zones (EPZs) of an operating nuclear power plant in the U.S. must plan, train for, and conduct emergency exercises annually in accordance with federal regulations. Detailed emergency plans are maintained by each affected agency. Four Emergency Classification Levels (ECLs) have been established in federal regulations to characterize the severity of the emergency and the response actions required. The ECLs must be used as the foundation for emergency response planning, training, and exercises, as described in Table 9.U.

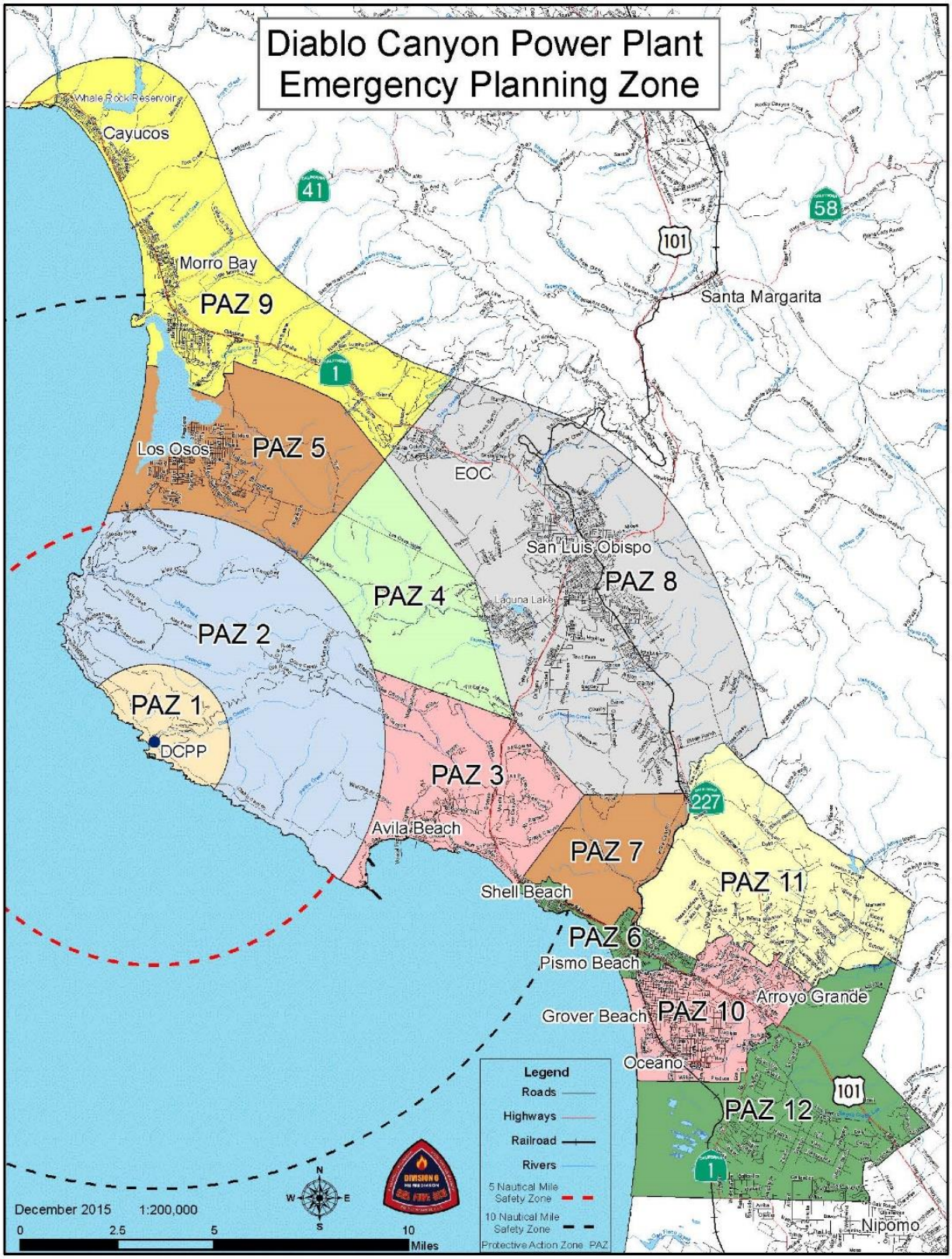
Table 9.U: Levels of Nuclear Power Plant Emergencies

Emergency Classification Level (ECL)	ECL Description and Purpose	Populations Affected*	Occurrences in California
Notification of Unusual Event	Issued when events are in progress or have occurred that indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.	Onsite only	Average 1-2 per year
Alert	Issued when events are in progress or have occurred that involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of hostile action. Any releases are expected to be limited to small fractions of the U.S. Environmental Protection Agency (EPA) Protective Action Guides (PAGs).	Onsite only	3 declared. Note: All 3 were rescinded after further investigation
Site Area Emergency	Issued when events are in progress or have occurred that involve actual or likely major failures of plant functions needed for protection of the public or hostile action that results in intentional damage or malicious acts 1) toward site personnel or equipment that could lead to the likely failure of, or 2) that prevent effective access to, equipment needed for the protection of the public. Any releases are not expected to result in exposure levels that exceed EPA PAG exposure levels beyond the site boundary.	Designated areas within the Emergency Planning Zone	0
General Emergency	Issued when events have occurred that involve substantial core degradation or loss of containment integrity. Radioactive releases are expected to exceed federal exposure guidelines.	Designated areas within the Emergency Planning Zone	0

**Includes only populations with special planning and response operations.*
Source: U.S. Nuclear Regulatory Commission, https://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/emerg-classification.html; California Governor's Office of Emergency Services (Cal OES) Nuclear Power Preparedness Program

The Emergency Planning Zone (EPZ) for the Diablo Canyon Power Plant is shown in Map 9.Z. The Nuclear Regulatory Commission (NRC) requires an approximate 10-mile radius EPZ around each plant site. California and local governments around Diablo Canyon Power Plant established an EPZ that follows the coastline and extends 18 miles to the north and 22 miles to the south. The EPZ size is established to provide for substantial reduction in early severe (acute) health effects in the event of a worst-case core melt accident.

MAP 9.Z: Emergency Planning Zones (EPZs) for Diablo Canyon Power Plant



Source: San Luis Obispo County Emergency Services

Assessment of Local Vulnerability and Potential Losses

For information on community vulnerability and loss, see Local Hazard Mitigation Plans.

Current Radiological Accident Mitigation Efforts

Cal OES Radiological Preparedness Unit

The Radiological Preparedness Unit (RPU) in Cal OES plans for, prepares for, responds to, mitigates, and assists in the recovery from radiological incidents that threaten public health and safety, property, and the environment. The goal of the RPU is to protect the public, property, and the environment from the possible harmful effects of radiation from incidents during transportation, at nuclear power plants and other fixed facilities, and from acts of terrorism. The RPU provides an effective and efficient emergency management system for radiological incidents by coordinating private entities and federal, state, and local government organizations.

The RPU is responsible for two programs:

- The California Radiological Emergency Preparedness (CalREP) Program
- The Nuclear Power Plant Program

Radiological programs are covered under the California Radiological Emergency Preparedness Plan. These programs address nuclear power plant incidents, transportation accidents involving radiological materials and wastes, other radiological emergencies, and nuclear terrorism (discussed in the terrorism hazard risk assessment in *Section 9.3.1*).

The California Radiological Emergency Preparedness Plan provides a framework outlining how local, state, and federal governments will respond and coordinate in anticipation of and immediately following a radiological emergency in the state.

California Department of Public Health Radiologic Health Branch

The California Department of Public Health (CDPH) Radiologic Health Branch (RHB) regulates the use of radioactive material through licensing and compliance programs under Health and Safety Code, sections 114960-115270 designed to protect the public, radiation workers, and the environment from the harmful aspects of radiation. This includes licensing of radioactive materials, certification of medical and industrial X-ray and radioactive material users, inspection of facilities that use radiation, investigation of radiation incidents, and surveillance of radioactive contamination in the environment.

RHB conducts routine monitoring of radioactive materials in the environment, including radioactive materials in media such as air, milk, food, and water. Routine air sampling occurs at nine fixed locations within California: Eureka, Richmond, Livermore, San Luis Obispo, Diablo Canyon, Baldwin Park, Long Beach, San Onofre, and San Diego.

The RHB Radioactive Materials Licensing and Inspection Program provides accountability and control for the use of radioactive material in California and licenses approximately 1,850 users of radioactive materials. The RHB Radiation Machine Registration, Professional Certification and Inspection Program registers approximately 85,000 radiation tubes used in approximately 32,000 facilities statewide that include uses in mammography, oncology, dental, and fluoroscopy radiation machines and computed tomography scanners. The program certifies approximately 78,000 physicians, technologists, and technicians (medical professionals) in possession of 118,000 individual certificates or permits who operate radiation machines and 87 radiation technology schools with more than 1,000 affiliated clinical sites that provide instruction and training to individuals seeking to become a medical professional qualified to operate radiation machines.

Operators of facilities or transport vehicles that handle radiological materials are responsible for ensuring the safety and security of the materials within their facilities or as carried by their transport vehicles and minimizing the hazard posed to the public. Facilities that handle radiological materials that are licensed by CDPH are required to notify

RHB when a reportable release occurs. RHB maintains staff and equipment capable of providing technical assistance in support of local response to radiological/nuclear emergencies in California.

RHB supports the California Preventative Radiological/Nuclear Detection initiative, which seeks to establish a statewide architecture to prevent the use of any radiological materials as a terrorist weapon within California through monitoring, detection, and intervention.

Nuclear Power Plant Safety

Nuclear power plants are designed with two principal safety objectives in mind:

1. To contain fission products to prevent offsite health effects.
2. To ensure that heat generated by the reactor, including heat generated by the decay of fission products after reactor shutdown, is removed.

If the decay heat is not continually removed from the reactor following shutdown, this heat could cause a failure of the system that is designed to contain the fission products. The fission products generated in the reactor core are highly radioactive; thus, releasing significant amounts of them to the environment could be quite harmful. Great care has been taken to prevent such a release through the defense-in-depth approach used in the design of nuclear power plants. The defense-in-depth approach ensures that any release of hazardous amounts of radioactive materials will be extremely unlikely. This approach uses three barriers to prevent the release of fission products from the reactor core to the environment:

- Fuel rods (fuel pellet and fuel cladding)
- Reactor vessel and primary coolant system
- Containment

The chance of any single barrier failing is unlikely. The chance of all three failing simultaneously is, therefore, extremely remote. A meltdown does not have to occur for sufficient fission products to be released from the fuel to pose a threat. What must occur is the loss of the many redundant systems designed to keep the core covered and cool (by removing the decay heat). These systems are designed to maintain cooling even under severe accident conditions such as a total break in the largest pipe in the system. Numerous systems and backup emergency core cooling systems are provided to ensure that reactor cooling water continues to flow through the reactor core to remove decay heat, even after the reactor has been shut down and the fission process has stopped. Control and safety systems within the plant are designed to overlap for safety. Automatic systems have the ability to shut down the reactors within seconds if monitoring devices detect unusual conditions, such as an excessive heat buildup. Should any individual safety component fail, there are backup systems that take over immediately.

The Nuclear Regulatory Commission (NRC) has resident inspectors assigned to each plant site. The inspectors oversee plant operations and ensure compliance with regulations governing operational and occupational safety. There are automatic communications systems that contact the State Warning Center in Sacramento if certain conditions, such as an earthquake or certain plant conditions, occur. The State Warning Center will be able to contact key personnel needed in an emergency.

Nuclear Power Plant Emergency Preparedness

Planning, preparing, and training for nuclear power plant emergencies are also part of the safeguards. Federal, state, and local emergency management agencies work with the utilities to ensure that nuclear power plants are safe and that each agency and utility has an effective emergency plan describing the actions to be taken in response to an emergency. Residents and businesses near a nuclear power plant should prepare a disaster plan for all emergencies, including nuclear power plant emergencies, and become familiar with the emergency preparedness information. Information regarding nuclear power plant safety issues, in general, is available from the NRC at: www.nrc.gov. As a federal agency, the NRC has primary jurisdiction over nuclear facilities in the United States and works closely with state and local emergency agencies.

Planning Zones

A series of zones has been established around each nuclear power plant to clearly identify the required activities in the event of an accident. Although three specific zones are identified, efforts to protect public health and safety and the environment are made without regard to whether particular areas are inside or outside of these zones. The three zones are as follows:

- The Emergency Planning Zone (EPZ) for which plans are in place to protect people, property, and the environment from the effects of exposure to a radioactively contaminated plume. As noted earlier, the EPZ around Diablo Canyon Power Plant follows the coastline and extends 18 miles to the north and 22 miles to the south.
- The Ingestion Pathway Zone. For Diablo Canyon Power Plant, this zone covers an approximate 50-mile radius around the plant. In this zone, plans are in place to mitigate the effects of radioactive contamination to agriculture, as well as food processing and distribution.
- The Public Education Zone, which includes areas approximately 35 miles from the plant. In this zone educational materials are distributed to inform the public about how the nuclear power plant operates, what to expect in the event of an accident, and what plans are in place for public protection. The utilities that operate the power plants are required to publish and disseminate information for residents and transient populations.

The CDPH Nuclear Emergency Response Program (NERP) protects the environment, and the health and welfare of the public from the consequences of a radiation release at a nuclear power plant. NERP plans and participates in graded exercises with local, state, and federal personnel to prepare for a nuclear power plant incident or terrorist attack. Without this program, Diablo Canyon Power Plant would not be able to maintain its U.S. Nuclear Regulatory Commission (NRC) licensure and, therefore, would be unable to operate.

Radiological Waste Transportation

Since 1989, the staff of the California Energy Commission has represented California on two western state groups: the Western Governors' Association Waste Isolation Pilot Plant (WIPP) Transportation Advisory Group and the Western Interstate Energy Board's High-Level Radioactive Waste Committee. Both groups work with the U.S. Department of Energy and other state and regional groups to develop accident prevention and emergency response plans for major federal non-classified shipments of radioactive waste. Staff also coordinates the California Nuclear Transport Working Group that develops and updates accident prevention and emergency response plans for federal shipments of transuranic waste to the WIPP in New Mexico.

To mitigate disaster, federal regulations require that 1) radiological materials transported by train use special packaging based on the hazard of the shipment, 2) there is extensive worker training and documentation, 3) vehicles and packages of radioactive materials are inspected, and 4) the waste travels via specific, controlled routes. More information about radiological waste transportation can be found on Cal OES's radiological transportation web page, at the following link: http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/waste-isolation-pilot-plant-program.

Radiological Exposure and Public Health

CDPH RHB tracks information from generators of low level radioactive waste. These generators are required to submit annual reports to RHB concerning low level radioactive waste shipped and stored. California's risk mitigation strategy for radiological sources includes participation in the Department of Energy Cesium Irradiator Replacement Program that provides financial incentives to California hospitals and medical facilities that remove and replace cesium-137 irradiators with X-ray technologies.

Additional Radiological Accident Hazard Mitigation Opportunities

The nuclear power plant mitigating strategies currently in place were developed in the context of a localized event that was envisioned to challenge portions of a single unit. The events at Fukushima, however, demonstrate that "beyond-design-basis" external events (i.e., events that were not allowed for in a plant's design because they were

considered too unlikely) may adversely affect 1) more than one unit at a site with two or more units, and 2) multiple safety functions at each of several units located on the same site.

Nuclear plants are typically designed with multiple independent and redundant layers of defense to compensate for potential human and mechanical failures so that no single layer, no matter how robust, is exclusively relied upon. This "defense in-depth" strategy includes the use of access controls, physical barriers, redundant and diverse key safety functions, and emergency response measures. However, the events at Fukushima further highlight the possibility that extreme natural phenomena could challenge even this approach to prevention, mitigation, and emergency preparedness.

To address the uncertainties associated with beyond-design-basis external events, the NRC is now requiring a three-phase approach for mitigating such events. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities. The transition phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Additionally, the NRC has initiated studies to learn more from the events at Fukushima. These studies will likely result in further changes in requirements for mitigation, preparedness, and response at U.S. nuclear power plants.

9.2.5 TRAIN ACCIDENTS RESULTING IN EXPLOSIONS AND/OR TOXIC RELEASES

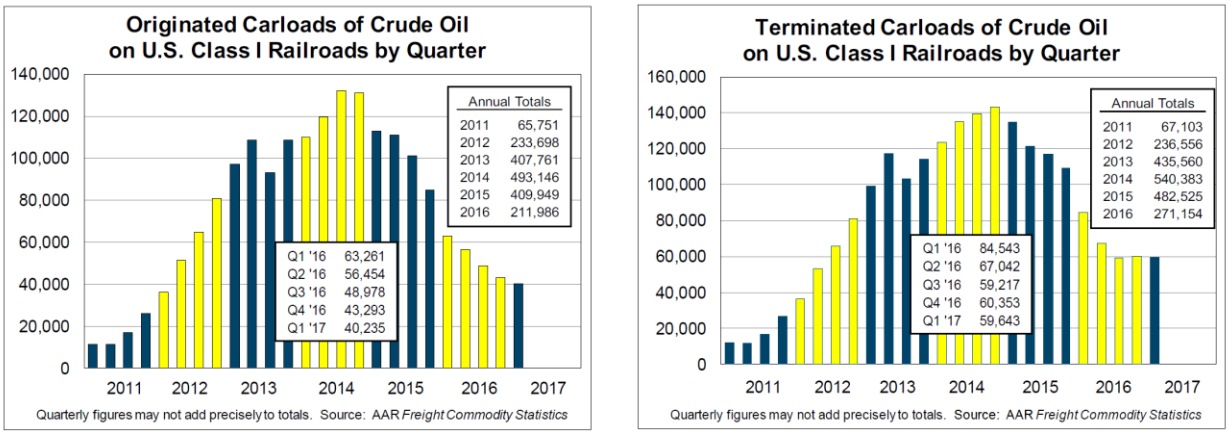
Identifying Train Accidents Resulting in Explosions and/or Toxic Releases

Train accidents are generally localized, and the incidents result in limited impacts at the community level. However, if there are toxic, volatile, or flammable substances on the train and the train is in a highly populated or densely forested area, death, injuries, and damage to homes, infrastructure, and the environment, including forest fires, can occur.

One of the most significant concerns in rail accidents is related to oil trains, or the transport of largely crude oil by rail. Due to the sharp rise in U.S. crude oil production, much of the increased oil product output is transported by rail. In 2008, U.S. Class I railroads originated 9,500 carloads of crude oil and by 2014, this number had increased by an estimated 5,100 percent to 493,146 carloads.

The majority of traditional crude oil refineries are located in production areas, such as Texas, Oklahoma, and Louisiana. Therefore, the product must be transported to areas where it can be processed and/or transferred to marine tankers. These facilities are generally located in coastal areas such as California, the state of Washington, New England, and the Gulf of Mexico. Railroads have helped fill the gap in transportation of crude oil as the traditional pipeline network linking refineries has reached capacity. After peaking in 2014, carloads of crude oil transported by rail have fallen sharply from 540,383 loads to 59,643 loads in 2016. Chart 9.C demonstrates the decrease in crude oil transportation by rail in the United States since 2014.

Chart 9.C: Crude Oil Transportation by Rail in the United States, 2011-2017



Source: Association of American Railroads, https://www.aar.org/todays-railroads/what-we-haul/crude-oil-by-rail

According to a 2014 report to the California Joint Legislative Committee on Emergency Management, crude-oil-by-rail imports into California were projected to increase as much as 25-fold by 2016, driven by increasing domestic production in the United States as well as Canada. This raised serious safety concerns due to a string of train derailments occurring in North America in 2013 and 2014. Of greatest concern were oil trains transporting Bakken oil, a lighter, highly flammable crude oil produced in the Bakken region of North Dakota and derived from tar sands in Canada.

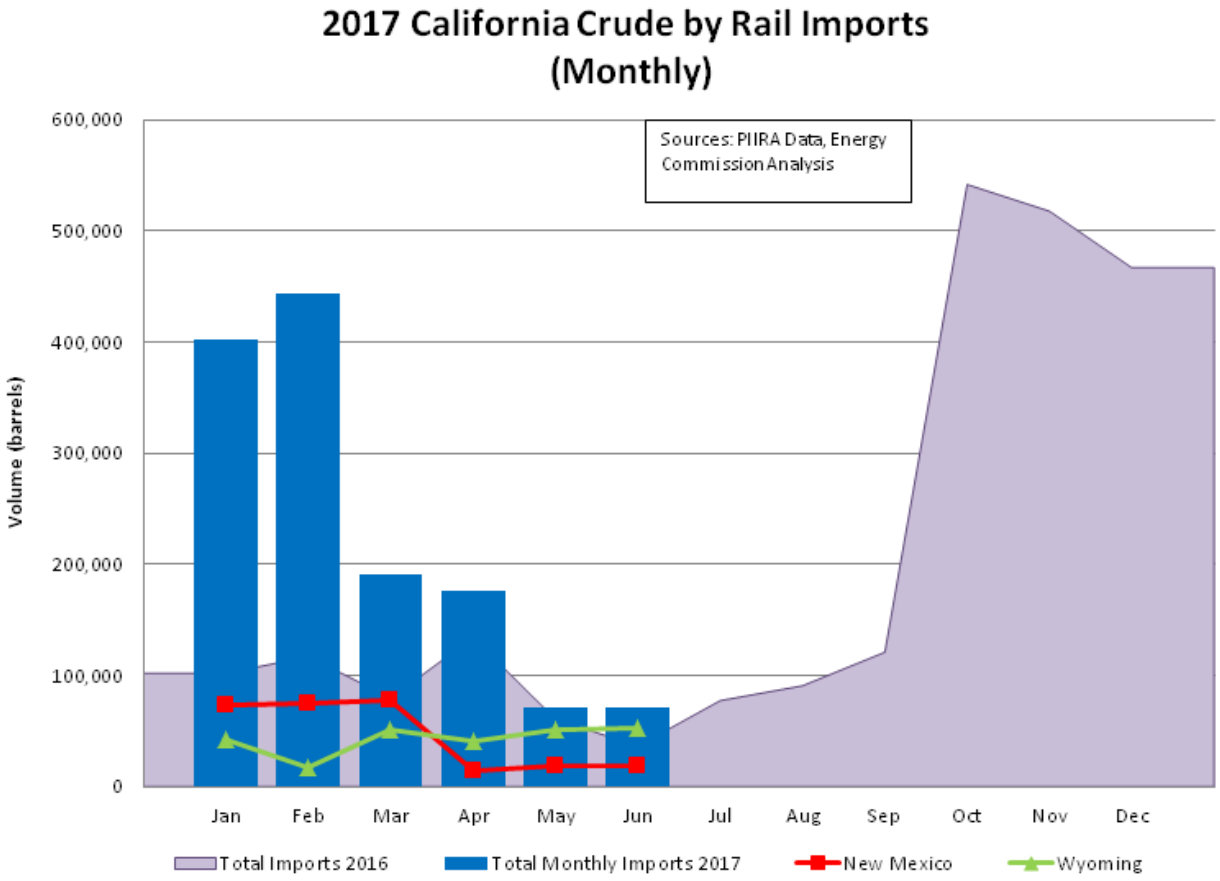
In 2014, 100-car Bakken oil trains originating in North Dakota traveled through the Feather River Canyon and midtown Sacramento once or twice a week en route to Richmond in the San Francisco Bay Area. By 2016, however, the number of those oil trains had diminished greatly due to economic factors leading to a decline in the need for importing crude oil to the Richmond refinery.

Several more oil trains were proposed to be initiated in 2015, including the Valero Refining Company's plan to run two 50-car oil trains a day through Sacramento to its plant in Benicia, and Phillips 66's plan to run oil trains five days a week into its refinery in San Luis Obispo County, some from the north and some via southern routes. Political and community opposition to the proposed new oil train routes, based on safety and environmental concerns, resulted in lengthy delays to those projects into 2017, when both the Valero and Phillips 66 projects were ultimately stopped by local governing body votes to deny the necessary permits to move forward with construction.

As of 2017, there are only two active crude-by-rail facilities in the state. The most active continues to be the Plains All American facility in Bakersfield. The other is the Kern Oil Refining facility, also in Bakersfield. The Kinder Morgan facility that operated for a short time in Richmond has been shuttered.[322]

Although the projections for increased Bakken oil trains never materialized, economic recovery and the increased demand for crude oil have produced an upswing in the number of crude rail imports into California. As can be seen in Figure 9.D, imports increased significantly during the fourth quarter of 2016, continued through the first quarter of 2017, and again declined during that summer.

Figure 9.D: Crude-by-Rail Imports into California, 2016 and 2017



Profiling Train Accidents Resulting in Explosions and/or Toxic Releases

According to Cal OES, there have been 14 train accidents affecting 12 communities since 1950. Several significant train accidents, derailments, fires and hazardous material releases have occurred in California in the past 40 years that resulted in multiple deaths, numerous injuries, and property damage and have, thus, stimulated changes in land

[322] CPUC, Rail safety report to the legislature. 2016.

use and rail safety regulations. Rail incidents involving oil in California increased from 3 in 2011 to 36 in 2013 and to 28 by mid-2014.[323]

Roseville Train Explosion

A dramatic example in California history was the major explosion and chemical plume release that occurred in April 1973 in the Roseville railroad yard when 6,000 bombs on a train bound for the Concord Naval Weapons Stations detonated after a car caught fire. Although no one was killed, the blast reportedly injured about 100 people and damaged 5,500 buildings, some more than a mile away.[324]

Duffy Street Derailment, San Bernardino

On May 12, 1989, a six-locomotive/69-car Southern Pacific freight train picked up speed while descending down the Cajon Pass in Southern California. The train reached a speed of 110 miles per hour on a curve at Duffy Street in San Bernardino designed for no more than 40 miles per hour. The train derailed and plowed into a residential area on Duffy Street. The conductor, head-end brakeman, and two residents were killed in the crash. Seven homes were destroyed, as was the entire train.

During the cleanup effort, an underground 14-inch high-pressure gasoline transit pipeline suffered undetected damage. On May 25, 13 days after the train derailment, the pipeline burst, showering the neighborhood in gasoline and igniting a large fire that killed two people and destroyed 11 more homes. The total property damage was $14.3 million. Many residents moved after this, and homes are no longer allowed to be built next to the rail lines.

Investigations determined several causes that contributed to the derailment: a miscalculation of the weight of the freight, which was underestimated by 40 percent; lack of dynamic brakes on three of the six locomotives; and train engineer error in activating the emergency brake, which cancelled the dynamic brakes on the functioning three locomotives.

Cantara Loop Spill, Upper Sacramento River

On the night of July 14, 1991, a Southern Pacific train derailed into the upper Sacramento River at a sharp bend of track known as the Cantara Loop, upstream from Dunsmuir, California, in Siskiyou County. Several train cars made contact with the water, including a tank car that initially appeared to be undamaged; however, a small rupture below the water line allowed its contents to be released into the river. Early the following morning, it became apparent that the tank car had ruptured and spilled approximately 19,000 gallons of metam sodium, a potent herbicide and pesticide used primarily to sterilize soil for agricultural purposes.

When mixed with water, metam sodium breaks down into several highly toxic compounds having varying toxicities and half-lives in the aquatic environment. Though some are highly toxic, all dissipate in a matter of hours or weeks and do not linger long-term. Some of the compounds volatilized into the air, creating a toxic cloud above the river as the chemical plume moved downstream. Efforts to determine the extent of damage to aquatic life from the metam sodium spill were delayed 12 to 48 hours due to the hazard of fume exposure.

Ultimately, over a million fish and tens of thousands of amphibians and crayfish were killed. Millions of aquatic invertebrates, including insects and mollusks, which form the basis of the river's ecosystem, were destroyed. Hundreds of thousands of willow, alder, and cottonwood trees eventually died. Many more were severely injured. The chemical plume left a 41-mile wake of destruction, from the spill site to the entry point of the river into Shasta Lake. Traveling at just under 1 mile per hour on average, the plume entered Shasta Lake on the morning of July 17, 1991. Dilution and evaporation of the metam sodium, combined with continued aeration, reduced the chemical to undetectable levels in the lake by July 29, 1991.

[323] IEPR Workshop, June 25, 2014
[324] Roseville Local Hazard Mitigation Plan, 2004; Wikipedia

In July 1992, a lawsuit was filed by the State of California and the federal government against Southern Pacific Railroad and other parties considered responsible for the Cantara spill. The lawsuit was on behalf of the natural and biologic resources damaged or destroyed by the spill. The basis of the lawsuit was to recover damages for those injured resources. An out-of-court agreement was reached in 1994, and the entire settlement process was completed by August 1995. The plaintiffs were awarded $38 million in damages, reimbursements, and restoration funds, $14 million of which was to be administered by the Cantara Trustee Council for restoration activities, land acquisition and protection, research, and public education. The Cantara Trustee Council operated for a period of 12 years, from 1995 to 2007. For additional details on the activities and projects funded by the Cantara Trustee Council, see: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=17248&inline=true.

The severity of this spill and the long-term effects on the surrounding ecosystem prompted the California Public Utilities Commission (CPUC) to conduct a statewide risk assessment which identified 19 hazardous rail sites within the state.

Glendale Derailment

On January 26, 2005, a southbound Metrolink commuter train collided with a sport utility vehicle (SUV) that had been abandoned on the tracks near the Glendale-Los Angeles city boundary. The train jackknifed and struck trains on both sides of it, one a stationary freight train and the other a northbound Metrolink train traveling in the opposite direction. The collisions resulted in 11 deaths and 100 to 200 injuries. The driver of the SUV left the vehicle before the crash and was later charged and convicted of 11 deaths and arson.

Subsequent criticism focused on the issue of train configuration. Many commuter trains use a “pusher configuration” to avoid turnaround maneuvers and facilities required to reverse a train’s direction. This means the trains are pushed from the back by the locomotive. There were assertions that this type of configuration made the accident worse and claims that if the engine had been in the front, the train might not have jackknifed and caused the second Metrolink train to derail.

To increase rider safety, Metrolink temporarily roped off the first cars in all of their trains and allowed passenger seating in the second car and beyond. Metrolink gradually modified this policy. As of 2007, the line permitted passengers to sit in a portion of the first car when the train is in "push mode," but did not allow seating in the forward-most section of the first car.

Chatsworth Derailment

The September 12, 2008 Chatsworth train accident, resulting in 25 deaths and injuring more than half the train’s passengers, spawned significant changes to national rail safety standards. The head-on collision occurred in Chatsworth, a neighborhood of Los Angeles located at the western edge of the San Fernando Valley, and involved a Metrolink commuter train and a Union Pacific freight train. All three locomotives, the leading Metrolink passenger car, and seven freight cars derailed. According to the National Transportation Safety Board (NTSB), the Metrolink train engineer most likely caused the collision because he was distracted by sending text messages while on duty. He failed to obey a red stop signal that indicated it was not safe to proceed from the double-track into the single-track section and, thus, collided head-on with the freight train that was traveling on the same single-track section from the opposite direction.

The NTSB also believed that deployment of a positive train control (PTC), which is a safety backup system that can automatically stop a train and prevent train collisions, could have avoided the disastrous collision and derailment. Although not required at the time of the Chatsworth accident, PTCs have been a high priority for the NTSB following similar collisions since the mid-1980s, and voluntary implementation has been uneven and incremental across the country since that time, primarily due to the high costs associated with installation and maintenance. Following the Chatsworth collision, Metrolink expanded the existing automated train stop system used on 30 miles of Metrolink track in Orange County across its 350-mile system. Metrolink's automated train stop system will automatically apply the brakes to stop a train if the engineer fails to respond to a warning within 8 seconds.

Feather River Canyon Derailment

On November 25, 2014, 11 cars carrying corn derailed adjoining a portion of the Feather River about 50 miles northeast and upstream of Lake Oroville, releasing kernels and husks into the river. Most of the corn landed on the hillside above the river. Although this was not considered a toxic spill, it raised concerns among state and local officials because the rail track routinely carried trains transporting hazardous materials, including 100-car Bakken crude oil trains. At the time, the number of crude oil trains entering the state via mountain passes and river canyons was expected to jump substantially in the next several years as coastal refineries planned to purchase Bakken oil from fields in North Dakota, Canada, Colorado and Texas. As a result of this spill and others occurring in Canada, Virginia, and Pennsylvania, representatives of the CPUC and Cal OES provided testimony for U.S. Department of Transportation (US DOT) hearings regarding rail tank safety standards.

Roseville Derailment

On January 6, 2015, a westbound freight train departing the Union Pacific Railroad Davis Yard in Roseville derailed before it was able to leave the yard. Of the seven cars that derailed, three were upright, two were leaning, and two were on their side. The two rail cars that were on their sides included a tank car containing hazardous materials. The tank car sustained substantial damage to its outer shell, but the inner shell was not breached and consequently there was no release of hazardous material. Due to damage to the hazardous material car and initial uncertainty about a possible release, the Union Pacific Railroad initially set up a half-mile evacuation zone. The Union Pacific Railroad's initial report stated the cause was a broken rail on the lead track of the departure yard. This was substantiated by CPUC staff.

Train derailments involving hazardous materials where track defects are the primary cause are of particular concern. In locations where such statistics highlight this concern, CPUC staff will often monitor and mentor the railroad maintenance personnel, focusing on each employee's competency and ability to perform effective regular inspections. Mentorship and observations in the field allow CPUC inspectors to discuss training needs and other remedies with local railroad managers.[325]

[325] http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/2016%20Rail%20Safety%20Report%20to%20the%20Legislature%202016%20FINAL.pdf

Assessment of State and Local Train Accident Vulnerability

Increasing concerns regarding the rail transport of crude oil within the state prompted the Governor of California to convene an Interagency Rail Safety Working Group in January 2014 to examine safety concerns and recommend actions the state and others should take in response to this emerging risk.

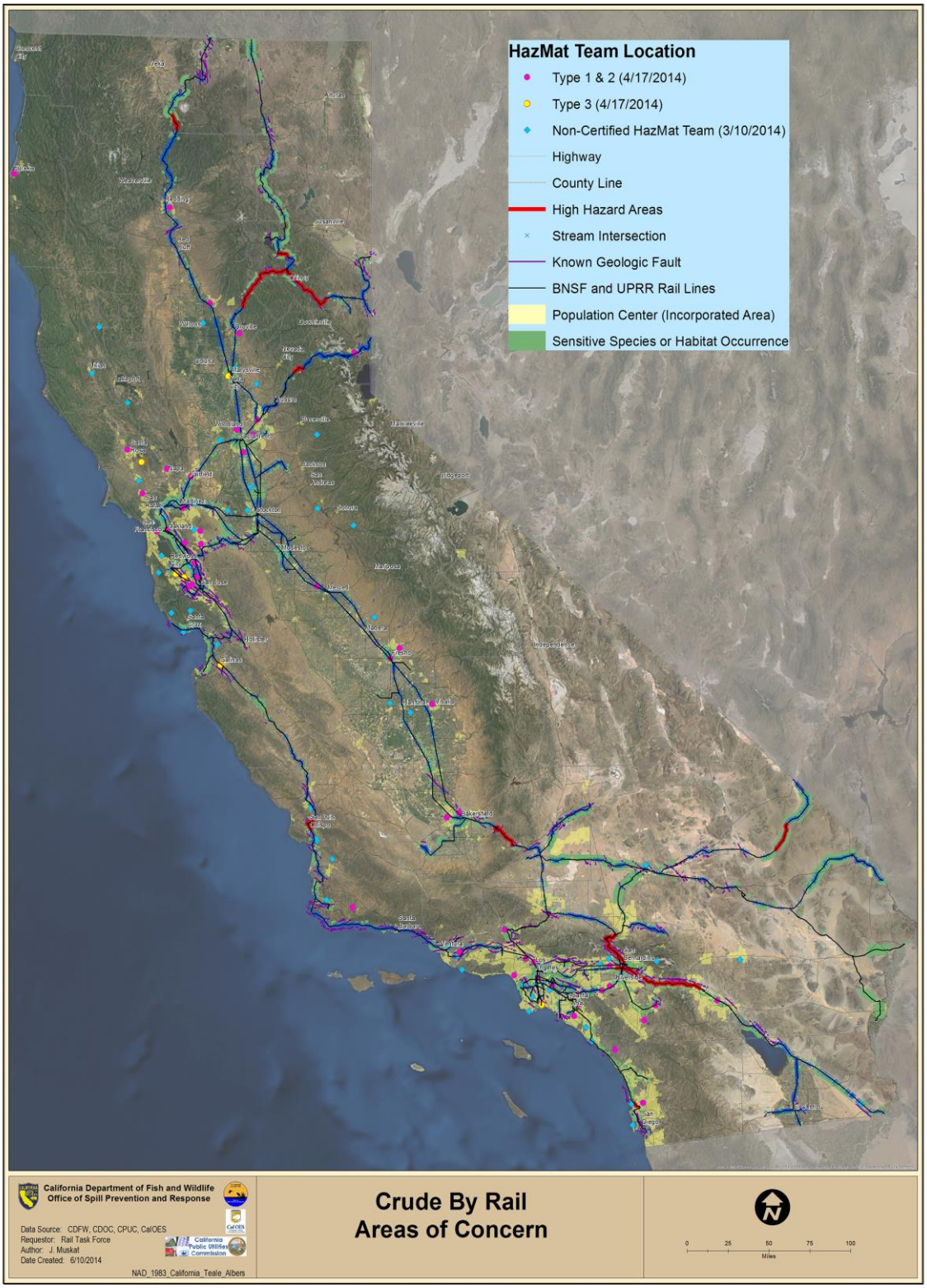
According to the Working Group, trains transporting crude oil are expected to travel along the Feather River or Donner Pass to the Bay Area, through the Tehachapi Pass to Bakersfield, or into Los Angeles. As a result, they will travel through some of the state's most densely populated areas, as well as some of the most sensitive ecological areas, since rail lines frequently operate near or over rivers and other sensitive waterways in the state. Agencies in the Working Group collaborated to identify and map areas along rail routes with potential high vulnerability, and to identify the locations of emergency response teams relative to the vulnerabilities. Map 9.AA and Map 9.BB provide an overview of oil train routes and potential high hazard sites, as well as the location of certified and non-certified hazardous materials response teams. Specifically, the mapping exercise found the following:

- High hazard areas for derailments are primarily located in the mountains, with at least one such site along every rail route into California. Some high hazard areas are also located in more urban areas, such as in the San Bernardino-Riverside and San Luis Obispo regions. Overall, high hazard areas represent an estimated 2 percent of track and 18 percent of the derailments that have occurred. This means that 82 percent of derailments have occurred in a wide range of other locations. The high hazard areas do not reflect the locations of other types of rail accidents (e.g., collisions). Therefore, while the highlighted areas are important, they are not the only sites where accidents may occur.

- Areas of vulnerable natural resources are located throughout the state, including in urban areas. A rail accident almost anywhere in California would place waterways and sensitive ecosystems at risk. The high hazard areas for derailments are generally located in areas with high natural resources vulnerability and nearby waterways (e.g., Dunsmuir, the Feather River Canyon).

- Emergency hazardous material response ("hazmat") teams in California have generally good coverage of urban areas, but none are located near the high hazard areas in rural Northern California. Some areas such as Yuba City and Monterey only contain "Type III Hazmat" teams—units that are equipped to perform only in a support role rather than lead role during a major chemical or oil incident.

Map 9.AA: Oil Train Routes and Potential High Hazard Sites



Map 9.BB: High Hazard Designations for Oil by Rail



Source: Cal OES, http://caloes.ca.gov/cal-oes-divisions/fire-rescue/hazardous-materials/hazmat-by-rail

Current Mitigation Efforts for Train Accidents Resulting in Explosions and/or Toxic Releases

There are numerous federal and State of California regulations aimed at preventing and mitigating rail accidents with the potential to cause death, injuries, and property and environmental damage. In general federal law as it relates to rail preempts state action on the subject. Federal regulations focus on design standards and safety technologies, while state and local regulations address areas of inspection, enforcement, preparedness, and response.

Notable Rail Safety Regulations

As with other hazards discussed in this SHMP, improved rail safety regulations have been implemented following specific destructive events, or in recognition of a significant risk.

Positive Train Control System Requirements

One such case is the development of regulations requiring the use of a positive train control (PTC) system designed to automatically stop a train to prevent a collision. In May 2007, prior to the Chatsworth collision, a bill requiring the installation and operation of PTC systems was introduced in the U.S. House of Representatives. The bill was passed by the House in October 2007 and moved on to the U.S. Senate, where it was being heard at the time of the Chatsworth collision. Following testimony by California Senator Boxer and others regarding the Chatsworth crash and the potential for avoidance of similar events through the mandatory deployment of PTC systems, the Senate passed the bill in October 2008. The legislation signaled that, despite the implementation costs, railroad employee and general public safety warranted mandatory and accelerated installation and operation of PTC systems.

The Railroad Safety Improvement Act of 2008 (RSIA08) requires the installation and operation of PTC systems on 1) all main lines, meaning all intercity and commuter lines, with limited exceptions; and 2) freight-only lines when they are part of a Class I railroad system, carrying at least 5 million gross tons of freight annually, and carrying any amount of poison-by-inhalation (PIH) or toxic-by-inhalation (TIH) materials. The RSIA08 mandated that widespread implementation of PTC systems across a major portion of the U.S. rail industry be accomplished by December 31, 2015. Each subject railroad was required to submit to the Federal Railroad Administration, by April 16, 2010, an implementation plan indicating where and how it intended to install PTC systems by December 31, 2015.[326]

Final Rule for Rail Transportation of Flammable Liquids

More recently, concerns over "oil trains," particularly those transporting the highly flammable Bakken crude oil throughout the United States, spawned new federal regulations. The Federal Railroad Administration, one of 10 agencies under the U.S. Department of Transportation (US DOT), has primary jurisdiction over railroad safety, covering the safety of track, grade crossings, rail equipment, operating practices, and movement of hazardous materials. US DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) and the U.S. Department of Homeland Security's Transportation Security Administration (TSA) issue safety standards for railways. The National Transportation Safety Board (NTSB), an independent federal agency, is responsible for making recommendations to prevent future incidents. Unlike the Federal Railroad Administration, the NTSB has no regulatory authority, although the Federal Railroad Administration often agrees with the recommendations provided by the NTSB.

In an effort to improve safety and reduce the potential for rail spills, government agencies in the U.S. and Canada have adopted additional safety standards and issued new regulations for crude oil railcars. US DOT, for instance, issued an emergency order in May 2014 that requires railroad operators to notify local emergency responders whenever oil shipments travel through their states. Canada has also announced that it will phase out the use of older rail cars used to transport oil by May 2017.

In May 2015, US DOT announced a Final Rule to strengthen safety standards for transportation of flammable liquids by rail. The Final Rule, "Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains," was issued by the PHMSA and the Federal Railroad Administration. The rule applies to "high-hazard flammable trains" which means "a continuous block of 20 or more tank cars loaded with a flammable liquid or 35 or more tank

[326] http://www.fra.dot.gov/Page/P0395

cars loaded with a flammable liquid dispersed through a train." The rule establishes a variety of new standards, including enhanced tank car standards, new braking standards, new testing and sampling requirements to determine product stability, and new operational protocols, such as risk assessments of routing requirements, speed restrictions, and procedures for informing local agencies of oil train shipments.

A major provision of the Final Rule was the requirement that all tanker cars that transport crude oil or other flammable liquids meet "DOT 117" specifications that are designed to meet higher safety standards. A timeline was established for the retrofit of existing tanker cars. The January 1, 2017 date would trigger a reporting requirement, and shippers would have to report to DOT the number of tank cars that they own or lease that have been retrofitted, and the number that have not yet been retrofitted.[327]

Major State Agency Areas of Responsibility

Although the federal government has primary authority over railroad safety, the State of California enforces federal requirements, as well as state-specific rules, and state and local agencies have the lead in the areas of emergency planning, preparedness, and response. States additionally can help ensure that federal and voluntary industry actions are adequate given the risks posed by oil by rail.

California Public Utilities Commission (CPUC) Responsibilities

The CPUC is the state agency that oversees rail safety in California. This oversight can be broken down into three areas:

1. *Railroad Safety.* The CPUC employs federally certified inspectors to ensure that railroads comply with both federal and state railroad safety regulations.
2. *Rail Transit Safety.* The CPUC has safety and security regulatory authority over all rail transit agencies in California and works in cooperation with the Federal Transit Administration and transit agencies to enhance public safety and security.
3. *Rail Crossing Safety.* The CPUC is the state agency with exclusive jurisdiction over rail crossings in California. CPUC engineers evaluate the safety of rail crossings and review proposed construction where roadways or pathways cross railroad or rail transit tracks.

The CPUC Railroad Safety Division is required by the California Public Utilities Code to prepare an Annual Railroad Safety Report to the California State Legislature that chronicles the operations of the CPUC Railroad Operations and Safety Branch (ROSB). The ROSB mission is to ensure that California communities and railroad employees are protected from unsafe practices on freight and passenger railroads by promoting and enforcing rail safety rules, regulations, and inspection efforts and by carrying out proactive assessments of potential risks before they create dangerous conditions.

Findings of the 2016 ROSB Annual Report can be found at: http://www.cpuc.ca.gov/rosb/.

California Department of Fish and Wildlife, Office of Spill Prevention and Response (OSPR) Responsibilities

The California Department of Fish and Wildlife, Office of Spill Prevention & Response (OSPR) is the lead state agency for oil spill preparedness and response. The OSPR was established as part of the 2014 Budget Act. It creates an integrated marine-inland spill prevention, preparedness, and response program; provides funds to pay for oil spill cleanup; addresses preparedness for rail, pipeline, and production industries; and, promotes effective, timely spill response, cleanup, and restoration of resources damaged by spills.

Additional details about OSPR may be found at: https://www.wildlife.ca.gov/OSPR.

[327] http://www.ncsl.org/research/energy/transporting-crude-oil-by-rail-state-and-federal-action.aspx#Timeline

California Governor's Office of Emergency Services (Cal OES) Responsibilities
The Hazardous Materials (HazMat) Section, under the Cal OES Fire and Rescue Division, coordinates statewide implementation of hazardous materials accident prevention and emergency response programs for all types of hazardous materials incidents and threats, including hazardous materials transported by rail.

Rail Safety Working Group Recommendations
As noted earlier, in January 2014, the Governor's Office convened a Rail Safety Working Group to examine safety concerns and recommend actions that the state and others should take in response to the emerging risk posed by increased shipments of crude oil by rail into California.

The Working Group included representatives from the CPUC; Cal OES; California Environmental Protection Agency (CalEPA); Department of Toxic Substances Control (DTSC); California Energy Commission (CEC); California Natural Resources Agency (CNRA); California Office of the State Fire Marshal (OSFM); Department of Oil, Gas, and Geothermal Resources (DOGGR); and Office of Spill Prevention and Response (OSPR). The Working Group published a Preliminary Findings and Recommendations Report on June 10, 2014.

The Working Group report recommended the following:
- Increase the number of CPUC inspectors (and inspections)
- Expand the OSPR program to cover inland oil
- Provide additional funding for local emergency responders
- Post an interactive, public website depicting rail lines and potential vulnerabilities
- Monitor industry compliance with items in an industry Voluntary Agreement
- Review state and federal emergency response plans
- Request "Worst-Case Scenario" plans from railroads
- Call on the federal government to enhance safety requirements

Senate Bill 84 (2015)
In 2015, the California Legislature passed Senate Bill (SB) 84 which addressed the following rail safety issues:
- Creating the Regional Railroad Accident Preparedness and Immediate Response Force in Cal OES, consisting of stakeholders
- Authorizing the Force as being responsible for providing regional and onsite response capabilities in the event of a release of hazardous materials from a railcar or a railroad accident involving a railcar designated to transport hazardous material commodities
- Requiring Cal OES, in consultation with stakeholders, to develop a state regional railroad accident preparedness and immediate response plan that would be an annex to the State Emergency Plan
- Requiring the Force and OSPR to coordinate in their respective authorities and responsibilities to avoid any duplication of effort, ensure cooperation, and promote the sharing of information regarding the risk of discharge of petroleum by rail into state waters
- Requiring the Cal OES Director to establish a schedule of fees to be paid by a person owning any of the 25 most hazardous material commodities that are transported by rail in California
- Requiring the Cal OES Director to create an industry advisory committee to advise the director on setting the fee and other policy matters
- Requiring every person who operates a railroad that transports hazardous materials by railcar to register with the board and to remit the fees to the board pursuant to the Fee Collection Procedures Law
- Creating the Regional Railroad Accident Preparedness and Immediate Response Fund

9.2.6 WELL STIMULATION AND HYDRAULIC FRACTURING HAZARDS

Identifying Well Stimulation and Hydraulic Fracturing Hazards

Hydraulic fracturing, commonly called "fracking," is a process that involves high-pressure injection of water, sand, and chemical additives to cause fracturing of sub-surface rock resulting in release of gas or oil trapped inside.

As defined in California state statute, hydraulic fracturing means a well stimulation treatment that, in whole or in part, includes the pressurized injection of hydraulic fracturing fluid or fluids into an underground geologic formation in order to fracture or with the intent to fracture the formation, thereby causing or enhancing the production of oil or gas from a well.[328]

Fracking is a type of well stimulation treatment that is known to boost oil and gas production. Another type of well stimulation treatment also used to increase oil and gas production is acid well stimulation, which introduces one or more acids (applied at any pressure) to a well or geologic formation, either alone or in combination with hydraulic fracturing treatments.

The California oil and gas industry uses a large number of hazardous chemicals during hydraulic fracturing and acid treatments. The use of these chemicals underlies all significant potential direct impacts of well stimulation in California.[329]

Hazards and environmental impacts that could result from fracking and well stimulation include 1) contamination of groundwater with chemicals, 2) air pollution from dispersion of chemicals and gases, and 3) contamination of sub-surface rock formations from the injected chemicals. These concerns exist anywhere fracking is used as a gas and oil extraction method.

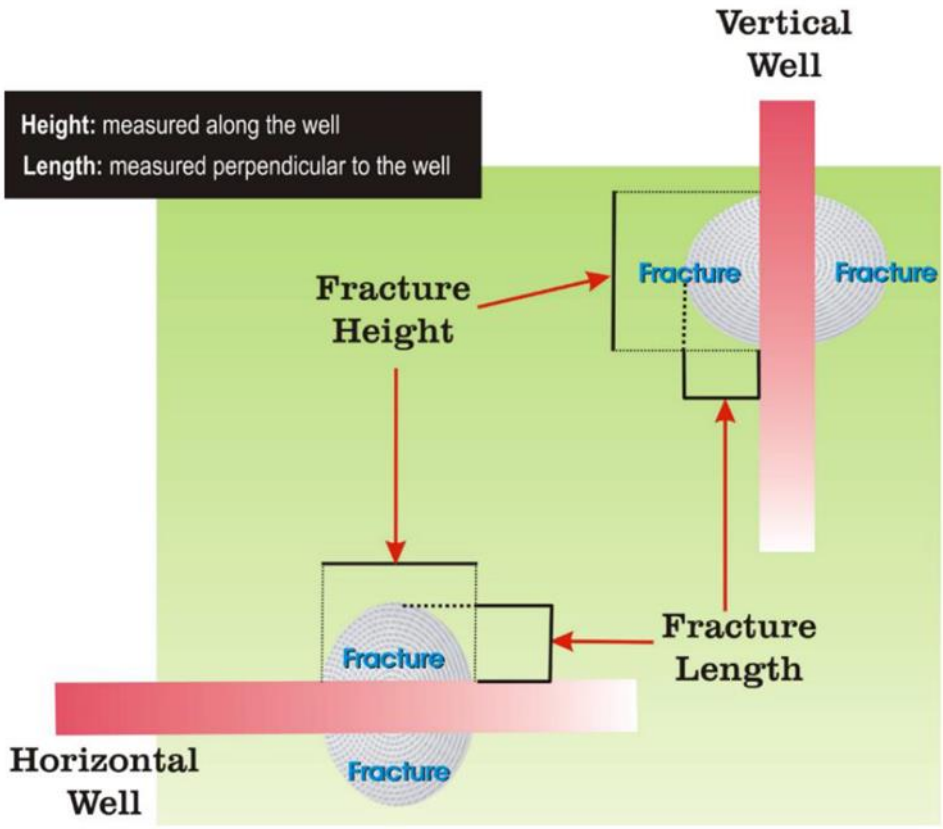
Profiling Well Stimulation and Hydraulic Fracturing Hazards

The more wells that are drilled, the higher the likelihood of some environmental damage, although the amount of damage is unknown. Fracking has been used in the gas and oil business for some time in California, with the majority of wells (approximately 90 percent) being found in Kern County on diatomite-type soils.

Newer technologies, however, allow for possible expansion of the practice to other areas, such as Los Angeles and Monterey Counties. Between July 2015 and June 2016, 579 well stimulations were performed, over 80 percent of them in diatomite formations. Wells in diatomite formation are generally shallow; average fracture height was 150 feet, average length was 76 feet, and average depth was 1,220 to 1,991 feet in 2016.[330] Less water is used in California wells than in wells outside of California. Related well dimensions are shown in Figure 9.E.

[328] Added by Statute 2013, Ch. 313, Sec. 2. Effective January 1, 2014
[329] California Council on Science and Technology 2015
[330] Division of Gas Oil and Geothermal Resources. Well Stimulation Treatment Annual Report, July 1, 2015-June 30th, 2016

Figure 9.E: Use of Height and Length in Describing Well Stimulation Treatment Fractures in California.



Source: Division of Gas Oil and Geothermal Resources. Well Stimulation Treatment Annual Report, July 1, 2015-June 30th, 2016.

As a result of these discoveries and the potential increase in fracking activities in the Central Valley (as well as elsewhere in California), the state legislature passed Senate Bill (SB) 4, which is intended to regulate well stimulation treatments, including fracking. SB 4, which was signed by the Governor in September 2013, amends the Public Resources Code as well as the Water Code.

Current Mitigation Efforts for Well Stimulation and Hydraulic Fracturing Hazards

As more wells were being developed nationally and public awareness of the risk to potable groundwater supplies grew, concern about fracking in California increased.

SB 4, signed by the Governor in September 2013, is intended to regulate well stimulation procedures and encourage development of new science information related to impacts. SB 4 directly supports 2018 SHMP Goal 3*: Protect the environment*.

As part of the SB 4 requirements, the California Natural Resources Agency conducted an independent study on well stimulation treatments that was completed in 2015. This report can be reviewed at the following website: https://ccst.us/projects/hydraulic_fracturing_public/SB4.php

SB 4 provides for oversight in several ways. The following five state agencies and a national lab now are involved in oversight and regulatory activities:

- Division of Oil, Gas, and Geothermal Resources (DOGGR)
- Office of Environmental Health Assessment
- Department of Toxic Substances Control (DTSC)
- State Water Resources Control Board (SWRCB)
- California Air Resources Board (CARB)
- Lawrence Berkeley/Livermore National Laboratories

The collective objectives of these agency efforts are to lower the probability of well failure and to identify any contamination problems quickly and act on measures to limit contamination impacts. The utilization of many state agencies also provides an integrated approach to addressing the threat of well failure and contamination, which directly supports SHMP Goal 4: *Promote community resilience through integration of hazard mitigation with public policy and standard business practices.*

Generally, the contamination of groundwater with chemicals is within the purview of the SWRCB and DOGGR. Contamination of sub-surface rock formations from the injected chemicals is also within the purview of DOGGR. DOGGR developed a set of permanent regulations for well drilling permitting that went into effect in September 2016, replacing an interim regulation process that was in place from July 2015 to June 2016.

DOGGR regulations for acquiring a permit call for review and oversight at three stages: during preliminary stimulation, during stimulation, and after stimulation. The applicant must include a water management plan and a groundwater monitoring plan in the application and obtain California Environmental Quality Act (CEQA) review from the lead agency (generally the local county government).

DOGGR serves as the responsible agency conducting the secondary review. As needed, other state agencies (such as the SWRCB and CARB) can provide additional agency reviews as needed. By addressing well drilling permitting as a three-stage process, consistent information is developed and shared, and the resources of many state agencies can be called upon to address this man-made threat to the environment. As part of the permitting process, DOGGR must post issued permits on the publicly accessible portion of its website.

SWRCB involvement occurs when a well site is close to an area of protected water (greater than 10,000 total dissolved solids). Under those conditions, a water monitoring plan is required to track any potential contamination and to quickly address any occurrences. The regulations are found in Section 10783 of the Water Code.

Air pollution from dispersion of chemicals and gases is the purview of CARB. CARB presently samples some well areas for air pollution related to chemical particulates. In the future, all new well fields developed will be fully monitored for air quality.

The DTSC is concerned with the chemicals and fluids used and their interaction and impact on sub-soil formations.

For the complete text of SB 4, go to:
http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB4

9.3 THREAT AND DISTURBANCE HAZARDS

While of great importance, the human-caused hazard risk assessments included in this section are less comprehensive in scope and content than those included in preceding sections, because threat and disturbance hazards typically affect a smaller geographic area than the hazards addressed in preceding sections.

9.3.1 TERRORISM

Identifying Terrorism Hazards

Technological hazards and terrorism are human-caused hazards. These are distinct from natural hazards in that they originate from human activity. The term "technological hazards" refer to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. For the sake of simplicity, this SHMP assumes that technological emergencies are accidental and that their consequences are unintended.

The term "terrorism" refers to intentional, criminal malicious acts. There is no single, universally accepted definition of terrorism, and the term can be interpreted in many ways. This SHMP uses the federal definition found in the Code of Federal Regulations (28 CFR, Section 0.85): "...the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."

For the purposes of this SHMP, terrorism refers to the use of weapons of mass destruction, including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and cyber terrorism. (Cyber threats are discussed in more detail in *Section 9.3.2*.)

The process of identifying and mitigating hazards before they become disasters is similar for both natural and man-made hazards. Whether dealing with natural disasters, threats of terrorism, or hazardous materials accidents, a four-phase mitigation process should be used: 1) identify and organize resources, 2) conduct a risk assessment and estimate potential losses, 3) identify mitigation actions, and 4) implement the actions, evaluate the results, and keep the plan up to date.

Profiling Terrorism Hazards

Terrorist events have continued to occur in California. From 2001 to 2011, there were 207 terrorist attacks in the United States. California was the leading state with 40 attacks, followed by 19 in New York State. The leading cities were New York (12), Washington, DC (9), and Los Angeles (8). The most common weapons used in the 207 terrorist attacks in the United States from 2001 to 2011 were incendiary devices and explosives. From 2001 to 2011, the most common targets of terrorists in the United States were businesses (62 attacks), private citizens and property (59 attacks), and government (43 attacks). Table 9.V summarizes terrorist events from 2006 to 2016.

Table 9.V: Terrorist Events in California, 2006 to 2016

Date	Location	Description
June 30, 2006	Los Angeles	Attempted firebombing of private home
June 24, 2007	Los Angeles	Attempted firebombing of private home
October 20, 2007	Los Angeles	Flooding of a private home
February 5, 2008	Los Angeles	Arson at a private home
February 17, 2008	Eureka	Arson at a Planned Parenthood facility
April 25, 2008	San Diego	Bombing of a FedEx facility
August 2, 2008	Santa Cruz	Simultaneous firebombing of two separate private homes
March 7, 2009	Los Angeles	Firebombing of a private vehicle

Date	Location	Description
July 3, 2009	Huntington Beach	Racially motivated stabbing of a man
November 16, 2010	Los Angeles	Razor blade booby trap mailed to a private home
April 23, 2011	Stockton	Arson at a mosque
January 8, 2012	Coalinga	Arson at a feedlot
November 1, 2013	Los Angeles	Active shooter targeting Transportation Security Administration (TSA) at Los Angeles Airport
November 4, 2014	Coachella	Drive-by shooting at a mosque
December 7, 2014	Los Angeles	Arson at an apartment complex
September 30, 2015	Thousand Oaks	Arson at a Planned Parenthood facility
November 4, 2015	Merced	Stabbing of students
November 6, 215	Inglewood	Racially motivated assault of a man
December 2, 2015	San Bernardino	Active shooter murder of 14 people
December 11, 2015	Coachella	Firebombing of a mosque
December 26, 2015	Tracy	Firebombing of a mosque
February 28, 2016	Los Angeles	Racially motivated attack of three people
May 25, 2016	Modesto	Firebombing of a Planned Parenthood facility

Source: California Governor's Office of Emergency Services (Cal OES) Homeland Security Division

In addition to the events listed in Table 9.V, there have been numerous crimes by like-minded groups that do not meet terrorism criteria, as well as dozens of terrorism plot disruptions by law enforcement.

Terrorist threats are difficult to predict. Many different groups use terrorist attacks for various reasons. Two things are clear from the perspective of hazard mitigation: the most often used weapons of terrorists in California are incendiary bombs, and the greatest potential for loss is from active shooters or weapons of mass destruction. Additional concerns include the use of chemical and biological weapons.

Assessment of State Vulnerability and Potential Losses

The following infrastructure (listed in order of terrorist attention in their internet messaging) has been identified as meeting one or more state significance criteria and vulnerable to attack from domestic and international terrorists:

- *Transportation Sector*: 50,000 lane miles of highways, 246 public use airports (30 of which provide scheduled passenger service), over 170,000 miles of public roads, more than 12,000 bridges, and 11 seaports (California handles nearly half of all the port traffic in the United States), with 22 assets analyzed as high risk
- *Commercial Facilities Sector*: 236 office and apartment buildings, retail centers, convention centers, and others, 41 of which are analyzed as high risk
- *Government Facilities Sector*: 124 federal, state, and local buildings, 13 of which are analyzed as high risk
- *Communications Sector*: 49 assets including wireline, wireless, satellite, cable, and broadcasting capabilities, with 9 assets analyzed as high risk
- *Energy Sect*or: 114 identified assets comprising 500 power plants, a 25,000-circuit-mile "electron highway," more than 115,000 miles of pipelines, 20 refineries, and over 100 terminal facilities, with 20 assets analyzed as high risk
- *Banking and Finance Sector*: 14 banks and financial institutions, 2 of which are analyzed as high risk
- *Critical Manufacturing Sector*: 27 assets involved in a complex array of manufacturing processes, with 4 analyzed as being high risk
- *Emergency Services Sector*: 47 assets housing California's first responder communities, 8 of which are analyzed as high risk
- *Chemical Sector*: Approximately 100 "high risk" facilities

The vulnerability of various assets to particular threats can change over time. Tracking the vulnerability of different components may be done using various programs and systems, including the National Critical Infrastructure Prioritization Program (NCIPP), California Baseline Infrastructure Prioritization Initiative Project, and other tools that can be used to determine which assets, systems, or networks are nationally critical, state critical, or locally critical based on current risk profiles.

Assessment of Local Vulnerability and Potential Losses

At the local level, law enforcement and public safety agencies designate Terrorism Liaison Officers (TLOs) who are trained in reviewing and assessing local reporting and conducting outreach to other public safety agencies, critical infrastructure operators, and community groups. The TLO is the local agency point of contact for all terrorism-related alerts, requests for information, warnings, and other notifications from regional, state, or federal homeland security agencies. Through a single web-based state terrorism website, the TLO and his or her agency will have access to all available terrorism alerts, notices, information, and documents through a searchable database and daily information exchange with key federal, state, and local agencies.

Vulnerability and loss assessments from terrorism for individual California communities may be found in Local Hazard Mitigation Plans, if the jurisdiction chooses to include them.

Current Terrorism Mitigation Efforts

Homeland Security and the Homeland Security Strategy

Cal OES is California's lead state organization for gathering and disseminating information critical to protecting state assets, creating the state's comprehensive security strategy, and designing and implementing critical state, regional, and local infrastructure protection programs.

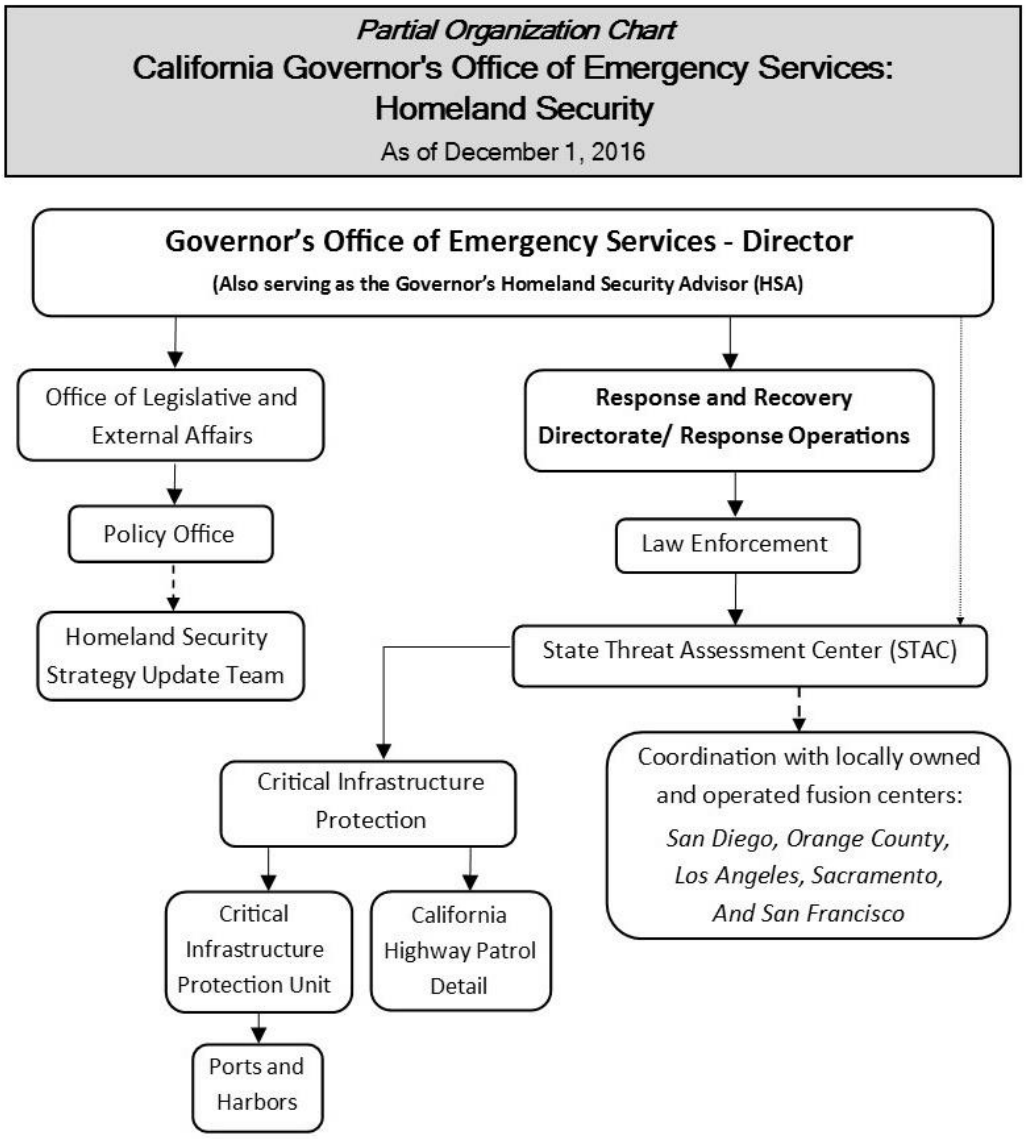
Homeland security is a statewide mitigation strategy to reduce the impact of human-made disaster events. This coordinated effort is focused on capacity-building for public agencies at the state and local level to prepare to prevent, protect against, mitigate, respond to, and recover from threats and acts of terrorism, and other human-made disasters or catastrophes. To carry out this effort, the state uses a risk management process to ensure that California has the right capabilities in place to manage those hazards that pose the greatest risk to its people, its critical infrastructure, and its key resources.[331] Reducing terrorism injury to the citizens of California and protecting vital infrastructure are key factors in the overall effort.

Between 2012 and 2016 Cal OES administered more than $500 million in federal grant funds at the state, regional, and local levels to significantly improve physical security at critical sites, upgrade equipment, and conduct training and exercises.

The Cal OES director is the Governor's Homeland Security Advisor. In 2016, the Homeland Security Advisory Committee (HSAC) was created to advise the Cal OES director on a 2017-2020 Homeland Security Strategy, which is the strategy that guides security activities in the state, as of February 2018. This inclusive committee is composed of federal department representatives, state cabinet members, and state associations (sheriffs, association of counties, etc.). The integration of federal, state, regional, and local entities ensures that the 2017-2020 strategy is a statewide coordinated effort and reflects the input from the main stakeholder groups, consistent with the SHMP strategy to strengthen inter-agency coordination actions, including state, regional, tribal, and local linkages.

[331] http://www.caloes.ca.gov/ICESite/Pages/Homeland-Security.aspx

Figure 9.F: Cal OES Homeland Security Organizational Structure



The HSAC developed 12 goals to guide the new Homeland Security Strategy and its associated objectives and then used 10 working groups to conduct a gap analysis and establish the associated objectives. The Homeland Security Strategy's goals that are closely related to terrorism and infrastructure are:

- Protect Critical Infrastructure and Key Resources from All Threats and Hazards
- Prevent Violent Extremism Through Multi-Jurisdictional/Inter-Jurisdictional Collaboration and Coordination
- Enhance Multi-Jurisdictional/Inter-Jurisdictional All-Hazards Incident Catastrophic Planning, Response and Recovery Capabilities

The 2017-2020 Homeland Security Strategy provides a framework for operating the main homeland security funding programs: Emergency Management Grant Programs, Homeland Security Grant Programs, and Infrastructure Protection Grant Programs. The Homeland Security Strategy also provides guidance to operational units within Cal OES such as the State Threat Assessment Center (STAC), the Cal OES Preventing Violent Extremism Program, and the Critical Infrastructure Protection (CIP) Unit. The organizational structure for this policy and operational effort is shown in Figure 9.F.

State Threat Assessment System

The State Threat Assessment System (STAS) is a key component of California's Homeland Security Strategy. The Cal OES' director, as California's Homeland Security Advisor, created the STAS to provide a framework for cooperative and effective work among federal, state, local, and tribal public safety agencies; criminal intelligence agencies; other state agencies; and critical infrastructure and key resource operators. The STAS assists in the detection, prevention, investigation, and response to criminal and terrorist activity; and disseminates intelligence to and facilitates communications among state, local, federal, and tribal agencies and private sector partners, to help them take action on threats and public safety issues.

The STAS is comprised of the STAC, four Regional Threat Assessment Centers, and one Major Urban Area Intelligence Center. The STAC serves as the state-level partner of the locally owned and operated fusion centers in Sacramento, San Francisco, Los Angeles, Orange County, and San Diego. Specific information about each can be found at the following links:

- STAC: http://www.caloes.ca.gov/cal-oes-divisions/state-threat-assessment-center
- Central California Intelligence Center: https://sacrtac.org
- Joint Regional Intelligence Center: https://www.jric.org
- Northern California Regional Intelligence Center: https://ncric.org
- San Diego Law Enforcement Coordination Center: https://sd-lecc.org
- Orange County Intelligence Assessment Center: https://ociac.ca.gov

The State Threat Assessment Center (STAC), is a partnership of the California Highway Patrol (CHP), California Department of Justice, and Cal OES and has connectivity with and participation of a number of state and federal agencies. The STAC acts as the California statewide information clearinghouse to aid in the prevention, preparation for, and response to strategic threats while preserving individual privacy and constitutional rights. The STAC develops intelligence products, including sector-specific critical information threat bulletins, for the state and local law enforcement, fire, and emergency management communities.

The STAC focuses on analyses of the following threats:

- International and domestic terrorism
- Transnational crime (including countering illicit narcotics trafficking and human trafficking)
- Criminal gangs
- Criminal domestic extremist movements
- Cyber crimes (including threats from state and non-state actors)
- Threats to California's critical infrastructure and key resources
- Threats developing from emerging and disruptive technologies

The Cal OES Preventing Violent Extremism Program

Cal OES established a Preventing Violent Extremism (PVE) Program in order to coordinate a statewide effort aimed at supporting and enriching community resilience against domestic and internationally inspired violence, beginning in January 2017.

The Cal OES PVE Program leverages existing state, federal, and private/non-profit partner resources in order to support community-led preventing violent extremism programs and to encourage further engagement in prevention efforts. As part of this effort, Cal OES has identified and assessed relevant trainings, funding opportunities, social service programs, global networks, and education initiatives offered by state, federal, and private partners in California.

This assessment of trainings, grants, social service programs, education initiatives, and PVE global networks throughout California was a necessary step in coordinating a statewide program aimed at connecting communities to the resources that meet their unique needs. The program has enhanced these five resources in order to meet

gaps in community needs and services and assist communities in building their own locally led prevention or intervention frameworks.

Further, the Cal OES PVE Program manages a website, equipped with a resources database and a Community Portal, which is an interactive platform that facilitates information sharing of best practices, knowledge, program models, and challenges among practitioners and communities. This website also hosts a virtual training aimed at assisting interested local governments in building program frameworks to enhance local resiliency against all forms of violence, at no cost to participants.

Additionally, Cal OES will fund non-profit pilot projects that support the PVE objectives outlined in the 2017-2020 Homeland Security Strategy. The PVE Non-Profit Pilot Grant Program supports five projects that will develop innovative and sustainable products by the end of the 18-month performance period, which will be completed in April 2020. This funding opportunity also aims to strengthen partnerships between community organizations and local, regional, and state government.

Protecting Critical Infrastructure

Since 9/11, California has worked closely with the federal Department of Homeland Security to enhance protection of California's complex and interdependent critical infrastructure and key resources.

Tactical security improvements must be rapidly implemented to deter, mitigate, or neutralize potential attacks. To facilitate the accomplishment of Homeland Security Presidential Directive 7 (HSPD-7), California's Critical Infrastructure Protection Objectives, described in the State's Homeland Security Strategy, are three-fold. California is committed to:

- Identifying and assuring the protection of infrastructures and assets deemed most critical in terms of consequences of terrorist attacks or natural disasters that impact California's public health and safety, governance, economic and national security, and public confidence
- Providing timely warning and assuring the protection of infrastructure and assets that face a specific, imminent threat
- Assuring the protection of other infrastructure and assets that may become terrorist targets over time by pursuing specific initiatives and enabling a collaborative environment in which federal, state, and local governments and the private sector can better protect the infrastructures and assets they control

On February 12, 2013, President Barack Obama signed the Presidential Policy Directive-21 (PPD-21). This directive, which superseded HSPD-7, advances a national unity of effort to strengthen and maintain secure, functioning, and resilient critical infrastructure. PPD-21 emphasizes that critical infrastructure must be secure and able to withstand and rapidly recover from all hazards.

The Cal OES Critical Infrastructure Protection (CIP) Unit works to address emerging issues related to the many varied aspects of infrastructure protection. The CIP Unit provides a mechanism to foster relationships and facilitate coordination between public-private partnerships throughout infrastructure sectors. The CIP Unit's key initiatives and services include critical infrastructure identification and prioritization, physical security and vulnerability assessments, information sharing, geospatial information systems analysis and mapping, and Threat and Hazard Identification and Risk Assessment (THIRA).

In 2010, the CIP Unit undertook an effort designed to establish criteria for defining "state significant" infrastructure, to identify assets meeting those criteria, and to perform a baseline risk analysis and prioritization. The CIP Unit collected data through open source research and subject matter expert collaboration, and analyzed the data by applying a risk scoring methodology to each asset. The end result was a risk-informed list of California's most significant infrastructure across 15 sectors.

California chooses to recognize the following critical infrastructure sectors: Chemical and Hazardous Materials; Commercial Facilities; Communications; Critical Manufacturing; Dams; Defense Industrial Base; Emergency Services; Energy; Financial Services; Food and Agriculture; Government Facilities; Healthcare and Public Health; Information Technology; Nuclear Reactors, Materials, and Waste; Transportation Systems; and Water and Wastewater Systems.

California accounts for assets in one remaining federal sector, Defense Industrial Base, within the Manufacturing sector. The CIP Unit's effort allows the state to make informed decisions related to the vast amount of critical infrastructure that exists. The CIP Unit used the Department of Homeland Security's MSHARRPP+V system of determining risk and vulnerability[332] as its risk-informed prioritization tool to focus on physical security and human-caused threat. This tool allows for systematic ranking of infrastructure by overall risk, or by any of its components. The outcomes can be used to make mitigation investments in the 15 critical infrastructure sectors. For example, the outcomes using this approach show the Commercial Facilities and Transportation Systems sectors having the highest risk scores, while the lowest risk scores are in Emergency Services; Nuclear Reactors, Materials, and Waste; and Food and Agriculture.[333]

Nuclear Detonation Response Program

Cal OES is California's lead agency in preparing the state for an attack using nuclear weapons. The spread of scientific and technical information has increased the risk that terrorists possessing sufficient nuclear material may attempt to develop their own improvised nuclear device. The national planning scenario for nuclear terrorism presumes an improvised nuclear device with a yield of 10 kilotons detonated at ground level in a major U.S. city.

The possibility also exists that a nation-state with nuclear capability may launch a nuclear attack against the United States. California, with its large population, substantial economic value, strategic military bases, and land and maritime border, represents a significant potential target. A nation-state with a dedicated nuclear program might develop weapons with higher potential yields, up to 100 kilotons or more.

The purpose of the Nuclear Detonation Response Program is to develop the State Nuclear Detonation Response Plan (NDRP). The NDRP provides a framework that describes how local, state, and federal partners will respond and coordinate following a nuclear detonation in California. The primary focus of the NDRP is the prompt execution of actions that will save lives and reduce injuries. The NDRP focuses on the immediate response phase, beginning with the notification of an attack or nuclear detonation and continuing through approximately 72 hours, at which point it is expected that state and federal resources will have begun integrating into a unified response organization.

Development of the NDRP began in 2017 with the drafting of the Base Plan. The Base Plan includes the actions the state will take in the first 15 minutes, 24 hours, and 72 hours in the event of a nuclear detonation. These actions include focusing on communicating with the public the risks of dangerous fallout from a nuclear blast. In 2018, continued NDR planning efforts include creating tactical level procedures and checklists for key state agencies and organizing a coordinated communications plan for alerting and messaging with state and local officials. Socialization of the plan and media outreach to the public will begin in late 2018.

Maritime Security

The California Maritime Security Council (CMSC) was created by Executive Order S-19-06 to enhance port security through statewide collaboration and information sharing. The CMSC works directly inside of the STAC operations to analyze seaport threats and develop a statewide maritime security strategy. There are maritime operatives assigned to Southern and Northern California and co-located with U.S. Naval and Coast Guard Intelligence. They are embedded in Port Security and/or U.S. Coast Guard Law Enforcement. There are also Area Maritime Security Committees that focus on the same duties as the CMSC, but at a regional level.

[332] MSHARRPP+V stands for: Mission, Symbolism, History, Accessibility, Recognizability, Recoverability, Population, Proximity,+ vulnerability. It is a systematic approach to assign a numerical score to each asset based on nine characteristics.
[333] Cal OES CIP Baseline Infrastructure Prioritization Initiative Report, June 30,2015.

Protecting the Food Supply

Collaboration continues among the Western Institute for Food Safety and Security (WIFFS), California Department of Food and Agriculture (CFDA), California Department of Public Health (CDPH), and UC Davis. The WIFFS is built on the functional relationships of these organizations and the private sector on the challenges of preventing intentional and unintentional contamination of food.

Grants Management

The Homeland Security Grant Section is responsible for the overall grant management of California's State Homeland Security Grant Program, Urban Security Initiative, Metropolitan Medical Response System, and Citizen Corps Program Grant Program.

The Homeland Security Grant Section conducts grant management and grant application workshops throughout the state. Programs addressed in the workshops include the following:

- Emergency Management Grant Programs
- Homeland Security Grant Programs
- Infrastructure Protection Grant Programs

California has made significant investments in homeland security. Table 9.W shows homeland security grant expenditures for the 2012-2016 period.

Table 9.W: Homeland Security Grant Program (HSGP) Expenditures, 2012-2016

HSGP Year	Solution Area					
	Planning	**Organization**	**Equipment**	**Training**	**Exercise**	**Total**
2012	$21,766,785	$12,365,244	$86,127,500	$10,264,394	$2,204,314	**$132,728,237**
2013	$20,368,513	$21,762,571	$76,308,843	$15,383,801	$2,864,492	**$136,688,220**
2014	$25,513,892	$25,912,786	$88,345,926	$15,770,284	$3,332,749	**$158,875,637**
2015	$13,118,333	$15,207,438	$34,517,803	$6,038,832	$2,172,832	**$71,054,868**
2016	$79,251	$84,415	$1,507,486	$158,559	$75,024	**$1,904,735**

Source: State of California, Automated Ledger System (ALS)

9.3.2 CYBER THREATS

Identifying Cyber Threats

Cyber threats are attempts by cyber criminals to attack a government, organization, or private party by damaging or disrupting a computer or computer network, or by or stealing data from a computer or computer network for malicious use.

A recent survey by the United States Government Accountability Office found that "agencies having high-impact systems identified cyber-attacks from 'nation-states' as the most serious and most frequently-occurring threat to the security of their systems."[334]

Profiling Cyber Threats

Nationally, cybersecurity incidents such as financial fraud and government database breaches have increased from 5,503 in 2006 to 67,168 in 2014.[335] This increase raises the question of whether there is a cybersecurity threat in California. Between 2012 and 2015, 50 million records of Californians were breached, and the majority of these breaches resulted from security failures, with malware and hacking; physical breaches constituted three quarters of all events.[336] As use of digital information expands, Californians will increasingly become more vulnerable to the slow-moving, potential technological hazard of cyber damage.

Assessment of State and Local Vulnerability and Potential Losses

Overview

Cyber vulnerability can occur in a variety of ways, including:

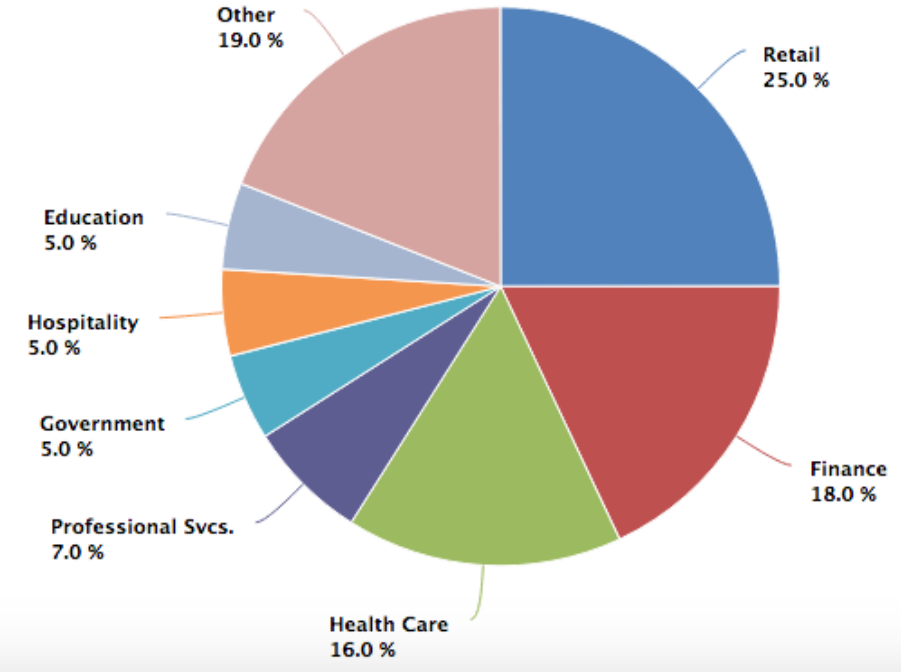
- Loss or theft of computer resources, assets, and funding
- Inappropriate access to and disclosure of personal and secure information
- Disruption of services
- Damage to networks
- High cost of remediation
- Disruption of essential operations supporting critical infrastructure needed for emergency management

Figure 9.G shows that there are cyber threats in all sectors of California's private and public life; with the retail, finance, and health sectors being most affected.

The state collects and processes data on a continuous basis (e.g., from motor vehicle records, through sales taxes) and is thus subject to all types of cyber threats. In 2016, the California Department of Technology (CDT) success rate in preventing unauthorized access to critical and sensitive data in the state data center was 99 percent, while there were 30 data breaches of personally identifiable information.[337]

[334] http://www.gao.gov/products/GAO-16-501?utm_source=blog&utm_medium=social&utm_campaign=watchblog, visited March 8, 2017
[335] Government Accountability Office, GTA -10-758T
[336] California Data Breach Report, California Department of Justice, February 2016
[337] California Department of Technology 2016 Annual Report

Figure 9.G: California Business Sectors Affected by Cyber Threats



Source: California Department of Justice, California Data Breach Report, February 2016. Figure 12, Breaches by Sector).

Assembly Bill 670 and Annual Vulnerability Assessment

Information security policy plays a critical role in the State of California and is vitally important to state government operations and service delivery. The CDT is the primary state government authority responsible for establishing policies for confidentiality, integrity, and availability of state systems and applications. It guards public data, is a leader in information technology services and solutions, and has broad responsibility and authority over all aspects of technology in California state government, including policy formation, inter-agency coordination, and advocacy. For more information about CDT, visit: https://cdt.ca.gov/about/.

To remain at the forefront, CDT adopted a Program Management Framework that shifts the state from a compliance-based practice to one that protects the highest-value assets through a management and risk-based approach. This approach provides a simplified set of 30 objectives mapped to 12 domains that security practitioners can use as focus areas for building a security program. The framework also allows state entities to assess, manage, and mature their security posture.

Assembly Bill (AB) 670 (Irwin, 2015) requires CDT to coordinate 35 vulnerability assessments each calendar year. State agencies will undergo these independent security assessments every two years based upon CDT's assessment criteria. The primary provider for this service is the California Military Department, through the Cal Guard Computer Network Defense Division. The resultant data are presented to the assessed state entity and CDT to allow them to implement and track remediation efforts.

CDT initiated an Information Security Audit Program to measure the effectiveness of its statewide policy and guidelines. The driver for the audit program is the need to assure that state entities are implementing appropriate administrative, operational, and technical information security safeguards. In 2016, this program was piloted in six state entities. Over time this audit may be used by all California levels of government to conduct vulnerability assessments.

Current Cyber Threat Mitigation Efforts

Certain mitigation efforts require cross-agency collaboration such that multiple agencies come together and work as a group toward specific mitigation goals. The State of California pursues a unified multi-department and partnering effort in addressing cyber threats. Many departments participate in four areas of activities:

- Threat monitoring
- Incidence response
- Prevention
- Education

State Emergency Plan, Cal OES, and Cyber Security

The 2017 State Emergency Plan (SEP) adds cyber security as a new California Emergency Support Function category (CA-ESF 18) and assigns Cal OES as the lead agency. Adding cyber security to the Emergency Support Function list is a recognition that cyber threats are a real and ongoing hazard. Unlike natural hazards, for which historical data are available and future events can be modeled, cyber threat is an emerging hazard, which can be more challenging to anticipate.

The SEP defines cyber security as "the protection of data and systems in networks that are connected to the Internet, including measures to protect critical infrastructure services. These services may include essential communications such as voice, email, and Internet connectivity,"

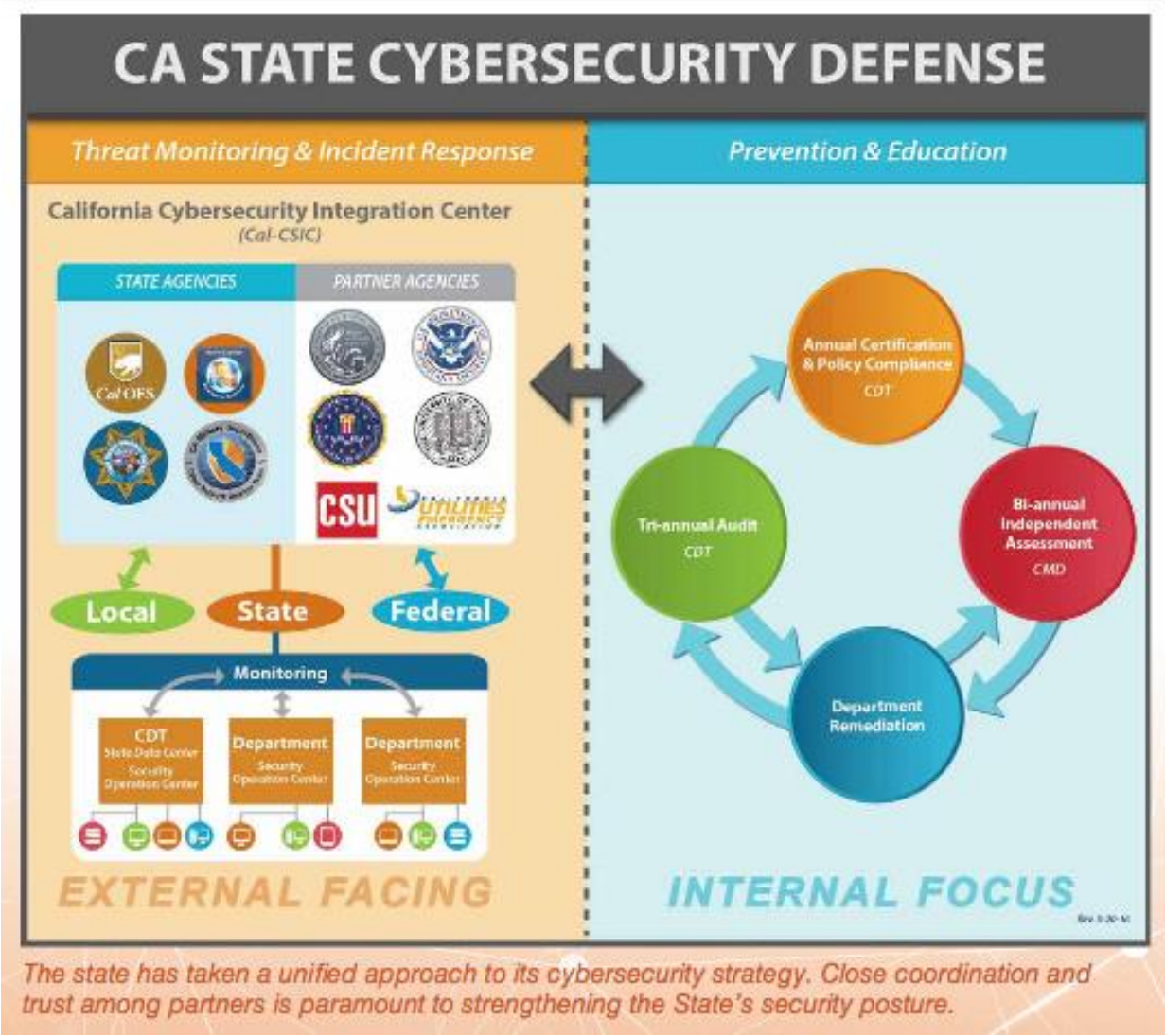
Since cyber attacks have the potential to occur on any day at any time, they are an ongoing, instantaneous threat, and integrated efforts are needed to prepare for, mitigate, respond to, and recover from these attacks. This integrated cyber security effort is led by Cal OES. In the lead agency role for cyber security defined by the SEP, Cal OES coordinates with other state agencies designated as support agencies and manages and operates the California Cybersecurity Integration Center (Cal-CSIC).

California Cybersecurity Integration Center and California Cybersecurity Task Force

The major cyber security efforts are conducted by CDT, Cal OES, the California Military Department, and the CHP, with those efforts grouped into two sectors—external facing and internal focus—as shown in Figure 9.H. The external-facing actions are coordinated through the work of the California Cybersecurity Integration Center (Cal-CSIC).

In 2013, Cal OES and CDT initiated the Cybersecurity Task Force to address the growing need for integrated action. In 2015, through Executive Order B-34-15, the Governor designated Cal OES to lead the Cal-CSIC.

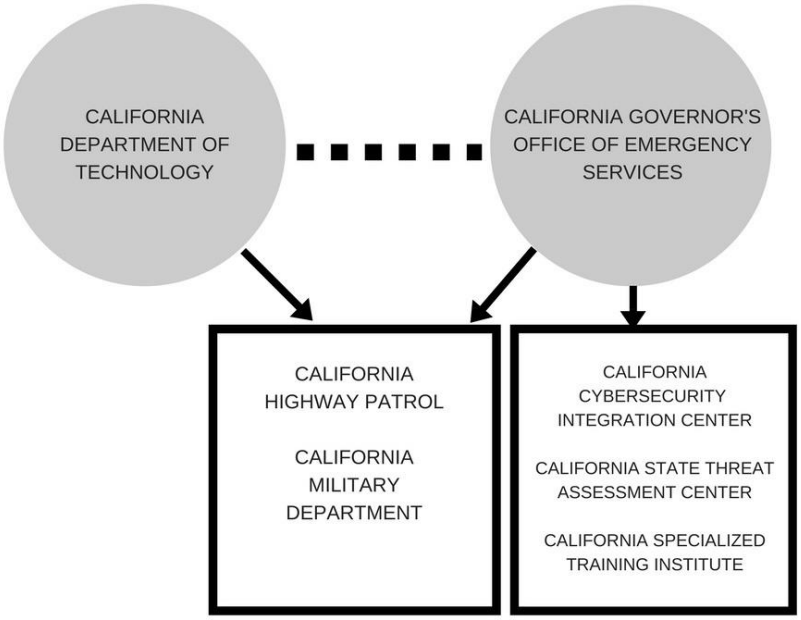
Figure 9.H: California Cyber Defense



Source: 2016 Annual Report California Department of Technology, p 9).

The Cal-CSIC's primary mission is to reduce the likelihood and severity of cyber incidents that could damage California's economy, its critical infrastructure, or public and private sector computer networks. The Cal-CSIC serves as the organizing hub of state government's cyber security activities and coordinates information sharing with local, state, and federal agencies, tribal governments, utilities and other service providers, academic institutions, and non-governmental organizations. Figure 9.I shows how the Cal-CSIC is linked to other agencies. This work directly puts into practice integration and thus addresses SHMP Goal 4: *Promote community resilience through integration of hazard mitigation with public policy and standard business practice*.

Figure 9.I: California Cybersecurity Integration Center (Cal CSIC) Linkage to Other Agencies



As nearly 95 percent of the nation's entire critical infrastructure is owned and operated by private industry, partnerships with California's private sector are critical to enhancing the cyber threat intelligence picture and state government's ability to respond effectively to significant cyber incidents.

The Cal-CSIC encourages private sector partnerships and hopes to foster a community of information sharing and mutual aid. Part of this effort is the California Cybersecurity Task Force, a statewide partnership comprised of key stakeholders, subject matter experts, and cyber security professionals from California's public sector, private industry, academia, and law enforcement.

The Task Force serves as an advisory body to State of California senior administration officials in matters related to cyber security. The Task Force is made up of the following seven subcommittees, each created to address specific Task Force goals and to support integration:

1. Cyber Risk Management Subcommittee
2. Information Sharing Subcommittee
3. Workforce and Education Development Subcommittee
4. Economic Development Subcommittee
5. Critical Infrastructure Subcommittee
6. High Tech and Digital Forensics Subcommittee

For more information about the Task Force and its subcommittees, visit: http://www.caloes.ca.gov/for-individuals-families/cybersecurity-task-force and http://www.caloes.ca.gov/for-governments-tribal/plan-prepare/cybersecurity-task-force/task-force-subcommittees

The Cal-CSIC is charged with a series of activities:

- *Operate* in close coordination with the California State Threat Assessment System and the U.S Department of Homeland Security - National Cybersecurity and Communications Integration Center, including sharing cyber threat information that is received from utilities, academic institutions, and private companies;

- *Establish* a Cyber Incident Response Team to serve as California's primary unit to lead cyber threat detection, reporting, and response in coordination with public and private entities across the state;
- *Provide* warnings of cyber attacks to government agencies and non-governmental partners;
- *Coordinate* information sharing among these entities, and assess risks to critical infrastructure and information technology networks;
- *Prioritize* cyber threats and support public and private sector partners in protecting their vulnerable infrastructure and information technology networks, and enable cross-sector coordination and sharing of recommended best practices and security measures;
- *Support* cyber security assessments, audits, and accountability programs that are required by state law; and
- *Develop* a statewide cyber security strategy, informed by recommendations from the California Cybersecurity Task Force. The cyber security strategy will be developed to improve how cyber threats are identified, understood, and shared in order to reduce threats to California government, businesses, and consumers.

Four primary Cal-CSIC outcomes are envisioned:

- *Actionable Intelligence:* The use of timely, accurate, and relevant intelligence to enhance decision-making and security of the state networks.
- *Network Resiliency:* The ability to disseminate security controls and alerting rules directly to partner networks and increase their resilience.
- *Incident Monitoring and Response*: Visibility into incidents affecting the state, and the ability to provide support coordination to critical incidents as they arise.
- *Security Solutions Engineering:* The ability to support partners by integrating Cal-CSIC security solutions into their infrastructures.

State Threat Assessment System and State Threat Assessment Center

In April 2016, Cal OES started the Cal-CSIC alongside the State Threat Assessment Center (STAC), California's information sharing clearinghouse of strategic threat analysis and situational awareness reporting. This co-location ensured immediate collaboration across the State Threat Assessment System (STAS), California's intelligence community.

The STAS helps safeguard California communities by serving as a dynamic security nexus comprised of the state, four Regional Threat Assessment Centers, and a major urban area fusion center. The STAS assists in the detection, prevention, investigation, and response to criminal and terrorist activity, and disseminates intelligence to and facilitates communications among state, local, federal, and tribal agencies and private sector partners to help them take action on threats and public safety issues. (See additional discussion of the STAS in *Section 9.3.1*)

Since April 2016, Cal-CSIC representatives from Cal OES, CDT, the California Military Department, and the CHP have been pooling resources to implement cyber vulnerability assessments and develop intuitive cyber threat alerts for the end user.

In July 2016, the Cal-CSIC hosted a Cyber Workshop where cyber security professionals from state government and the STAS met to discuss significant milestones in state cyber security and identify solutions to enhance cyber intelligence and incident response capabilities. Three primary goals stemmed from the workshop:

1. Collaborative development of a secure communications capability across STAS cyber elements
2. The standardization of intelligence tools and information streams, guaranteeing continuity and regional situational awareness
3. An education and professional development program to promote lateral training and enhance cyber capabilities for each fusion center

The STAS members include:

- California State Threat Assessment Center (STAC)
- Central California Intelligence Center (CCIC)
- Joint Regional Intelligence Center (JRIC)
- Northern California Regional Intelligence Center (NCRIC)
- Orange County Intelligence Assessment Center (OCIAC)
- San Diego Law Enforcement Coordination Center (SD-LECC)

The State Threat Assessment Center (STAC) is California's state primary fusion center, as designated by the Governor of California, and is operated by the CHP, Cal OES, and the California Department of Justice. Fusion centers are intended to assimilate cyber threat information from various sources, analyze acquired information for threat implications, and disseminate the information to various state, local, tribal, and private sector entities, and law enforcement.

In 2009, the STAC formalized its partnership through a Memorandum of Understanding between the California Department of Justice, Cal OES, and the CHP; the latter is vested with the day-to-day command and management of the STAC.

The STAC produces tailored all-source strategic intelligence designed to alert and inform California's policymakers and other public safety personnel on the numerous threats facing the state every day. Among the STAC threat domains are 1) cyber crimes (including threats from state and non-state actors), 2) threats to California's critical infrastructure and key resources, and 3) threats developing from emerging and disruptive technologies.

For more information regarding the STAC, visit: http://www.caloes.ca.gov/cal-oes-divisions/state-threat-assessment-center.

Evolving Training: California Cyber Training Complex

In 2017, the California Cyber Training Complex (CCTC) began as a multi-agency effort to protect California through enhanced cyber crime forensics and statewide tactical response training.

The CCTC is located centrally within California at Camp San Luis Obispo. This is close to the second largest fiber hub in the United States, allowing for high bandwidth communication and collaboration on data-intensive problems. Multiple law enforcement agencies already train at Camp San Luis Obispo, which serves as a base for the National Guard's Cyber Protection Team.

The mission of this unique program is to prepare law enforcement agencies and the nation's future cyber workforce in making California the most proactive state in the nation in addressing cyber threats. The CCTC includes a crime field training complex, a digital forensics lab, a cyber-academic training center and a test range and experimental laboratory. For the next few years the focus is on training local law enforcement, and California agency personnel (such as the CHP). In June 2017, the CCTC held a cyber-challenge event for high school students to develop interest in the cyber issues facing California.

Protecting Critical Power Grid Infrastructure

To protect power grid integration from cyber threats in California, the California Public Utilities Commission (CPUC) has funded a cyber-information sharing program, California Energy Systems for the 21st Century (CES-21). The research and development being pursued in this program has the potential to change the way utilities protect their critical assets.

CES-21, launched in 2014, aims to provide accurate and fast communication of cyber threats and the development of automated response capabilities to be executed prior to critical infrastructure damage. This initiative includes a team of technical experts from California's three largest public utilities —Pacific Gas and Electric Company (PG&E),

Southern California Edison and San Diego Gas and Electric (SDG&E)—and the Lawrence Livermore National Laboratory that will perform research in power grid cyber security.

The 2016 report on CES -21 related to cyber security states:

> *Given that 2015 was the startup year for the program, the learnings regarded the coordination of different utilities and national labs, as well as initial technical development. Model fidelity as a decision point for utilities working to produce models that are both extensible and actionable. If a model (and the language used to encode it) is too specific, it cannot be used by utilities with different equipment or configurations. If it is too vague, the results of the model are not actionable or applicable for a single utility.*
>
> *Finding the effective compromise between these extremes is an important step toward producing a model that can be productized by the private sector and used by utilities across the country. The work to automate the grid's cyber threat responses is nascent but fast growing. California is at the forefront of a research area that is attracting increased funding at the state and federal level for machine-assisted threat detection for industrial control systems.*

9.3.3 CIVIL DISORDER IN CALIFORNIA

The term "civil disorder" is defined by 18 U.S. Code Section 232 as any public disturbance involving acts of violence by assemblages of three or more persons, that causes an immediate danger of or results in damage or injury to the property or person of any other individual.

Civil disorders occur in California sporadically, and last from a few days to months. There are various causes, all man-made. All begin as local events; therefore, mitigation measures need to be planned and carried out locally and be supported by mutual aid agreements from near-by agencies. Extensive loss of life and loss of property have occurred in the last 25 years.

As summarized in the Table 9.X, there have been several significant civil disorders in the state since 1965 and more recently. These disorders have all taken place in metropolitan areas.

Table 9.X: Summary of Significant Civil Disorders in California

Disturbance	Location	Year	Deaths	Injuries	Damage
2016 Election Protests–*Protests against the election of Donald Trump. Thirty protesters were arrested, and three officers were injured.*	Oakland	2016	0	3	n/a
2016 Civil Disorder–*A rally of left-wing protesters and white nationalist groups outside the California State Capitol on June 26, 2016. Ten people were hospitalized for stabbing and laceration wounds.*	Sacramento	2016	0	10	n/a
2014 Oakland Riots–*A series of riots and civil disturbances following the decision of a Grand Jury in St. Louis not to charge Darren Wilson in the shooting death of black teenager Michael Brown in Ferguson, Missouri.*	Oakland	2014			n/a
2013 Oakland Riots–*Riots that occurred when protesters took to the streets on July 13, 2013, following the acquittal of George Zimmerman in the shooting death of Trayvon Martin.*	Oakland	2013	0	2	n/a
2012 Anaheim Police Shootings and Protests–*Two fatal shootings by police officers and subsequent public protests.*	Anaheim	2012	0	6	n/a
2011 Occupy California Protests–*Protests in 50 large and small cities and college campuses, along with 50,000 people participants in Occupy Oakland.*	Various	2011	0	1	$2.4 million
1992 Los Angeles Riots–*Riots that lasted six days and were a response to the acquittal of police officers for the beating of Rodney King*.	South Los Angeles	1993	50	Over 2,000	More than $1.0 billion
1965 Watts Riots–*ace riots that took place in the Watts neighborhood of Los Angeles.*	South Central Los Angeles	1965	34	1,032	$40 million

CHAPTER 10 – GRANTS MANAGEMENT CAPABILITIES AND ENHANCED PLANNING EFFORTS

CHAPTER CONTENT

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About Chapter 10

The strength of California's mitigation program is the diversity of efforts by various agencies throughout the state. Chapter 10 provides additional detail on the comprehensive and integrated nature of California's mitigation efforts, details the Federal Emergency Management Agency (FEMA) grant programs administered by the California Governor's Office of Emergency Services (Cal OES), and summarizes efforts by California to assess mitigation actions in order to inform the State Hazard Mitigation Plan (SHMP) strategies.

While this chapter addresses components of the enhanced state plan requirements of the FEMA State Mitigation Plan Review Guide, additional information responding to and meeting the enhanced element requirements is also found in the 2018 SHMP *Chapters 1 through 9* and the annexes and appendices.

10.1 INTEGRATION WITH OTHER PLANNING INITIATIVES

Under FEMA guidance for Enhanced Plans 44 Code of Federal Regulations (CFR) Section 201.5(b)(1), a state must detail how its plan is specifically integrated into other state, regional, and FEMA initiatives providing primary guidance for mitigation-related activities.

California's hazard mitigation efforts are more integrated in 2018 than any other time in its history. Examples of SHMP integration with other hazard mitigation planning initiatives are found throughout *Chapters 2 through 9* of the 2018 SHMP.

Chapter 2 presents the general legal, institutional, and policy framework that integrates mitigation practice in California. It also summarizes integration of the SHMP with other planning, emergency management and climate adaptation efforts. *Section 2.2.2* discusses coordination among agencies including sector specific coordination.

State mitigation goals and objectives are found in *Chapter 3*. The chapter also describes state mitigation strategies that emphasize horizontal coordination between state agencies and the private sector, as well as vertical coordination among federal, state, and local agencies. SHMP Strategy 2 calls for strengthening of inter-agency coordination actions.

Chapter 4 examines the complex relationships involving California's disaster history, growth factors exacerbating hazards and risk, development trends, vulnerable populations and new statewide climate change mitigation and adaptation planning initiatives. Notably, the Safeguarding California Plan: 2018 Update integrates hazard mitigation planning with statewide and climate change adaptation initiatives. The Safeguarding California Plan is a benchmark document that all state agencies can refer to in aligning their mitigation efforts to the state adaptation policy.

Chapters 6 through 9 present multiple statewide, regional, and local hazard mitigation programs, strategies, and projects addressing specific natural hazards. *Chapter 6, 7, and 8* focuses on plans and projects aimed at mitigating earthquake and geologic, flood, and wildfire hazards, risks, and vulnerabilities. Chapter 9 describes mitigation initiatives geared toward reducing losses from secondary hazards, such as climate change impacts, and technological hazards such as cyber threats and hazardous materials releases.

The following sections directly addresses the issue of integration with other planning initiatives by providing information on multiple dimensions—legislative, policy, state agency, and financial—and offering examples of how these dimensions are being manifested in day-to-day action.

10.1.1 LEGISLATIVE AND POLICY INTEGRATION

California's substantial body of state law dealing with hazards has grown over the past several decades. Crafted in response to a succession of disasters (see *Chapter 1, Section 1.4, and Annex 1: Guide to California Hazard Mitigation Laws, Policies, and Institutions*), legislation has been largely incremental, addressing specific issues perceived as problems. Incremental adjustment is the general process used by the California legislature and the executive branch to address state issues.

Examples of legislative and executive-level mitigation integration include state-local and public-private sector integration initiatives. An example of a state-local integration initiative is Senate Bill (SB) 379 (2015). SB 379 establishes a state-mandated climate adaptation requirement and further strengthens the general plan safety element's hazard mitigation content by requiring that climate adaptation and resiliency strategies applicable to the jurisdiction be addressed its next required general plan element update (Section 65302(4)). For more information about SB 379 (2015), see *Section 4.3.6.2*.

10.1.2 STATE AGENCY INTEGRATION

Supporting integration of hazard mitigation efforts in California has been a three-decade effort that started in 1991 with Governor's Executive Order W-9-91, which authorized the Director of the California Governor's Office of Emergency Services (Cal OES) to assign specific emergency support functions to state agencies through administrative orders.

Horizontal and vertical integration continues to be an ongoing process in California as shown by 2018 SHMP Goal 4 that promotes integration of mitigation efforts and policy within and among state agencies and with regional and local jurisdictions.

Parallel to this general movement toward formal integration, California has increased state-level coordination by expanding of the State Hazard Mitigation Team (SHMT) and promoting participation of all members in SHMP goals, objectives, strategies, and hazard assessment material. The interagency coordination accomplished through the SHMT informs the state's mitigation strategy. Strategic working groups have also been used in the last two SHMP updates to strengthen horizontal integration. See *Section 2.1* for more information on both the SHMT and strategic working groups.

Horizontal Integration Examples

Augmenting horizontal integration are various agency programs and actions demonstrating such integration. For example, Assembly Bill (AB) 162 (2007) requires inclusion of floodplain mapping in various elements of local general plans. A 2010 California Department of Water Resources (DWR) user guide for local governments, reinforces state and local floodplain management linkages. AB 162 and SB 5 (2007) direct cities and counties to integrate flood hazards into general plans statewide and also require local general plans in the Central Valley to be revised to be consistent with the regional Central Valley Flood Protection Plan, adopted in 2012. Another example of horizontal integration is Cal OES's Climate Change Working Group, which works to strengthen interagency coordination and information across programs and ensure projects and planning take into account impacts of climate change.

Cal OES's mitigation grants program review process relies on other state agency staff with relevant subject area expertise, such as the DWR, the California Governor's Office of Planning and Research (OPR), and the Department of Forestry and Fire Protection (CAL FIRE), to rate and rank local jurisdiction subapplicant grant proposals for funding. This consultation helps Cal OES identify and fund project proposals. Thus, the grant subapplication review process supports vertical integration of mitigation knowledge and practice from state agencies to sub-state jurisdictions.

For example, dam safety emergency action plans, required by SB 92 (2017), are reviewed by Cal OES's Dam Safety Planning Division. Inundation maps approved by DWR, Division of Safety of Dams, are integrated into these emergency action plans. The mitigation grants are potentially available to help local agencies finance the preparation of inundation maps and emergency action plans (EAPs) under SB 92. To further this integration, Cal OES encourages jurisdictions with dams to identify the dam inundation areas in their Local Hazard Mitigation Plans (LHMPs). For more integration information, see *Section 2.3*.

Cal OES also submits the Pre-Disaster Mitigation (PDM)/Flood Mitigation Assistance (FMA) projects selected for FEMA submittal to the State Clearinghouse (SCH) for review. The SCH coordinates the state-level review of environmental documents that are prepared pursuant to the California Environmental Quality Act (CEQA). As a division of OPR, the SCH is at the center of state agency involvement in the CEQA environmental review process. The SCH functions as the "State Single Point of Contact" for coordinating state and local review of applications for federal assistance under select programs. In this capacity, the SCH coordinates state and local review of federal financial assistance applications, federally required state plans, direct federal development activities, and federal environmental documents. The purpose of the process is to allow state and local participation in federal activities occurring within California.

Vertical Integration Examples

Vertical integration is strengthened by the fact that the SHMT provides a strong link between state and local government. Most agencies have long-established relationships with first responders, city managers, county administrative officers, and other local government entities, such as the San Francisco Bay Conservation and Development Commission (BCDC) (http://www.bcdc.ca.gov/). Examples of such vertical coordination include 1) CAL FIRE's Land Use Planning Program, which implements SB 1241 (2012) directing counties in CAL FIRE'S State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs) to take special precautionary measures related to wildfire hazards and threats; and 2) DWR's administration of flood mitigation assistance activities.

Emerging agency integration efforts include creation of task forces, such as the Fire Service Task Force on Climate Impacts and the California Cybersecurity Task Force, which support statewide partnerships comprised of key state agency stakeholders, local jurisdictions, and subject matter experts and professionals from California's public sector, private industry, academia, and law enforcement.

Other vertical integration efforts include the development of planning alignment resources through collaboration of state and federal agencies for use by local jurisdictions. One example is the Coastal Plan Alignment Compass, which was developed through collaborative efforts of National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), Federal Emergency Management Agency (FEMA), Cal OES, the Governor's Office of Planning and Research (OPR), California Coastal Commission (CCC), Ocean Protection Council (OPC), and other stakeholders, including local jurisdictions who provided feedback. The Compass is intended to assist coastal communities in aligning their various local plans, including general plan safety elements, local hazard mitigation plans (LHMPs), local coastal programs, and climate adaptation plans.

10.1.3 SHMP INTEGRATION WITH STATE AND REGIONAL PLANNING INITIATIVES

The following are examples that illustrate California's efforts to integrate mitigation into different sectors in order to achieve greater risk reduction and resilience.

Integration with Emergency Management

Mitigation was first formally recognized in 1970 by the California Emergency Services Act, which noted the importance of coordinated emergency preparedness, response, recovery, and mitigation efforts. The 2017 update of the State Emergency Plan (SEP) acknowledges that understanding the potential severity and occurrence of natural hazard events is a major consideration in emergency management. Mitigation, then, is a prime tool integrated into the SEP for disaster risk reduction.

For more discussion of SHMP integration with the SEP and with the emergency management sector, see *Sections 2.3.5 and 2.3.6*.

The Safeguarding California Plan: 2018 Update integrates emergency management within multiple sectors and strategies. Recommendations include leveraging both pre- and post-disaster assistance programs to support resiliency planning, mitigation, and reconstruction that take into account future climate conditions; improving integration of climate impacts and adaptation strategies within all phases of emergency management; and training emergency management personnel across California to ensure consistency and support to local emergency response efforts to increase mutual aid and provide for maximum surge capacity. See *Section 4.3.6.4* for more on discussion on the Safeguarding California Plan.

Integration with Economic Development

Minimizing disruption of economic activity following a disaster is supported by many integrated state mitigation efforts. One important example is the California Utilities Emergency Association (CUEA), which serves as a point-of-contact for critical infrastructure utilities and the California Governor's Office of Emergency Services (Cal OES) and other governmental agencies before, during, and after disaster events. The CUEA's efforts are critical in supporting

restoration of utility services, which allows businesses to return to operation with a minimum amount of functional down time.

Within Cal OES, the Office of Private Sector/Non-Governmental Organization (NGO) Coordination is an important link between the state and various economic development agencies. The purposes of the Office of Private Sector/NGO Coordination are to design, coordinate, and implement statewide outreach programs to foster relationships with businesses, associations, companies, and universities, as well as non-profit, non-governmental, and philanthropic organizations. This office works to maximize the inclusion and effective use of private sector, philanthropic, and NGO staff and resources in all phases of emergency management, including mitigation. After the initial response, disaster recovery becomes the focus of government resources. Private industry, working with government, can provide necessary help to Californians affected by the disaster through recovery assistance, rebuilding efforts, and volunteer services.

Cal OES's Office of Private Sector/NGO Coordination also operates the Business Operations Center, which organizes synchronous exchange of information and resources between public and private sector organizations in mitigating against, preparing for, responding to, and recovering from disaster events.

Another example of an important economic development partnership is the California Business Liaison Committee (CBLC). The CBLC was formed in 2016 as a forum for emergency management business liaisons in California to discuss and work toward solving mutual concerns. The CBLC consists of representatives from state, county and city governments throughout California. The committee meets quarterly in each Cal OES administrative region and strives to promote collaboration in all levels of emergency management.

For more information about the Office of Private Sector/NGO Coordination, visit: http://www.caloes.ca.gov/cal-oes-divisions/private-sector-ngo-coordination/disaster-preparedness-for-business

The California Natural Resources Agency (CNRA) is collaborating with a broad range of agencies on the implementation of Senate Bill (SB) 859 (Committee on Budget and Fiscal Review) through the development of recommendations by the Wood Products Working Group, which should lead to actions that tie economic development and resilience to climate impacts. The state's Community Development Block Grant (CBDG) program provides investments for economic development in many disadvantaged areas, and the California Department of Housing and Community Development (HCD) has incorporated climate considerations into this program. HCD is administering over $70 million in federal funds from the National Disaster Resilience Competition to be invested in Tuolumne County, for recovery from the Rim Fire, in partnership with other state, federal, and local partners. The goal of this program is to support rural economic development and environmental resilience through community, forestry, and biomass utilization strategies.

Integration with Land Use Development

In California, general plans are required by state law for all municipalities and counties, and they must include a safety element. The integration for mitigation action occurs as the required safety element is used to inform the land use element. All elements of a general plan, whether mandatory or optional, must be consistent with one another. California's updated 2017 General Plan Guidelines, by the Governor's Office of Planning and Research (OPR), include hazard identification requirements for general plan safety elements.

California uses a multiple review procedure in the land use development process. Various state agencies, as well as local municipalities can be involved in hazard assessment and mitigation before development is permitted. For example, for approval of a hydraulic fracking permit, at a minimum a county planning agency and the California Department of Conservation Division of Oil, Gas, and Geothermal Resources (DOGGR) are involved. Depending on the permit location, the California Department of Water Resources (DWR) may be involved in relation to aquifer protection, and the Department of Toxic Substances Control, and the California Air Resources Board can conduct air quality and chemical hazards reviews. This multiple review procedure allows different types of expertise to be used in order to promote hazard reduction using an "as needed" team effort.

Another example of California's efforts to integrate hazard mitigation with land use development is Senate Bill (SB) 1241 (2012). Among other things, this legislation requires local governments in SRAs and VHFHSZs to update their general plan safety elements to recognize specific wildfire risks in such areas. For more information about this and other requirements of SB 1241 (2012), see *Section 3.9 and Chapter 8, Section 8.1.5.1*.

The Safeguarding California Plan: 2018 Update includes recommendations for land use planning and community development. Safeguarding California recommends coordination of "state guidelines and policies to promote climate resilience and hazard avoidance through local government general plans, zoning ordinances, subdivision regulations, and development incentives." The state further promotes "aggressive smart growth" in land use planning around the state in "The Strategy for California @ 50 Million" published in November 2015 by the Governor's Office of Planning and Research (OPR). More information on this land use strategy is included in *Section 4.1.2*.

Integration with Housing and Community Development

Review Procedures

The California Department of Housing and Community Development (HCD) has incorporated disaster planning into the state's Community Development Block Grant (CDBG) program. Applicants that include strategies to address these issues receive more points in this highly competitive grant program. Cal OES works with the Mobile Home section of HCD to review mitigation actions related to mobile home installations. HCD is charged with certifying the general plan housing elements which are updated every five years. The update now triggers an associated review of the safety element. This change further ties the location of future housing, especially work force and affordable units to hazard mitigation issues.

Additionally, the Office of the State Fire Marshal's Code Development and Analysis Division reviews all of California's regulations relating to fire and life safety for relevancy, necessity, conflict, duplication, and/or overlap. The division also prepares the California State Fire Marshal's fire and life safety regulations and building standards for review and adoption by the California Building Standards Commission.

National Disaster Recovery Competition

A $1 billion federal program administered by the U.S. Department of Housing and Urban Development (HUD), the National Disaster Recovery Competition (NDRC) provides grants to communities to rebuild in a more resilient way following major disasters. An exceptional integration effort is underway in Tuolumne County, where $70 million of funding under the NDRC is supporting a three-part program: forest watershed health (with the U.S. Forest Service), biomass utilization for employment and fire risk reduction, and a Community Resilience Center for social capital development in the region. The partnership is between HCD, the county, and the U.S. Forest Service.

Integration with Health and Social Services

The capacity for resilience in the face of climate change is significantly driven by the living conditions and the forces that shape them (including wealth, education, housing, transportation, environmental quality, social capital, and the experience of violence or other trauma) and access to resources and services, such as health care, healthy foods, and safe spaces.

To pursue better health outcomes, the state has established the Health in All Policies (HiAP) Task Force. HiAP is a collaborative approach to improving the health of all people by incorporating health, equity, and sustainability considerations into decision-making across sectors. The HiAP Task Force brings together 22 state departments, agencies and offices and is facilitated by the California Department of Public Health (CDPH), the Strategic Growth Council, and the Public Health Institute. The Task Force creates multi-agency collaboration and initiatives including: Active Transportation, Healthy Public Policy, Urban Greening, and Places to be Active. Members of the HiAP include: the Governor's Office of Planning and Research (OPR), the California Air Resources Board (CARB), the California

Department of Housing and Community Development (HCD), the Department of Social Services, the Department of Forestry and Fire Protection (CAL FIRE), and the Department of Food and Agriculture.

Integration with Infrastructure

In California, government managers take climate change adaptation into account in all aspects of their work. This approach links climate change adaptation with mitigation. For example, since the Loma Prieta Earthquake, all California Department of Transportation (Caltrans) highway bridges have been evaluated for seismic safety, and over 1,200 have been upgraded, at a cost of more than $1 billion. Now, Caltrans is including climate change analysis in its mitigation project system as part of its risk reduction approach.

To address increasing cyber threats to communications infrastructure, the state has created a Cyber Task Force to integrate efforts of multiple departments to share information and to audit agencies for cyber protection. These are efforts to protect state agency data and procedures across all departments.

Integration with Natural and Cultural Resources

The mission of the California Natural Resources Agency (CNRA) is to restore, protect, and manage the state's natural, historical, and cultural resources. Responding to the 2017 Orville dam spillway failure, CNRA's Department of Water Resources (DWR) has restructured itself to further bolster dam and flood safety, emphasize climate resilience and incorporate lessons learned from recent impacts of extreme weather on the state's water system. This action complements the Cal OES Dam Safety Planning Division that will review dam repair and improvement projects. The state has taken the federal tools as a base for its own program and then enhanced them. Cal OES will also work with local public safety agencies to help them incorporate emergency plans into their local planning efforts. The Cal OES program integrates dam safety with emergency management and critical infrastructure.

CNRA funds programs directed at the protection of water and air resources, which supports 2018 SHMP Goal 4. Examples of funding includes the $8.2 million spent on 21 projects in the Environmental Enhancement and Mitigation Grant Program in 2016 on programs such air quality improvement and urban greening for greenhouse gas reduction.

10.1.4 FINANCIAL INTEGRATION

The strength of California's mitigation approach stems from the utilization of multiple funding sources, including federal grant funding, state grant funding, and municipal/county funding. The diversity of funding sources provides stability and continuity to projects and lessens the downside of single-source funding.

California promotes funding opportunities consistently through coordination with local, tribal, regional, state, and federal agencies. The Hazard Mitigation Assistance (HMA) program works with local, tribal, and state agencies and stakeholders to promote available funding opportunities, including HMA funding and other known opportunities, to support implementation of their mitigation and adaptation projects and activities. *Annex 2* of this document also provides information on funding mechanisms available to fund implementation activities, including a summary of some funding already in use (i.e. HMA program which has funded implementation of local, tribal, and state mitigation activities). For projects that have not yet been implemented, the lead agency for each project are encouraged to work with HMA staff and/or reference *Annex 2* for additional potential funding opportunities.

Special funds and the state general fund provide support for various other legislatively mandated programs. The California Earthquake Authority (CEA) is funded through insurance policy premiums. The work of the California Utilities Emergency Association (CUEA) is membership-supported. The continuous upgrading of seismic hazard maps by the California Geological Survey is funded by a levy on local building permit fees that replenishes the program's funding on an annual basis.

An example of financial integration for mitigation planning was passage of Assembly Bill (AB) 2140 (2007), mentioned previously. This bill provides incentives for LHMP preparation by authorizing cities and counties to adopt LHMPs as

part of their general plan safety elements. The bill authorizes the California legislature to provide to such cities and counties a state share of costs exceeding 75 percent of total state-eligible post-disaster costs under the California Disaster Assistance Act. It also requires Cal OES to give future priority to local jurisdictions without an LHMP to prepare and adopt one.

The Safeguarding California Plan: 2018 Update notes that California is actively investing in the best available science including cutting-edge findings from California's Fourth Climate Change Assessment and the data it provides to the state's Cal-Adapt.org platform. Cal OES and its partners are working to incorporate efforts to reduce climate risks through hazard mitigation activities where climate science provides critical support, including but not limited to reducing fire hazard, enabling climate-resilient rehabilitation, and improving flood protection.

An example of financial integration in climate mitigation efforts is the use of state funds from the California Air Resources Board-operated Cap-and-Trade Program to invest in climate mitigation programs by other state agencies and organizations, such as the Water-Energy Efficiency Program run by the California Department of Water Resources (DWR). Another example is the financial integration mandated by Assembly Bill (AB) 1550 (2016) which requires a minimum of 25 percent of greenhouse gas reduction funding to be allocated to projects located within and benefiting individuals living in disadvantaged communities and provides additional funding to benefit low-income households.

10.1.5 INTEGRATION WITH FEMA PROGRAMS

Pre-Disaster Mitigation/Flood Mitigation Assistance/Hazard Mitigation Grant Program Integration

Cal OES administers FEMA's Hazard Mitigation Assistance (HMA) programs in California through its Hazard Mitigation Grant Program (HMGP) and Pre-Disaster/Flood Mitigation (PDFM) Divisions. Between 2013 and early 2017, FEMA HMA grant programs, HMGP and Pre-Disaster Mitigation (PDM), have provided funding for over 40 mitigation projects (with more pending for 2017 funding), and support to develop over 50 local hazard mitigation plans in California. In that same period, over $5 million in Flood Mitigation Assistance (FMA) grants funded flood mitigation projects. California also aims to leverage both pre- and post-disaster assistance programs to support resilient planning, mitigation, and reconstruction that take into account future climate conditions. As part of this effort, California continues to work to align PDM and FMA funding opportunities for projects that maximize whole community climate readiness and resilience.

For detailed information about HMGP, PDM, and FMA program participation and Cal OES capabilities, see *Section 10.5*.

Section 406 Public Assistance Grant Program Integration

When warranted, the Cal OES Recovery Section, in coordination with FEMA Region IX, prepares Presidential Disaster Declaration requests, serves as the recipient for the approved disaster assistance grant programs under the Stafford Act (e.g., PA, Fire Management Assistance Grants (FMAGs), and/or Hazard Mitigation Grant Programs), and administers the state cost share for these and other federal disaster assistance programs including the Federal Highway Administration (FHWA) Emergency Relief (ER) Program, the Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) Program and the U.S. Department of Housing and Urban Development (HUD).

Section 406 of the Stafford Act hazard mitigation is defined as incorporating cost-effective betterments into a permanent work project to harden or protect disaster damaged facilities from repetitive damage in future similar disaster events. Section 406 hazard mitigation typically applies only to permanent work projects and is generally applied to the part(s) of the facility that were damaged by the disaster. In some instances, an eligible mitigation measure may not be an integral part of the damaged facility. FEMA will consider these exceptions on a case-by-case basis. In the Section 404 HMGP program, mitigation measures are proposed that may involve facilities other than

those damaged by the disaster, new facilities or even non-structural measures such as development of floodplain management regulations. For a detailed discussion of how Cal OES administers the HMGP program, see *Section 10.5*

FEMA's Public Assistance (PA) grant program provides federal assistance to government organizations and certain private non-profit organizations following a Presidential Disaster Declaration so that communities can quickly respond to and recover from major disasters or emergencies. The PA program is administered through a coordinated effort between FEMA, the state or tribe (grantee), and the applicants (subgrantees). PA supports local communities with opportunities to strengthen infrastructure that has proven to fail under disaster conditions.

The PA program provides assistance to supplement federal disaster grants for debris removal, life-saving emergency protective measures, and the repair, replacement, or restoration of disaster-damaged publicly owned facilities, and the facilities of certain private non-profit organizations. The state share of this supplemental assistance covers the cost share of 75 percent of the non-federal share. The PA program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.

Challenges of implementing the PA program since 2013 include the need for more FEMA PA support and the need to provide more clarity to FEMA support staff during recovery to ensure that their efforts promote and effectively support PA hazard mitigation. To address this, Cal OES is working with FEMA Region IX for expanded support of the PA program. PA is a priority for the state, thus working with FEMA to ensure that adequate support exists to further the program and efforts to reduce risk is a high priority. Cal OES PA staff are using outreach to teach communities about PA and to share Cal OES's PA program information with incoming state and FEMA staff when a Joint Field Office is established.

The state continues to support additional mitigation funding efforts and the Section 406 mitigation program is a beneficial source that can boost California's resiliency to disaster effects. It would benefit the state and FEMA IX to dedicate more mitigation experts to ensure that PA funds are used to increase the protection to infrastructure or facilities that have already proven faulty in disaster conditions. This will help to ensure resilience with local communities. These ongoing efforts align with the state's mitigation strategy to assist local and tribal governments in hazard mitigation efforts.

Fire Management Assistance Grant Program

Fire Management Assistance Grants are available to states, local and tribal governments, for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, where the fire threat could become a major disaster. The Fire Management Assistance declaration process is initiated when a state submits a request for assistance to the Federal Emergency Management Agency (FEMA) Regional Director at the time a "threat of major disaster" exists. The entire process is accomplished on an expedited basis and a FEMA decision is rendered in a matter of hours. The Fire Management Assistance Grant Program (FMAGP) provides a 75 percent federal cost share with the local jurisdiction responsible for the remaining 25 percent.

After a Fire Management Assistance Declaration is granted, Cal OES Recovery staff deliver applicant briefings to provide potential applicants with basic information to assist them in their efforts to understand the requirements associated with applying for PA due to a FMAG declaration. As part of these briefings Cal OES Recovery staff provides information on cost-effective Section 406 hazard mitigation measures. Recovery staff are also working with Cal OES HMGP staff to encourage integration of hazard mitigation as part of recovery efforts.

HMGP Post-Fire Grant Program

In 2015, FEMA provided mitigation assistance following Fire Management Assistance Grant (FMAG) declarations under a program known as the HMGP FMAG Pilot. Each FMAG declaration resulted in approximately $460K of HMGP funding to implement mitigation activities in the FMAG declared counties. As of September 2018, Cal OES and FEMA have funded four projects under the HMGP FMAG pilot program, as shown in Table 10.A.

Due to the success of the pilot program, the Bipartisan Budget Act of 2018 authorizes FEMA to provide HMGP FMAGs, otherwise known as "HMGP Post-Fire". Rather than awarding funding for each FMAG, FEMA will provide an aggregate amount of funding for FMAG declarations from October 1, 2016 through September 30, 2018, totaling nearly $18 million. FMAG declared counties receive priority for this funding. If the funding available cannot be spent in FMAG declared counties, then any eligible applicant may apply.

Table 10.A: Active Post-Fire Grants, as of September 2018

Disaster Number	Grant Awardee	Project Funded	Project Benefit
FM-5089-PJ0001-0001	Big Bear Lake Fire Protection District	Replacement of wood shingle roofs within the district for approximately 70 homes	To minimize the effects of wildfires spreading within the community by making homes more fire resistant
FM-5091-PJ0001-0001	Solano County	Installation of erosion control measures in fire impacted areas	To ensure that sediment and debris flow is contained to prevent damage to surrounding areas from debris flow or flooding
FM-5093-PJ0001-0001	Lake County	Culvert upsizing	To safeguard the county's infrastructure from additional debris and sediment flows resulting from the impacts of the wildfires
FM-5112-PJ0001-0001	Lake County	Culvert upsizing	To safeguard the county's infrastructure from additional debris and sediment flows resulting from the impacts of the wildfires

Source: California Governor's Office of Emergency Services (Cal OES) HMA Program

In addition to the grants listed in Table 10.A, a fifth HMGP Post-Fire award to Calaveras County was obligated, however, due to the time that it took for the subapplication environmental/historical preservation (EHP) review, the jurisdiction decided to withdraw. During the length of time taken for the EHP review, vegetation naturally regrew on the project site, making further erosion controls that the award would have funded unnecessary. Due to this vegetation regrowth, the County determined that the wildfire effects no longer posed any danger of soil erosion that the post-fire project could further mitigate. While the state understands the importance of ensuring the protection and enhancement of environmental, historic, and cultural resources, the EHP review process continues to be a challenge for timely obligation of grant funding. In some cases, such as for Calaveras County, taking action on a project can be highly time sensitive, so delays caused by lengthy EHP reviews can become problematic to the timely implementation of a post-fire project.

As noted above, California has received approximately $18 million in additional funding through the HMGP Post-Fire program under declaration FM-5189. The amount of funding may increase if any additional FMAGs are declared before September 30, 2018, which is the closing date for the 2016-2018 HMGP Post-Fire funding period. The funding from any additional FMAG declarations will be aggregated into the noted dollar amount.

Cal OES has created a preliminary list of post-fire project applications and will assess each application to determine which projects will most effectively reduce post-fire risk. Priority will be given to FMAG declared counties for the following types of projects 1) wildfire mitigation (hazardous fuels reduction, defensible space, and ignition resistant construction) and 2) watershed risk reduction (erosion control, soil stabilization, and other landslide prevention measures). When the list of projects is finalized, Cal OES will determine if additional outreach to other FMAG declared counties is necessary. If another FMAG is declared, the application period will also be extended.

National Flood Insurance Program and Community Rating System Integration

Another example of integration with FEMA programs is Cal OES' efforts in aligning PDM and FMA funding opportunities for projects that maximize whole community climate readiness and resilience to catastrophic natural disasters. As outlined in Presidential Policy Directive (PPD-8), FEMA's "whole community" concept supports the effort to build an integrated, layered, and all-of-nation approach to preparedness.

The FMA program has funded flood elevation projects that support the objectives of FEMA's Community Rating System (CRS) in conducting floodplain management activities that exceed the minimum National Flood Insurance Program (NFIP) standards. For more information about NFIP and CRS participation, see *Section 7.1.5.8*.

RiskMAP Integration

According to FEMA, all Risk Mapping, Assessment, and Planning (Risk MAP) projects begin with a project planning and "discovery" step to define the location and scope of future projects. The discovery process is particularly relevant to hazard mitigation planning in that federal and state agency representatives meet with emergency response officials, floodplain management staff, public works staff, planning officials, and other appropriate stakeholders to 1) determine what natural hazard information already exists, 2) identify what natural hazard information is still needed to make mitigation decisions, and 3) identify which areas and resources could be most vulnerable during a natural hazard event. At the meeting, more is learned about the risks and hazards that communities face and an overview of available FEMA and other resources is provided to help support risk reduction in the community.

This information is assembled into a discovery report and discovery maps that are presented to and discussed with communities at the discovery meetings. The discovery process is also an opportunity to assess community capability and plan for technical assistance and training based on that capability.

In California, Discovery Meetings were hosted by FEMA Region IX, the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey, University of Southern California Sea Grant, California Coastal Commission, California State Coastal Conservancy, The Nature Conservancy, the Association of Monterey Bay Area Governments, the Central Coast Wetlands Group, the City of Monterey, and Monterey County, in collaboration with Cal OES, the California Department of Water Resources, Caltrans and other state agencies. The California Discovery Meetings were held in the following counties:

- Yolo and Colusa Counties; August 17, 2017
- Napa County and Solano Counties; August 15, 2017
- Lake County; August 16, 2017
- Monterey County Coastal Resilience Workshop; September 27, 2017

National Dam Safety Program Integration

California has partly based its Dam Safety Program on the National Dam Safety Program. The state has taken the federal tools as a base for its own program and then expanded on them. As part of this program, the California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) has categorized state-regulated, jurisdictional dams based on FEMA's hazard classifications. For California's dam program, DSOD split FEMA's "high" classification into two classifications: high and extremely high. Government Code Section 8589 even references FEMA's guidelines for dam Emergency Action Plan (EAP) development, as dam owners are required to develop their EAPs based on the federal guidelines.

As required by the FEMA guidelines, California also mandates that dam owners must execute an EAP notification exercise, as well as update the EAPs and inundation maps on a prescribed schedule. In conjunction with DSOD, Cal OES will work with local public safety agencies to help them incorporate the EAPs into local hazard planning efforts. For more information about National Dam Safety Program integration, see *Section 7.5.4*.

FEMA Hazard Mitigation Planning Integration

Cal OES's Hazard Mitigation Planning Program coordinates with the FEMA Region IX Mitigation Division, under the RiskMAP program, to co-administer the state's local hazard mitigation and tribal mitigation planning programs. This program administration consists of providing hazard mitigation technical assistance and training to local jurisdictions and tribal governments. Cal OES and FEMA Region IX also work together to conduct and expedite joint reviews of some LHMPs, in order to ensure reviews are completed within the 45-day LHMP review timeframe (a shared Cal OES-FEMA goal), or in a timely manner when HMA funding is pending. For more information about the LHMP Program, see *Section 5.1*.

Threat and Hazard Identification and Risk Assessment Process Integration

The State of California Threat and Hazard Identification and Risk Assessment (THIRA) relies on the mitigation analysis contained in the SHMP to complete THIRA Step 1: Identify the Threats and Hazards of Concern and Step 2: Give the Threats and Hazards Context. FEMA requires the State of California to submit its assessment annually through the Unified Reporting Tool (URT).

Emergency Management Performance Grant Program Integration

The purpose of the Emergency Management Performance Grant (EMPG) Program is to provide federal funds to states to assist state, local, and tribal governments in preparing for all hazards. In California, the EMPG Program continues to be leveraged by state, local, and tribal emergency management agencies to acquire the resources necessary to ensure a well-organized and rapid response to disasters. In addition to supporting local capabilities, the EMGP Program supports California's Standardized Emergency Management System (SEMS) activities (SEMS and the Incident Command System [ICS] are the cornerstone for that National Incident Management System [NIMS]).

In California, eligible subaward subrecipients are local and state agencies and federally recognized tribes. Funds provided under the EMPG Program must be used to support activities that effectively contribute to capabilities to prevent, prepare for, mitigate against, respond to, and recover from natural and/or man-made emergencies and disasters. In support of the Department of Homeland Security (DHS) Notice of Funding Opportunity (NOFO) that is issued by FEMA when funds are available, California issues the "California Supplement to the Federal Notice of Funding Opportunity," otherwise known as the State Guidance, and the "California Tribal Supplement to the Federal Program Notice of Funding Opportunity," otherwise known as the State Tribal Guidance.

The State Guidance and the State Tribal Guidance are the authority documents for California's EMPG Program, providing state, local, and tribal governments with guidance and forms to apply for, perform, and close out an EMPG subaward, as well as other subaward-related information and requirements.

Additional information on the state's administration of the EMPG Program can be found at http://www.caloes.ca.gov/cal-oes-divisions/grants-management/criminal-justice-emergency-management-victim-services-grant-programs/emergency-management-performance-grant.

10.2 COMMITMENT TO A COMPREHENSIVE MITIGATION PROGRAM

Under FEMA guidance for Enhanced Plans (Disaster Mitigation Act of 2000 [DMA 2000], Section 201.5(b)(4)(i-vi)), a state must detail how its plan reflects a commitment to a comprehensive mitigation program. California's commitment to a comprehensive mitigation program is expressed through the sum of all of its integrated mitigation efforts to address various hazards that are implemented at the state, regional, and local levels. The state's comprehensive program is reflected in the mitigation efforts directed at the first three SHMP goals: reducing injury and loss of life, minimizing physical damage and service interruptions, and protecting the environment.

The nine SHMP mitigation strategies (see *Chapter 3*) are the framework for California's comprehensive mitigation program. The strength of California's mitigation program is the diversity of efforts by various agencies throughout the state. There are efforts directed at individual homeowners through seismic upgrades; other efforts for jurisdictions, such as how to conduct climate adaption planning; and still other for regional and statewide agencies, such as cybersecurity. Special attention is given in the 2018 SHMP to climate change issues and their integration into all aspects of mitigation. How the state will address climate change was the central focus of the Governor's State of the State address on January 25, 2018.

The following are the programmatic efforts being undertaken by all major state agencies that are working together for a more resilient California:

1. Support for local hazard mitigation planning. Since 2013, Cal OES has sponsored LHMP development workshops and presentations in various parts of the state that have been attended by hundreds of representatives from local governments and private sector organizations. The workshops and presentations are provided to help local governments develop their LHMPs and to identify local mitigation opportunities. For more information about Cal OES's LHMP Technical Assistance and Training Program, see *Chapter 5, Section 5.1*.

   Cal OES staff continues to maintain positive working relationships with local government constituents through informal contact, such as phone and e-mail communications, as well as attendance at regional meetings, and letters providing continued technical assistance support and information as needed.

   Cal OES has placed links to county LHMPs and FEMA local mitigation planning resources on the Cal OES Hazard Mitigation Division web page to support local jurisdictions' LHMP development and update efforts. The Cal OES webpage also includes a link to "MyPlan" and "MyHazards" Internet Mapping Tools, which provide users with practical Geographic Information Systems (GIS0-based information at the local level to begin a risk assessment.

   Commitment to support of local mitigation planning is further represented by the ongoing educational program operated by the California Specialized Training Institute (CSTI) in San Luis Obispo. As an outreach operation of Cal OES, CSTI has been providing training in mitigation planning to local agencies since long before the Disaster Mitigation Act was passed by Congress in 2000. CSTI's focus is on facilitating and/or providing the best possible solutions in training, exercises, and education with an eye on building capabilities, using an all-hazards, total resource approach. For more information about CSTI, visit:
   http://www.caloes.ca.gov/cal-oes-divisions/california-specialized-training-institute.

   Various other state agencies also provide workshops with mitigation content. These agencies include the Governor's Office of Planning and Research (OPR) which performs the crucial role of coordinating regional and local adaptation efforts with state initiatives to coordinate state government's comprehensive strategy to adapt to climate change. Other agencies providing workshops addressing mitigation include the California Natural Resources Agency which coordinates Safeguarding California and FEMA coastal mapping workshops; the California Seismic Safety Commission; the Department of Water Resources (DWR) and California Silver Jackets; Caltrans; CAL FIRE through the Firewise program; and the California Utilities Emergency Association (CUEA), which provides workshops for its members and associate members.

Upcoming efforts to support local hazard mitigation planning include updates to the nationally acclaimed California Adaptation Planning Guide (APG), as directed by Senate Bill (SB) 246 (2015). The APG update effort may include development of an interactive web application using the most innovative climate-relevant data and tools to support the APG. The Safeguarding California Plan: 2018 Update includes a lengthy discussion on steps for climate adaptation and emergency management integration.

2. Statewide program of hazard mitigation. The standard 2018 SHMP illustrates various facets of California's statewide hazard mitigation program including legislative initiatives, mitigation task forces/technical advisory groups, and executive actions that promote hazard mitigation. Following are some examples that demonstrate California's commitment to hazard mitigation, which are discussed in more detail in the standard plan chapters (*Chapters 1 through 9*).

   The California Fire Safe Council is an active mitigation council in the state that acts as a federal grant clearinghouse providing subgrant funding to local fire safe councils for wildfire mitigation activities. The California Earthquake Authority (CEA) Earthquake Brace+Bolt (EBB) program has provided over 3,600 grants to homeowners for seismic retrofit in specifics areas of the state. Initial funding for the EBB program was provided through CEA's Loss Mitigation Fund (LMF). In 2016, and again in 2017, the State of California provided $3,000,000 in funding to the EBB program. In 2018, $6,000,000 is appropriated for the EBB program.

   The State of California also mandates that local jurisdictions include safety elements as part of their general plans. This planning requirement is unique to California. Senate Bill (SB) 379 (2015) requires risk analyses of LHMPs to include climate adaptation and resiliency strategies (effective after January 2017) and requires general plans to integrate climate adaptation and resilience into the safety element.

   Executive Order B-30-15 integrates directives on climate change mitigation and adaptation, thus providing a powerful framework for action. This order requires all state agencies to take current and future climate impacts into account in all planning and investment. It directs the preparation of implementation plans to ensure coordinated progress on the objectives of the Safeguarding California Plan, and emphasized the State's commitment to protecting vulnerable populations and making flexible, adaptive, and natural infrastructure solutions a top priority.

3. State provision of a portion of the non-federal match for mitigation projects. Assembly Bill (AB) 2140, passed by the legislature in 2007, authorizes financial incentives for local governments to integrate LHMPs with mandated general plan safety elements.

4. Promotion of nationally applicable model codes and standards. California has led the nation in requiring local governments to adopt current versions of nationally applicable model building codes, enhanced by state laws specifically requiring local governments to address natural hazards. This applies not only for design and construction of state-sponsored mitigation projects, but also for all private construction. In 2005, the California Building Standards Commission (CBSC) approved the Office of the State Fire Marshal's emergency regulations amending the California Building Code, to add Chapter 7A Materials and Construction Methods for Exterior Wildfire Exposure. These codes are updated regularly. California and local jurisdictions have adopted the 2016 California Building Code and Fire Code, with the 2015 International Building Code and the International Fire Code as the base documents. These codes include provisions for ignition-resistant construction standards in the wildland-urban interface.

Another example affecting local development is the linking of Department of Water Resources (DWR) floodplain management programs to city and county statutory general plan processes. State law requires local commitments to comprehensive mitigation action through state-mandated general plan safety elements with which local development actions must be consistent. AB 162 (2007) modified state planning law to require inclusion of floodplain mapping in several elements of mandatory local general plans. DWR has completed a user guide for local governments to implement that law. Local governments in the Central Valley must amend their general plans and zoning to be consistent with the Central Valley Flood Protection Plan adopted in 2012.

Statewide green building code. In 2010, the CBSC adopted the nation's first mandatory green building code, the California Green Building Standards Code (CALGreen Code) that became effective in January 2011. This code outlines standards for newly constructed buildings and covers all residential, commercial, hospital, and school buildings. During the 2016-2017 fiscal year, the California Department of Housing and Community Development (HCD) updated the CALGreen Code through the 2015 triennial code Adoption cycle. The code requires builders to install plumbing that cuts water usage by up to 20 percent, to divert 65 percent of construction waste from landfills to recycling, and to use low-pollutant paints, carpeting, and flooring. Under this code, the inspection of energy systems is mandated to ensure efficiency. For non-residential buildings, the code requires installation of different water meters for indoor and outdoor water usage. Local jurisdictions may adopt ordinances with more stringent green building codes. The CALGreen Code is adopted by state and local government as part of the California Code of Regulations, Title 24, Part 11.

5. Post-disaster mitigation of building risks. Through the California Seismic Safety Commission, the state has sponsored comprehensive, multi-year efforts to mitigate risks posed to existing buildings identified as necessary for post-disaster response and recovery operations. For example, after the December 23, 2003 San Simeon Earthquake, the Seismic Safety Commission assessed the need for accelerated local mitigation of unreinforced masonry buildings, stimulating the legislature to pass new occupant disclosure requirements for unreinforced masonry buildings not yet retrofitted.

6. Integration of mitigation with post-disaster recovery. This chapter provides examples of how California integrates mitigation with its post-disaster recovery operations through federal and state project grants. Beyond such standard recovery and mitigation management operations are the following evolving procedures integrating mitigation with post-disaster recovery:

   - State Emergency Plan
   - Disaster Recovery and Mitigation Handbook
   - California Earthquake Loss Reduction Plan
   - California Earthquake Loss Reduction Plan Recovery Element
   - California Vital Infrastructure Vulnerability Assessment (Cal VIVA)

   The SHMP is an important supporting document to the California State Emergency Plan (SEP). The 2017 SEP defines and describes the fundamental systems, strategies, policies, assumptions, responsibilities, and operational priorities that California uses to guide and support emergency management efforts. The SEP and the SHMP are closely interlinked. Section 8 of the SEP identifies mitigation as one of the four emergency management functions and references the role of the SHMP in describing and mitigating hazards, risks, and vulnerabilities, thereby reducing disaster losses.

   The Recovery Element of the California Earthquake Loss Reduction Plan is an example of mitigation and recovery linkages in various California single-hazard mitigation plans. It includes the following basic objective: "Establish and fund a statewide earthquake recovery plan aimed at social and economic recovery in the public and private sectors through better and more responsive plans, procedures, and utilization of resources." Recovery Element Action 11.1.1, to "develop a strategic Statewide Disaster Recovery Plan," and Recovery Element Action 11.1.2, to "identify and secure sources of funding for disaster recovery and mitigation," are both classified as Very Important.

7. Major state hazard mapping efforts. Significant investments in hazard risk mapping have been made by major state agencies responsible for mitigation of California's primary hazards. For example, the California Geological Survey implements the Seismic Hazards Mapping Act program that identifies ground shaking, liquefaction, landslides, probabilistic earthquake maps (www.quake.ca.gov), and other earthquake-related hazards. The Department of Water Resources (DWR) has developed 200-year flood maps that will significantly increase flood hazard information, and CAL FIRE continues to update data sets on wildland-urban interface, High Fire Hazard Severity Zones, and other wildfire hazards.

   Many of the state's hazards mapping tools along with many other GIS tools are accessible on the State of California Geoportal website (http://portal.gis.ca.gov/geoportal/catalog/main/home.page). The Governor's Office of Planning and Research (OPR) has also released the General Plan Guidelines Data Mapping Tool, which can be used for hazard mitigation planning (http://opr.ca.gov/planning/general-plan/data-mapping-tool.html). All of these efforts combine to provide critical science-based information to benefit state and local agency users in creating and implementing effective and comprehensive mitigation plans and projects.

8. SHMT working groups. In an effort to advance interagency cooperation and learning about mitigation, SHMT strategic working groups have been formed and used at various times over the last 10 years. These groups include the following:

   - 2018 SHMP Goal and Objectives Strategic Working Group
   - Social Vulnerability Model Update Strategic Working Group
   - Geographic Information Systems Technical Advisory Working Committee (GIS TAWC)
   - Cross-Sector Communications and Knowledge Sharing Strategic Working Group
   - Mitigation Progress Indicators and Monitoring Strategic Working Group
   - Land Use Mitigation Strategic Working Group

These strategic working groups are discussed in detail in *Section 2.2.2*.

Implementing the Comprehensive Mitigation Program

In California, all levels of government participate in funding disaster mitigation measures. This multi-level participation is part of California's comprehensive mitigation approach. At the state level, billions of dollars have been spent on earthquake, flood, and wildfire mitigation measures. State voters have approved billions of dollars in mitigation investments yet to be spent.

California's local governments are also creative and innovative in their mitigation finance approaches. At the county and city levels, hundreds of millions of dollars have been spent on retrofitting buildings and supporting flood control. At these local levels, special bonding, sales tax districts, and tax rebate programs have been established to fund earthquake, flood, and wildfire mitigation. Most of these efforts require local voters to approve the finance mechanism, usually in the form of additional fees and taxes. Thus, Californians do use their "pocketbook" to mitigate hazards.

10.3 EFFECTIVE USE OF AVAILABLE MITIGATION FUNDING

The Enhanced Plan must demonstrate that the state effectively uses existing mitigation programs to achieve its mitigation goals (44 CFR Section 201.5(b) (3)). The state must document that it has fully and effectively made use of FEMA and other funding already at its disposal, such as taking full advantage of FEMA programs (FMA, PDM, and HMGP) to fund mitigation actions and using other FEMA and non-FEMA funding to support mitigation.

As previously noted, the state uses many funding resources, policies, and programs in its comprehensive program to mitigate against loss of life, injury, and damage to property.

Use of HMA Funding

Federal funding received over the 2013 to 2016 period has resulted in 81 FEMA funded projects, with many more projects in the process of being obligated under 2017 funding, as shown in Tables 10.B and 10.E. These mitigation investments are generally located in the high-hazard and high-vulnerability areas shown in the hazards maps included in *Chapters 6 through 9*. These high vulnerability areas are prioritized for mitigation funding to help the state meet its goal of reducing vulnerability in high risk areas while increasing the state's overall capabilities and resiliency.

FEMA mitigation funds are allocated to projects that are aligned with SHMP goals and priorities. Prevention or significant reduction of loss of life and injuries is the state's primary goal, plans and mitigation projects across the state reflect a commitment to life safety, as well as preservation of environmental, and historic cultural resources. The joint Cal OES and FEMA grant program objective is to expend all HMA funds on cost-effective and feasible mitigation activities. Cal OES also maximizes local opportunities for receiving federal mitigation funding by establishing a project waiting list of HMGP, PDM, and FMA subapplicants from previous funding cycles for consideration for future funding cycles.

Table 10.B summarizes the distribution of HMGP, PDM, and FMA grant funding from 2013 to 2016. Table 10.C shows the distribution of grants from 2013 to 2016, by program and project type. From 2013 to 2016, planning grants were the predominant type of HMA grant to local jurisdictions, with a total of 44 awarded. The second most common project type funded by HMA grant award was for structural retrofit, with a total of 15 awarded from 2013 to 2016.

Table 10.B: Distribution of Major FEMA Support Grant Programs in California, 2013-2016

Federal Emergency Management Agency (FEMA) Grant Program	Obligated Funds	Number of Projects	Number of Counties Served
Flood Mitigation Assistance (FMA)	$5,683,594	2	1
Hazard Mitigation Grant Program (HMGP)	$40,177,815	50	29
Pre-Disaster Mitigation (PDM)	$2,943,435	29	18
Total	**$48,804,844**	***81***	***48***

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

Table 10.C: Project Types Funded in California, 2013-2016

Federal Emergency Management Agency (FEMA) Grant Program	Project Type	Number of Projects
Flood Mitigation Assistance (FMA)	Elevation	2
Pre-Disaster Mitigation (PDM)	Planning	28
PDM	Structural Retrofit	1
Hazard Mitigation Grant Program (HMGP)	Acquisition	1
HMGP	Elevation	1
HMGP	Fire Resistant Material	1
HMGP	Flood Control	4
HMGP	Generator	5
HMGP	Non-Structural & Structural Retrofit	5
HMGP	Planning	16
HMGP	Other	2
HMGP	Soil Stabilization	1
HMGP	Structural Retrofit	14
Total		***81***

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

As illustrated in Tables 10.D and 10.E, in 2017, the HMGP grant funding pool expanded significantly as a result of the four federally declared disaster events, with Notice of Interest (NOI) submittals more than tripling in 2017 versus the previous four years combined.

The Cal OES HMGP has responded by greatly expanding its staffing level, hiring 14 additional staff in 2017 and 2018 to handle the additional workload. Also of note, the 2017 PDM NOI submittals more than doubled from the previous year (38 PDM NOIs submitted in 2016), as a result of expanded outreach efforts by Cal OES grants staff.

Table 10.D: Notices of Interest Submitted, Approved and Obligated for 2013-2016

Federal Emergency Management Agency (FEMA) Grant Program	Number of Notices of Interest (NOIs) Submitted	Number of NOIs Approved	Number of NOIs Approved
FMA	126	79	2
HMGP	262	199	50
PDM	313	171	29
Total	***701***	***449***	***81***

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

Table 10.E: Notices of Interest Submitted and Approved (obligations pending) for 2017, as of July 2018

Federal Emergency Management Agency (FEMA) Grant Program	Number of Notices of Interest (NOIs) Submitted	Number of NOIs Approved	Number of NOIs Approved	Obligated Funds
FMA	30	11	0	$0
HMGP*	854	611	32, others pending	$9,812,361 *with additional funding pending*
PDM	146	86	2	$135,483
Total	***1,030***	***708***	***34, others pending***	***$9,947,844***

Source: California Governor's Office of Emergency Services (Cal OES) HMA program
** Includes DR-4301, DR-4305, DR-4308, DR-4344*

While Cal OES recommends that projects use all available federal mitigation grant funds for the last five years, de-obligations occur for a variety of reasons, including cost underruns from projects being completed under budget. In

a few cases, deobligations occurred due to project withdrawal or non-completion. Whenever possible, Cal OES will realign the deobligated funding to other projects for which additional funds are requested, or work with stakeholders and/or jurisdictions to fund additional projects. Cal OES is aware of these challenges and is taking steps to monitor project budgets more closely to better align project costs. In addition to the FEMA funding, California integrates its own mitigation investment funds with those provided through multiple sources as noted previously.

Where subapplications for a funding opportunity are less than the total funding available, grants staff re-advertise the funding announcements and accept new Notices of Interest (NOIs) for new projects. Grants staff also review PDM and FMA project and planning subapplications that did not receive funding to determine possible eligibility for HMGP funding opportunities.

HMGP works with FEMA and Cal OES Hazard Mitigation staff to co-facilitate workshops to better inform local sub-grantees on the subapplication process. See *Section 10.5.1.4* for more information about Cal OES's HMA technical assistance and training efforts. Additionally, HMGP staff conduct and participate in outreach efforts with other state agencies and local jurisdictions to share information on upcoming funding opportunities and help maximize the use of FEMA funds. Cal OES HMA grant program staff also work with other organizations to further distribute HMA grant opportunity information to their stakeholder lists.

In addition to the FEMA-supported funding, California integrates its own mitigation investment funds with those provided through many other sources. These additional mitigation and resiliency funding sources come from the public and private sectors as well as other state and federal sources.

Expedited Funding of HMGP to Support Post-Fire Mitigation Actions in 2017 and 2018

After the declaration of the October 2017 Wildfires (DR-4344) and the December 2017 California Wildfires and Debris Flows (DR-4353), the Hazard Mitigation Grant Program (HMGP) conducted outreach to the fire affected jurisdictions. This outreach was initiated by phone to the cities, counties, local, and tribal governments. The jurisdictions that were contacted consisted of Butte County, City of Clear Lake, Lake County, Los Angeles County, Madera County, Mariposa County, Mendocino County, Napa County, Nevada County, Orange County, Riverside County, Santa Barbara County, Ventura County, San Diego County, Solano County, Riverside County, Sonoma County, City of Santa Rosa, Trinity County, Tulare County, Tuolumne County, City of Los Angeles, City of Sonoma, City of Vallejo, Yuba County, and Tule River Indian Tribe.

Once the initial outreach found that there was a need for post-wildfire mitigation, a workshop was developed by HMGP staff. Cal OES and FEMA jointly performed a total of nine workshops in Mariposa County, Sonoma County, Mendocino County, Ventura County, Santa Barbara County, Lake County, Yuba County, City of Santa Rosa, and San Diego County. Messaging and handouts at the workshops emphasized Cal OES' willingness to expedite the subapplication process to quickly obligate funding for prioritized post-fire mitigation measures in the fire-impacted areas, addressing soil stabilization, erosion control, replanting/reforestation, flood diversion and storage, and drainage improvements. There were nine projects that were quickly developed (one withdrew after obligation), approved by Cal OES, and obligated by FEMA.

- *Post Detwiler Fire Disaster Erosion Control.* DR-4344-PJ002-1 awarded funds to Mariposa County to implement a post-fire project to remove fire debris contaminated soils and install emergency erosion control protective measures on county maintained roads impacted by the Detwiler Fire, and to install and maintain protective waddles and silt fencing to protect the stormwater system from the future collection contaminated soils resulting from fires into the storm systems. This project protects the integrity of critical roadway structures for use by emergency responders throughout the rainy season. This project was particularly effective during the rainstorms of March 21-23, 2018. During that heavy rainfall, all the treated areas were successfully mitigated by keeping sediment and major debris from culvert drainage, protecting roadways from washouts, and allowing the roads to be freely travelled for response and recovery activities by emergency vehicles as well as residents.
- *Laughlin Post Wildfires Soil Stabilization.* DR-4344-PJ003-2 awarded to Mendocino County for landslide hazard for flood control. This project will protect identified slopes from the risk of eroding and sloughing due to loss of

vegetation from the fire. The project will seed the hillside above and below the project road segment to ensure that rainfall does not destroy the only roads to access the emergency communications systems that allow emergency personnel to communicate in the event of an emergency.

- *Fountain Grove Revegetation and Slope Replanting.* 4344-PJ0351-4 awarded to the City of Santa Rosa in Sonoma County. This is a replanting/reforestation activity to prevent further erosion damage resulting from the Tubbs/Nun Fire which affected over 110,000 acres. In the Fountain Grove area, steep terrain was devastated, exposing raw land. This project will replant the landscape area along Fountain Grove, Stagecoach road and portions of Parkerhill Road and Thomas Lake Harris Road. This project, although obligated, has not started due to Public Assistance work needing to be completed prior to starting the replanting.
- *City of Corona Soil Stabilization.* 4353-PJ0307-01 awarded to the City of Corona. This is a soil stabilization project to protect the erosion of hillsides that would cause unstable conditions for 48 private residents in the event of heavy rainfall, flash flooding, and debris flow. This covers 200,000 square feet of burn area.
- *Santa Barbara Land Trust Debris Removal and Revegetation.* 4353-PJ0308-05 awarded to the Land Trust for Santa Barbara. This project was a debris removal and replanting project to protect the community from soil destabilization. Due to the heavy mudflows in Santa Barbara County, the oak trees were in danger of suffocation and dying with the potential to result in even more unstable soils that could cause more mud and debris flows which would result in additional danger to life and property. Maintaining tree health helps to stabilize the soil and in the event of major debris flow, these large trees will help to add a barrier to hold back much of the larger debris, such as eroded trees and boulders.
- *City of Santa Barbara Drainage System Strengthening*. 4353-PJ0309-04 awarded to the City of Santa Barbara to strengthen the headwall of a drainage system directly affected by the fires and install a debris barrier to ensure that the culvert will not be clogged and overturned in the event of heavy rainfall and debris. This project will ensure that road blockages do not occur so that emergency vehicles and residents can move freely and efficiently, if evacuation or emergency access is required.
- *Ventura Land Trust Revegetation.* 4353-PJ0310-02 awarded to the Ventura Land Trust funds revegetation on Land Trust lands which will assist in preventing mudflows that could cause damage to the surrounding community and sedimentation to downstream communities in the event of heavy rainfall.
- *Ojai Valley Land Conservancy Revegetation.* 4353-0311-03 awarded to Ojai Valley Land Conservancy. This project is to replant areas that were affected by the fires as well as adding drainage controls to ensure that major trails are not destroyed and do not add debris flow to the surrounding community including water infrastructure in the area in the event of heavy rainfall.

These projects followed criteria that was set forth by the state to mitigate immediate post-fire threats. These projects were managed by Cal OES and FEMA to ensure speedy obligation for the communities to ensure a timely project performance period.

Other Available Funding For Mitigation Efforts

As discussed in *Chapters 6 through 10*, billions of dollars of state, local, tribal, and private funds are committed to hazard mitigation efforts in amounts far exceeding those administered by FEMA. This multi-agency approach is coordinated and cross-cutting, yet decentralized.

Operating through separate agency programs, the state's comprehensive mitigation program is fiscally supported by a variety of financial sources, including general funds, bonds, fees, and federal grants. Some federal, state, and local funding sources are described more in *Annex 2: Public Sector Funding Sources*.

10.4 OVERVIEW OF FEMA HAZARD MITIGATION ASSISTANCE PROGRAMS ADMINISTERED BY CAL OES

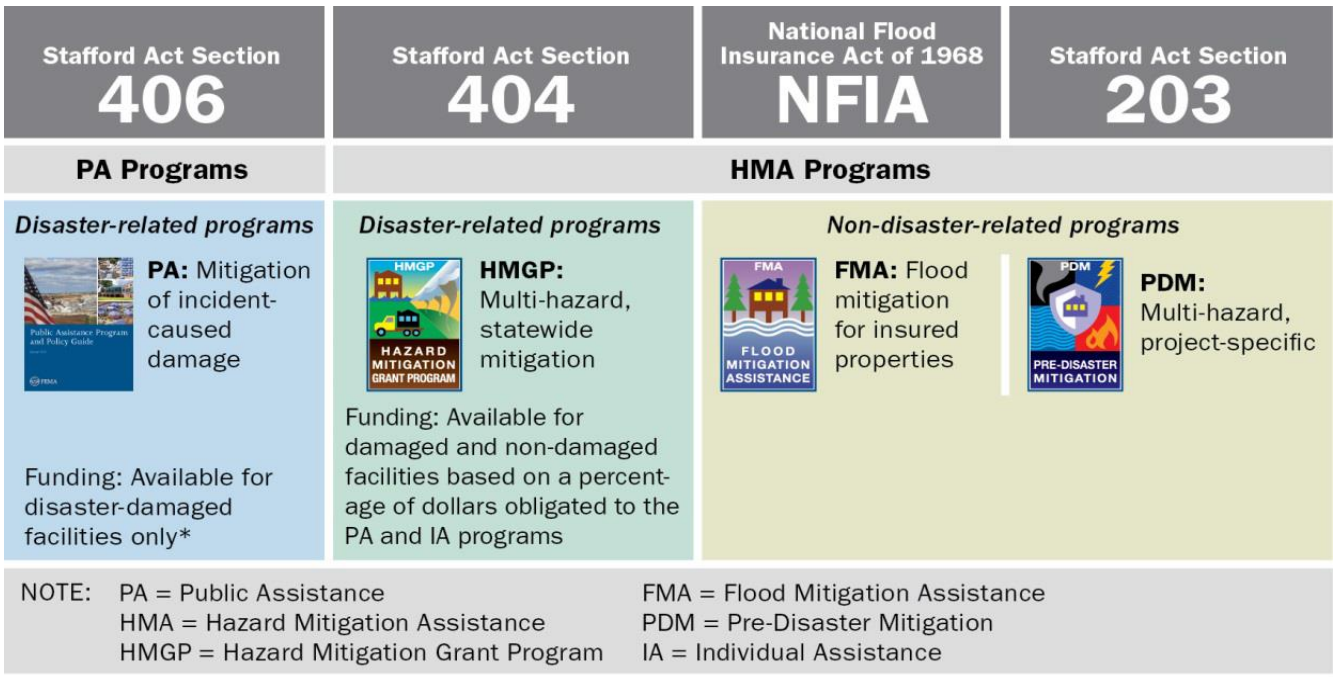
Cal OES is responsible for administering federal Hazard Mitigation Assistance (HMA) programs in California. Detailed discussions about Cal OES's program management capabilities in administering each of the FEMA HMA programs are included in *Section 10.5* of this chapter. This section provides a brief overview introducing each of FEMA's HMA programs:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)

When a federal disaster is declared by the President, FEMA Hazard Mitigation Grant Program (HMGP) funds become available to support mitigation planning and project efforts to mitigate the effects of future disasters. In California, these funds are administered by Cal OES's HMGP Division within the Response and Recovery Directorate. Annual appropriations of PDM and FMA funds are administered through Cal OES's Pre-Disaster and Flood Mitigation Division within the Preparedness and Planning Directorate. Eligible applicants include state agencies, local governments, special districts, federally recognized tribes, and private non-profit organizations consistent with the Code of Federal Regulations (CFR) Title 44- 206.221(e). Eligible mitigation projects and mitigation planning activities can be funded through the HMGP, PDM, and FMA programs.

Figure 10.A shows the linkage of HMA programs to sections of the Stafford Act and the National Flood Insurance Act.

Figure 10.A: FEMA Public Assistance and Hazard Mitigation Assistance Programs



Source: Federal Emergency Management Agency (FEMA) Public Assistance Program and Policy Guide

Eligible Mitigation Projects

HMA funding is available for eligible mitigation activities that implement an independent solution to mitigate risks to the built environment and minimize loss of life and property from future disasters. Mitigation projects submitted for HMA grants must be feasible and cost-effective, and they must mitigate the risks of the hazard for which the projects were specifically designed. The feasibility of a project is demonstrated through conformance with accepted engineering practices, established codes, standards, modeling techniques, or best practices. Effective mitigation measures funded under HMA should provide a long-term or permanent solution. Consideration of technical feasibility and effectiveness during the project scoping process facilitates project development. Table 10.F lists eligible mitigation activities from FEMA's 2015 Hazard Mitigation Assistance Guidance.

Eligible Hazard Mitigation Planning Activities

Mitigation plans are the foundation for effective hazard mitigation. The mitigation planning process includes hazard identification and risk assessment leading to the development of a comprehensive mitigation strategy for reducing risk to life and property. Planning activities can include assessing risk, updating the mitigation strategy, and promoting resilience to reflect current disaster recovery goals. Planning activities funded under HMA are designed to develop state, tribal and local mitigation plans that meet the planning requirements outlined in 44 CFR Part 201.

Table 10.F: Mitigation Activities Eligible for Hazard Mitigation Assistance Funding

Eligible Activities	Hazard Mitigation Grant Program (HMGP)	Pre-Disaster Mitigation (PDM)	Flood Mitigation Assistance (FMA)
1. Mitigation Projects	***X***	***X***	***X***
Property Acquisition and Structure Demolition	***X***	***X***	***X***
Property Acquisition and Structure Relocation	***X***	***X***	***X***
Structure Elevation	***X***	***X***	***X***
Mitigation Reconstruction	***X***	***X***	***X***
Dry Floodproofing of Historic Residential Structures	***X***	***X***	***X***
Dry Floodproofing of Non-Residential Structures	***X***	***X***	***X***
Generators	***X***	***X***	
Localized Flood Risk Reduction Projects	***X***	***X***	***X***
Non-Localized Flood Risk Reduction Projects	***X***	***X***	
Structural Retrofitting of Existing Buildings	***X***	***X***	***X***
Non-Structural Retrofitting of Existing Buildings and Facilities	***X***	***X***	***X***
Safe Room Construction	***X***	***X***	
Wind Retrofit for One- and Two-Family Residences	***X***	***X***	
Infrastructure Retrofit	***X***	***X***	***X***
Soil Stabilization	***X***	***X***	***X***
Wildfire Mitigation	***X***	***X***	
Post-Disaster Code Enforcement	***X***		
Advance Assistance	***X***		
5 Percent Initiative Projects	***X***		
Miscellaneous/Other*	***X***	***X***	***X***
2. Hazard Mitigation Planning	***X***	***X***	***X***
Planning-Related Activities	***X***		
3. Technical Assistance			***X***
4. Management Cost	***X***	***X***	***X***

**Miscellaneous/other indicates that any proposed action will be evaluated on its own merit against program requirements. Eligible projects will be approved provided funding is available.*

Source: Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Guidance, February 2015. https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf

10.4.1 HAZARD MITIGATION GRANT PROGRAM (HMGP) OVERVIEW

The Hazard Mitigation Grant Program (HMGP) is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (the Stafford Act), Title 42, United States Code (U.S.C.) 5170c. The key purpose of the HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. The HMGP is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. The HMGP may be limited to declared counties, but is typically available statewide.

The amount of HMGP funding available to eligible applicants is based upon the estimated total federal assistance to be provided by FEMA for disaster recovery under the Presidential major disaster declaration. Under the 2013 SHMP enhanced approval, California was eligible to apply for up to 20 percent of the cost of recovery for the declared disaster. Based on disasters declared in 2017, the additional amount available to the state in HMGP funds because of California's Enhanced 2013 SHMP was approximately $160 million. Up to seven percent of available HMGP funding can be allocated to mitigation planning activity grants.

Five Percent Initiative Projects

Funds for five percent initiative projects, which are only available pursuant to an HMGP disaster, provide an opportunity to fund mitigation actions that are consistent with the goals and objectives of the state and local mitigation plans and meet all HMGP requirements, but for which it may be difficult to conduct a standard Benefit-Cost Analysis (BCA) to prove cost-effectiveness. The proposed activities submitted under the five percent initiative are identified and selected at the discretion of the Cal OES Director, based on recommendations of the State Hazard Mitigation Officer (SHMO) and in consideration of the SHMP goals and objectives.

HMGP Post Fire

FEMA is now providing mitigation assistance for state, tribal, and local governments using the HMGP for Fire Management Assistance declarations in fiscal years 2017 and 2018, which covers October 1, 2016, through September 30, 2018. The Bipartisan Budget Act of 2018 authorizes FEMA to provide HMGP assistance for this specified time period. Typically, HMGP funding is only available following Presidential major disaster declarations.

FEMA will provide a national aggregate calculation based on an average of historical Fire Management Assistance designations from the last 10 years. The total amount available for HMGP for states and tribal applicants with standard state or tribal hazard mitigation plans will be $425,008 for each declaration and $566,677 for applicants with enhanced state or tribal hazard mitigation plans.

HMGP Post Fire follows current guidance with the following exceptions:

1. A Fire Management Assistance declaration rather than a Presidential major disaster declaration activates HMGP assistance.
2. Assistance is first available for counties and tribal lands that receive Fire Management Assistance declarations. If these areas cannot use the funding it may be available statewide. Applicants must detail their respective process, with deadlines, in their HMGP Administrative Plan.
3. HMGP funding amounts are based on a national aggregate for each Fire Management Assistance declaration and HMGP assistance shall be aggregated under the first declaration.
4. There is a 6-month application period from date of applicant (state, territory, or federally recognized tribe) funding notification, and extensions may be requested.

10.4.2 PRE-DISASTER MITIGATION (PDM) GRANT PROGRAM OVERVIEW

The Pre-Disaster Mitigation (PDM) Program, authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, assists states, U.S. territories, and federally recognized tribal governments. Local governments, including cities, townships, counties, and special district governments, are considered subapplicants and must submit subapplications for mitigation projects and planning activities to Cal OES. Tribal governments may submit applications/subapplications for mitigation projects and planning activities to either FEMA or Cal OES in accordance with HMA guidance.

The goal of the PDM program is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters. The PDM program also strengthens national preparedness and resilience and supports the mitigation mission area in the National Preparedness System and National Preparedness Goal. The PDM program awards planning and project grants and provides opportunities for raising public awareness in reducing future losses before disaster strikes. Mitigation planning is a key process used to break the cycle of disaster damage, reconstruction, and repeated damage.

PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis. Each year, FEMA publishes a Notice of Funding Opportunity (NOFO) which summarizes the distribution of the annual appropriation of both PDM and FMA funds.

Legislative Pre-Disaster Mitigation (LPDM) Grants

LPDM grants had previously been authorized by a Joint Explanatory Statement in the annual federal appropriations budget. Although the federal budget no longer designates funds for specific projects, as of early 2018, Cal OES has three previously allocated projects under the LPDM grant program that are still in process. Funds awarded through the LPDM grant program are applied toward the appropriation for the designated fiscal year. Proposed activities must be in conformance with the PDM eligibility criteria defined in the HMA Unified Guidance.

10.4.3 FLOOD MITIGATION ASSISTANCE (FMA) GRANT PROGRAM OVERVIEW

The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The FMA program makes available federal funds to state, U.S. territories, and federally recognized tribal governments to reduce or eliminate the risk of repetitive flood damage to buildings and structures insured under the NFIP. Local governments, including cities, townships, counties, and special district governments are considered subapplicants and must submit subapplications for mitigation projects and planning activities to Cal OES. Tribal governments may either submit applications/subapplications for mitigation projects and planning activities to FEMA or Cal OES in accordance with HMA guidance.

The FMA program strengthens national preparedness and resilience and supports the mitigation mission area in the National Preparedness System and National Preparedness Goal. All subapplicants must be participating in the NFIP, and not be withdrawn or suspended, to be eligible to apply for FMA grant funds. Flood insurance must be maintained through completion of the mitigation activity and for the life of the structure. For more information about the NFIP see *Section 7.1.5.8*.

10.4.4 CAL OES HMA PROGRAM PRIORITIES FOR HMA GRANT FUNDING

Each disaster has particular characteristics that influence the specific mitigation priority determination. For example, earthquake hazards differ from those that affect much of the rest of the nation. Priority determination also takes into account the nature of the disaster. Specific post-disaster priorities are determined as part of initial program guidance to potential applicants. Information to be considered in establishing priority categories may include the evaluation of natural hazards in the disaster area, state-of-the-art knowledge, and practices relative to hazard reduction, existing state mandates or legislation, existing state or local programs, and long-term mitigation goals and objectives at the state, local, and community level. Also an important consideration for prioritization of grant

funding are those communities with high levels of growth and development, as well as those with repetitive loss issues.

Projects must mitigate imminent hazards, be highly cost-effective, and assist in critical efforts to help communities recover from disasters. Non-competitive priority is typically given to shovel-ready projects within the county (or counties) declared in the disaster proclamation. The remainder of the disaster relief funding is made available to all counties for any type of eligible mitigation project meeting program requirements on a competitive basis.

Establishing this priority provides guidance for local governments to build in flexibility for identifying critical mitigation needs that may arise from a disaster when there is no time to update a local plan. Up to seven percent of available HMGP funding can be allocated to planning grant subawards. Using sever percent HMGP funding to develop new and/or updated multi-jurisdiction LHMPs is a high priority, and these projects are given priority points in the ranking NOI criteria.

The following summarizes the core priorities established for the distribution of FEMA Hazard Mitigation Assistance (HMA) grant funding by Cal OES, supporting state agencies, and FEMA:

- **Protecting lives and property at risk from imminent hazards created or exacerbated by disasters**. Mitigating risk in in high hazard areas of the state is a priority both pre- and post-disaster. Recovery efforts after a disaster have several sources of funding that can help in abating or mitigating hazards. The process for making Hazard Mitigation Grant Program (HMGP) funds available usually takes 180 to 300 days. A Hazard Mitigation Operational Strategy is developed and outlines how the Cal OES and FEMA will operate in the Joint Field Office (JFO) to address the priorities established by California's State Hazard Mitigation Officer (SHMO), in response to damage from disaster declaration.

  Priority is given to funding projects that will mitigate imminent hazards, that are highly cost-effective, and that assist in critical efforts to help communities recover from disasters. These priorities together all lead toward better protecting lives and property. Establishing this priority provides guidance for local and tribal governments to build in flexibility for identifying critical mitigation needs that may arise from a disaster when there is no time to update a local and tribal plan.

- **Protecting vulnerable critical facilities and infrastructure**. Another important priority for federal funding is to help with protecting critical facilities and infrastructure. Though the state and many communities have ongoing capital improvement programs, there remains an almost overwhelming need to retrofit, replace, protect, or relocate facilities and infrastructure that are important to the state's communities and are at risk from hazards.

- **Maximizing project benefit versus cost.** A principal criterion for awarding grants is the extent to which a project maximizes benefits in relation to the associated mitigation project costs. In other words, the greater the cost-effectiveness of the project, the lower future disaster costs will be. As part of the HMA grant subapplication review, the higher the project benefit cost ratio, the higher the subapplication is ranked, thus giving the project higher priority to receive grant funding.

- **Reducing repetitive losses.** Mitigation areas with repetitive loss are high priorities for hazard mitigation funding and resiliency efforts. Repetitive losses are a drain on community, state, and national disaster management resources and are very cost-effective to mitigate. The current national and state priority is the reduction of repetitive flood losses because these translate into a loss to the National Flood Insurance Program (NFIP). California has numerous areas of repetitive flood loss. Through the Community Rating System, building codes, education and resiliency programs, California works to reduce these losses. Additionally, many areas of the state experience repetitive losses from other hazards which are also mitigated through education and various funding opportunities. See *Section 7.1.4.1* and *Appendices J and K* for repetitive loss information.

- **Ensuring that communities are eligible for federal programs by supporting local multi-hazard mitigation planning and encouraging all communities to prepare and adopt a Local Hazard Mitigation Plan (LHMP)**. FEMA provides states with hazard mitigation grant funding from three programs: the Hazard Mitigation Grant Program (HMGP), described under the Robert T. Stafford Act, the Pre-Disaster Mitigation (PDM) program described in the Disaster Mitigation Act of 2000, and the Flood Mitigation Assistance (FMA) program as part of the National Flood Insurance Reform Act (NFIRA) of 1994. These programs require approved projects to be consistent with local- and state-developed mitigation plans to comprise a of cost-effective long-term mitigation program. Also, each program allows some funding to be available for hazard mitigation planning efforts.

  Encouraging communities to develop and implement LHMPs is a high priority for California. Such plans are necessary to ensure that local communities are made aware of the hazards and vulnerabilities within their jurisdictions, develop strategies to reduce those vulnerabilities, and receive certain federal financial assistance for hazard mitigation. See *Chapter 5* for more information about the LHMP program in California.

- **Addressing climate impacts.** For HMA funding the state is working with FEMA to prioritize projects that address climate impacts or adaptation efforts. This effort includes Climate Resilient Mitigation Activities (CRMA) identified by FEMA as eligible for HMA funding.

- **Protecting vulnerable populations.** Funding of mitigation projects in disadvantaged communities is prioritized through the HMA grant subapplication process. Disadvantaged communities within California are identified by the California Environmental Protection Agency (CalEPA) CalEnviroScreen tool.

10.5 CAL OES HAZARD MITIGATION ASSISTANCE GRANT PROGRAMS: PROJECT IMPLEMENTATION CAPABILITY

The Governor designated Cal OES as the state administrative agency responsible for the implementation of FEMA funding, including funds available through the various Hazard Mitigation Assistance (HMA) grant programs. In addition, Cal OES serves as the State Administrative Agency for numerous other federal grant programs administered by the Department of Homeland Security, the Bureau of Justice Assistance, the Violence Against Women Grant Office, the Department of Health and Human Services, the National Institute of Justice, and other federal funding agencies. To competently administer these federal grant programs, Cal OES has established an extensive infrastructure for the support of grants administration.

This staff infrastructure includes a very large contingent of full-time professional staff dedicated to the review, approval, processing, oversight, monitoring, and payment of federal grants and subgrants to state and local agencies for the implementation of federal and state programs. In total, Cal OES administers more than 70 separate grant programs to more than 1,400 grant recipients (state agencies, local jurisdictions, non-governmental organizations [NGO's], and tribal entities) and manages $1.4 billion in federal trust fund authority.

The Hazard Mitigation Grant Program (HMGP) is administered within a different directorate of Cal OES from the Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) grant programs. All program staff work in collaboration with FEMA, state and local partners, and stakeholders.

In some cases, the grants process is parallel for both HMPG and PDM/FMA grants, but some processes differ. This section reviews the grant program processes. Where the processes are the same or very similar, a single description of the process is presented. Where processes differ, each process is described under the heading of each grant program.

Cal OES's HMGP Division Organizational Structure

As of March 2018, the HGMP Division is within the Response and Recovery Directorate and includes nine permanent and fourteen limited-term full-time staff. The number of additional HMGP staff may expand and shrink to accommodate additional grant funding efforts following declared disaster events.

Chart 10.A shows the organizational structure of the HMGP Division permanent staff and limited-term staff brought in to accommodate large grant funding workloads following a declared disaster.

The HMGP Division has developed written standard operating procedures for the grants process, which are then further customized depending on specific conditions of each declared disaster. Details of the HMGP grants process are discussed in the remainder of this section.

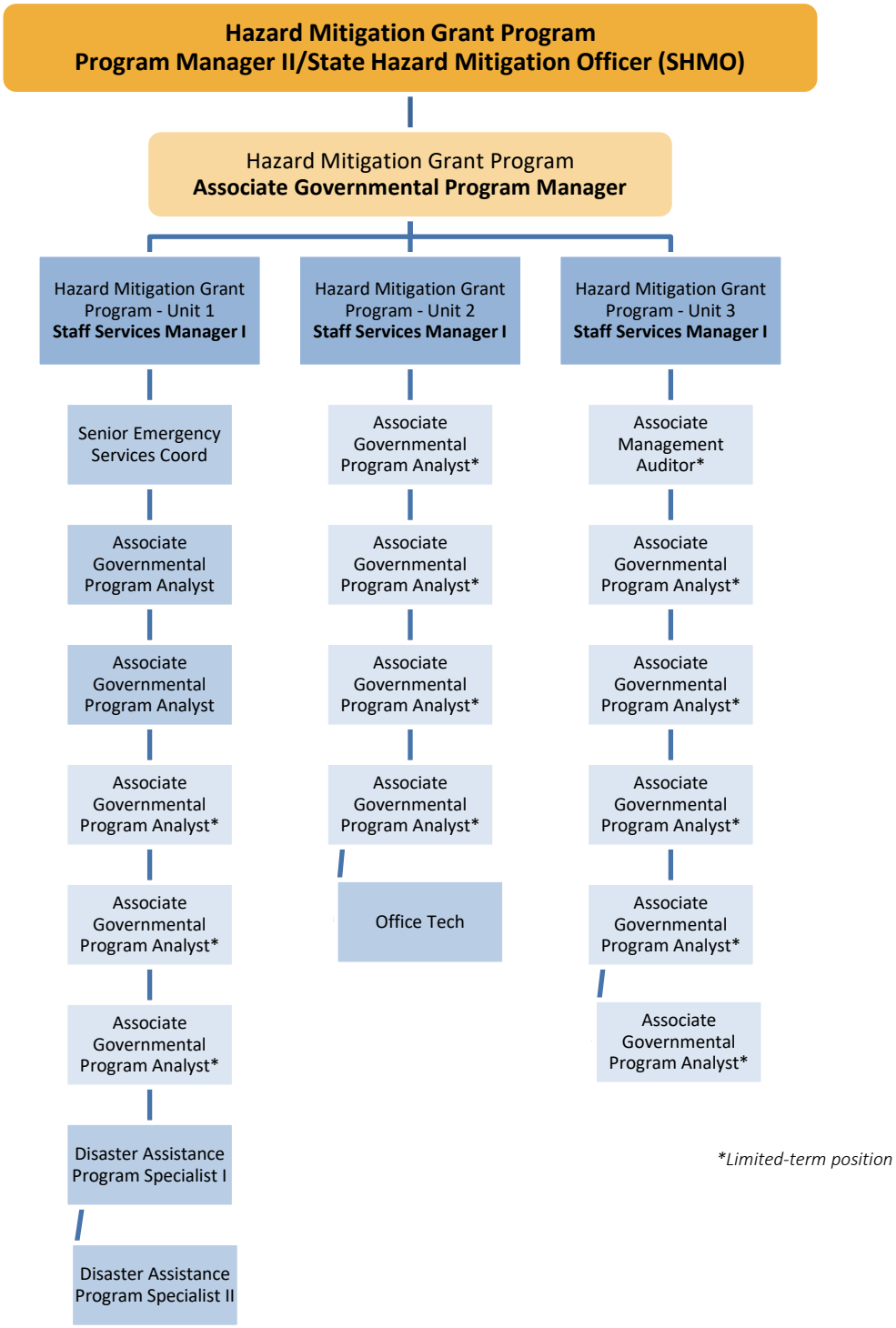
Cal OES's Mitigation and Dam Safety Branch Organizational Structure

In 2017, Cal OES created the Mitigation and Dam Safety Branch within the Planning and Preparedness Directorate. The Mitigation and Dam Safety Branch includes the Dam Safety Planning Division, Hazard Mitigation Planning Division, and the Pre-Disaster and Flood Mitigation Division.

Chart 10.B shows the organizational structure of the Mitigation and Dam Safety Branch. As of June 2018, staffing within the branch includes the following: the Dam Safety Planning Division has one Program Manager and three staff; the Hazard Mitigation Planning Division has one program manager, four full-time staff, and two limited-term staff; and the Pre-Disaster and Flood Mitigation Division has one program manager, three full-time staff, and one limited term staff.

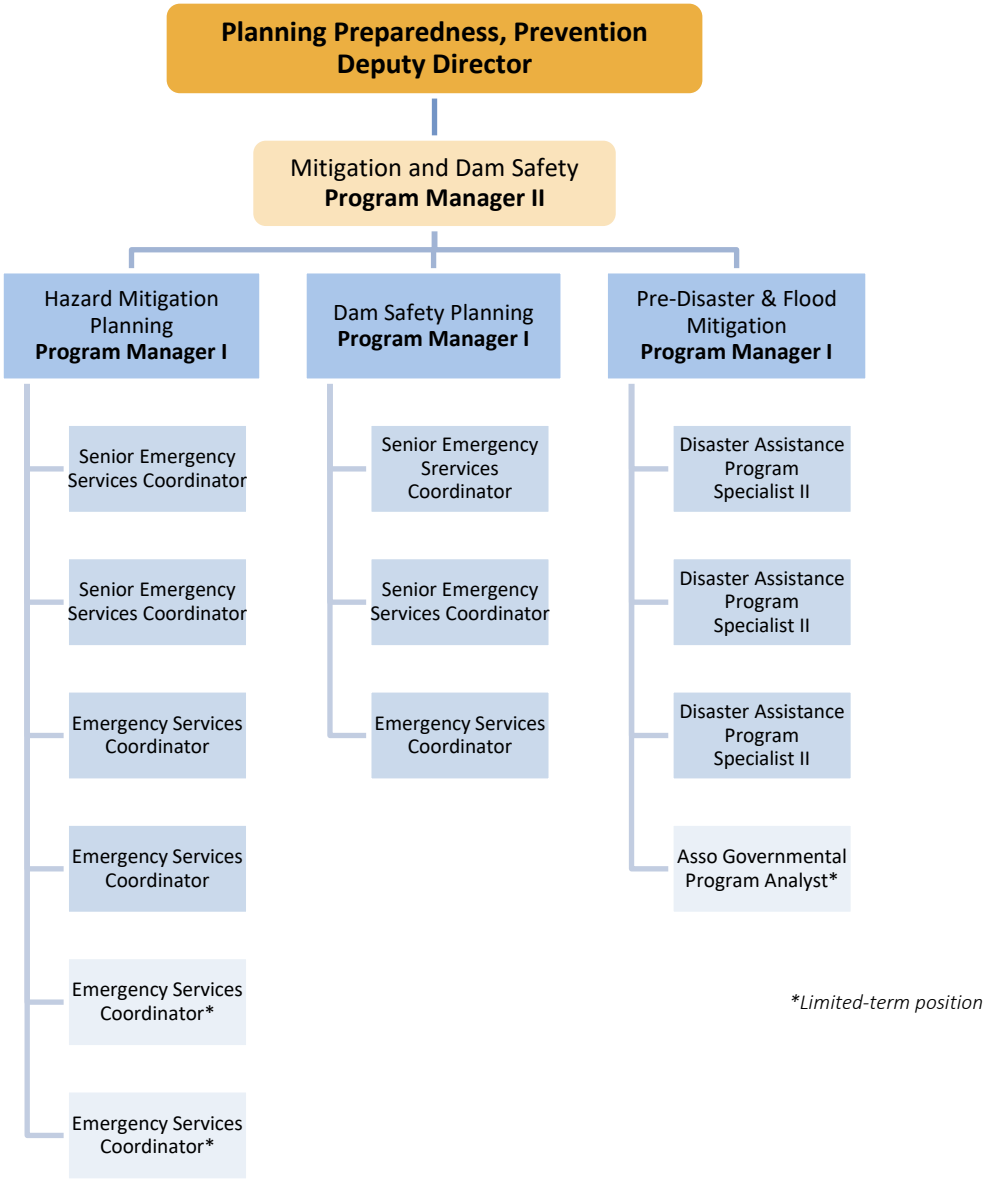
Each division within the branch has developed written standard operating procedures that detail specific internal processes. These written procedures assist current and new staff with standard and consistent processes and increase overall program management capabilities.

Chart 10.A: Cal OES HMGP Division Organization, as of March 2018



Source: California Governor's Office of Emergency Services (Cal OES)

Chart 10.B: Cal OES Mitigation and Dam Safety Branch Organization, as of June 2018



Source: California Governor's Office of Emergency Services (Cal OES)

10.5.1 CAL OES GRANT PROPOSAL PROCESS

The Enhanced Plan must document the state's project implementation capability, identifying and demonstrating the ability to implement 44 CFR Section 201.5(b)(2)(i) and (ii), including:

- Establishing eligibility and state criteria to rank multi-hazard mitigation measures
- Developing a system to determine the effectiveness of mitigation measures, consistent with OMB Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, and ranking the measures according to the state's eligibility criteria

10.5.1.1 AVAILABILITY OF MITIGATION GRANT FUNDING OPPORTUNITIES

This section defines the specific steps that California takes to start the process of receiving HMA grant funding, resulting from disaster declarations or congressional appropriations of mitigation funding.

When HMGP Funding Becomes Available

Cal OES receives a revised estimate of available HMGP funds six months after the date of declaration of the disaster, and a lock-in amount at twelve months. The HMGP ceiling will fluctuate in the first twelve months after a disaster due to ongoing adjudication of Public Assistance, Individual Assistance, Debris Removal recovery costs, and other federal reimbursement programs from which HMGP funding calculations are determined. The maximum federal share that can be requested per mitigation activity is set by Cal OES for each disaster based on the amount of funding that is available. Cal OES has the authority to set or change funding priorities based on the needs of affected communities. Funding recommendations are determined through a competitive scoring and ranking of all subapplications submitted for a specific disaster.

HMGP funding notification is accomplished primarily through email distribution lists (maintained by Cal OES's HMGP Division) and dissemination of notifications to Cal OES regional administrators, other state agencies, and federal partners. HMGP staff also present information about funding opportunities at public assistance applicant briefings conducted jointly by Cal OES and FEMA in declared disaster areas.

Cal OES may offer non-competitive funding to severely impacted eligible subapplicants in declared counties, for eligible shovel-ready mitigation activities where not implementing those mitigation activities could result in further loss of life or property under probable impending circumstances. As an example, in 2018, Cal OES offered non-competitive HMGP funding to jurisdictions in burn scar areas to implement immediate erosion control and soil stabilization measures to prevent mudslide and debris flows in areas with forecasted precipitation significant enough to cause such conditions. Non-competitive projects must meet the following criteria:

- The project must be shovel-ready
- The subapplicant must have an adopted/approved LHMP
- The subapplicant must be able to meet a 25 percent local cost match
- The project must not have not started construction before the approval

When PDM/FMA Funding Becomes Available

PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis. Each year, FEMA publishes a Notice of Funding Opportunity (NOFO) that summarizes the distribution of the annual appropriation of both PDM and FMA funds. FEMA requires state, territorial, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including funding for PDM projects.

Occasionally during the subapplication development process, a jurisdiction may have an updated or new LHMP in review with Cal OES or FEMA. Mitigation Planning staff categorize LHMPs from subapplicant jurisdictions as "high review priority" to quickly complete the review and approval process and enable such jurisdictions to submit project subapplications. Cal OES grant staff review applications and subapplications to verify that LHMPs are in place by the application deadline and at the time of obligation in accordance with Title 44 Code of Federal Regulations (CFR) Part 201.

For both PDM and FMA, federal funding is available for up to 75 percent of the eligible activity costs. The remaining 25 percent of eligible activity costs must be derived from non-federal sources. A match commitment letter must be submitted to Cal OES as part of the Notice of Interest (NOI) process and attached to the subapplication within FEMA's Mitigation eGrant System. Small, impoverished communities are eligible for up to a 90 percent federal cost share for their mitigation planning and project subapplications in accordance with the Stafford Act. As of early 2018, Cal

OES limits the maximum federal share for LHMPs to $250,000 for multi-jurisdiction plans and $125,000 for single jurisdiction plans.

FEMA requires that all mitigation projects submitted as part of a PDM grant application be consistent with the goals and objectives identified in a) the current, FEMA-approved state or tribal (standard or enhanced) mitigation plan and, b) the LHMP for the jurisdiction in which the project is located. There is no mitigation plan requirement for applicants and subapplicants to submit planning subapplications for the development of a new hazard mitigation plan or the update of a mitigation plan. Planning subapplications submitted for consideration for PDM funding must result in a mitigation plan adopted by the jurisdiction(s) and approved by FEMA. All proposed mitigation activities submitted to FEMA must be cost-effective and feasible and must provide a long-term, independent solution to mitigate natural hazards.

For FMA grants, FEMA may provide up to 100 percent federal cost share for Severe Repetitive Loss (SRL) properties and up to 90 percent federal cost share for Repetitive Loss (RL) properties. Cal OES coordinates with the Department of Water Resources (DWR), the Flood Managers Association, and California Silver Jackets to contact communities with SRL properties informing them of the availability of the FMA grants and providing guidance regarding requirements. The state coordinates with the communities with the most SRL properties to encourage them to develop and update their Local Hazard Mitigation Plans (LHMP). The identified communities are given preference in the award of flood project grants. As of December 31, 2017, Sonoma and Los Angeles Counties were the top SRL counties in California. See *Appendices J and K* for summaries of SRL and RL counties in 2017.

10.5.1.2 CAL OES GRANTS NOTICE OF INTEREST ELIGIBILITY REVIEW PROCESS

HMGP Notice of Interest Review

The Notice of Interest (NOI) is an electronic form that can be submitted electronically via a link on the HMGP webpage and serves as subapplicants' proposal of a mitigation activity. The NOI is published for a defined period of time that is based on the priorities of a specific disaster, typically 30 to 60 days. Jurisdictions must complete the NOI by the deadline. Once the deadline has passed, HMGP staff will review all NOIs to determine eligibility of each subapplicant and the proposed activity. Subapplicants are notified about their eligibility, based on their NOI, via an automatic email notification that is generated by the Mitigation Grants Management (MGM) database.

Beginning with the NOI, all project information is entered into the MGM database. This information is continuously updated throughout the life of the project. The MGM database includes the following information for all grants:

- Executive Summary
- Applicant Information
- Project Information
- Application Review
- Project Monitoring
- Financial Information
- Closeout Information

At a minimum, all subapplicants must have an approved LHMP in order to be eligible for HMGP funding. Eligible subapplicants include state agencies and universities, local governments, special districts, federally recognized tribes, and private non-profit organizations. Information on eligible activities may be found in FEMA's Hazard Mitigation Assistance (HMA) Guidance.[338] See Table 10.G for a summary of the HMGP NOI steps.

[338] https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf

Table 10.G: Summary of HMGP NOI Process

Step	Hazard Mitigation Grant Program (HMGP) Notice of Interest (NOI) Steps
1	Following a declared disaster, the California Governor's Office of Emergency Services (Cal OES) develops and posts the notice for HMGP grant funding opportunities.
2	The subapplication process for HMGP subgrants begins when potential subapplicants review and download the NOI information from the Cal OES website at: http://www.caloes.ca.gov/cal-oes-divisions/recovery/disaster-mitigation-technical-support/404-hazard-mitigation-grant-program
3	Subapplicants complete the NOI form online and submit it electronically.
4	The Cal OES HMGP Division reviews each NOI for eligibility of subapplicant and eligibility of project/planning activity.
5	An email notification is sent to the subapplicant notifying them of their NOI eligibility status and, if eligible, they are invited to submit a full subapplication by the deadline established in the HMGP priorities.
6	The HMGP Division will provide workshops to eligible subapplicants offering instruction on development of the subapplication, program guidelines, and Benefit-Cost Analysis.

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

PDM/FMA Notice of Interest (NOI) Review

Following the release of FEMA's NOFO, an extensive outreach effort is implemented to jurisdictions across the state to notify them of funding availability and the California NOI submittal information and deadlines. Outreach efforts include the following:

1. *Posting of Notice. T*he Cal OES Pre-Disaster and Flood Mitigation Division posts a notice of funding availability and instructions for submittal on the Cal OES website
2. *State Agency Outreach*. Multiple state agencies and organizations such as Department of Water Resources (DWR), Governor's Office of Planning and Research (OPR), and California Coastal Commission (CCC) disseminate the Cal OES NOI announcement to their distribution lists
3. *Partner Organization Outreach*. Partner organizations such as the Flood Managers Association, the Association of Bay Area Governments, California Fire Safe Council, and the Federal Silver Jackets disseminate the Cal OES NOI Announcement to their distribution lists
4. *Targeted Outreach*. The PDFM Division also works with the Cal OES Hazard Mitigation Planning Division to target outreach for planning grants to local jurisdictions that either do not have an Local Hazard Mitigation Plan (LHMP) or have an LHMP which is about to expire
5. *Outreach to Repetitive Loss Communities*. SRL and RL communities are notified of FMA funding opportunities for their NFIP insured properties

All NOIs received are reviewed directly by Cal OES PDFM grant staff to confirm subapplicant and project eligibility. Following eligibility review, an email is sent to jurisdictions notifying them of eligibility results. See Table 10.H for a summary of the PDM/FMA NOI steps. Eligible jurisdictions with eligible project or planning activity NOIs are then invited to submit a subapplication for Cal OES review and ranking through FEMA's web-based mitigation electronic grants (eGrant) system.

Table 10.H: Summary of PDM/FMA NOI Process

Step	Pre-Disaster Mitigation (PDM)/ Flood Mitigation Assistance (FMA) Notice of Interest (NOI) Steps
1	Upon receipt of the Federal Emergency Management Agency (FEMA's) Notice of Funding Opportunity (NOFO) the California Governor's Office of Emergency Services (Cal OES) develops and posts instructions for filing a NOI for PDM and FMA grant funding opportunities.
2	The application process for PDM and FMA subgrants begins with potential subapplicants reviewing the NOI information from the Cal OES website at: http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/.
3	Potential subapplicants complete the NOI form online and submit it electronically to Cal OES.
4	The NOI is reviewed by Cal OES to confirm eligibility of the subapplicant and the proposed project or planning activity.
5	An email notification is sent to the subapplicant notifying them of their NOI eligibility status. Eligible jurisdictions with eligible planning or project activities are invited to submit a competitive subapplication via FEMAs eGrants system by the deadline established by Cal OES.

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

10.5.1.3 CAL OES GRANTS SUBAPPLICATION PROCESS

Subapplication Environmental Review

Subapplicants for all grants (HMGP, PDM, and FMA) must submit the resulting environmental and historical review documentation as part of their subapplication package to FEMA. Cal OES grants staff confirm that the environmental and historical review documents are submitted by the subapplicant to meet state and federal requirements.

Upon FEMA review, if a project is "identified for further review," FEMA will continue its internal review and selection process. FEMA initiates the National Environmental Policy Act (NEPA) compliance review and approval process before project approval and any project activities are permitted to begin. Before FEMA approval of a subgrant, the project activities must comply with all applicable federal, state, and local codes and standards including the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) (PL 91-190, as amended). After NEPA approval is provided, project approvals and grant awards/subawards are initiated between FEMA and Cal OES as the grantee.

The federal environmental and historical review documents are verified and submitted with each subapplication:

- National Historic Preservation Act-Historic Building and Structures
- National Historic Preservation Act-Archeological Resources
- Endangered Species Act and Fish and Wildlife Coordination Act
- Clean Water Act, Rivers and Harbors Act, and Executive Order 11990 (Protection of Wetlands)
- Executive Order 11988 (Floodplain Management)
- Coastal Zone Management Act
- Farmland Protection Policy Act
- Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Hazardous and Toxic Materials)
- Executive Order 12898, Environmental Justice for Low Income and Minority Populations

In California, jurisdictions are required to conduct environmental review of proposed projects under CEQA. CEQA generally requires state and local government agencies to inform decision makers and the public about the potential environmental impacts of proposed projects, and to reduce those environmental impacts to the extent feasible. If a project subject to CEQA will not cause any adverse environmental impacts, a public agency may adopt a brief document known as a negative declaration. If the project may cause adverse environmental impacts, the public agency must prepare a more detailed study called an environmental impact report (EIR). An EIR contains in-depth studies of potential impacts, measures to reduce or avoid those impacts, and an analysis of alternatives to the

project. A key feature of the CEQA process is the opportunity for the public to review and provide input on both negative declarations and EIRs. The California Natural Resources Agency (CNRA) maintains a flowchart summarizing the CEQA process: http://resources.ca.gov/ceqa/flowchart/.

Benefit-Cost Analyses

A Benefit-Cost Analysis (BCA) is required as part of the subapplication for all grants (HMGP, PDM, and FMA). Subapplicants must use the FEMA-approved BCA tool to develop this information. A Benefit-Cost Ratio (BCR) of 1.0 or greater must be achieved in order for the subapplication to be eligible. As part of the subapplication review process, grant program staff review the BCA submitted by the subapplicant to ensure that it was completed correctly and meets the 1.0 minimum. *The variety and amount of detail of technical data gathered and incorporated into the BCA tool are often a determining factor in whether a project is awarded*.

Guidance for using FEMA's BCA tool is available to jurisdictions on the Cal OES website and FEMA website at: www.fema.gov/benefit-cost-analysis. Due to the complexity of the BCA, HMGP staff dedicate a portion of their subapplication development workshops to the BCA requirements, outlining how and where to gather required data, and offers individual BCA technical assistance. The workshops include interactive training on the FEMA-approved BCA Tool. Cal OES also provides BCA data sources on its website for each of the grant programs. See *Section 10.5.1.4* for more information on technical assistance and training offered by grants program staff.

If the applicant is unable to achieve a qualifying BCR, they are informed that their project is not eligible, and are advised not to expend any further effort or cost. Once the applicant has submitted a qualifying BCA, Cal OES HMA grant program staff continue to work with the subapplicant on the development of their subapplication. Cal OES grant staff also review the sub-applicants grant management capability and verify that the jurisdiction is able to manage the grant funds and complete the activity within the project performance period.

BCA Challenges

The BCA process has been a challenging component for jurisdictions and newly hired Cal OES grant staff. With a huge influx of new staff to support the grants and turnover of existing staff, a challenge for the HMA program is to ensure that new staff are trained in and understand BCA development. To address this, Cal OES works with FEMA to train new grants staff and supplement training for ongoing staff. Newly hired Cal OES HMA grant program staff participate in the subapplication development workshops as well as in additional internal trainings to become proficient in the BCA review tool and process.

Cal OES has requested and continues to receive additional BCA training by FEMA Region IX and JFO staff to enhance BCA knowledge and capabilities within Cal OES and in local jurisdictions. This additional training will increase and leverage best available data for successful BCA analysis in future subapplication submittals.

HMGP Subapplication Development and Support

Upon receiving notification of an eligible NOI, subapplicants are invited to attend subapplication development workshops and submit a subapplication. Subapplication development guidance documents are available on the HMGP webpage and are recommended for subapplicants to review and follow during development of the subapplication. HMGP staff strives to consistently improve guidance and technical assistance material after each disaster based on best practices and feedback from subapplicants.

HMGP grants specialists follow CFR 44 and FEMA's HMA guidance to process each subapplication.

HMGP Subapplication Scoring and Ranking

Subapplication scoring criteria and ranking worksheets are included *Appendix L*. After the subapplicant submittal deadline, Cal OES will conduct a further eligibility review of the complete subapplications, including scoring each on several ranking criteria. HMGP staff is equipped with detailed checklists that facilitate the review of subapplications. In 2017, HMGP staff incorporated FEMA's Completeness and Eligibility Checklist into the internal HMPG checklist. A

typical scoring checklist is included in *Appendix L*. This checklist may vary for different disaster relief funding opportunities, based on the state's priorities.

The State Hazard Mitigation Officer (SHMO) will recommend ranked subapplications for funding. Subapplications that receive the highest scores will be vetted with executive management and upon approval will be submitted to FEMA for funding consideration. If a complete subapplication is submitted to Cal OES and does not require a request for additional information, and meets the minimum BCR requirement of 1.0, HMGP staff may prioritize its recommendation for funding. As an example, the selection process for HMGP funding may recommend for funding the highest-ranked activities located in the counties that suffered the greatest damages as a result of a declared disaster.

Once a subapplication is submitted to FEMA for funding, the HMGP Division coordinates with the subapplicant and FEMA to provide any additional information necessary for FEMA to approve the application and obligate the funds, including the environmental review and verification of the BCA. Table 10.I summarizes the HMGP Subapplication steps.

HMGP Application Submittals and Challenges

From 2013 to 2016, Cal OES did not consistently submit complete subapplications to FEMA. During this time period subapplications occasionally included problematic BCA or were missing pieces of critical information to determine eligibility. The HMGP Division has consistently strived to meet time frame and completeness goals for technically feasible, and eligible proposed subapplication submittals with appropriate supporting documentation.

In late 2016, Cal OES appointed a new State Hazard Mitigation Officer (SHMO). Since 2017, the HMGP Division under the direction of the new SHMO has worked in concert with FEMA to identify and correct deficiencies in oversight of subapplication development. To correct these deficiencies, Cal OES has implemented several measures to improve education and outreach for subapplication development including: increasing staffing levels, providing current and relevant information on Cal OES's 404 Hazard Mitigation webpage, revamping and improving subapplication development workshops to include one-on-one technical assistance to interested jurisdictions, and combining Cal OES's and FEMA's eligibility review checklist to ensure a more thorough and consistent review by state staff. This is to ensure that all subapplication issues are identified and corrective action is established to bring the subapplication to completeness.

With these corrective measures implemented, 2017 grant subapplications submittals were completed in accordance with FEMA procedural guidelines for the HMGP.

Table 10.I: Summary of HMGP Subapplication Process

Step	Hazard Mitigation Grant Program (HMGP) Subapplication Steps *(following Notice of Interest [NOI] steps listed in Table 10.G)*
7	Subapplicants submit two hardcopy subapplications to the California Governor's Office of Emergency Services (Cal OES) by the identified deadline. (This Step 7 continues from Step 6 in the NOI process.)
8	HMGP staff will review projects for activity eligibility and completeness. HMGP staff will score and rank all eligible subapplications.
9	Incomplete/ineligible applications are rejected and not submitted to the Federal Emergency Management Agency (FEMA) for further review.
10	Applications that do not meet minimum scoring are rejected and not submitted to FEMA for further review.
11	All proposed subapplications recommended for funding consideration by HMGP staff are vetted through Cal OES executive management for concurrence.
12	All subapplications recommended for funding are sent to FEMA for review.

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

PDM/FMA Subapplication Development and Support

Following NOI acceptance, subapplicants submit PDM/FMA subapplications through the FEMA eGrants system. Cal OES PDM/FMA grants staff download the submitted subapplications from the eGrants system and reviews each subapplication for completeness.

PDM/FMA subapplications must include:

- Scope of work
- Project schedule
- Project cost estimate/budget
- If applicable, pre-award costs *(A pre-award cost may be eligible if it is a line item in the budget and "current"—if it occurs between application notification and grant award)*
- Match commitment letter – funds must be secured
- Cost effectiveness and feasibility statement (based on FEMA Module 5.3.0 for Benefit-Cost Analysis [BCA])

To support subapplication development, Cal OES grants staff has presented information webinars detailing NOFO requirements and the associated subapplication process. Staff work one-on-one with jurisdictions throughout the submittal process to provide technical assistance on subapplication development.

As part of subapplication completeness review, PDM/FMA grants staff verifies that the subapplicant's project scope aligns with the proposed project budget and timeline, and confirms that the subapplicant has included their funding match commitment letter in the subapplication. During the completeness review process, PDM/FMA grants staff also score the subapplicant for the type of approved LHMP with multi-jurisdictional plans gaining the highest score and confirm that the proposed mitigation project is identified as a high priority in the jurisdiction's approved LHMP.

PDM/FMA Subapplication Scoring and Ranking

Along with federal priorities identified within FEMAs NOFO, State priorities (see *Section 3.15.2*) are a consideration for funding priorities as well. As part of Cal OES's review and ranking of subapplications received, extra points are provided for:

- Development of new or updated Local Hazard Mitigation Plans
- Severe Repetitive Loss (SRL) and Repetitive Loss (RL) projects and communities that participate in the Community Rating System (CRS) for flood projects
- Cost-effectiveness and feasibility
- Projects within high hazard severity zones
- Projects or plans that include Climate Resilient Mitigation Activities (CRMA)

Local hazard mitigation planning activities and projects with higher Benefit-Cost Ratios (BCRs) receive a higher number of points. Extra points are also provided if the LHMP and/or flood plans are adopted into the safety element of the general plan and if the project protects or enhances a critical facility or infrastructure. For projects located in areas of higher hazard risk (such as mapped high seismic activity areas or Very High Fire Hazard Severity Zone areas identified by CAL FIRE), a higher number of points is applied to the project ranking. Subapplication scoring criteria and ranking worksheets are included *Appendix L*.

PDM/FMA grants staff have worked to strengthen the grant ranking process and review team by adding subject matter experts and refining the scoring criteria. Following PDM/FMA subapplication completeness review, PDM/FMA staff then rank all subapplications using a review team that typically consists of all PDM/FMA division staff, two Department of Water Resources (DWR) civil engineers reviewers, two Cal OES earthquake program reviewers, and two Cal OES fire program reviewers. Each group ranks the subapplications and PDM/FMA staff then merge these scores into a final ranking. As noted above, as of early 2018, HMGP staff are ranking HMGP subapplications using multiple reviewers within their division, but intends to expand their review team in the future

to include subject matter expert reviewers. Priority is given to projects addressing Severe Repetitive Loss or Repetitive Loss. For more information about Severe Repetitive Loss and Repetitive Loss, see *Section 7.1.4.1*.

Once a PDM/FMA subapplication has been reviewed and scored, Cal OES grants staff work directly with the subapplicant to strengthen the project subapplication to more successfully compete for federal funding. Table 10.J summarizes the PDM/FMA subapplication steps.

PDM/FMA Application Submittals and Challenges

From 2013 to 2017 PDM/FMA subapplications to FEMA were submitted through the Mitigation eGrants system meeting all FEMA submittal deadlines. Grant staff review subapplications using FEMA's eligibility checklist and strive to meet application completeness requirements in each funding cycle, but, challenges do exist. Periodically, subapplication submittals have problematic BCA or are missing pieces of critical information to determine eligibility. To address these challenges, grant staff have greatly improved upon their expertise in the NOI and subapplication review process, and are receiving more in-depth BCA training to increase their overall sub application capability. Additionally, staff will continue to refine the ranking criteria based on feedback from the subject matter experts on the review team to ensure that projects are being selected based on the state's highest priorities and fully meet all HMA subapplication requirements.

Table 10.J: Summary of PDM/FMA Subapplication Process

Step	Pre-Disaster Mitigation (PDM)/ Flood Mitigation Assistance (FMA) Subapplication Steps *(following Notice of Interest [NOI] steps listed in Table 10.H)*
7	Jurisdictions with eligible projects or planning activities are invited to submit a subapplication via the Federal Emergency Management Agency (FEMA) eGrant system for competitive review and ranking. Once submitted, the California Governor's Office of Emergency Services (Cal OES) downloads the subapplications from eGrants to review and rank.
8	The Cal OES grant review team, including subject matter experts from agencies, rates each subapplication. The final rating scores for each project are entered into a database that ranks each subapplication by score in categories by county, by hazard type, and by activity type.
9	Subapplicants are notified of the results electronically.
10	Selected subapplicants are assigned a Disaster Assistance Program Specialist (DAPS) to further assist the subapplicant in developing a competitive subapplication for federal review.
11	Cal OES, as the primary applicant, compiles all accepted subapplications in ranking order and submits them to FEMA for national competitive reviews. Highly ranked subapplications not submitted may be held by Cal OES pending the availability of additional funds.
12	Cal OES, as the primary applicant, compiles all accepted subapplications in ranking order and submits them to FEMA for national competitive reviews. Highly ranked subapplications not submitted may be held by Cal OES pending the availability of additional funds.

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

After the FEMA deadline announced in the NOFO has passed, applications can no longer be submitted. FEMA reviews subapplications submitted by each applicant to ensure compliance with the HMA guidance, including eligibility of the applicant and subapplicant, eligibility of proposed activities and costs, completeness of the subapplication, cost effectiveness and engineering feasibility of mitigation projects, and eligibility and availability of non-federal cost share.

10.5.1.4 TECHNICAL ASSISTANCE AND TRAINING

HMGP Technical Assistance

Following the 2017 disasters in California, Cal OES HMGP staff members worked with FEMA Region IX staff to develop and conduct 11 general subapplication development and BCA training seminars throughout the state. Cal OES grant specialists, FEMA specialists, and FEMA BCA contractors all attended these training seminars to train subapplicants on the processes related to applying for HMGP funding. Training locations for these training seminars were strategically chosen to reach the majority of subapplicants who submitted Notices of Interest (NOIs) for the HMGP funding the state received as a result of the 2017 disaster events. Cal OES HMGP staff also conducted roughly 15 additional community outreach opportunities during the Public Assistance Applicant Briefings that were held as a result of the 2017 HMGP funding received.

These 11 general training seminars were split into two days. The first day consisted of presentations regarding the HMGP and the BCA tool, and second day was dedicated to one-on-one appointments that addressed project-specific inquiries from the subapplicants. The presentations discussed the HMGP in detail, provided an in-depth review of the subapplication process, and covered all necessary documentation required for funding consideration. Cal OES staff also developed a specifically designed USB card to provide subapplicants with all of the necessary tools, documents, and resources they would need to be successful in completing their subapplications. These coordinated efforts by the Cal OES HMGP team were successful in reaching nearly 1,000 stakeholders across the state, representing state departments, local government agencies, special districts, and non-profit organizations.

Also occurring during the outreach period for the 2017 funding the state received, Cal OES HMGP staff conducted six subapplication development training seminars targeted specifically to the federally recognized tribes in California that applied for the HMGP funding. These tribal training seminars were specifically tailored to the tribe and the mitigation activity for which each tribe applied. The training was held on each tribal reservation and was for tribal members only. The smaller groups allowed the training to be conducted in one day (versus two) and included the subapplication development information and BCA training. These tribal training seminars were successful in reaching six tribes, affecting over 2,500 tribal members across the state. As outreach was conducted to share information with tribes on how they can successfully apply for HMGP funding, the tribal project subapplications received almost doubled between the Winter Storms of 2017 (DR-4301 DR-4305, DR-4308) and the December 2017 wildfires (DR-4344, DR-4353). Table 10.K lists the general and tribal-specific subapplication and BCA training seminars that were held as a result of the HMGP funding received from the various 2017 disaster events in California.

PDM/FMA Technical Assistance

PDM/FMA grants staff periodically conduct application development workshops and webinars (often coordinated with OPR, DWR, and California Silver Jackets) prior to start of subapplication submittal. Grants staff routinely work one-on-one with subapplicants to ensure strong correlation between subapplicants' scope, budget, and timeline. Critical subapplication information and deadlines are posted on the Cal OES web page to assist with subapplication development.

Table 10.K: Grant Subapplicant Technical Training by Cal OES and FEMA

Date	Topic	Target Audience (and Location)
DR-4301, DR-4305, DR-4308		
August 29, 2017	Project Subapplication and Benefit-Cost Analysis (BCA) Training Seminars	All eligible subapplicants (Sacramento)
August 30, 2017	One-on-one subapplicant appointments	All eligible subapplicants (Sacramento)
September 5, 2017	Project Subapplication and BCA Training Seminar	All eligible subapplicants (San Jose)
September 6, 2017	One-on-one subapplicant appointments	All eligible subapplicants (San Jose)
September 11, 2017	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Humboldt)
September 12, 2017	One-on-one subapplicant appointments	All eligible subapplicants (Humboldt)
September 14, 2017	Project Subapplication and BCA Training Seminar	All eligible subapplicants (San Diego)
September 15, 2017	One-on-one subapplicant appointments	All eligible subapplicants (San Diego)
October 3, 2017	Project Subapplication and BCA Training Seminar	Eligible tribal subapplicants – Bishop Paiute (Bishop)
October 11, 2017	Project Subapplication and BCA Training Seminar	Eligible tribal subapplicants – Tule River (Porterville)
October 25, 2017	Project Subapplication and BCA Training Seminar	Eligible tribal subapplicants – Los Coyotes (Warner Springs)
October 26, 2017	Project Subapplication and BCA Training Seminar	Eligible tribal subapplicants – Viejas (Alpine)
October 27, 2017	Project Subapplication and BCA Training Seminar	Eligible tribal subapplicants – Rincon (Valley Center)
November 14, 2017	Project Subapplication and BCA Training Seminar	Eligible tribal subapplicants – San Pasqual (Valley Center)
DR-4344		
March 5, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Humboldt)
March 6, 2018	One-on-one subapplicant appointments	All eligible subapplicants (Humboldt)
March 12, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Sacramento)
March 13, 2018	One-on-one subapplicant appointments	All eligible subapplicants (Sacramento)
March 15, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Sonoma)
March 16, 2018	One-on-one subapplicant appointments	All eligible subapplicants (Sonoma)
March 20, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (San Jose)
March 21, 2018	One-on-one subapplicant appointments	All eligible subapplicants (San Jose)
March 27, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Orange)
March 28, 2018	One-on-one subapplicant appointments	All eligible subapplicants (Orange)
March 29, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Santa Barbara)
March 30, 2018	One-on-one subapplicant appointments	All eligible subapplicants (Santa Barbara)
DR-4344 and DR-4353		
June 5, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Orange)
June 7, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Santa Barbara)
June 19, 2018	Project Subapplication and BCA Training Seminar	All eligible subapplicants (Santa Rosa)
2018 PDM and FMA		
August 28, 2018	Eligibility and Subapplication Process Webinar	All eligible subapplicants (statewide)

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

10.5.1.5 APPEALS

For both HMGP and PDM/FMA subapplications, appeals are addressed on a case-by-case basis.

10.5.2 CAL OES GRANT ADMINISTRATION

Between 2013 and 2016, the HMGP and PDM/FMA Divisions established 81 new hazard mitigation project and planning grants in 48 counties using more than $48 million in federal funds. As of May 2018, 20 grants are obligated for 2017 funding, totaling over $6 million, with more obligations pending.

An Enhanced Plan must demonstrate that the state has the capability to effectively manage all mitigation grant programs and provide a record of the following (DMA 2000, Section 201.5(b) (2) (iii A-D)):

- Meeting all mitigation grant application time frames and submitting complete, technically feasible, and eligible proposed activities applications with appropriate supporting documentation
- Preparing and submitting accurate environmental information and BCA
- Submitting complete and accurate quarterly progress and financial reports on time
- Completing all mitigation grant activities, including financial reconciliation, within established performance periods

HMGP and PDM/FMA staff incorporated FEMA's January 9, 2017 site visit recommendations to enhance their grant administration and management compliance.

In addition to subapplication development review and support, the functions of the HMGP and PDM/FMA Divisions include:

- Management and monitoring of active grants
- Closeout of completed grants

10.5.2.1 GRANT PROJECT MANAGEMENT

Once funds have been obligated for a grant by FEMA, the subapplicant becomes a subrecipient. Cal OES's Grants Processing Unit (GPU) establishes a Grant Award Agreement between the state and the subrecipient and provides guidance on submittal of reimbursement requests.

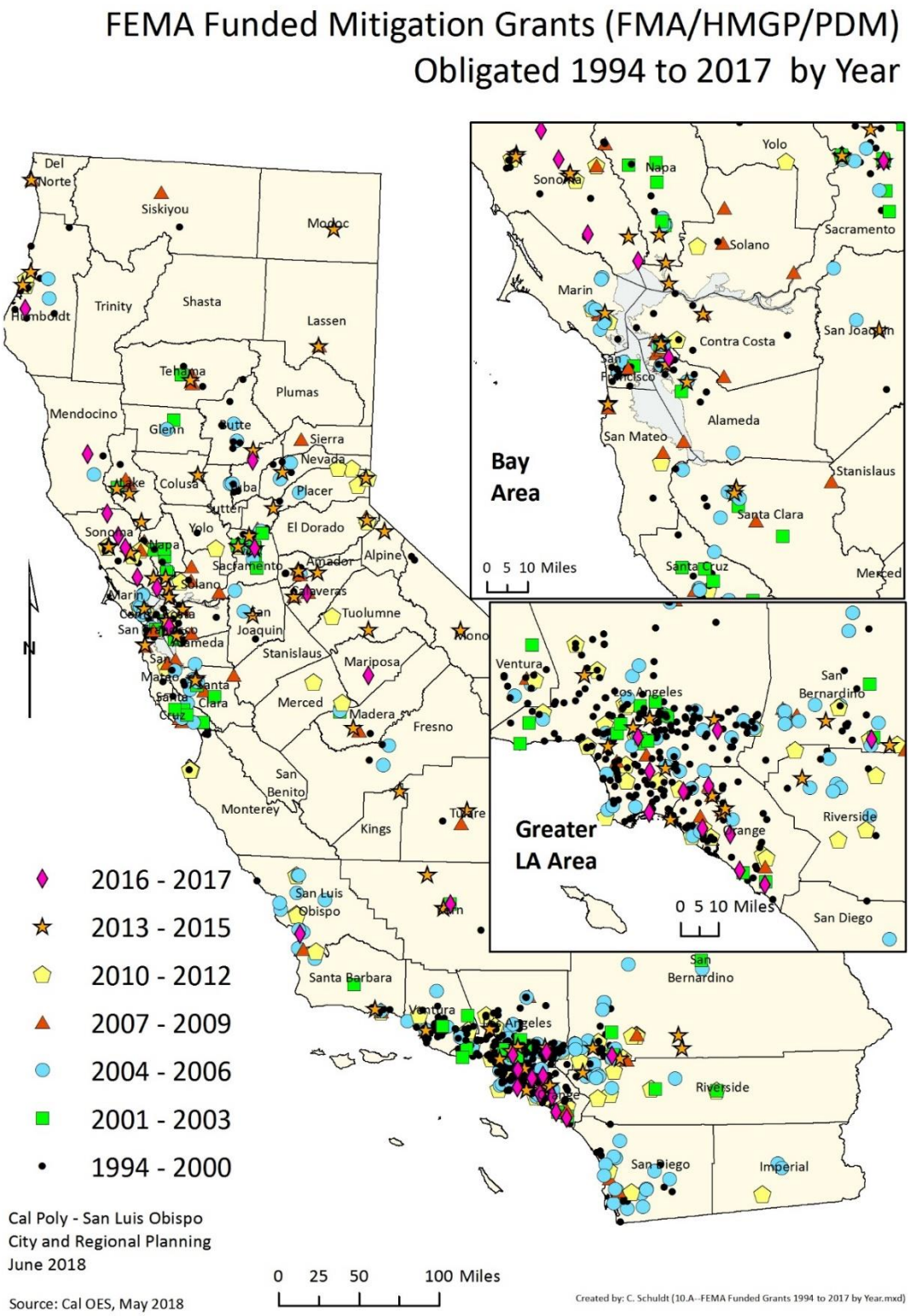
Each grant is assigned a grants specialist to provide assistance to the subrecipient and oversight on the implementation of the grant. The grants specialist maintains project information entries in the MGM lotus notes database and FEMA's National Emergency Management Information System (NEMIS) and quarterly reporting via FEMA's eGrants website to document project tracking. The grants specialist arranges a project site visit kick-off meeting with the subrecipient which entails review of project deliverables, associated project timelines, reporting requirements, the monitoring requirement checklist form, compliance, and financial requirements, and review of the project site.

Grants staff effectively monitor their projects throughout the life of the grant. They provide technical assistance, monitor progression of the project through constant communication with the subrecipient; process requests; review quarterly reports; conduct routine site visits or conduct initial, mid-term, and closeout site visits, and complete any other tasks that provide every opportunity for success of the project.

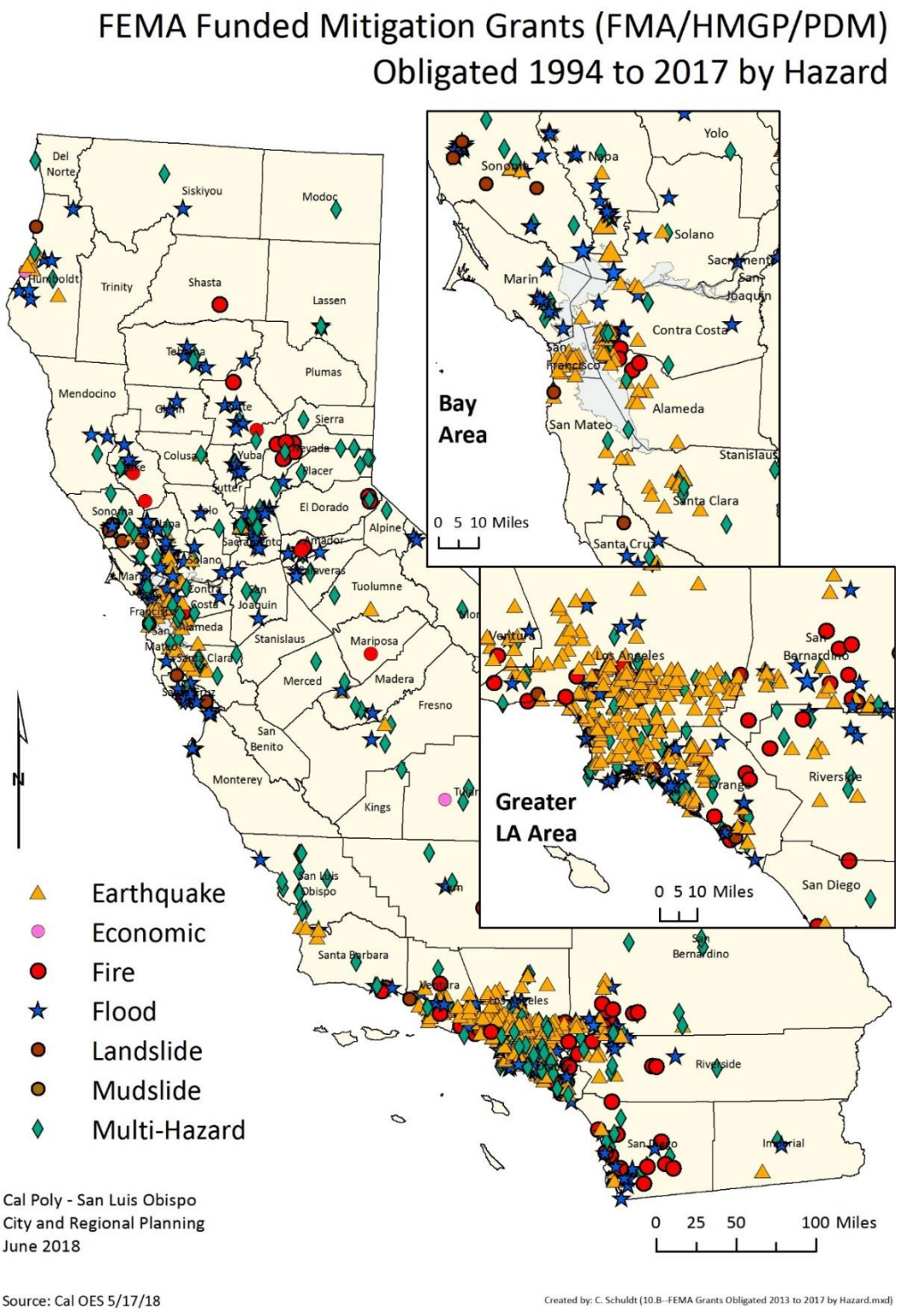
Cal OES is tracking mitigation grant projects geographically by geocoding each location for ease of reference. On the following pages, Maps 10.A and 10.B show FEMA-funded hazard mitigation grant projects obligated between 1994 and 2017, by year and by hazard. Map 10.C shows a close up view of the FEMA-funded hazard mitigation grant projects obligated between 1994 and 2017 in the San Francisco Bay Area and greater Los Angeles area in relation to relative vulnerability to all hazards.

Spatially, the majority of grant funded projects are located in areas of highest population density and highest hazard risk in the state. For example, the high earthquake hazard risk in the Bay Area is reflected by the patterns of seismic mitigation grants awarded, which in turn are validated by the 2018 U.S. Geological Survey's HayWired Earthquake Scenario, which illustrates the catastrophic potential of a large seismic event along the Hayward Fault.

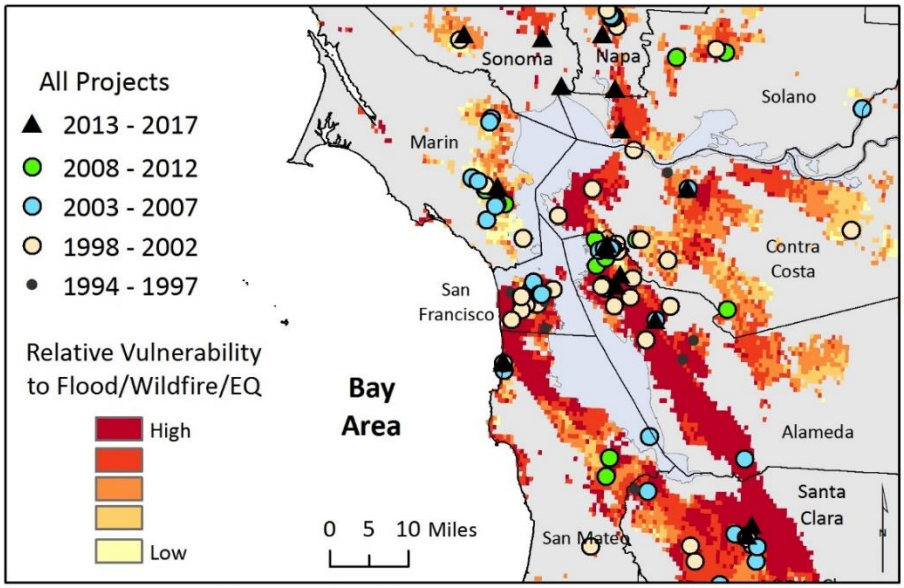
Map 10.A: FEMA-Funded Hazard Mitigation Grant Projects Obligated from 1994-2017, by Year



Map 10.B: FEMA-Funded Hazard Mitigation Grant Projects Obligated from 1994-2017, by Hazard



Map 10.C: FEMA-Funded Hazard Mitigation Grant Projects by Year – Bay Area and Greater Los Angeles Area

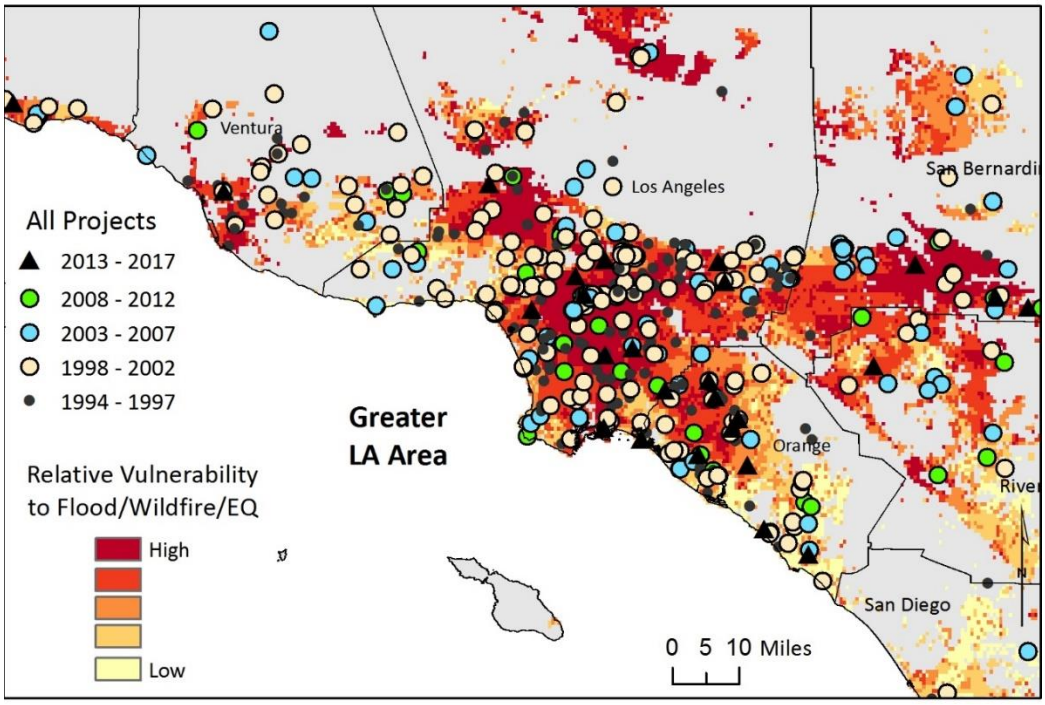


FEMA Funded Hazard Mitigation Grant Projects - Bay Area

Cal Poly - San Luis Obispo
City and Regional Planning
June 2018

Source: Cal OES, May 2018

Created by: C. Schuldt (10.B.2--Bay Area - LA Area FEMA Funded Grants 2007 to 2017.mxd)



FEMA Funded Hazard Mitigation Grant Projects - Greater LA Area

Cal Poly - San Luis Obispo
City and Regional Planning
June 2018

Source: Cal OES, May 2018

Created by: C. Schuldt (10.B.2--Bay Aea - LA Area FEMA Funded Grants 2007 to 2017.mxd)

Map 10.C indicates clusters of hazard mitigation projects in and around the Los Angeles area and San Francisco Bay Area, demonstrating that Cal OES is investing in mitigation projects within high risk and high-vulnerability areas. For maps showing the distribution of hazard mitigation projects in relation to the primary hazards, see *Chapters 6, 7, and 8*.

10.5.2.2 MONITORING OF PROJECT PROGRESS

Cal OES provides oversight of individual grants to ensure the timely and accurate reporting of fiscal and programmatic data and to assist the grant recipient with the administrative complexities of managing the grant. All subrecipients are required to report project status on a quarterly basis. Quarterly reports based on measurable outcomes are generated by the subrecipient and reported to Cal OES.

If, during review of quarterly project reports, a grants specialist identifies project issues or risks, such as delays in meeting project deadlines, the specialist will contact the subrecipient to address the identified issues, and if necessary will conduct a site visit.

Project Site Visits

Site visits measure progress and ensure subgrantee compliance, as well as monitor project and/or plan implementation. Site visits with project personnel to review the progress of the project and discuss the implementation of the grant include completion of a site assessment performance report form which captures information on the following:

- Identifying information for the jurisdiction visited
- The identity of the person conducting the site visit
- The purpose of the site visit
- The project personnel involved in the site visit
- A narrative description of the site visit
- The outcomes of the site visit
- Indication that the sub-recipient is aware of the federal requirements regarding:
  1. Scope of Work Status–Title 2 CFR Section 200.210(d) and Title 2 CFR Section 200.308(b)
  2. Cost Share (Match) Requirements–Title 2 CFR Section 200.306(b)(1)
  3. Financial Management Review–Title 2 CFR Section 200.302(3),Title 2 CFR Section 200.403-405 and Title 2 CFR Section 200.501
  4. Quarterly Progress Reports & Reimbursement Requests–Title 2 CFR Section 200.328(b)(1)
  5. Grant Funded Personnel–Title 2 CFR Section 200.430(i)(1)
  6. Procurement Policies–Title 2 CFR Section 200.318-320
  7. Contract Provision/Clauses – Title 2 CFR Section 200.323, Title 2 CFR Section 200.433, Title 2 CFR Section 200 Appendix II and Required Contract Clauses.

The site assessment performance reports, are reviewed and approved by management, and retained in Cal OES' project files. The site visit report generated from the site visit also identifies any areas of non-compliance and calls for corrective action to address that non-compliance. The subrecipient must then generate a corrective action plan to be approved and monitored by Cal OES. A copy of the site assessment performance report form is included in *Appendix M*.

PDM/FMA Reporting

Cal OES has a long record of consistently submitting complete and accurate quarterly PDM and FMA reports prior to FEMA-required deadlines. The Cal OES PDM/FMA grant staff obtain and review for completeness the quarterly reports submitted from each subrecipient prior to the internal deadline established by the PDM/FMA Division. Grant staff then update the Cal OES internal grants management database with the information submitted by the stakeholders. The Cal OES PDM/FMA Division Program Manager further uses this database to track and develop the PDM/FMA quarterly reports for submittal to FEMA. This information is directly pulled from each PDM or FMA approved project or plan monitored within the division. The Program Manager reviews the pre-formatted quarterly report for accuracy and adds any additional comments as necessary. Since the 2013 SHMP, the Division has submitted all PDM and FMA program and fiscal quarterly reports within required time frames.

HMGP: Addressing Period of Performance Time Extensions

Based on the specific year of FEMA's NOFO, the period of performance typically begins with the opening of the application period and ends no later than 36 months from the funding selection date. The expectation is that all subrecipients will complete their projects in the defined period of performance. Due to complications that can arise during the construction process, however, alterations to the project schedule may sometimes become necessary. For changes within the 36-month performance period that do not extend the overall project schedule, depending on the reason for the delay, and with legitimate justification, Cal OES may grant a time extension.

In some cases, project delays may push completion beyond the overall grant period of performance. If determined necessary, Cal OES can make a request to FEMA for an extension to the overall 36-month period of performance.

PDM/FMA: Addressing Period of Performance Time Extensions

For PDM/FMA grants, if necessary, an internal time extension may be granted. These extensions are reviewed and approved internally through the PDM/FMA Division with concurrence from FEMA. If necessary, Cal OES may make a request to FEMA for an extension to the overall 36-month period of performance.

Throughout the life of the project, PDM/FMA staff review all project quarterly reports; conduct initial, mid-term, and closeout site visits; and review the monitoring requirement checklist form with each subrecipient.

10.5.2.3 QUARTERLY PROGRESS AND FINANCIAL REPORTING TO FEMA

Quarterly project reports based on measurable outcomes are generated by the subrecipient and reported to Cal OES. Cal OES compiles the quarterly project reports from subrecipients, assesses the programmatic and financial components, and then enters the information into a database before sending a formal quarterly report to FEMA. The quarterly reports submitted to FEMA include:

- Percentage completion of the project
- Progress on milestones identified in the original schedule
- Overall assessment of the schedule
- Adherence to budget (including over- and under-reporting)

HMGP Reporting

Between 2013 and early 2016, timeliness of Cal OES's HMGP quarterly grant reporting to FEMA varied due to issues with staffing resources. In mid-2016, there was only one full-time staff person overseeing approximately 80 active grants. To correct this, a new SHMO was appointed in late 2016 and additional staff have been hired.

PDM/FMA Reporting

During the 2013-2017 period, all PDM/FMA quarterly report including federal financial reports (FFR) were complete and submitted.

Project Expenditures

As part of progress tracking, grants staff verify that actual ongoing project expenditures align with the initial proposed budget included in the initial subapplication. If project expenditures change significantly, grants staff may require a formal change to budget line items.

Compliance with Financial Standard Requirements

While grants are typically in compliance with Financial Management Standard (FMS) requirements, there have been some occurrences of non-compliance.

10.5.2.4 GRANT PROJECT COMPLETION AND CLOSEOUT

The closeout procedures are similar for all mitigation grant programs and are initiated when 1) the subrecipient informs Cal OES that they have completed their project, or 2) the performance period for the grant will soon expire. The subrecipient may receive a closeout letter during the project monitoring phase if, through the quarterly report, it is determined that the project appears to be ready for closeout.

Ninety days prior to completion of the grant period of performance, Cal OES grants staff sends the subrecipient a close out packet, which includes forms and statements the subrecipient is required to complete and return to Cal OES within 30-days. After the closeout packet is sent, Cal OES grants staff schedules a closeout site visit. The site assessment performance report form is used during the closeout process as a checklist to verify appropriate expenditures are consistent with SF-424A or SF-424C budget forms according to the submitted cost estimate.

For each grant program, the grants staff confirms that closeout documents are completed and submitted on time by the subrecipient. As part of the closeout process and within 90 days from the end of the period of performance, subrecipients are required to submit reports documenting that the proposed activities were completed according the deliverables identified in their original obligation letter, and that all expenditures are consistent with SF-424A or SF-424C per the budget.

Once the closeout packet is returned to Cal OES, the completed forms are logged and forwarded to the assigned grants specialist to review for completeness and to verify that the project was completed as proposed. Closeout documents are then sent to the Grants Processing Unit (GPU) for formal closeout. GPU will verify that the eligible cost share match is accurate and complete. This information is tracked and managed in the Mitigation Grants Management (MGM) database and Cal OES financial ledger systems. Grant close out forms are included in *Appendix M*.

Once all completed closeout documents are received, Cal OES submits closeout documents to FEMA in a final report package. The final report package includes a certification that all funds have been expended, a listing of all subawards and their total expenditures, a request for reimbursement or deobligation of excess funds, and the final quarterly report.

Most of the time, grant closeout activities are completed within 90 days from the end of the performance period. To address the burden of competing priorities on permanent staff, the grants programs have hired limited term staff to assist with workloads and ensure obligated performance.

10.5.3 PROGRAMMATIC AND FINANCIAL MONITORING

An on-site programmatic and financial monitoring review was conducted January 9-20, 2017, by the FEMA Region IX Grants Management Division (GMD). During the review, the monitoring team assessed whether the financial and administrative operations of Cal OES properly accounted for the receipt and expenditure of Department of Homeland Security (DHS) funds, whether expenditures were in compliance with federal financial regulations, and whether expenditures were in compliance with the applicable funding parameters for the grant award reviewed. A review was conducted of accounting of grant funds, documented policies, procedures, disbursement records, and expenditures charged to DHS funds.

The review found that actions were required to comply with federal grant programmatic and financial regulations. Follow-up documentation was submitted to FEMA Region IX, and Cal OES has implemented actions including establishment of written procedures and processes to enhance monitoring of DHS funds, including HMA grant and sub-grant supported activities to assure that compliance and performance goals are achieved. Cal OES has also expended the sub-recipient monitoring process to include three monitoring site visits with each jurisdiction during the project performance period. (See *Appendix M* for monitoring checklist)

10.5.4 WAY FORWARD FOR CAL OES HAZARD MITIGATION ASSISTANCE GRANT PROGRAM

Annually Cal OES management and staff evaluate the HGMP and PDM/FMA HMA programs. Through this evaluation program strengths, as well as areas where improvement may be needed, are identified.

In 2017, Cal OES staff identified the following program areas where improvement is needed and both the HMGP and PDM/FMA Divisions have overlapping consistent obstacles and challenges:

- *Developing HMA programs subject matter experts due to staff attrition:* Most of Cal OES HMA program staff has less than 18 months of experience. Lack of staffing experience has dramatically affected HMA Programs. Working with FEMA, Cal OES has instituted training and reinforcement training for staff to help establish quality assurance in subgrant management and provide technical customer service to local jurisdictions.
- *Team staffing:* Responding to a large number of disasters in 2015, 2016, and 2017 critically affected staff's availability and ability to conduct compliance site visits and reviews. To address this, Cal OES hired limited-term HGMP and PDM/FMA grant program staff to manage subgrant projects and plans to sustain workloads. Additionally, Cal OES is assessing cross-training opportunities between HGMP and PDM/FMA program staff to allow continued efficiency in grant processing and management.
- *Tracking informal technical training and assistance*: HMA programs have realized that informal technical training and assistance efforts have not been consistently and fully documented. Lack of complete documentation inhibits effective reporting of progress in communication between Cal OES and local jurisdictions. To address this, Cal OES staff are working to ensure improved documentation of subgrant management within the Cal OES hazard mitigation databases (including recording phone calls, emails, and other personal communications).
- *Strengthening integration of hazard mitigation planning staff with HMA grant programs staff:* An ongoing challenge for Cal OES has been maintaining clear and detailed communication about jurisdiction LHMP status and proposed and ongoing grant-funded local mitigation projects. An additional challenge has been capturing HMA program progress for the SHMP, as well as socializing the SHMP with new HMA grants staff hired since 2017 to ensure their awareness of the SHMP and its linkage to HMA-funded mitigation activities. These challenges have been further exacerbated by separation of HMGP grants staff into a different directorate from PDM/FMA and the Hazard Mitigation Planning Division. To address this challenge, hazard mitigation staff are fostering information-sharing opportunities and strengthening intra- and inter-program communication.

These continued improvement efforts demonstrate the state's continued commitment to a comprehensive mitigation program and successful grants management. Cal OES continues to develop and implement new procedures, policies, and training for HMA grants staff in order to more effectively supporting enhance local hazard mitigation capabilities.

10.6 ASSESSMENT OF MITIGATION ACTIONS

The SHMP must document the system and strategy by which the state conducts an assessment of completed mitigation actions and includes a record of the effectiveness of each mitigation action. The state must describe how effectiveness of each completed mitigation action is assessed and what agency or agencies are involved in the assessment, and indicate the time frame for carrying out this assessment. The state must also describe how it tracks potential losses avoided for each action taken.

Cal OES maintains the extensive Mitigation Grants Management (MGM) database that contains HMPG, FMA, PDM, and SRL projects, including over 900 completed projects. This database provides information on scope and geo-coded locations of completed projects, and local contacts for each project. For projects that have been completed, this database is the starting point for assessments that lead to expanded loss avoidance studies.

To address these requirements, the state has developed the following assessment system.

10.6.1 STATE MITIGATION ASSESSMENT REVIEW TEAM (SMART) SYSTEM

Background

While general Cal OES project assessments have been ongoing as part of the Hazard Mitigation Assistance (HMA) grants program, in 2010 Cal OES developed a more structured assessment system called the State Mitigation Assessment Review Team (SMART). The purpose of the SMART system is to assess previously completed mitigation projects, after a disaster event occurs to establish a record of the effectiveness of the mitigation actions. The current SMART system objectives are to assess the outcome of previously funded mitigation projects in a disaster area by 1) efficiently ascertaining the project performance after a disaster event, and 2) identifying effectiveness of mitigation practices. SMART is a system to be used to conduct a quick assessment of HMA grant funded hazard mitigation projects within the area of minor or small hazard events to determine if the project actually met or exceeded the subrecipients stated BCA from the original grant subapplication.

The SMART concept was initiated in 2007, when Cal OES with assistance from California Polytechnic State University, San Luis Obispo (Cal Poly), conducted a successful pilot of the SMART system by assessing the effectiveness of the Yountville Flood Barrier Wall Project located in Yountville, California, which was "tested" by the December 31, 2005 flooding of the Napa River. The project cost $4.2 million, with $3.2 million funded from HMGP DR-1044 funds. The estimated loss avoidance benefits of the project comprised $1.6 million for this one event in 2005. This is considered a conservative estimate.

The original SMART field assessment system approach provided statewide coverage and the support of trained assessors through a Memorandum of Understanding (MOU) establishing a partnership with the California State University (CSU) system. It was later determined, however, that using state agency experts to perform the assessments would be more effective.

For more detailed information about the original SMART program, see Section 7.4 of the 2013 SHMP.

SMART Process Overview

Under the current process, when a disaster event occurs, the Cal OES SMART Coordinator performs an initial analysis based on project data from the mitigation grant management databases to determine if any HMA mitigation projects have been completed in the area of the disaster. The SMART evaluation of a project involves three tasks or "assessment levels": 1) using GIS to determine and map locations of mitigation projects completed prior to the disaster within or near the disaster area, 2) conducting telephone interviews of involved local project administrators to determine local assessment of project performance, and 3) conducting detailed field investigations to determine general project effectiveness (where practicable, based on results of the first two assessment levels). Post-disaster staffing for SMART is provided by Cal OES and other state agencies.

The results of these efforts are summarized in a report that can then be used by the HMGP staff to determine if a full loss avoidance study should be initiated with FEMA. Through SMART, all completed FEMA-funded mitigation projects have been geo-coded with location coordinates and described with other digital data. The state uses these data to conduct detailed assessments of mitigation projects and their effectiveness. Thus, all events require Cal OES staff to perform an initial MGM database analysis to identify completed mitigation projects in the area and determine whether a detailed project assessment is needed, yet not all events require activation of detailed project assessment procedures.

Pre-Assessment Activities

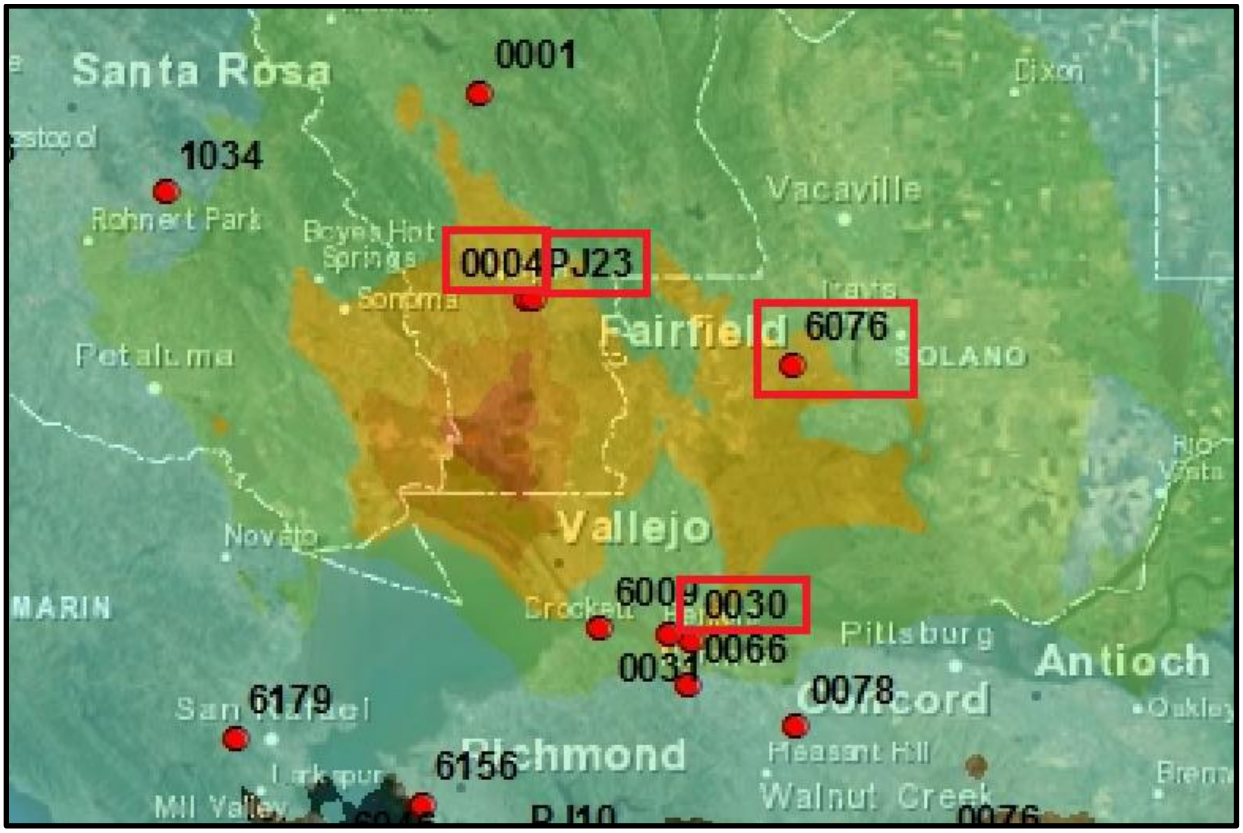
As HMA grant projects are closed out, the Cal OES SMART Coordinator pulls the project information from the MGM database and provides the information to the GIS staff to geo-code project data for later use in SMART mapping efforts. Latitude and longitude information is now required as part of the HMA grant project subapplication and is used to geo-code.

First-Level Assessment – Hazard Maps

The Cal OES SMART Coordinator monitors situation reports provided by the California Warning Center for information on current flood, fire, and earthquake disaster events. Depending on the size and type of the event, the SMART Coordinator works with GIS staff to develop maps of the event zone(s) with an over-lay of completed HMA projects using data from the MGM database that correlate to hazard type. Once the map is completed, the Cal OES SMART Coordinator reviews the map and makes recommendations to management if it is determined that any projects merit further levels of assessment. If management concurs, second-level assessment is initiated.

Map 10.D is the first-level assessment map prepared after the 2014 South Napa Earthquake.

Map 10.D: Hazard Mitigation Grant Projects near 2014 South Napa Earthquake



Source: California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Planning

Second-Level Assessment – Telephone Interviews

During second-level assessment, the SMART Coordinator conducts a telephone interview with a representative of the jurisdiction. A template questionnaire is used to interview the jurisdiction contact and gather their assessment of the effectiveness of the HMA project in preventing damages that may have otherwise resulted from the disaster event. If the jurisdiction's assessment concludes that the HMA project prevented damages, injuries, deaths, or environmental degradation, Cal OES flags the project as eligible for a third-level assessment.

Third-Level Assessment – Detailed Project Field Assessments

After the response phase is over, the SMART project assessment team coordinates with appropriate local agencies to conduct on-site assessments of completed HMA projects with a primary focus on estimating loss avoidance. Each team uses current regionally adjusted construction data and other pertinent data to estimate loss avoidance. Once an assessment is completed, the SMART report is sent back to Cal OES. This information, along with assessment forms for the type of event (earthquake, flood, wildfire, etc.) and a summary of the project background, is then placed on the Cal OES Web Portal.

SMART Assessments Performed from 2013 to 2017

From September 2013 to December 2017, the events listed in Table 10.L were assessed using the SMART system. All events on this list were mapped but those events with no projects within or directly adjacent to the event perimeters were not assessed any further. For projects that were found (through Level 1 assessment) not to be within or adjacent to the event zone, telephone interviews and field visits (Level 2 and Level 3 assessments) were not conducted.

Table 10.L: SMART Assessments Performed, 2013-2017

Hazard Type	Event Name	County	Projects Identified (Level 1)	Telephone Assessments (Level 2)	Field Assessments (Level 3)
Fire	2013 Mountain Fire	Riverside	DR-1005-19 Fuel Management	Yes	No
Fire	2013 Springs Fire	Ventura	DR-1005-10 La Canada Flintridge Wildfire Mitigation	Yes	No
Fire	2013 Falls Fire	Riverside	No projects within/adjacent to event zone	No	No
Fire	2013 American Fire	Placer	No projects within/adjacent to event zone	No	No
Fire	2013 Corral Complex	Humboldt	No projects within/adjacent to event zone	No	No
Fire	2013 Deer Fire	Tehama	No projects within/adjacent to event zone	No	No
Fire	2013 Hough Complex	Plumas	No projects within/adjacent to event zone	No	No
Fire	2013 Panther Fire	Tehama	No projects within/adjacent to event zone	No	No
Fire	2013 Rim Fire	Mariposa and Tuolumne	No projects within/adjacent to event zone	No	No
Fire	2013 Morgan Fire	Contra Costa	No projects within/adjacent to event zone	No	No
Fire	2013 Clover Fire	Shasta	No projects within/adjacent to event zone	No	No
Fire	2013 Campbell Fire	Tehama	No projects within/adjacent to event zone	No	No
Fire	2013 San Diego	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Red Fire	Humboldt	No projects within/adjacent to event zone	No	No

Hazard Type	Event Name	County	Projects Identified (Level 1)	Telephone Assessments (Level 2)	Field Assessments (Level 3)
Fire	2014 Colby Fire	Los Angeles	No projects within/adjacent to event zone	No	No
Fire	2014 Pine Incident	Los Angeles	No projects within/adjacent to event zone	No	No
Fire	2014 Pierce Incident	Riverside	No projects within/adjacent to event zone	No	No
Fire	2014 Aurora Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Bernardo Incident	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Etiwanda Fire	San Bernardino	No projects within/adjacent to event zone	No	No
Fire	2014 Miguelito Fire	Santa Barbara	No projects within/adjacent to event zone	No	No
Fire	2014 Poinsettia Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Pulgas Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 San Mateo Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Shirley Fire	Kern	No projects within/adjacent to event zone	No	No
Fire	2014 Tomahawk Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Bald Fire	Shasta and Lassen	No projects within/adjacent to event zone	No	No
Fire	2014 Beaver Complex	Siskiyou	No projects within/adjacent to event zone	No	No
Fire	2014 Bully Fire	Shasta	No projects within/adjacent to event zone	No	No
Fire	2014 Butts Fire	Napa	No projects within/adjacent to event zone	No	No
Fire	2014 Coffee Complex	San Diego	No projects within/adjacent to event zone	No	No
Fire	2014 Coleman Fire	Modoc	No projects within/adjacent to event zone	No	No
Fire	2014 Dark Hole Fire	Mariposa	No projects within/adjacent to event zone	No	No
Fire	2014 Day Fire	Modoc	No projects within/adjacent to event zone	No	No
Fire	2014 Eiler Fire	Shasta	No projects within/adjacent to event zone	No	No
Fire	2014 El Portal Fire	Mariposa	No projects within/adjacent to event zone	No	No
Fire	2014 French Fire	Madera	No projects within/adjacent to event zone	No	No
Fire	2014 Gulch Fire	Modoc	No projects within/adjacent to event zone	No	No
Fire	2014 July Complex	Modoc	No projects within/adjacent to event zone	No	No
Fire	2014 Little Deer Fire	Siskiyou	No projects within/adjacent to event zone	No	No
Fire	2014 Lodge Complex	Mendocino	No projects within/adjacent to event zone	No	No

Hazard Type	Event Name	County	Projects Identified (Level 1)	Telephone Assessments (Level 2)	Field Assessments (Level 3)
Fire	2014 Modoc July Complex	Modoc	No projects within/adjacent to event zone	No	No
Fire	2014 Monticello Fire	Yolo	No projects within/adjacent to event zone	No	No
Fire	2014 Nicolls Fire	Kern	No projects within/adjacent to event zone	No	No
Fire	2014 Hunters Fire	Mariposa	No projects within/adjacent to event zone	No	No
Fire	2014 Cocos Fire	San Diego	DR-1005-24 San Marcos Brush Management	Yes	No
Earthquake	2014 Napa Earthquake	Napa	DR-1342-04 Goodman Library Seismic Retrofit	Yes	Yes
Earthquake	2014 Napa Earthquake	Napa	DR-1342-05 Borreo Building Seismic Retrofit	Yes	Yes
Earthquake	2014 Napa Earthquake	Napa	FMA06-PJ11 Home Elevations	No	No
Earthquake	2014 Napa Earthquake	Napa	DR-1155-39 Single Family Home Elevations	No	No
Earthquake	2014 Napa Earthquake	Napa	DR-1044-367 Flood-proofed properties	No	No
Earthquake	2014 Napa Earthquake	Napa	DR-1155-40 Soscol Avenue Area Drainage Interceptors	No	No
Fire	2015 Fork Complex	Siskiyou	No projects within/adjacent to event zone	No	No
Fire	2015 DeLuz Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2015 Oak Fire	Calaveras	No projects within/adjacent to event zone	No	No
Fire	2015 Valley Fire	Mariposa	No projects within/adjacent to event zone	No	No
Fire	2015 Highway Fire	San Diego	No projects within/adjacent to event zone	No	No
Fire	2015 Oak Fire	Calaveras	No projects within/adjacent to event zone	No	No
Fire	2015 Valley Fire	Mariposa	No projects within/adjacent to event zone	No	No
Fire	2015 Oak Fire	Calaveras	No projects within/adjacent to event zone	No	No
Fire	2015 Valley Fire	Mariposa	No projects within/adjacent to event zone	No	No
Fire	2015 Valley Fire and Butte Fire	Lake and Amador	No projects within/adjacent to event zone	No	No
No Event	2016 No Events	statewide	No events to identify with projects	Not applicable	Not applicable
Flood	2017 January Storms	Placer	DR-1044-0012 Flood Control Projects	No	Yes
Fire	October 2017 CA Wildfires	Sonoma	No projects within/adjacent to event zone	No	No
Fire	December 2017 CA Wildfires & Debris Flows	Santa Barbara	No projects within/adjacent to event zone	No	No

Source: California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Planning

Progress Summary 10.A: SMART Field Assessment: South Napa Earthquake

Progress as of 2018: Since the 2013 State Hazard Mitigation Plan (SHMP) was adopted, one earthquake disaster occurred that required activation of State Mitigation Assessment Review Team (SMART) field assessments. The August 2014 South Napa Earthquake (DR-4193) resulted in earthquake damage Napa, Solano, and Sonoma Counties. The earthquake occurred in the early morning of August 24, 2014. It had a reported magnitude of 6.0 and was centered approximately 6 miles southwest of downtown Napa.

Initial SMART analysis (Level 1 assessment) conducted in the fall of 2014 identified two mitigation projects located within the area of the City of Napa affected by the earthquake which qualified for a more detailed project assessment. After telephone interviews (Level 2 assessment) were conducted with representatives, it was determined that these two mitigation projects—the Goodman Library and Borreo Building seismic retrofits for structural mitigation—were eligible for Level 3 SMART field assessments, as described below.

Goodman Library Seismic Retrofit, City of Napa

The Goodman Library is a two-story building that was built in 1901 of unreinforced stone masonry walls with wood framed floor and roof. The seismic upgrade included two new concrete shear walls, new plywood roof sheathing, new wall anchorage at the floor and roof, parapet bracing, and stone repairs. The work was undertaken in approximately 2005 and cost $1,584,000 which included a $318,000 Federal Emergency Management Agency (FEMA) mitigation grant.

The seismic upgrade was designed to comply with building code requirements for historic buildings in effect at the time of the design. The design was anticipated to substantially reduce the likelihood of damage and risk to occupants. According to the Benefit-Cost Analysis (BCA) the project was expected to provide close to $1 million in benefits (net present value of annualized benefits).

Damage observed in the building included minor cracking of exterior stone wall mortar joints, cracking and spalling of the interior plaster, and cracking and partial separation of the ceiling from adjacent exterior walls at the rear of the building. While the most significant damage observed was the dislodging of a number of stones in a tall stone feature at the front of the building roofline, overall the structure performed well and there were no injuries or loss of life. The damage observed was significantly less than what was anticipated before strengthening.

Street View of the Goodman Library and Minimal Damage on the Goodman Library



Source: South Napa Earthquake SMART Assessment Report 2014

Borreo Building Seismic Retrofit, City of Napa

The Borreo Building is a two-story building that was built in 1877 of unreinforced stone masonry walls with wood-framed floor and roof. The seismic upgrade included a new steel moment frame, a new concrete stair and elevator core, new plywood roof sheathing, new wall anchorage at the floor and roof, supplemental vertical supports, and stone repairs. The work was undertaken in approximately 2005 and cost $872,000, which included a $654,000 FEMA mitigation grant.

The seismic upgrade was designed to comply with building code requirements for historic buildings in effect at the time of the design. The design was anticipated to substantially reduce the likelihood of damage and risk to occupants. According to the BCA, the project was expected to provide $3.69 million in benefits (net present value of annualized benefits). The original BCA yielded a Benefit-Cost Ratio of 3.66 without considering casualties, and 4.16 with casualties considered.

While the damage observed in the building included moderate cracking of some interior and exterior wall, the building performed well structurally and there were no injuries or loss of life as a result of the earthquake. The damage observed was significantly less than what was anticipated before strengthening.

The estimated earthquake repair cost recently provided by the City's consultants, was $48,500 ($24,600 in 2004 dollars). The total loss avoidance estimated is approximately $5.49 million (in 2004 dollars).

Street View of the Borreo Building and Minimal Damage to Borreo Building Interior Walls



Source: South Napa Earthquake SMART Assessment Report 2014

For more success stories from the 2014 South Napa Earthquake, refer to FEMA's publication titled Best Practices Stories, South Napa EQ DR-1493 at: http://www.caloes.ca.gov/HazardMitigationSite/Documents/001-DR-4193%20Best%20Practice%20Compilation.pdf.

During late 2016 and early 2017, Cal OES HMA programs experienced 75 percent to 100 percent staff turnover. Additional staff were hired in mid to late 2017 to handle ongoing workloads and increased workloads from the major flood and fire disasters that occurred in 2017. Furthermore, as a result of the disasters, HMA program staff were activated to perform response- and recovery- related duties in the State Operations Center, Joint Field Office (JFO), and Local Assistance Centers. Therefore, HMA programs performed limited SMART assessments in 2017, or performed them later in 2018.

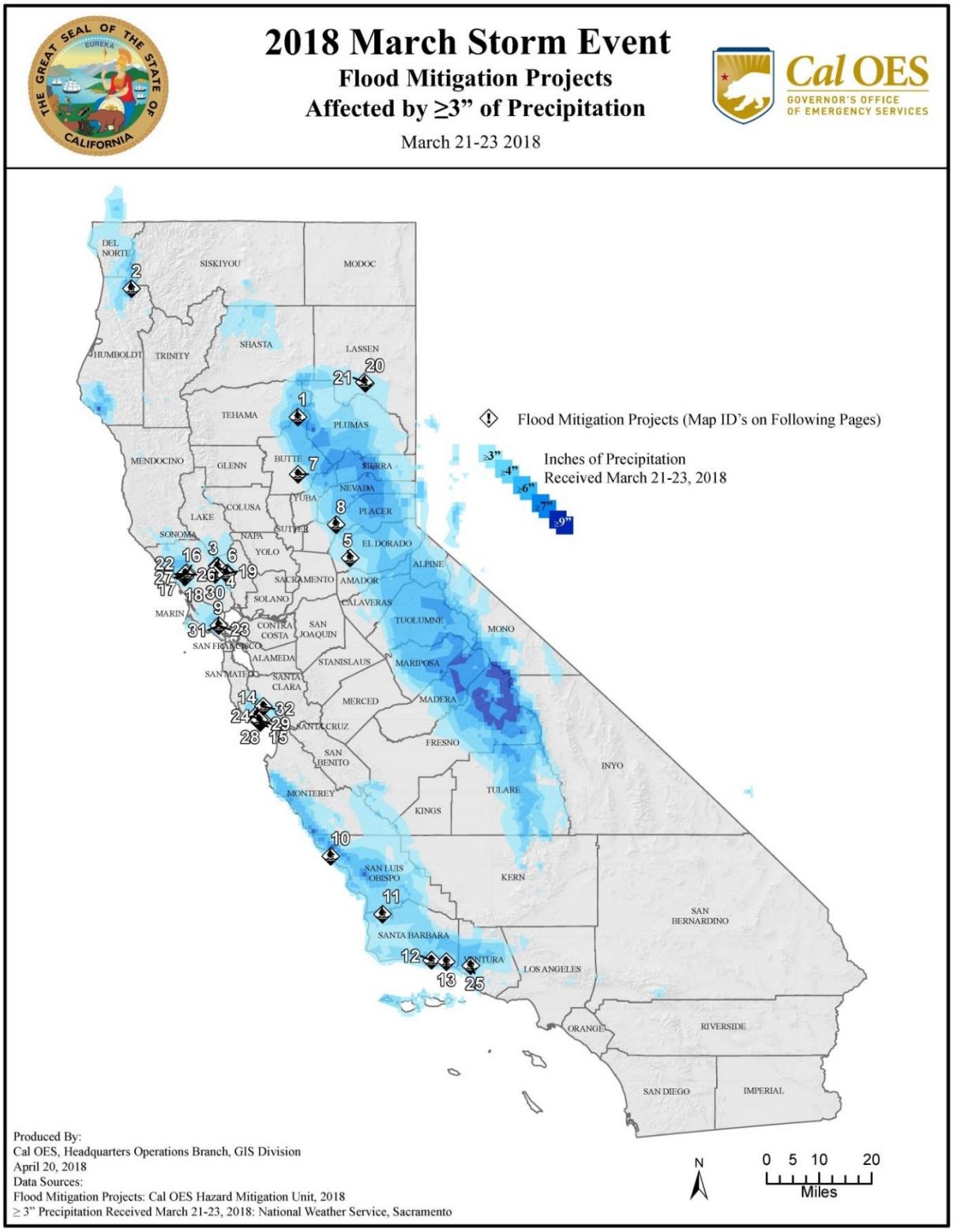
Even though the March 2018 storms were not a FEMA-declared disaster, Cal OES HMA programs determined it was worthwhile to initiate the SMART assessments in order to be proactive in project follow-up. After the March 2018 storms, SMART began assessing several counties flood mitigation projects affected by precipitation of 3 inches or more. SMART finished conducting Level 2 assessments and will begin conducting Level 3 field assessments in July 2018 (noted in Table 10.M as pending field assessments). SMART program staff expect to complete the Level 3 field assessments by the fall of 2018. It is expected that the Level 3 field assessments for some of the projects will conclude that a full project loss avoidance study should be conducted. Table 10.M and Map 10.E show the flood mitigation projects mapped and assessed in 2018 using the SMART system.

Table 10.M: SMART Assessments Performed in 2018, as of May 2018

Hazard Type	Event Name	County	Projects Identified (Level 1)	Telephone Assessments (Level 2)	Field Assessments (Level 3)
Flood	2018 March Storm Event	Butte	Projects affected by ≥3 inches of precipitation/needs further review	Yes	No
Flood	2018 March Storm Event	Humboldt	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Napa	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	El Dorado	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Placer	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Marin	Projects affected by ≥3 inches of precipitation/no further review required	Yes	No
Flood	2018 March Storm Event	San Luis Obispo	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Santa Barbara	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Santa Cruz	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Sonoma	Projects affected by ≥3 inches of precipitation/no further review required	Yes	No
Flood	2018 March Storm Event	Lassen	Projects affected by ≥3 inches of precipitation/needs further review	Yes	Pending
Flood	2018 March Storm Event	Ventura	Projects affected by ≥3 inches of precipitation/needs further review	Yes	No

Source: California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Planning

Map 10.E: Mapping of HMA Grant Funded Projects Related to March 2018 Storm Event



Source: California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Planning

Progress Summary 10.B: City of Roseville Flood Control Improvement Project Result in Flood Loss Avoidance

Progress as of 2018: Following extensive flooding in 1995, including two Presidential disaster declarations (FEMA-1044-DR-CA and FEMA-1155-DR-CA), the HMA (Hazard Mitigation Assistance) grant program funded projects for the City of Roseville to convert three undersized culverts to a bridge spanning Sunrise Avenue, a major thoroughfare that runs from Roseville to Elk Grove, including installing twin 9-foot-diameter bypass pipelines in the Oakridge area, installing berms and floodwalls, developing a bypass channel that avoids the flooding of a residential neighborhood, making property acquisitions, and elevating residences to an identified flood protection elevation.

The construction period of performance dates for the Sunrise Avenue bridge project were February 1, 1996, to March 1, 2003. Prior to start of the project, this area of Sunrise Avenue had flooded nine times: in 1930, 1967, 1970, 1973, 1982, 1983, 1986, and twice in 1995. The largest of these flood events, in 1986, flooded 30 square miles, caused the evacuation of more than 24,000 residents, damaged 3,000 homes, and destroyed 150 businesses. The 1995 flood events damaged close to 270 residential units along with various commercial structures, and caused infrastructure problems, resulting in nearly $3 million in damages.

Since the completion of the bridge replacement and the construction of the bypass channel, there have been numerous events that have avoided many losses. The storm events in early January 2017, late January 2017, and February 2017 (collectively referred to as "2017 Winter Storms") were major events that triggered the declaration of three federal disasters: DR-4301, DR-4305, and DR-4308. During these events, there is no record of any major losses in the mitigated area on Sunrise Avenue. As a result of the mitigation activities that were performed in the Sunrise Avenue area, there are now 233 structures that are no longer in the floodplain and 44 structures with a decreased chance of flooding. During the 2017 Winter Storms, there was no loss of function on Sunrise Avenue and therefore no adverse effect on businesses or residential properties.

In 2018, the California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Grant Program (HMGP) began evaluating a grant proposal to fund a Comprehensive Loss Avoidance Study of multiple flood mitigation measures within the City of Roseville. As part of the comprehensive study detailed loss avoidance analysis of the Sunrise Avenue projects would be performed that would outline the exact measured waterflows and avoided damages, including loss calculations of avoided structure damage, contents damage, displacement time, and loss of public services. Cal OES will monitor the study effort and incorporate information from the study, when completed, into future State Hazard Mitigation Plan (SHMP) updates.

Inlet to Bypass Culverts on Linda Creek, Roseville During March 2018 High Water Event and in April 2018



Source: City of Roseville Floodplain Management Section Staff (left photo), Andrew Gillings, California Governor's Office of Emergency Services (Cal OES) (right photo)

Progress Summary 10.C: Assessment of Mitigation Efforts in the Areas of the October 2017 Wildfires and December 2017 Wildfires and the January 2018 Debris Flow

Progress as of 2018: Through a thorough analysis, using Geographic Information Systems (GIS) to map the projects within the disaster areas for the October 2017 Northern California fires, the December 2017 Southern California wildfires, and January 2018 debris flow, State Mitigation Assessment Review Team (SMART) initial assessment work has determined that there have been no positive mitigation impacts resulting from any previously funded mitigation projects for DR-4344 or DR-4353.

There has been one wildfire mitigation project completed in the impact area for DR-4353. The project, Sloan–Prescription Burn 1008-6057, was a vegetation management project that consisted of prescribed burning of vegetation as a mitigation effort against uncontrolled burning in future. This project was completed in 2004, 14 years ago. The projected useful life of vegetation management is one to four years; thus any risk reduction resulting from this mitigation project is no longer in effect.

Gooseneck Point, Clearlake, Following the October 2017 Northern California Wildfires





Source: Judy Worman

Way Forward for SMART

In December 2017, responsibility for assessing effectiveness of mitigation actions was transferred to the Hazard Mitigation Grant Program (HMGP) within Cal OES's Response and Recovery Directorate. HMGP staff, working with Hazard Mitigation Planning Division staff and FEMA Region IX staff, are in the process of redeveloping and implementing consistent analyses of losses avoided as a result of completed mitigation projects. As of September 2018, HMGP has five dedicated staff members responsible for facilitating and coordinating the SMART program.

The SMART program staff will conduct Level 3 field assessments and prepare subsequent SMART reports in conjunction with technical experts from other state agencies, such as geologists, hydrologists, fire management personnel, and sub-contractors. For example, as of late 2018, Cal OES is engaging with California Department of Water Resources (DWR) to obtain assistance with loss avoidance studies from DWR technical experts under an existing MOU between the two agencies. This arrangement will support Cal OES and local jurisdiction efforts to collect sufficient data to calculate mitigation benefits of completed projects. The partnership will allow Cal OES to utilize DWR's resources, specifically those that pertain to flood data, floodplain management, and NFIP information to maximize the state's understanding of mitigation project effectiveness. As of September 2018, an expanded loss avoidance study of the effectiveness of City of Roseville flood mitigation projects (described in Progress Summary 10.B) utilizing this interagency agreement is underway.

In addition to DWR's flood resources, Cal OES will reach out to other technical experts such as Cal OES earthquake and tsunami program staff, California Earthquake Authority staff, Seismic Safety Commission staff, Cal OES fire division staff, CAL FIRE staff, and others as needed. These efforts support multiple mitigation goals and strategies, in particular the state's strategies to expand the SMART program and strengthen interagency coordination.

The SMART team will not only analyze HMGP grant funded projects, but will also take a closer look at Section 406 Public Assistance funded mitigation projects and locally funded mitigation projects in order to broaden the understanding of the effectiveness of mitigation projects throughout the state funded by HMGP or other sources. The objective of these updates to the SMART Program are to help to better assess the effectiveness of mitigation projects and quantify that these efforts meet state mitigation goals. Future assessments of projects funded as a result of the 2017 and 2018 disasters, and beyond, will help to further define the direction of the state's mitigation strategy and to continue to focus on reducing risk. In addition to reinforcing the benefits of dollars spent on mitigation, assessing the effectiveness of previously funded projects will inform the state's understanding of the potential strengths or deficiencies in what type of projects are being funded and in what locations.

Cal OES plans to include SMART and loss avoidance information in various outreach efforts, briefings, and workshops to local and tribal communities, public and private sector groups, and other state and federal agencies to increase the understanding of the value of dollars spent on mitigation. To further outreach efforts and increase transparency about the SMART program, final SMART reports may be shared on the Cal OES website in the future.

10.6.2 OPPORTUNITIES FOR OTHER MITIGATION ASSESSMENTS

Cal OES will continue to evaluate completed mitigation projects throughout the state to assess the effectiveness of mitigation projects and usefulness of the mitigation dollars spent.

HGMP Funding for Fire Resistant Material Retrofits

During the 2007 Southern California Fires and Debris Flows (DR-1731), Cal OES funded project 1731-PJ0040-0027 for Lake Valley Fire Protection District in El Dorado County to replace wood shake shingle roofs with ignition resistant roofing material for 353 homes. Being a community in a heavily forested area, these homes were determined to be extremely vulnerable to wildfire. The area is also heavily touristed, bringing in additional members of the public, which both increases the potential for human-caused fires as well as the number of persons at risk if a wildfire event were to occur.

The retrofit of numerous homes, as well as implementation of building codes which call for new construction and remodels to follow the same requirements for ignition resistant materials is anticipated to mitigate spread of fire in the event that a wildfire does break out. These efforts are expected to help safeguard escaped embers from starting additional roof fires and keep firefighting costs down.

As of 2018, this project is completed and is in the closeout process. Cal OES is working with the jurisdiction to discuss the possibility of a more detailed analysis of the effectiveness of the project.

HMGP Expedited Post Fire Erosion Control

The Post Detwiler Fire Disaster Erosion Control mitigation project in Mariposa County was funded by expedited HMGP funding after the October 2017 Wildfires (DR-4344). This post-fire project removed fire debris contaminated soils and installed emergency erosion control protective measures on county maintained roads impacted by the Detwiler Fire.

Following the rainstorms of March 21-23, 2018, Cal OES SMART program staff reached out to Mariposa County to check on the success of the erosion control mitigation project. The County reported that all of the mitigated areas were successful in preventing sediment and major debris from culvert drainage, protecting roadways from washouts, and allowing the roads to be freely travelled for response and recovery activities by emergency vehicles as well as residents.

Cal OES SMART program staff will be reaching out to Mariposa County again in 2019 to assess how this mitigation project success can be formally captured to help show the effectiveness of mitigation actions.

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ANNEX 1 – GUIDE TO CALIFORNIA HAZARD MITIGATION LAWS, POLICIES AND INSTITUTIONS

ANNEX CONTENT

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1.1. INTRODUCTION

This annex enlarges upon the summary of the federal, state, and local disaster mitigation and emergency management laws summarized in *Section 1.4* of *Chapter 1: Introduction*, providing more complete descriptions of federal, state, and local laws, policies, and institutions.

To understand state and local hazard mitigation, it is useful to examine primary laws and policies at each level of the federal system. Development of disaster management systems in the U.S. has been piecemeal rather than systematic and comprehensive. Mitigation planning is conducted within a complex, fragmented and overlapping context of federal, state, and local laws, institutions, and policies, in turn intermingled with a variety of private sector risk reduction practices. The following are key elements of these systems.

1.2. NATIONAL FLOOD INSURANCE ACT

Public Law 90-448 of 1968, known as the National Flood Insurance Act, established the National Flood Insurance Program (NFIP) which provides for federal government backing of flood insurance sold by private companies. Supported by a national mapping system showing boundaries for 100- and 500-year floodplains, NFIP encourages local governments to direct development away from floodplain areas or elevate construction to mitigate flood risks through local regulation. Through the Community Rating Service (CRS), the NFIP provides for financial incentives in the form of lower insurance rates for local communities encouraging mitigation of flood hazards in a manner parallel

to rate incentives related to private fire insurance and enforced by the mortgage industry.

Additionally, the National Flood Insurance Act was modified in 1994 by Public Law 103-325, the National Flood Insurance Reform Act, to provide for flood hazard mitigation planning and project grants.

The Biggert-Waters Act passed in 2012 was intended to reform the NFIP. In response to outrage over the increase in flood insurance premiums resulting from the Biggert-Waters Act, the Homeowners Flood Insurance Affordability Act passed in 2014 with the intent of reducing the financial burden for policyholders. The act repeals and modifies certain provisions of the Biggert-Waters Flood Insurance Report Action by reducing policy increases, and allowing policyholders to maintain the risk rating based on compatibility with previous flood maps, even if new maps indicate increased susceptibility.

See *Chapter 7: Flood Hazards: Risks and Mitigation, Section 7.1.5.8*, for more information about the National Flood Insurance Program. For an overview of Homeowners Flood Insurance Affordability Act modifications to the Biggert-Waters Insurance Reform Act visit: https://www.fema.gov/media-library/assets/documents/93074.

The Flood Mitigation Assistance (FMA) program assists states and local communities in implementing flood hazard mitigation measures before a major disaster occurs. The program targets NFIP communities with numerous repetitive losses. The program offers two types of grants to local communities: planning and project grants. A community must have a FEMA-approved Floodplain Management Plan (FMP) to be eligible for FMA grant funding. Under the FMA program, a community has two years from the time it is awarded a planning grant to develop an FMP. When awarded a project grant, the community has three years to complete the project with FMA grant funds. States also receive technical assistance with grants to administer the FMA program.

1.3. STAFFORD ACT

Public Law 93-288 of 1988, entitled the Robert T. Stafford Disaster Relief and Emergency Assistance Act (more commonly known as the Stafford Act), is the basic disaster relief law of the country. It authorizes three post-disaster programs implemented by the Federal Emergency Management Agency (FEMA), now part of the Department of Homeland Security (DHS):

1. Individual and Household Assistance (IA), which provides limited post-disaster grants to assist displaced homeowners with mortgage payments and minor repairs

2. The Public Assistance Program (PA), which provides grants to local governments and non-profit groups for post-disaster repair of infrastructure and facilities

3. The Hazard Mitigation Grant Program (HMGP), which provides post-disaster grants to state and local governments to mitigate future damage

It should be noted that in addition to these three programs the Stafford Act includes preparedness and response authorities. Examples include the Fire Management Assistance Grant (FMAG) program, Part 204 of 44 CFR under the Stafford Act, along with other miscellaneous programs. Subpart F has unemployment assistance, legal aid, relocation, and crisis counseling. Subpart K has community disaster loans.

Under the Pet Evacuation and Transportation Standards Act (PETS) of 2006, the Stafford Act was amended by Congress to require states seeking FEMA assistance to accommodate pets and service animals in their plans for evacuating residents facing disasters.

Under the Sandy Recovery Improvement Act of 2013, the Stafford Act was amended by Congress to include advances to states of up to 25 percent of the amount of estimated cost of post-disaster HMGP funds, together with other streamlining measures, and to direct FEMA to create a comprehensive national strategy for reducing the cost of future disasters.

1.4. DISASTER MITIGATION ACT OF 2000

The most important federal hazard mitigation law is the Disaster Mitigation Act of 2000 (DMA 2000). It amended the Stafford Act and the Public Works Act to require preparation of hazard mitigation plans by local governments as a precondition for receipt of Hazard Mitigation Grant Program project funds. State governments were already required by the Stafford Act to prepare such plans. An initial deadline of November 2003 was extended to November 2004 and then to May 2005.

The general purpose of DMA 2000 was to reduce preventable, repetitive disaster losses by encouraging states and local jurisdictions to plan more wisely through mitigation of natural hazards, vulnerability, and risk. The basic reason for its passage was the growing volume and severity of preventable, repetitive losses from natural disasters aggravated by the widespread problem of poorly planned local development. Major disasters during the 1990s, including the 1993 mid-western floods along the Missouri and Mississippi rivers, and the Northridge Earthquake of 1994 together with an increase in wildland-urban interface fires, convinced Congress that more should be done locally to reduce the growing number of disaster losses.

1.4.1. LOCAL HAZARD MITIGATION PLANS

Preparation of a Local Hazard Mitigation Plan (LHMP) is a pre-condition for a local jurisdiction to receive Hazard Mitigation Assistance (HMA) funding. Local jurisdictions include cities, counties, special districts, and Native American organizations. DMA 2000 requires all locally applicable hazards to be addressed in LHMPs, which can be prepared by a single jurisdiction or on a multi-agency regional basis. Whether the LHMPs singly or jointly prepared, FEMA requires direct participation, selection of mitigation strategies, and formal adoption by each jurisdiction. FEMA also has promoted open public involvement in the process, documented participation of stakeholders, and provided opportunity for public review and comment on the mitigation plan. Other key aspects of LHMP preparation encouraged by DMA 2000 include 1) pre-disaster planning, 2) integrated state and local planning, 3) use of all-hazards approaches, 4) risk assessment and risk reduction measures, and 5) community-based processes, including public/private partnerships.

1.4.2. HAZARD MITIGATION GRANT PROGRAM

The HMGP program represents a disaster-based approach to allocating federal funds for use in mitigating hazards that might cause future disasters. HMGP funds are administered by states as sub-grants to local governments that have FEMA-approved LHMPs. Generally, HMGP allocations have represented from 7½ to 15 percent of post-disaster Stafford Act funding authorizations by Congress. Under H.R. 5441, the 2007 Department of Homeland Security Appropriations Act passed by Congress in October 2006, states with standard multi-hazard mitigation plans receive HMGP project funding based on varying proportions of a federally declared post-disaster Stafford Act funding authorization:

- 15 percent for amounts not more than $2 billion
- 10 percent for amounts more than $2 billion and not more than $10 billion
- 7½ percent for amounts more than $10 billion and not more than $35 billion

A more extensive discussion of the HMGP program is provided in *Chapter 10*.

1.4.3. PRE-DISASTER MITIGATION

DMA 2000 also provides for Pre-Disaster Mitigation (PDM) grants for hazard mitigation planning. PDM is administered in California by Cal OES. It was created under DMA 2000 to provide a funding mechanism that was not dependent on a presidential disaster declaration. Of the $25 million appropriated in fiscal year 2002 nationwide, California received approximately $1 million or 4 percent. The majority of these funds were spent on the development of the 2004 SHMP. Starting in fiscal year 2003, the PDM program was split into two different grants: planning and competitive. A more detailed discussion of the PDM program is provided in *Chapter 10*.

1.4.4. FLOOD MITIGATION ASSISTANCE

The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The FMA program makes available federal funds to state, U.S. territories, and federally recognized tribal governments to reduce or eliminate the risk of repetitive flood damage to buildings and structures insured under the NFIP. Local governments, including cities, townships, counties, and special district governments are considered subapplicants and must submit subapplications for mitigation projects and planning activities to Cal OES. Tribal governments may either submit applications/subapplications for mitigation projects and planning activities to FEMA or Cal OES in accordance with HMA guidance.

The FMA program strengthens national preparedness and resilience and supports the mitigation mission area in the National Preparedness System and National Preparedness Goal. All subapplicants must be participating in the NFIP, and not be withdrawn or suspended, to be eligible to apply for FMA grant funds. Flood insurance must be maintained through completion of the mitigation activity and for the life of the structure. For more information about the NFIP see Section 7.1.5.8.

1.5. OTHER FEDERAL DISASTER LAWS

Other federal laws authorize post-disaster funding to support restoration of highways, housing, and business. These include the Housing and Community Development Act, Federal-Aid Highways Act, Public Works Act, and Small Business Administration Act, which generally provide grants and loans for post-disaster recovery and reconstruction.

The Federal-Aid Highways Act, for example, authorizes emergency grants for freeways and highways on the federal network.

The Housing and Community Development Act provides for several types of post-disaster assistance including:

1. Section 235 rental assistance
2. Section 8 rental vouchers
3. Community Development Block Grants (CDBG) for housing repair and commercial loans that are also used locally to help finance local hazard mitigation projects associated with rebuilding

The Small Business Administration Act authorizes emergency provision of business resumption loans for small businesses and loans to homeowners for damage restoration. The Public Works Act authorizes assistance to small businesses as well as assistance to local governments for economic development.

1.6. FEDERAL EMERGENCY MANAGEMENT ADMINISTRATIVE DIRECTIVES

In addition to federal disaster management laws are a series of administrative directives regarding federal emergency management systems. These have been put in place over the past two decades by FEMA and, more recently, by the Department of Homeland Security, of which FEMA is now a part, in order to standardize disaster preparedness, response, and recovery practices nationwide.

The theory underlying the federal emergency management systems is a “bottom-up” concept that places priority in an emergency on local use of all locally available resources, including those supplied by mutual aid partners, before assistance is requested from the state government. In turn, it also emphasizes state use of all available state resources before assistance is requested of the federal government.

Thus, where local resources are overwhelmed in an emergency, assistance is requested from the state government. The Governor can declare a state of emergency and, if the emergency is so great as to overwhelm state resources, can request assistance from the federal government. Federal emergency response is provided after the President receives a request from a state and declares a federal emergency.

In return for federal emergency resources and post-disaster financial assistance, state and local governments are expected to follow specific federal regulations and guidelines associated with federal mitigation, preparedness, response, and recovery programs. This expectation forms the basis for the institutional arrangements and operations created at the state and local levels under federal administrative direction. Principal among these federal systems are:

- The National Incident Management System (NIMS), which provides uniform rules for incident command
- The National Response Framework (NRF), which provides response and recovery guidelines
- National Preparedness System
- Threat and Hazard Identification System
- National Mitigation Framework
- The National Disaster Recovery Framework (NDRF) adopted by FEMA in late 2011
- Presidential Policy Directive - 8, which addresses threats to security and other hazards
- A series of Comprehensive Preparedness Guides published by FEMA

1.6.1. NATIONAL INCIDENT MANAGEMENT SYSTEM (NIMS)

NIMS is a standardized incident command system (ICS) providing standardized terminology and procedures for common use in an emergency in any jurisdiction. NIMS uses standard incident command functions for managing an emergency (i.e., command, operations, planning and intelligence, logistics, and finance). NIMS is similar in many respects to a previously adopted system in California known as the Standardized Emergency Management System (SEMS).

NIMS is a major source of guidance for all state and local emergency management agencies in developing their own ICS protocols. Beginning in 2005, state and local governments wishing to receive federal financial assistance have been required by DHS to prepare emergency management plans that comply with NIMS. This is known as "NIMS compliance."

1.6.2. NATIONAL RESPONSE FRAMEWORK (NRF)

The National Response Framework (NRF), released by the Department of Homeland Security (DHS) in 2008, supersedes the National Response Plan. The NRF is a comprehensive guide for how the nation conducts incident response to all-hazards. Identified within the NRF are five key response principles: engaged partnerships; tiered response; scalable, flexible, and adaptable operational capabilities; unity of effort through unified command; and the readiness to act. One of the most important functions of the NRF is defining the roles, responsibilities, and relationships of local, state, and federal government, the private sector, and non-governmental organizations (NGOs) for responding to incidents. Within the NRF, there are 15 Emergency Support Functions (ESF) annexes. In addition, the NRF provides support annexes, incident annexes, and partner guides. Annex Table 1.A lists the 15 ESFs along with the scope of each function.

Annex Table 1.A: Emergency Support Functions and Scopes

Emergency Support Function	Scope
ESF #1-Transportation	Aviation/airspace management and control Transportation safety Restoration/recovery of transportation infrastructure Movement restrictions Damage and impact assessment
ESF #2-Communications	Coordination with telecommunications and information technology industries Restoration and repair of telecommunications infrastructure Protection, restoration, and sustainment of national cyber and information technology resources Oversight of communications within the federal incident management and response structures

Emergency Support Function	Scope
ESF #3-Public Works and Engineering	Infrastructure protection and emergency repair Infrastructure restoration Engineering services and construction management Emergency contracting support for life-saving and life-sustaining services
ESF #4-Firefighting	Coordination of federal firefighting activities Support to wildland, rural, and urban firefighting operations
ESF #5-Emergency Management	Coordination of incident management and response efforts Issuance of mission assignments Resource and human capital Incident action planning Financial management
ESF #6-Mass Care, Emergency Assistance, Housing, and Human Services	Mass care Emergency assistance Disaster housing Human services
ESF #7-Logistics Management and Resource support (facility space, office equipment and supplies, contracting services, etc.)	Comprehensive, national incident logistics planning, management, and sustainment capability
ESF #8-Health and Medical Services	Public health Medical Mental health services Mass fatality management
ESF #9- Search and Rescue	Life-saving assistance Search and rescue operations
ESF #10-Oil and Hazardous Materials Response	Oil and hazardous materials (chemical, biological, radiological, etc.) response Environmental short- and long-term cleanup
ESF #11-Agriculture and Natural Resources	Nutrition assistance Animal and plant disease and pest response Food safety and security Natural and cultural resources and historic properties protection and restoration Safety and well-being of household pets
ESF #12-Energy	Energy infrastructure assessment, repair, and restoration Energy industry utilities coordination Energy forecast
ESF #13-Public Safety and Security	Facility and resource security; Security planning and technical resource assistance; Public safety and security support. Support to access, traffic, and crowd control General law enforcement
ESF #14-Long-Term Community Recovery	Social and economic community impact assessment Long-term community recovery assistance to States, local governments, and the private sector Analysis and review of mitigation program implementation
ESF #15-External Affairs	Emergency public information and protective action guidance Media and community relations Congressional and international affairs Tribal and insular affairs

Source: U.S. Department of Homeland Security. National Response Framework, Emergency Support Function Annexes: Introduction.2008.

1.6.3. NATIONAL PREPAREDNESS SYSTEM

A national initiative to integrate various prior and ongoing emergency management statutory and administrative directions from Congress and the President is embodied in Presidential Policy Directive (PPD) 8: National Preparedness, which was released in March 2011. Its goal is to strengthen the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the Nation. PPD-8 defines five mission areas—Prevention, Protection, Mitigation, Response, and Recovery—and mandates the development of a series of policy and planning documents to explain and guide the Nation's approach to ensuring and enhancing national preparedness.

1.6.4. THREAT AND HAZARD IDENTIFICATION AND RISK ASSESSMENT (THIRA)

The THIRA follows a four-step process, as described in Comprehensive Preparedness Guide (CPG) 201, Second Edition, and available on FEMA's website. The State of California THIRA relies on the mitigation analysis contained

in the SHMP to complete THIRA Step 1: Identify the Threats and Hazards of Concern and Step 2: Give the Threats and Hazards Context. FEMA requires the State of California to submit its assessment annually through the Unified Reporting Tool (URT).

1.6.5. NATIONAL MITIGATION FRAMEWORK

Also part of the National Preparedness System is the National Mitigation Framework (NMF), is which builds on the National Preparedness Goal. The National Mitigation Framework sets the strategy and doctrine for building, sustaining, and delivering the core capabilities for Mitigation identified in the National Preparedness Goal. This Framework considers the full spectrum of threats and hazards, including natural, technological/accidental, and adversarial/human-caused.

The Mission Areas for the National Mitigation Framework are consistent with those of THIRA: Prevention, Protection, Mitigation, Response, and Recovery. The Framework provides the following definitions of the mission areas:

- Prevention: The capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism. As defined by PPD-8, the term "prevention" refers to preventing imminent threats.
- Protection: The capabilities necessary to secure the homeland against acts of terrorism and manmade or natural disasters.
- Mitigation: The capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- Response: The capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- Recovery: The capabilities necessary to assist communities affected by an incident to recover effectively.

This Framework establishes a common platform and forum for coordinating and addressing how the Nation manages risk through mitigation capabilities. It describes mitigation roles across the whole community. The National Mitigation Framework was published May 2013 and is available on FEMA's website: http://www.fema.gov/national-preparedness.

1.6.6. PRESIDENTIAL POLICY DIRECTIVES

Presidential Policy Directive - 8

PPD – 8 and the National Mitigation Framework provide an emerging institutional backdrop for the federal and state laws, policies, and strategies presented previously, as well as the detailed hazard and risk assessments described in *Chapters 6 through 9*.

Presidential Policy Directive – Critical Infrastructure Security and Resilience

The Presidential Policy Directive (PPD) on Critical Infrastructure Security and Resilience (2013) advances a national unity of effort to strengthen and maintain secure, functioning, and resilient critical infrastructure. Three strategic imperatives shall drive the Federal approach to strengthen critical infrastructure security and resilience: 1) Refine and clarify functional relationships across the Federal Government to advance the national unity of effort to strengthen critical infrastructure security and resilience; 2) Enable effective information exchange by identifying baseline data and systems requirements for the Federal Government; and 3) Implement an integration and analysis function to inform planning and operations decisions regarding critical infrastructure.

1.7. CALIFORNIA EMERGENCY SERVICES ACT

Among the more important laws, regulations, and administrative orders governing disaster management in California are the California Emergency Services Act, California Disaster Assistance Act, and Title 19 of the California Code of Regulations. The California Emergency Services Act provides the legal authority for emergency management and foundation for coordination of state and local emergency response, recovery, preparedness, and mitigation activities throughout California.

1.7.1. STATE EMERGENCY PLAN

The Governor's Executive Order W-9-91 requires the Director of the Office of Emergency Services (OES), to prepare the State of California's State Emergency Plan (SEP) and coordinate activities of all state agencies during the preparedness and response phases of emergencies. This Executive Order also directs state government organizations to submit agency emergency plans and procedures to the Director of OES for review and approval, provide personnel emergency training, define lines of succession, and ensure effective use of resources during response and recovery.

The State Emergency Plan describes the California Emergency Organization that provides the state and local agencies access to public and private resources during emergencies. The SEP can be downloaded from the Cal OES website from the following link:
http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/state-of-california-emergency-plan-emergency-functions

State Emergency Plan Linkage with SHMP

The SEP and the SHMP are closely interlinked; Section 8 of the SEP identifies mitigation programs as one of the four emergency management functions and Section 8.1 references the role of the SHMP in describing and mitigating hazards, risks, and vulnerabilities, thereby reducing disaster losses. For more discussion on SEP and SHMP linkage see *Chapter 2: Planning Process, Section 2.3.6*.

SEP Functional Annexes and Appendices

The State Emergency Plan (SEP) implements Emergency Function working groups, which develop functional annexes that follow an established format to describe discipline-specific goals, objectives, operational concepts, capabilities, organizational structures, and related policies and procedures. The functional annexes are developed separately from the basic plan and make reference to existing agency and department plans and procedures. Subsequent plans and procedures that are developed in support of the State Emergency Plan, such as mutual aid plans, the SHMP and other hazard-specific plans, catastrophic plans, and related procedures, are incorporated by reference and maintained separate from the SEP.

The SEP establishes the California Emergency Support Functions (CA-ESFs) as a key component of California's system for all-hazards emergency management. The California Emergency Management Agency (Cal OES) initiated the development of the CA-ESFs in cooperation with California's emergency management community including federal, state, tribal, and local governments, public/private partners and other stakeholders to ensure effective collaboration during all phases of emergency management.

The development of the CA-ESFs involves organization of the participating stakeholders and gradual development of emergency function components. This development also includes a process to maintain each of the CA-ESFs as a permanent component of California's emergency management system. The 18 emergency support functions identified in the 2017 SEP are listed in Annex Table 1.B.

Annex Table 1.B California Emergency Support Functions and Lead Agencies

California Emergency Support Function	Lead Agency
Transportation	*Business Transportation and Housing Agency*
Communications	*State and Consumer Services Agency*
Construction and Engineering	*State and Consumer Services Agency*
Fire and Rescue	*Cal OES*
Management	*Cal OES*
Care and Shelter	*Health and Human Services Agency*
Resources	*State and Consumer Services Agency*
Public Health and Medical	*Health and Human Services Agency*

California Emergency Support Function	Lead Agency
Search and Rescue	*Cal OES*
Hazardous Materials	*California Environmental Protection Agency*
Food and Agriculture	*Department of Food and Agriculture*
Utilities	*Resources Agency*
Law Enforcement	*Cal OES*
Long-Term Recovery	*State and Consumer Services Agency /Business, Transportation and Housing Agency*
Public Information	*Cal OES*
Evacuation	*Business, Transportation, and Housing Agency*
Volunteer and Donations Management	*California Volunteers*
Cybersecurity	*Cal OES*

Source: 2017 California State Emergency Plan Executive Summary

The California Emergency Support Function Executive Summary documents and more information regarding CA-ESFs is available on the Cal OES website:
http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/state-of-california-emergency-plan-emergency-functions

SEP Revisions

The State Emergency Plan is revised periodically. Draft versions of revisions of the State Emergency Plan are posted on the Cal OES website for review and comment by other governmental entities and the public.

An updated SEP was released in October 2017. To download the SEP from the Cal OES webpage, visit:
http://www.caloes.ca.gov/cal-oes-divisions/planning-preparedness/state-of-california-emergency-plan-emergency-support-functions

1.7.2. STANDARDIZED EMERGENCY MANAGEMENT SYSTEM (SEMS)

The Standardized Emergency Management System (SEMS) is the system required by Government Code Section 8607(a) for managing response to multi-agency and multi-jurisdiction emergencies in California.

There are five SEMS organization levels which, together with the private sector, comprise the California Emergency Organization. This virtual organization potentially represents all resources available within the state that may be applied in disaster response and recovery phases. The five levels are:

- *Field* - On-scene responders
- *Local* - County, city, or special districts
- *Operational Area* - Management and/or coordination of information, resources, and priorities among all local governments within the boundary of a county
- *Regional* - Management and coordination of information and resources among operational areas
- *State* - Statewide resource coordination integrated with federal agencies

SEMS operates from established Emergency Operations Centers (EOCs) at the state, regional, operational, and local levels, as well as in many businesses and industries. SEMS incorporates the use of the Incident Command System (ICS), the Master Mutual Aid Agreement, existing mutual aid systems, the operational area concept, and multi-agency or inter-agency coordination. A prime objective in emergency operations is to provide local jurisdictions with

the resources to meet their disaster needs and maintain continuity of government. All state employees are Disaster Service Workers (DSW) under Governor's Executive Order W-9-91.

Its use is required under federal law for state response agencies and local government agencies seeking eligibility for state emergency management funds. The prime objectives are to maintain continuity of government and provide local jurisdictions with resources to meet disaster needs.

1.7.3. ROLE OF CAL OES AND SEMS

Cal OES performs executive functions assigned by the Governor. The Director of Cal OES coordinates the state's disaster preparedness and response activities, assisted by representatives of state agencies. SEMS helps unify all elements of California's emergency management organization into a single integrated system. Its use is required for state response agencies and local government agencies seeking eligibility for state funding of response-related personnel costs.

1.7.4. LOCAL GOVERNMENT COORDINATION

An important point of vertical and horizontal integration of emergency preparedness and response at the local level is the county operational area EOC. This EOC manages and/or coordinates information, resources, and priorities among all local governments within the boundary of a county. There are 58 operational areas within California, consistent with the number of counties. While each city within a county may have its own EOC, the county EOC has a special responsibility under SEMS to be the clearinghouse for all other EOCs in that particular county. These fall within one or another of three Cal OES Administrative Regions.

1.7.5. CAL OES ADMINISTRATIVE REGIONS

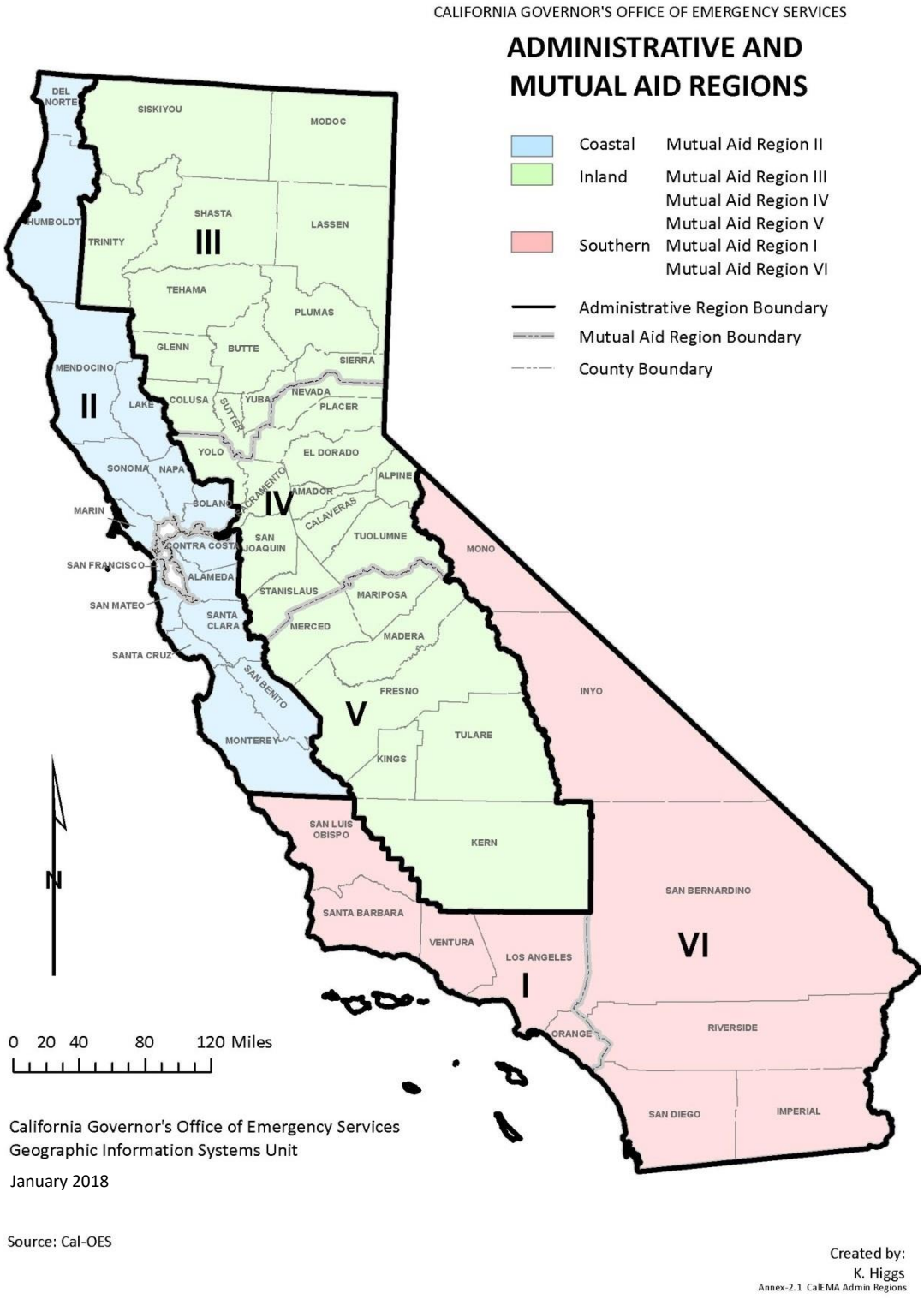
Cal OES is an Office of the Governor. Cal OES' mission is to protect lives and property by effectively mitigating, preparing for, preventing, responding to, and recovering from all threats, crimes, hazards, and emergencies. Cal OES responds to and coordinates emergency activities to save lives and reduce property loss during disasters and facilitates disaster recovery efforts. Cal OES provides leadership, assistance, training, and support to state and local agencies and coordinates with federal agencies to plan and prepare for the most effective use of resources in emergencies. All state employees are designated Disaster Service Workers (DSW).

There are three Cal OES Administrative Regions (Inland, Coastal, and Southern) in California. Within these are six Mutual Aid Regions for fire and general mutual aid coordination. The State OES oversees the mutual aid regions. Law Enforcement and Coroners have seven Mutual Aid Regions. The Cal OES Administrative Regions manage and coordinate information and resources among operational areas within mutual aid regions and between operational areas and state agencies for support during emergency mitigation, preparedness, response, and recovery activities.

Annex Map 2.A on the following page identifies the 58 county operational areas within the three Cal OES Administrative Regions and six fire and general coordination Mutual Aid Regions. The Coastal Cal OES region extends from Monterey County on the south to Del Norte County on the north and is a single Mutual Aid Region. The Inland Cal OES region extends from Kern County on the south to Siskiyou and Modoc counties on the north and contains three Mutual Aid Regions. The Southern Cal OES region extends from San Diego County on the south to San Luis Obispo County on the north along the Pacific Coast and Mono County on the north along the California-Nevada border and contains two Mutual Aid Regions.

For more information visit: http://www.caloes.ca.gov/cal-oes-divisions/law-enforcement/mutual-aid-system

Annex Map 2.A: Cal OES Administrative Regions



1.8. RELATIONSHIP OF SHMP TO EMERGENCY MANAGEMENT

As discussed initially in *Chapter 1: Introduction* as well as later in the SHMP, the SHMP is a supporting document to the California State Emergency Plan (see Annex Chart 1.A). By referencing the SHMP, the State Emergency Plan acknowledges the potential risks associated with identified hazards.

The Standardized Emergency Management System (SEMS) is the system required by Government Code Section 8607(a) for managing responses to multi-agency emergencies in California. The State Emergency Plan supports the policies, concepts, and protocols specified in the SEMS Guidelines for the implementation of SEMS. The use of SEMS is required by law during multi-agency or multi-jurisdictional emergency response by state agencies. Local government must also use SEMS to be eligible for reimbursement of certain response-related personnel costs.

1.8.1. SPECIAL NOTE ON RELATIONSHIP OF MITIGATION AND EMERGENCY PLANS

The Disaster Mitigation Act of 2000 (DMA 2000) brought hazard mitigation to the forefront by requiring FEMA-approved state and local hazard mitigation plans in order for state agencies and local governments to remain eligible for reimbursement for permanent work under the federal Public Assistance Program and all federal hazard mitigation grant funding.

In addition, since 2005 state and local emergency management plans must be consistent with the National Incident Management System (NIMS) in order to be eligible to qualify for federal preparedness funds NIMS added prevention and protection to the emergency management cycle. In this way, the Department of Homeland Security merged under one roof the capability to anticipate, preempt, and deter threats to the homeland whenever possible and the ability to respond quickly when such threats do materialize.

The overall strategy of the revised emergency management cycle can be expressed very simply: what you cannot mitigate or prevent you must be prepared to respond to and recover from (see Annex Chart 1.B).

Other Cal OES plans and guidance documents referencing mitigation include the California Emergency Plan, Disaster Recovery and Mitigation Handbook, Electric Power Disruption, Emergency Planning Guidance for Local Government (revised 2007), Emergency Management in California (2003), Emergency Planning Guidance for Public and Private Water Utilities, Recovery Manual, Risk Communication Guide for State and Local Agencies, and Statewide Emergency Management Strategic Plan (2005-2010).

1.8.2. VITAL ROLE OF SHMP IN EMERGENCY MANAGEMENT

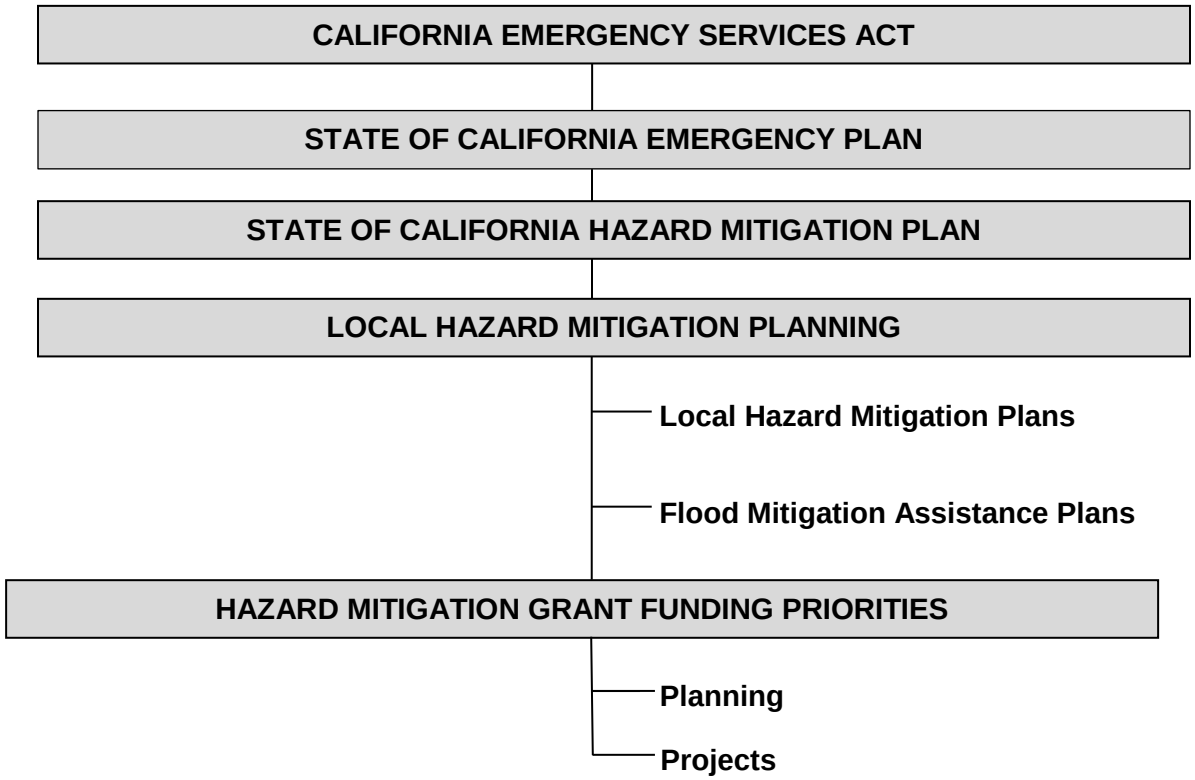
As pointed out in other chapters, the SHMP plays a fundamental role in comprehensive, integrated emergency management in California. Among other things, it identifies and analyzes the consequences of the risks associated with human-caused and natural hazards, together with vulnerabilities of people and property associated with such risks and mitigation programs devised to lessen their impact. Timely and effective hazard mitigation has multiple benefits, including the following:

- Minimizes deaths, injuries, and other negative disaster impacts on the public
- Reduces disaster losses to property, facilities, and infrastructure
- Minimizes negative impacts on the environment and economic condition of the state
- Lessens the work of emergency responders
- Assures greater continuity of government operations, including continued delivery of services
- Creates conditions by which recovery can happen more quickly and be less costly
- Heightens public confidence in the jurisdiction's governance

The SHMP identifies these benefits as an integral part of its various chapters, providing detailed evidence of the value of reducing specific hazards, risks, and vulnerabilities to achieve such benefits. Such benefits are reflected in the SHMP goals, strategies and actions in *Chapter 3*, profile of California's setting in *Chapter 4*, evaluation of primary

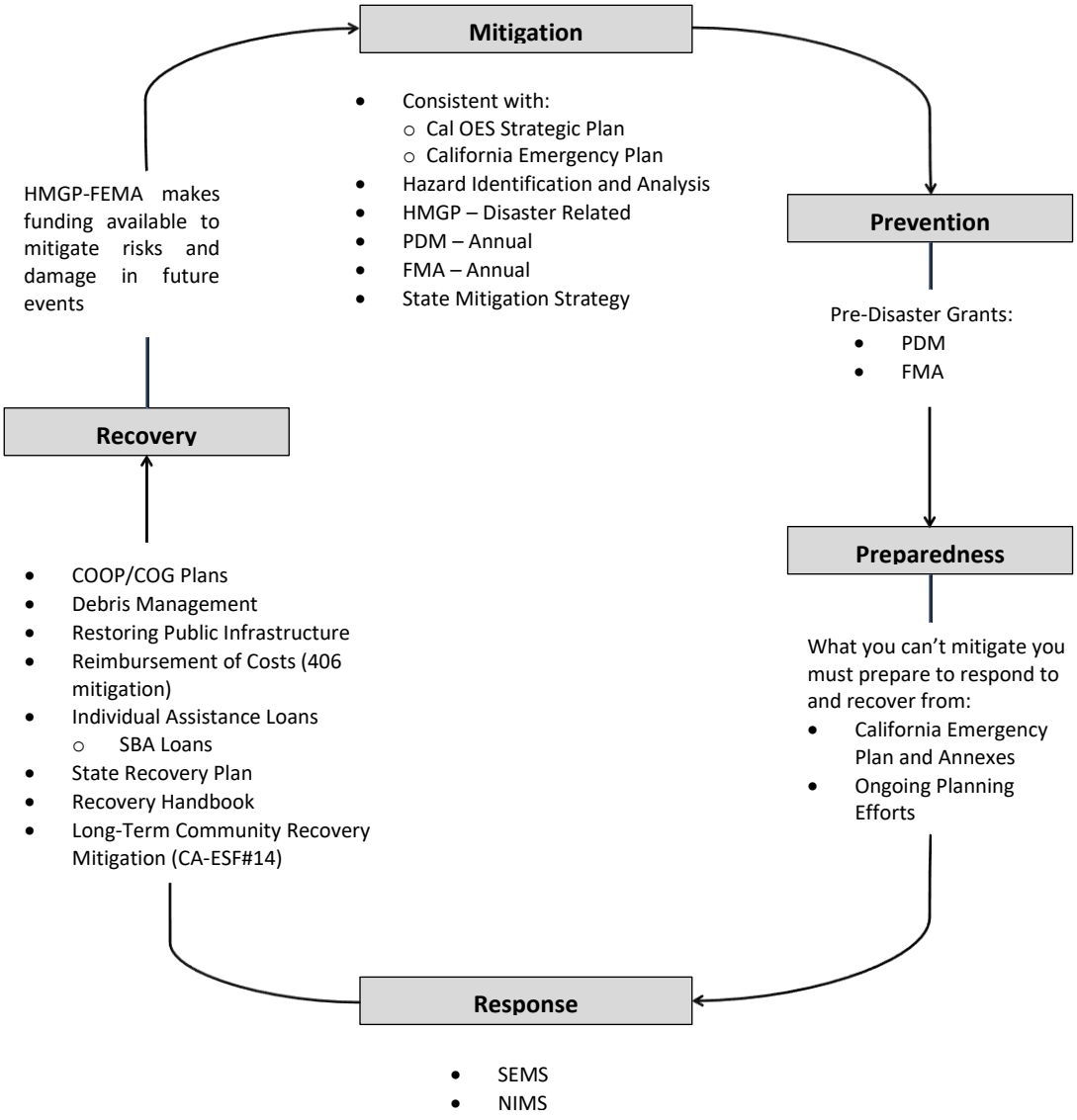
and other hazards and their mitigation in *Chapters 6 through 9*, and the description of the California's comprehensive mitigation program management in *Chapter 10*.

Annex Chart 1.A: Hierarchy of Hazard Mitigation Programs



Source: Cal OES

Annex Chart 1.B: Emergency Management Cycle after DMA 2000



Source: Cal OES

1.9. STATE AGENCY RESPONSIBILITIES

The preceding laws are administered by more than 40 state agencies, departments, and divisions responsible for their implementation, many of which have been active in the State Hazard Mitigation Team (SHMT). Many of these agencies have key responsibilities for emergency management and hazard mitigation activities assigned by statute. Annex Table 1.C provides a list of state agencies involved in various disaster mitigation functions.

Annex Table 1.C: State Agency Emergency Management and Mitigation Responsibilities

Agency	Emergency Management and Mitigation Role
Business, Transportation and Housing Agency	
California Highway Patrol	Protects state employees and property; supports evacuations and public safety in emergencies
Department of Housing & Community Development	Expands and preserves safe and affordable housing options; enforces seismic codes and standards for mobile homes/manufactured homes and special housing programs for vulnerable populations
Department of Transportation	Assures safety standards of California highway infrastructure; implements seismic strengthening of highway bridges and overpasses
California Earthquake Authority	Provides residential earthquake insurance; conducts mitigation pilot projects
California Environmental Protection Agency	
Air Resources Board	Regulates toxic air contaminants; oversees Climate Action Team; manages programs which reduce air pollution
Department of Pesticide Regulation	Regulates sale and use of pesticides; develops pest management systems
Department of Toxic Substances Control	Regulates transport, treatment, storage, and disposal of hazardous waste; monitors and cleans up waste sites
California Department of Resources Recycling and Recovery	Manages generated waste; promotes reduction of waste; implements Disaster Debris Management Plan
Office of Environmental Health Hazard Assessment	Assesses exposure and risks to public health from toxic substances; supports green chemistry
State Water Resources Control Board	Administers National Pollutant Discharge Elimination System (NPDES) program and cleanup of underground storage tanks; monitors drinking water quality. Administers water rights, including curtailment and enforcement actions during drought emergencies.
California Health & Human Services Agency	
Department of Public Health	CDPH monitors, assesses, and responds to all-hazard (CBRNE) public health threats. CDPH maintains surveillance of various threats through the CDPH Duty Officer Program and other CDPH programs. Examples include assisting with Strategic National Stockpile coordination, maintaining and managing the Medical and Health Coordination Center (MHCC), monitoring radiologic threats, overseeing statewide public health and environmental health disaster planning, distributing and overseeing funds to local health departments for disaster planning, and operating the California Health Alert Network (CAHAN). CDPH also monitors emerging infectious diseases, such as West Nile Virus, Influenza, bioterrorism threats, and Zika.
Office of Statewide Health Planning and Development	Regulates the safety of acute care hospital design, construction and retrofits
California Public Utilities Commission	Participates in Energy Action Plan, reducing greenhouse gas emissions and encourages solar energy infrastructure in existing homes and businesses
California State Archives	Preserves historic records of state government
California State Military Reserve	Responds to natural and man-made threats to California

Agency	Emergency Management and Mitigation Role
California State University (CSU) system	Regulates the safety of CSU campus facility design, construction and retrofits
California Volunteers	Coordinates volunteer activities through coordination with volunteer organizations, citizen corps programs, national service programs and other non-governmental organizations
Department of Corrections and Rehabilitation	Provides labor for vegetation management and wildland firefighting
Department of Education	Identifies nonstructural earthquake hazards in public schools, assists with California Schools Integrated Pest Management Program; oversees school preparedness programs
Department of Food and Agriculture	Food safety oversight and inspection; responds to invasive animal and plant disease; oversees integrated pest control
Department of Insurance	Enforces compliance with residential earthquake insurance policy
Department of Social Services (Disaster Services Bureau)	Provide coordination, collaboration, and resource identification for mass care and shelter, to support the State of California's capabilities to minimize the humanitarian impact of disasters and other emergencies through all four phases of emergency management
Office of Historic Preservation	Oversees seismic upgrading issues in historical buildings
Office of the Governor – State of California	
California Governor's Office of Emergency Services (Cal OES)	Protects the public and the state from natural and man-made disasters through comprehensive emergency management programs; provides mitigation planning and technical assistance; administers hazard mitigation grant programs; gathers and disseminates information critical to protection of the state; oversees Critical Infrastructure Protection Plan
Governor's Office of Planning and Research (OPR)	OPR serves as staff for long-range planning and research, and constitutes the comprehensive state planning agency. It issues guidelines and advice for regarding city and county general plans, including safety elements, serves as the State Clearinghouse under the California Environmental Quality Act, and provides technical advice related to land use and environmental issues.
Resources Agency	
CAL FIRE	
(Department of Forestry and Fire	
Protection)	Protects and manages forest and vegetation resources, protects people and property from fires, responds to emergencies; develops fire hazard maps; develops fire safe standards; monitors forest pest infestations; conducts public education programs
Office of State Fire Marshal	Protects life and property from fires through education, enforcement and fire prevention engineering
California Coastal Commission	Administers California Coastal Act, manages conservation and development of coastal resources
California Conservation Corps	Provides critical front-line and logistical support for natural and man-made hazards; assists with pre and post-disaster mitigation

Agency	Emergency Management and Mitigation Role
California Energy Commission	Statewide energy policy and planning; implements Energy Emergency Response Plan and supports Green Building Initiatives
California State Lands Commission	Manages and protects important natural and cultural resources on public lands within state
Marine Invasive Species Program	Manages and protects important natural and cultural resources on public lands within the state
Oil Spill Prevention Program	Responsible for the prevention of oil spills at marine terminals; prevents or minimizes the introduction of NIS from commercial vessels
Delta Protection Commission	Implements the Land Use and Resource Management Plan for the Delta
Department of Boating and Waterways	Controls invasive species in Sacramento-San Joaquin Delta
Department of Conservation	Disseminates seismological and geological information regarding earthquakes, landslides and other geological hazards
California Geological Survey	Provides expert technical services and advice on seismic, volcanic, and tsunami hazards and earthquake engineering
Department of Fish and Wildlife	Maintains native fish, wildlife, plant species and natural communities for their ecological value; monitors invasive species and implements the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Office of Spill Prevention and Response	Spill prevention and response responsibilities
Department of Parks and Recreation	Has property jurisdiction for approximately 1.5 million acres, including over 300 miles of ocean coastline. Serves approximately 80 million or more visitors to state park facilities each year. Mission is to protect natural/cultural resources and the state's biodiversity and provide quality recreational experiences
Department of Water Resources	Provides dam safety and flood control services, water quality monitoring; monitors drought conditions; administers CALFED program; participates in Delta levee risk reduction; operates and maintains the State Water Project; administers the drought water bank. Administers planning and water shortage assistance programs.
State & Consumer Services Agency	
California Building Standards Commission	Reviews, approves, and publishes building codes for new construction and alterations (including retrofits) proposed by state agencies
California Seismic Safety Commission	Provides decision-makers and the general public with cost-effective recommendations that reduce earthquake losses and expedite recovery
Department of General Services	Manages state-owned or state-leased properties statewide
Division of the State Architect	Regulates the safety of design, construction, and retrofits for state-owned facilities, K-12 public schools, and essential services facilities
Office of Public School Construction	Adopts sound repair standards for state's public schools
Department of Technology Services	Recovers critical computer applications in event of disaster
The Reclamation Board	Designates floodways in Central Valley
University of California (UC)	Regulates the safety of UC campus facility design, construction, and retrofits

A detailed chart showing state agency contact information, general functions, mitigation responsibilities, and corresponding enabling legislation, is provided in Appendix *B, State Agency Functions – Agency Responsibility Matrix.*

1.10. STATE EMERGENCY MANAGEMENT AND MITIGATION LAWS

During the course of California's history as a state, the California legislature has adopted dozens of laws dealing with emergency management and hazard mitigation. The following is a representative list of such laws:

1. Air Pollution, Health and Safety Code Section 42320
2. Air Toxics Hot Spots, Health and Safety Code Section 44300
3. Alquist-Priolo Earthquake Fault Zoning Act, Public Resources Code Section 2621
4. California Building Code, CCR, Title 24
5. California Disaster Assistance Act, Government Code Section 8680
6. California Environmental Quality Act (CEQA), Public Resources Code Section 21000
7. California Fire Code, CCR, Title 24, Part 9
8. Dam Safety Act, Water Code Sections 6000-6501
9. Disaster Project Law, Health and Safety Code Section 34000
10. Disaster Recovery Reconstruction Act, Government Code Section 8877.1
11. Earthquake Hazards Reduction Act, Government Code Section 8871
12. Earthquake Fault Zoning Mapping Act, Public Resource Code Section 2621
13. Economic Disaster Act, Government Code Section 8695
14. Employees Safety Act, Labor Code Section 2801
15. Emergency Response Team for State Operations, Government Code Section 8549.10
16. Emergency Services Act, Government Code Section 8550
17. Essential Services Buildings Seismic Safety Act, Health and Safety Code Section 16000
18. Field Act for K-12 public school design and construction safety, Education Code Section 17280, Section 81130, Section 17365
19. FIRESCOPE Act, Health and Safety Section 13070
20. Flood Control Law, Water Code Section 8000
21. Flood Control Law of 1946, Water Code Section 12800
22. Flood Plain Management, Water Code Section 8400
23. Hazardous Substances Highway Spill Containment and Abatement Act, Vehicle Code Section 2450
24. Hazardous Materials Release Response Plans and Inventory, Health and Safety Code Section 25500
25. Alfred E. Alquist Hospital Facilities Seismic Safety Act, Health and Safety Code Section 129675
26. Integrated Waste Management Act, Resources Code Section 40050
27. Katz Act, Education Code Sections 35295-35297
28. (Requires schools to plan for earthquakes and other emergencies)
29. Natural Hazards Disclosure Act, Civil Code Section 1102
30. Oil Refinery and Chemical Plant Safety Preparedness Act, Government Code Section 51020
31. Oil Spill Prevention and Response Act, Government Code Section 8674.1
32. Planning and Zoning Law, Government Code Section 65000
33. Radiation Protection Act, Health and Safety Code Section 114650
34. Riley Act, Health and Safety Code Section 19100
35. Sabotage Prevention Act, Military and Veterans Code Section 1630
36. Seismic Hazards Mapping Act, Public Resources Code Section 2690
37. Alfred E. Alquist Seismic Safety Commission Act, Government Code Section 8870
38. Subdivision Map Act, Government Code Section 66410
39. Water Shortage Emergency Act, Water Code Section 350
40. Cyber Security, Irwin AB 670
41. Seismic Safety Account, Insurance Code Section 12975.9
42. General Plan Amendments (related to Safety), Government Code Section 65302
43. Local government financing of seismic, flood and hazardous material programs and projects, Government Code Section 53369)

44. Amends Business and Professions Code related to funding of Seismic Retrofits, Business and Professions Code, Sections 10147 and 10149
45. Oil and Gas Well Stimulation regulation requirements. Resources Code, Section 3150, Chapter 1, Division 3
46. Amends General Plan requirements related to Safety Element Update Notification to California Geologic Survey. Government Code 65302.5, Section 101.
47. School building disaster plan requirements and earthquake emergency procedure, Education Code 32282
48. Earthquake Early Warning System in California Using Public-Private Partnerships, Government Code 8587.8

Through Executive Order the Governor has provided leadership in several hazard areas including:
1. *B-34-15 - Cyber Security:* establishing OES as the lead agency directing cyber threat integration
2. *B-30-15 - Climate Change*: Sets the California Greenhouse Gas Target as 40% below 1990 level by 2030
3. *B-21-13 - Drought*: streamlines voluntary water transfer approvals to assist agricultural industry
4. B-37-16 - Drought: Strengthens local drought resilience and directs DWR to work with urban water suppliers, agricultural water suppliers, and counties to improve drought planning

1.11. LOCAL EMERGENCY MANAGEMENT RESPONSIBILITIES

Cities and counties typically adopt ordinances establishing their local emergency organization, authorizing establishment of a local disaster council and adoption of an emergency plan, designating responsibilities for emergency management operations, and specifying officials authorized to declare a local emergency.
Most local jurisdictions have adopted the master mutual aid agreement to share critical skilled personnel and equipment and have conducted training for emergency response and taken advantage of training made available by a wide variety of agencies. During an immediate threat or in actual disaster conditions, local authorities immediately put emergency response plans into operation and take actions required to cope with disaster situations. As conditions require, all immediately available local, state, and federal resources are committed to protect lives, property, and the environment.

Traditionally, special districts also play an important role in emergency preparedness and response. Special districts are active participants in the operational area that is a focal point for all local emergency management information and the provision of mutual aid.

1.12. LOCAL HAZARD MITIGATION RESPONSIBILITIES

Local hazard mitigation is implemented by cities, counties, and special districts in California under certain of the laws listed previously. Each agency is responsible for mitigating hazards within its jurisdiction, as well as assuring health and safety conditions related to development constructed by the private sector and local government.

1.12.1. BUILDING AND FIRE CODES

In California, state laws and state-mandated professional building and fire codes adopted under the state's various safety planning laws have helped to create a solid foundation for mitigating impacts of floods, fire, earthquakes, and other natural hazards in new development. Such safety planning laws and codes have created a supportive policy framework for passage of laws dealing with retrofitting of existing potentially hazardous structures. A well-recognized example of such retrofit programs is the City of Los Angeles unreinforced masonry (URM) seismic retrofit program underway since the 1980s. According to the City of Los Angeles, 9,211 of its URM buildings had been retrofitted or demolished by 2006 under this program (CSSC 2006-04). Additional information on local URM programs can be found in *Section 6.1*.

1.12.2. PLANNING AND ZONING

Beyond facility safety are the mitigation practices improving safety from natural hazards having to do with the location and form of new development. These include local development planning and development oversight responsibilities delegated to cities and counties. Principal among these are compliance with the Planning and Zoning Law (Government Code Section 63200), Subdivision Map Act (Government Code Section 66410), and California

Environmental Quality Act (CEQA), (Public Resources Code Section 21000).

The Planning and Zoning Law requires all cities and counties to adopt a comprehensive general plan including land use, circulation, housing, safety, open space, conservation, and noise elements. It also mandates consistency among all general plan elements as well as consistency between the general plan and implementation measures such as zoning and subdivision review.

General Plan Safety Element

California is one of approximately 10 states mandating that natural hazards be addressed as a required element of the local general plan. The general plan safety element establishes policies and programs to protect the community from risks associated with earthquakes, floods, wildfire, and other natural and human-caused hazards.

According to the general plan safety element guidelines of the Governor's Office of Planning and Research:

> The aim of the safety element is to reduce the potential risk of death, injuries, property damage, and economic and social dislocation resulting from fires, floods, earthquakes, landslides, and other hazards. Other locally relevant safety issues, such as airport land use, emergency response, hazardous materials spills, and crime reduction, may also be included. Some local jurisdictions have even chosen to incorporate their hazardous waste management plans into their safety elements.
>
> The safety element overlaps topics also mandated in the land use, conservation, and open-space elements. When preparing a new general plan or undertaking a comprehensive revision of an existing general plan, OPR suggests addressing these common topics in a single place rather than scattering them among four separate elements. The key concern should be to integrate effectively these common issues into the decision-making process.
>
> The safety element must identify hazards and hazard abatement provisions to guide local decisions related to zoning, subdivisions, and entitlement permits. The element should contain general hazard and risk reduction strategies and policies supporting hazard mitigation measures. Policies should address the identification of hazards and emergency response, as well as mitigation through avoidance of hazards by new projects and reduction of risk in developed areas.

As a required element of the general plan, the safety element provides the foundational information and policy direction regarding hazards, vulnerability, and risk upon which proactive mitigation strategies and actions can be based over time. All other general plan elements must be consistent with the safety element, and vice versa. Likewise, all zoning, subdivisions, and capital improvements must be consistent with the safety element.

Subdivision Review

The Subdivision Map Act is clear regarding the requirement for consistency of subdivisions with the general plan. No tentative subdivision map can be approved unless the city or county finds that the subdivision, including its design and improvements, is consistent with the general plan. This requirement for direct implementation of the general plan through the specific implementation tool of subdivision review appears to be unusual when comparing California planning laws to those of other states.

Environmental Review

The California Environmental Quality Act (CEQA) is also an important California law reinforcing hazard mitigation as discussed below. CEQA requires an environmental review of any "discretionary" project such as a general plan amendment, zone change, specific plan, subdivision, or development plan review. If significant impacts are found, an environmental impact report (EIR) must be prepared.

1.12.3. SEISMIC ZONATION

Complementing these laws are seismic zonation requirements of the Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Section 2621), which prohibits buildings designed for continuing human occupancy from being constructed across an active fault, and Seismic Hazards Mapping Act (Public Resources Code Section 2690), which directs the California Geological Survey to provide maps showing areas susceptible to ground shaking, landslides, or liquefaction. Local governments must take such maps into account in their planning and development review.

1.12.4. STATE RESPONSIBILITY AREAS

Under the California Fire Plan, areas designated by CAL FIRE as State Responsibility Areas (SRAs), local governments must consult with the California Department of Forestry and Fire Protection on development review to assure safe development conditions.

1.12.5. HAZARD MITIGATION THROUGH LOCAL LAND USE PLANNING

To maximize the value of effective pre-disaster mitigation, many jurisdictions have written hazard mitigation provisions into local zoning, development subdivision, and environmental review ordinances and codes for reference in routine project review. Such ordinances are designed to address hazards identified in federal and state hazards mapping, such as Flood Insurance rate Maps (FIRM) for 100-year floodplains, as well as any identified in the general plan or a Local Hazard Mitigation Plan prepared by the locality under the Disaster Mitigation Act of 2000.

Ordinance language provides direction for further investigation where scientific evidence regarding hazard presence, return periods, or potential magnitude of impact is not clear. Such ordinances also identify standard hazard mitigation measures that can be attached to the project or subdivision as conditions to be met prior to subsequent stages of development.

Examples of commonly applied zoning and subdivision regulatory approaches to new developments in naturally hazardous areas include:

- Transfer of allowable density or intensity from hazardous parts of a site to safer areas during development plan review
- Restriction of allowable residential densities, thereby reducing the potential number of structures at risk
- Enforcement of suitable building setbacks from flood, landslide, and fault zones
- Adoption of slope-density formulas to limit the number of dwellings on hillsides
- Modification of proposed parcel boundaries and street locations to avoid hazardous areas
- Requirement of multiple ingress and egress points for emergency access and evacuation
- Provision of adequate street widths for two-directional movement in an emergency
- Assurance of sufficient water storage and pressure for adequate fire flows
- Assurance of sufficient water supply during drought conditions

Also commonly in use is an array of complementary techniques for avoiding private property development in hazard-prone areas. Examples include:

- Application of agricultural and conservation easements by private land trusts
- Establishment of open space easements or donation of property for tax relief purposes
- Acquisition of land or development rights using developer fees or public park bonds
- Limitations on infrastructure provision and extensions

Together, these regulations and practices represent a powerful combination of tools to strengthen natural hazard mitigation in the course of day-to-day development planning review.

Among these land use processes are three critical points at which communities make important risk reduction decisions related to new development in hazard-prone areas: 1) mandatory environmental review under CEQA, 2) general plan and zoning decisions, and 3) subdivision map approvals. Environmental review, general plan, zoning, and subdivision decisions all have far-reaching consequences in areas where natural hazards can create the potential for damage to development. If flooding, geological, and other hazards are not sufficiently recognized at these key decision points, a "multiplier" effect can be created in which the existing hazards are distributed among many new land parcels authorized under the decision. Environmental review provides an opportunity to identify and evaluate risk-reducing natural hazard mitigation measures as a prelude to the land use planning process. For more information, see Annex 1.

1.13. RELATIONSHIPS OF LOCAL PLANNING PROCESSES TO LHMPS

An important interest of FEMA in promoting compliance with the LHMP process as part of planning for hazard mitigation grants of various kinds is creation of an interface of mitigation planning with comprehensive planning (i.e., the local general plans, regional blueprint plans, and regional transportation plans).

Within this regional and local planning framework, key considerations identified by FEMA in evaluating mitigation planning strategies include considerations such as:

- Compatibility with community goals
- Legal authority
- Ability to implement and enforce mitigation actions
- Technical feasibility
- Financial capability
- Cost/benefit ratio of a proposed solution
- Priority level of the proposal project among the hazards addressed
- Completeness of the solution

Some benefits of integrating mitigation planning with comprehensive planning include reduction of vulnerability to disasters, stimulation of pre- and post-disaster decision-making, formation of partnerships between planners and emergency managers, expansion of external funding opportunities, and facilitation of the post-disaster return of the community to normalcy, as well as resolution of locally sensitive issues with community-based rather than externally based solutions.

A California legislative action reinforcing these principles is Assembly Bill 2140, signed into law by the Governor in October 2006. AB 2140 provides the following incentives for LHMP preparation: 1) authorizes cities and counties to adopt Local Hazard Mitigation Plans prepared under the terms of DMA 2000 as part of mandated general plan safety elements; 2) requires Cal OES to give preference for grant fund assistance in developing and adopting such a plan to local jurisdictions that have not adopted an LHMP; and, most importantly, 3) authorizes the legislature to provide to such cities or counties a state share of local costs exceeding 75 percent of total state-eligible post-disaster costs under the California Disaster Assistance Act.

1.14. UTILITIES

The California Utilities Emergency Association (CUEA) cooperates with Cal OES to coordinate public and private utility emergency-related issues in California. Largely supported by memberships from public and private utilities with jurisdiction or service territory in California, the CUEA operates and manages the Utilities Branch at Cal OES. Utilities membership in the CUEA includes gas, electric, telecommunications (including wireless), water, wastewater, and petroleum pipeline industries. During emergencies, the Utilities Operations Center (UOC) is activated to enhance the utilities' capability to respond to and recover from emergencies by providing a structure for cooperation and communication among utilities and government agencies.

Beyond involvement in emergency management, private utilities are continuously involved in ongoing investments increasing service capacities and replacing obsolete equipment and facilities. Many of these investments represent incremental improvements in the resilience against natural and human-caused hazards within their plants and facilities.

Additional discussion on private utility mitigation investment in hazard mitigation is provided within Annex 3.

1.15. BUSINESS, INDUSTRY, AND COMMUNITY-BASED ORGANIZATIONS

Many business and industry organizations are recognizing that preparedness and mitigation can make a difference between a company surviving a disaster or going out of business. Risk managers and chief executive officers assess threats posed by disasters and, where risks are high, implement mitigation and preparedness measures. Employee injury and illness prevention programs and business resumption plans are helping to influence many businesses to develop or expand their emergency plans and move forward on hazard mitigation investments.

The American Red Cross (ARC) provides disaster relief to individuals and families and emergency mass care in coordination with government and private agencies. It receives its authority from a congressional charter that cannot be changed by state or local emergency plans and procedures. In providing their services, the ARC will not duplicate the programs of other public or private welfare agencies, nor will it assume financial responsibility for their actions.

Community-based volunteer agencies represent the most extensive source of response resources in an emergency. A multitude of volunteer organizations are able to provide caring and knowledgeable assistance in support of emergency response and recovery operations. Government recognizes the value and importance of community-based organizations which perform services and have resources that can augment the ARC and other traditional response and relief agencies.

Recognizing the critical need for coordination with the private sector, Governor Schwarzenegger signed Senate Bill (SB) 546 in September 2005 to help expand public/private partnerships and allow greater participation by the private sector in governmental emergency management efforts. SB 546 authorized OES (now Cal OES) to support partnership activities funded by the private sector.

California also has an extensive system of Fire Safe Councils, which are 501(c)3 non-profit organizations involving thousands of citizens as well as over 50 corporate partners. Activities include community outreach and education, hazardous fuel assessment, community wildfire protection planning, and community chipping projects. Everyone is a volunteer. The California Volunteers connects volunteers with hundreds of community-based organizations. Following a disaster, volunteer agencies continue to provide services for their constituents as well as for the governmental agencies that might have need of their unique services.

Many of these organizations have already been identified through statewide information and referral networks and are trained in SEMS to maximize their efficiency and ability to become better integrated into response and relief efforts. Many groups providing voluntary disaster services can be contacted through the National Voluntary Organizations Active in Disasters (VOAD).

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ANNEX 3 – LIFELINES INFRASTRUCTURE AND HAZARD MITIGATION PLANNING

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- 3.1.2 Cascading Lifeline Failures

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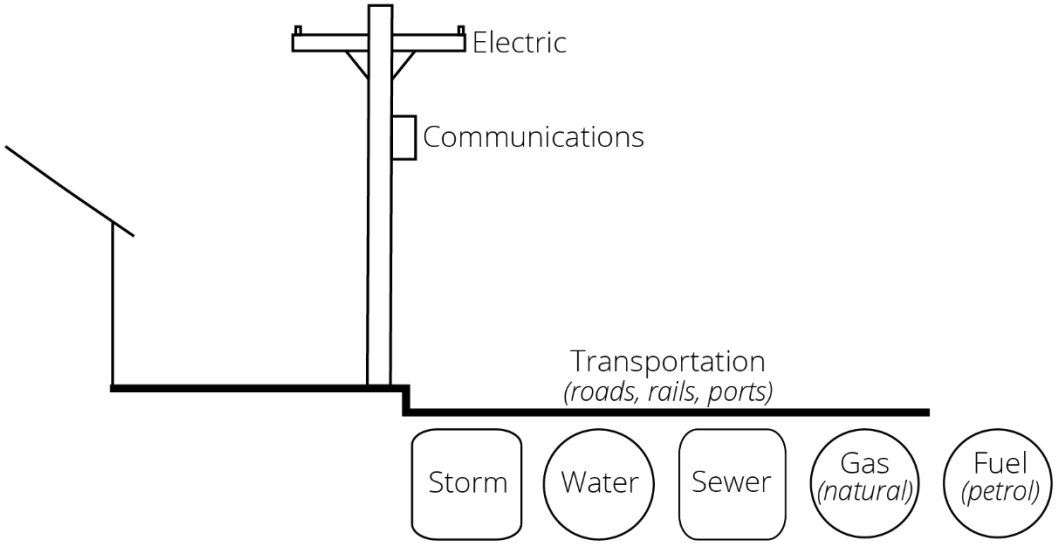
3.1. INTRODUCTION

A functioning society requires basic essentials (such as water, electricity, etc.) that are delivered through systems often referred to as lifeline infrastructure. California has vast networks of vital lifeline infrastructure upon which normal daily human activities depend.

A lifeline is defined here as any spatially continuous engineered system that delivers essential services. The main categories of lifeline infrastructure systems can include transportation, communication, power, gas, water, and wastewater (see Annex Diagram 3.A below). Other services and facilities interact with lifelines, such as; responders (e.g., police, fire, ambulance), distribution services (e.g., food), collection services (e.g., solid waste), and emergency operations centers used to support disaster response.

These systems are often interdependent so that a service interruption in one may lead to failure of another. They are also interdependent with service sites and facilities such as city halls, schools, hospitals, and parks. While separate service sites are important, this discussion will focus on lifeline systems and the special considerations they require due to their system structure.

Annex Diagram 3.A: Services Typically Included as Lifelines

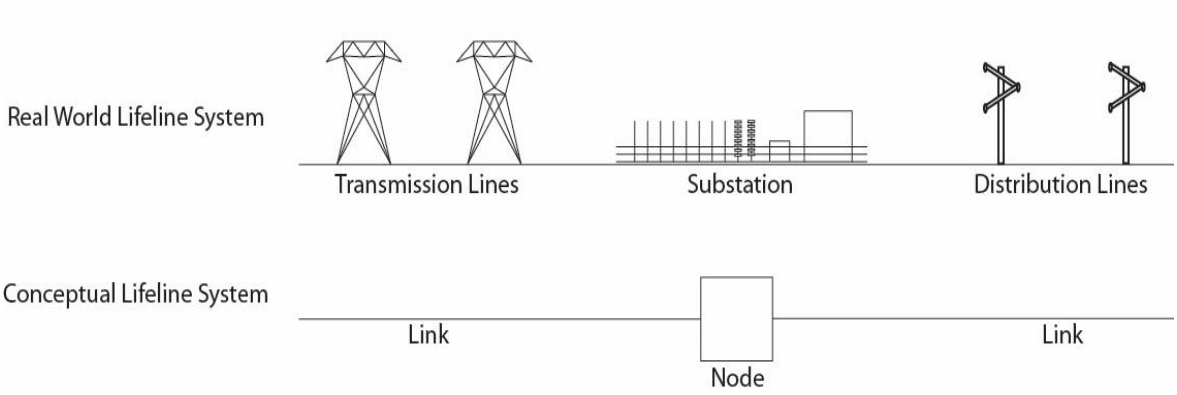


Source: Cal Poly SHMP Support Team

Lifeline systems provide the necessary services and resources for the day-to-day functioning of government, businesses, and society as a whole. Society relies heavily on lifelines without giving much consideration to their reliability until a disaster curtails or interrupts services. The failure of these systems can have a catastrophic impact on communities or regions. Lifeline failure can come about due to obvious system weaknesses (e.g., bridge failure due to poor design), as well as through interconnected or cascading failures for which the causes may not be obvious.

Lifeline systems are generally composed of links and nodes. Links are components such; as pipelines, canals, roadways, and power lines. Nodes are components such as; pump stations, interchanges, switching hubs, and bridges (see Annex Diagram 3.B).

Annex Diagram 3.B: Lifelines as Links and Nodes



Source: Cal Poly SHMP Support Team

Hazard mitigation historically has focused on the individual components of a system, the lifeline nodes. However, lifelines are systems that have unique mitigation challenges. A single failed component may have a direct impact in the immediate vicinity and also in areas unaffected by the hazard that caused the failure. For example, a bridge collapse due to a flood may cause traffic congestion not only in the immediate area, but also in parts of the region unaffected by the flood. Lifelines must be seen as systems where the failure of a single component has the potential to affect the whole system, well beyond the failed single component Thus, lifeline mitigation must be measured by

system performance. The goal is to minimize service interruption and ensure continuity or quick return of lifeline services to keep society functioning.

3.1.1. HAZARD MITIGATION AND CALIFORNIA LIFELINE SYSTEMS

In California, lifeline systems come into direct contact with multiple hazards, crossing earthquake faults, floodplains, and fire hazard zones. The interaction of lifelines with a hazard could cause significant impacts to society. In Southern California alone, for example, water aqueducts and canals cross the San Andreas Fault 32 times.[339] Annex Map 3.A, Southern California Water Vulnerability, shows multiple crossings of the San Andreas Fault by the State Water Project (SWP), Los Angeles Aqueduct, and Colorado River Aqueduct, as well as location of a pumping plant on that fault.

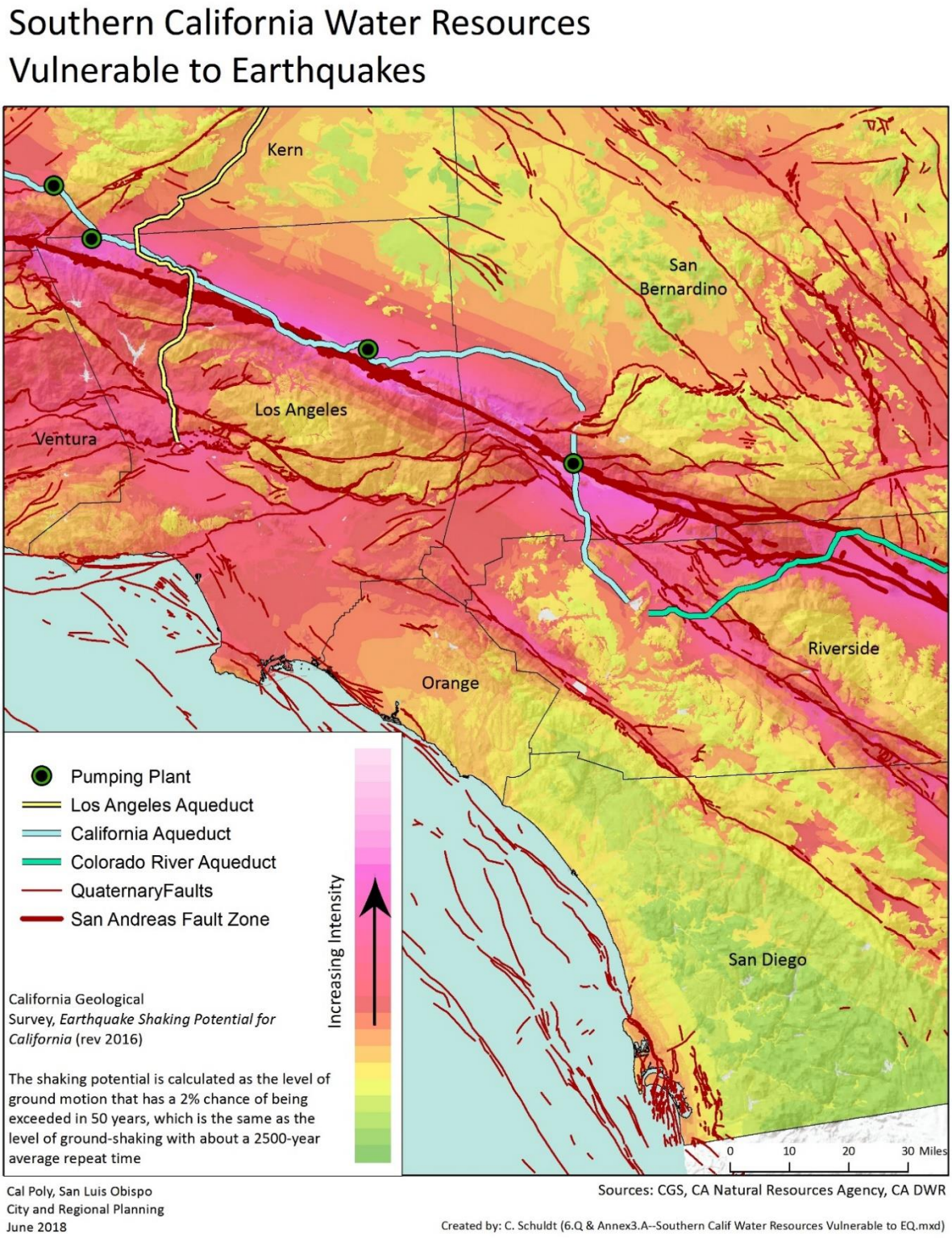
A study conducted in conjunction with the 2008 Shakeout Scenario for a potential magnitude 7.8 earthquake on the San Andreas Fault estimated four to 18 months would be required to restore all three aqueducts to service following such an event. This would disrupt delivery of water from external water supplies which comprise 70% of Southern California's water use (EERI, 2011). For further information on Shakeout see *Chapter 6, Section 6.1.3.1*.

This example only considers one type of hazard and one type of lifeline system. When all hazards and all lifeline systems are overlaid, the potential for failure is evident. Unlike hazard impacts on separately sited facilities, like schools or fire stations, the potential for failure on a particular lifeline can affect service delivery of that system well beyond a failed bridge or other component. Individuals relying on lifeline systems can lose service even hundreds of miles from the point of failure.

In California, it is common to find corridors that contain multiple lifeline systems. Topography is partially responsible, with mountains often forcing the routing of many lifelines through narrow passes and corridors. In other cases, development has constrained the rights-of-way potentially available for lifelines, thereby causing multiple lifelines to be located along the same path. This collocation of lifeline systems can lead to multiple lifeline failures in the same event.

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Annex Map 3.A: Southern California Water Resources Vulnerability to Earthquakes



3.1.2. CASCADING LIFELINE FAILURES

Various lifeline infrastructure maps in *Chapter 6, Section 6.1.3* separately suggest some common corridors along which many lifelines are routed. Common routing can be either beneficial or hazardous depending upon the level of hazard mitigation. If multiple lifelines are strengthened against common hazards along the same corridor or placed together to avoid hazardous areas, they will all benefit from such mitigation actions. If lifelines are placed together through a hazardous area without appropriate mitigation, however, in many cases the failure of one lifeline can influence or precipitate failure of another. Damaged gas, water, wastewater, and electrical lines can become a secondary hazard resulting in damage to other lifelines. (For more information on vulnerability of various lifelines systems, see *Section 6.1.4.2*.)

Similarly, restoration of each lifeline following a disaster is largely interdependent with restoration of all other lifeline services. Communication systems and transportation networks are needed by repair crews to restore services. Those same lifelines often require electricity or other lifelines to operate. The interdependence of lifelines is often not fully realized until a cascading failure has occurred.

3.2. LIFELINE FAILURE CASE EXAMPLES

The best way to describe typical lifeline failures is to explore brief case examples of lifeline disruption, highlighting some principles. Drawn from actual experiences, such examples show the important role of redundancy in the design of lifeline systems. The discussion below describes case examples, summarizes the concepts behind systems failure, and presents methods for improving the resilience of lifelines.

3.2.1. LOMA PRIETA EARTHQUAKE - IMPACT ON WATER AND TRANSPORTATION

The 1989 magnitude 6.9 Loma Prieta Earthquake was a large event, but the epicenter was located far enough away from the San Francisco Bay Area that the earthquake caused substantially less damage than if it were a direct hit. Nonetheless, there were a number of lifeline failures from this event that warrant careful attention.

Ground shaking and liquefaction in the Marina District of San Francisco caused widespread damage to soft-story wood-frame residential structures. Soft-story structures are those with two or more stories built over a "soft" or "weak" story that typically consists of commercial space or parking garage. During the earthquake gas mains into some of these structures ruptured, which sparked a fire that quickly spread. Fire crews arrived on the scene only to find that their water suppression system had failed and no water pressure was available to put out fires.

The City and County of San Francisco has a 135-mile “seismically resistant” auxiliary water suppression system (AWSS) consisting of distributed large cisterns to provide scattered water sources across the city without relying on long stretches of pipeline (see Annex Map 3.B below). A 12-inch main of the AWSS failed and six fire hydrants were damaged by soil deformations in the area south of Market Street. It is estimated that this drained the 750,000-gallon Jones Street tank near the Marina District in about 20 minutes (Schiff, 1990). Air entered the nearest pumping station, further preventing water from reaching the fire.

Two fortunate events limited the potential damage due to fire: 1) calm winds, and 2) availability of the (soon to be decommissioned) fire boats. The San Francisco Fire Department was in the process of selling off the fire boats when the earthquake occurred, because there was full reliance on the “seismically resistant” water distribution system. The redundancy of the fire boats provided the independent backup system needed to suppress the fires.

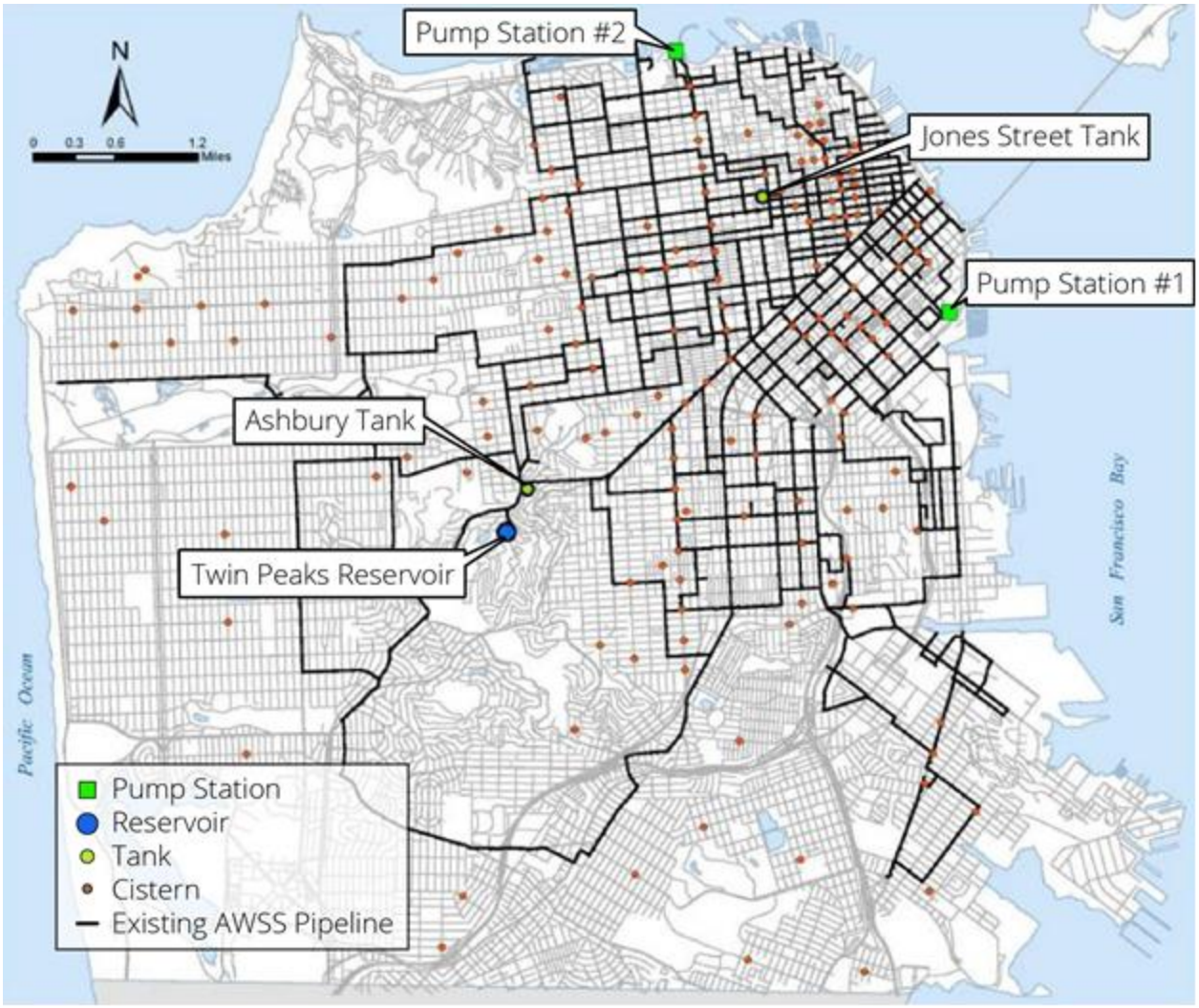
The transportation systems in the greater Bay Area sustained over $1 billion in damage due to the earthquake. The most prominent failures were the collapse of the Bay Bridge deck and the collapse of the Cypress Viaduct freeway structure in Oakland. The Bay Bridge was closed for a full month, while the Cypress Viaduct was never rebuilt to its original form (Schiff, 1990). Before the earthquake, the heavily trafficked Bay Bridge corridor carried 240,000 vehicles and nearly 400,000 people across the bay on a daily basis (Deakin, 1991).

To offset the loss of this corridor, alternative corridors and alternative means of transportation provided the redundancy needed to maintain some functionality. A new ferry service transported 400 to 500 passengers a day. Bay Area Rapid Transit (BART) increased its ridership from 218,000 daily passengers to 357,000, a 64-percent increase (Schiff, 1990). Alternative bridges across the bay experienced traffic increases. The Golden Gate Bridge had the busiest day in its history 10 days after the earthquake.

Principles Identified:

- In both the emergency water system and the transportation system, the importance of redundancy is demonstrated.
- To ensure lifeline redundancy, the backup system should be independent. This means that the backup system is either not subjected to or is resistant to the same loading conditions.
- When independent redundant systems are infeasible, isolating failures to the main system can improve overall system performance.

Annex Map 3.B: Auxiliary Water Suppression System in San Francisco



Source: City and County of San Francisco, 2010

3.2.2. LA CONCHITA LANDSLIDE – IMPACT ON TRANSPORTATION

During the wet winter of 2005, a landslide/debris flow occurred along the Central California coast at La Conchita, west of Ventura (Jibson, 2005). This landslide, in an area that is known for previous slides, resulted in the tragedy of life loss for 10 people living below the slope.

The landslide/debris flow blocked Highway 101 and the Union Pacific rail line in a mountainous coastal area where there are no easy alternate transportation routes. The corridor was closed for five days. The alternate driving route from Santa Barbara to Ventura, nominally 35 miles on Highway 101, required a circuitous trip of approximately 200 miles. The alternate rail line also required a substantial detour through the Central Valley. A ferry option was available, but at a cost of $35 one way (Pool, 2005). No substantial fix was put in place and the occurrence of future similar failures is just a matter of time and rainfall intensity. The 2018 debris flows in Montecito, just 25 miles North of La Conchita, had even more severe impacts on the community, and a longer closure of the Highway 101 corridor.

Principles Identified:

- Some transportation corridors do not have simple alternate routes, particularly when dealing with difficult topography.
- The cost of armoring certain lifelines against closure should be weighed against the repeat costs of closure. If possible, **cost benefit analysis** of mitigation decisions should include not only life and property loss, but also lifeline repairs or lifeline outage consequences.

3.2.3. NAPLES, ITALY, GARBAGE STRIKE, SAN FRANCISCO COMBINED SEWER OVERFLOW, AND POST-DISASTER DEBRIS – IMPACT ON SOCIETY

These two case examples highlight reliance on lifeline systems that are often taken for granted. Rather than representing acute disasters, the examples demonstrate how substantial disruption may occur over extended periods.

In 2008, garbage pickup services in Naples, Italy, were suspended due to a labor strike and landfills that had reached capacity. While waste disposal is not often thought of as a lifeline, it also functions as a spatially distributed engineered system using city streets, and when this system is not functioning properly there can be a disruption of society. Waste disposal requires nodes (landfills) for long-term storage of the waste and recycle sites for material salvage and conversion, together with a distributed system of trucks and streets along which they can travel. For about seven months in Naples, the streets were full of accumulated garbage, which became a public health and sanitation issue, and day-to-day society functions were disrupted. At the peak of the strike there were over 200,000 tons of garbage in the streets (Economist, 2008), dampening the city's tourism, Naples' largest economic sector. Many businesses received half their normal business during this period and subsequently experienced a lag in return to business as usual.

Waste lifelines may also include combined storm/sewer systems that have the traditional link and node configuration. During intense rainfall these systems can overflow, resulting in raw sewage being released into rivers, lakes, and the sea, as well as backing up and threatening municipal drinking water. The City and County of San Francisco's combined storm/sewer system can overflow at 39 separate locations when rainfall intensity exceeds 0.05 centimeters per hour and previously had an average of 80 overflows in a typical rainfall year (Hoffman and Meighan, 1984). The effects depend on the concentration of pollutants, the constituents in the pollutants, and the locations where the overflow is released.

Following many disasters (e.g., earthquake, tsunami, etc.), debris can block access to critical assets or prevent access for crews attempting to restore other lifelines (Yesler, 2011). Making access routes for emergency response the top priority, identifying corridors needed to restore essential services, and ranking other routes according to the need and timeliness for clearing debris will aid in more rapid recovery and rehabilitation.

Principles Identified:

- Sewer and storm water systems, along with household and solid waste systems, are essential for societal function and require lifelines consideration because of their spatially distributed nature.
- Combined storm/sewer systems can result in small but chronic failures that affect the health of the environment and citizens.
- Debris after a disaster can hinder rescue and recover. Addressing post-disaster debris in pre-disaster planning efforts can enhance post-event response.

3.2.4. NEW ORLEANS LEVEE FAILURE – IMPACT ON LIFE

Hurricane Katrina caused widespread damage to the Gulf Coast in 2005. Levee systems are used in the Mississippi Delta to limit flooding from peak flows as well as to hold back storm surge. In the New Orleans area levees failed due to poor engineering, not overtopping (ILIT, 2006). Low-lying swaths of the city were flooded, resulting in over 1,833 deaths and $146 billion in damage (NOAA, 2012).

Levees are continuous earthen embankments which control the flow and spread of water. They are often built on soft soils which tend to subside or erode. Although there are exceptions, levee systems usually lack redundancy due to the high costs of building parallel backup levees and acquiring rights-of-way with sufficient space for low-angle embankments having a very wide footprints. Levees and other embankments are not difficult to design and build well, but continuous flood mitigation along the entire length of a levee in both space and time is a difficult task.

Principles Identified:

- Levees can and do fail under less than peak loads due to adverse foundation soil conditions.
- Redundancy is often too costly or infeasible to ensure with levee systems.
- In coastal, tidal, and delta regions, sea-level rise will increase the hazard to existing levees and make protecting low-lying areas with levees an increasingly risky proposition.

3.2.5. CHILE EARTHQUAKE – IMPACT ON POWER, WATER, COMMUNICATION, AND TRANSPORTATION

The 2010 magnitude 8.8 Maule Earthquake affected a vast region of Central Chile (EERI, 2010a). Although the epicenter was 210 miles away from Santiago, the ground shaking had a large impact on the city. The electric grid went down throughout most of Central Chile including metropolitan Santiago, a region of 6.1 million people. The loss of power precipitated the loss of communication in the form of radio, television, telephone, cell phone, internet, and others. The loss of power also halted Santiago's water distribution system, which relies on electric pumps. This lack of services presented an inconvenience to some people, a risk to other more vulnerable populations, and a hindrance to disaster recovery particularly because Santiago is the seat of power for the country. The interconnectedness of the power, communication, and water systems is an obvious concept but difficult to untangle for ensuring resiliency.

Closer to the epicenter was the city of Concepcion, population 900,000. Here not only was power, water, and communication out, but all road access to the city was severed. The city was isolated and had no means of communicating with the rest of the country or receiving word that help was on the way. The lack of information compounded the lack of essential services and resulted in a break in the social fabric of that community (American Red Cross, 2011). Once communication was restored, the civil unease dissipated and recovery and reconstruction began.

The main highway that runs north-south in Chile is Ruta 5. Ground shaking and/or liquefaction resulted in damage to this transportation artery at multiple locations, slowing relief efforts, reconstruction, and regular commerce. The damage occurred generally due to two types of failures (GEER, 2010). The first was foundation soil failure at small water crossings. The major water crossings were engineered with well-designed bridges and abutments, but the lesser crossings were not addressed with the same engineering rigor and often failed, sometimes catastrophically,

taking out large sections of the four-lane highway. The second type of failure was small but ubiquitous seismic deformations of the engineered abutments throughout the affected region. In this case, a few centimeters of settlement of a bridge abutment in the approach to a bridge necessitated a slowing of traffic. This was observed at over 100 bridges. The failures were not catastrophic but nonetheless represented pervasive damage that was costly to fix because of the large number of bridges needing attention.

Displacement and Closure of Highway Overpass Following Chile Earthquake



Source: EERI, 2010b

Principles Identified:

- The interconnectedness/interdependence of lifelines can result in cascading or multiple service failures.
- Communication is often the most critical service during a disaster. Without it society cannot function.
- Major transportation corridors, because they cover large spatial areas, are susceptible to a range of failures which all result in diminished capacity.

3.2.6. JAPAN EARTHQUAKE AND TSUNAMI - NUCLEAR DISASTER

The 2011 magnitude 9.0 Tohoku Earthquake resulted in widespread devastation, primarily due to the ensuing tsunami. The Fukushima Nuclear Power Plant was designed both for strong ground shaking due to an earthquake and for tsunami flooding, but the level of armoring against a tsunami was inadequate in several areas.

The Fukushima Nuclear Power Plant was a substantial node in Japan's power system. The safe operation and shut down of the power plant required a constant supply of electricity through the connection to the grid. This can be termed an active system requiring constant input to function, versus a passive system that does not need constant input. The tsunami disrupted the grid and severed the supply of incoming electricity to the power plant. In the event of such a disruption, electricity was to be supplied by backup generators located on the site. Due to poor planning and design, these backup generators were inundated by the tsunami as well and were inoperable. With no viable redundancy in power supply, the power plant could not effect a safe cool down, and "meltdown" ensued.

Principles Identified:

- To have backup systems function as true redundant systems, the design must ensure that they are not subject to the same loading as the primary systems.
- Critical nodes that require active input are not reliable when that input is severed. A passive system, in this case a nuclear power plant that can cool down without being connected to the grid, presents a more reliable node.

3.2.7. HURRICANE SANDY - GAS SHORTAGE

In 2012, Hurricane Sandy battered the East Coast of the U.S., causing widespread flooding, wind damage, and related storm damage. Because of the widespread damage, many lifeline systems were affected to a greater or lesser extent.

The electric grid went down mainly due to widely distributed damage to lines and substations. More than three weeks after the hurricane, there remained a persistent gasoline shortage that hindered recovery efforts and contributed to a lingering delay in people resuming daily life operations (Sandalow, 2012). The dearth in gasoline was primarily due to an interconnected systems problem. Gasoline in the greater New York area is brought in mainly through the ports. These tankers were able to reach the ports quickly after the hurricane but could not unload the gasoline because there was no electricity to run the pumps. The lack of electricity hindered gasoline distribution at many levels along the supply chain.

Principles Identified:

- **Interdependence** of electricity and gasoline distribution was highlighted in this disaster. Simple redundant measures (e.g., manual pumps) could have alleviated some of the electricity-caused gasoline shortage.

3.2.8. MISSISSIPPI BRIDGE AND OROVILLE DAM FAILURES – SERVICE LIFE AND AGING INFRASTRUCTURE

In 2007 the I-35W Mississippi River Bridge suddenly collapsed during rush hour on August 1. This failure resulted in 13 deaths and 145 injuries. This bridge was designed and built in the 60's, coming into service in 1967. It provided 40 years of service and handled up to 140,000 vehicles daily prior to collapse. The National Transportation Safety Board (NTSB) investigation cited causes of failure due to undersized gusset plates, excessive load from added concrete of road resurfacing, and excessive load from traffic at the weakest point at the time of failure. The poor initial design was exacerbated by the fatigue and wear the bridge experienced over 40 years.

In February of 2017 the Oroville Dam experienced a failure of its main spillway and emergency spillway under high-flow release conditions leading to the evacuation of 180,000 people living downstream in the Feather River watershed. There was no subsequent catastrophic release but the spillways did not function as intended resulting in the emergency situation. The Dam was completed in 1968 and is the tallest earth dam in the US with a height of 750 feet. Oroville Dam is part of the California State Water Project and functions as a flood control, provides water storage, and produces hydroelectric power.

During the winter of 2016-2017 heavy snowfall and precipitation quickly filled the reservoir and operators began using the main spillway for a release ahead of further anticipated inflow. Severe erosion of a portion of the main spillway became evident and after several tests the choice was made to allow the reservoir to fill and release through the emergency spillway. Severe erosion of the unlined emergency spillway occurred rapidly and the flow was directed back to the main spillway with further erosion expected. Eroded debris from the main spillway blocked the river and forced the closure of the hydroelectric facility thereby further limiting the means of releasing from the reservoir. Fortunately, inflows to the reservoir decreased and the operators were able to bring the situation under control. This dam provided almost 50 years of service with minor maintenance and safety issues until this compound failure of the main and emergency spillways. Investigations are ongoing but some possible culprits are; undersized main spillway, incomplete design of the emergency spillway, poor construction of the main spillway, misdirected maintenance of the main spillway, and others.

Principles Identified:

- Aging of infrastructure is often not considered until a failure occurs. And when these "old age" failures occur they can be catastrophic.
- Prior code-based designs may not be sufficient for aging infrastructure.
- Backup components (e.g., emergency spillways) should be functional in a crisis and not subject to the same weaknesses as the main components.

3.3. LIFELINES AND SYSTEMS CONCEPTS

The case examples begin to highlight key system concepts that are important when assessing lifelines and weighing mitigation options. A key defining characteristic of a lifeline is the system structure. Lifelines are often:

- Series, a single component failure results in total system failure
- Parallel, each component has a redundant counterpart, such that when one fails, the other maintains the system function
- General, a system with sections that are series, and sections that are parallel.

In addition to the structure, other concepts are important to understand lifeline risk. These additional concepts include:

- Correlation
- Interdependence
- Capacity
- Aging

Using these concepts with knowledge about a lifeline system and natural hazards, stakeholders can study lifeline risk. A simple decision tree example offers a common analytical method to study lifeline system risk. All these concepts are discussed below.

3.3.1. TYPES OF SYSTEMS

Series Systems

Most lifelines are arranged in what can be called series systems. If visualized as a chain, the lifeline fails when any single "link" in the chain fails (see Annex Diagram 3.C). This chain analogy represents a functional definition of a series or non-redundant system. Examples of series systems include:

- A transportation corridor where the failure of any bridge or highway section results in the closure of that corridor
- A gas main where a rupture anywhere along its length results in disruption of gas delivery
- A levee system where a single breach results in flooding on the protected side of the levee
- An electricity grid that is down because a substation component has failed
- A water canal where a fault has rupture through the canal section thereby ceasing all flow downstream

Annex Diagram 3.C: A Series System When All Nodes and Links are Performing (Left) and When Failure of a Single Component Results in a System Wide Failure (Right)



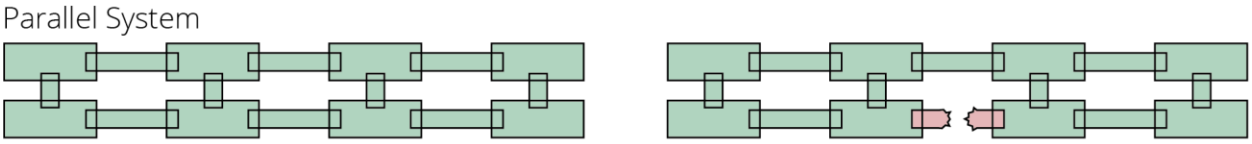
Source: Cal Poly SHMP Support Team

Parallel Systems

Some systems have redundancy and are called parallel systems. Parallel systems can be conceptualized as a set of series systems where each series component must fail to realize system failure (see Annex Diagram 3.D). One key to having serviceable and functioning lifelines during or after a disaster is to build redundancy into the system. But, as seen in the case histories, ensuring redundancy is often difficult, even when the adverse loading conditions can be anticipated. Examples of parallel systems include:

- A local water system that has access to stored water in a reservoir, groundwater basin, and an intertie to a neighboring jurisdiction.
- A transportation corridor that is serviced by highway, rail, and ferry services
- A fuel system that is serviced by multiple refineries is able to produce sufficient fuel when one refinery is shut-down.

Annex Diagram 3.D: A Parallel System That Has Two Components Performing the Same Function (Left), Allowing the System to Continue Functioning Along the Redundant Component When a Single Component Fails (Right)

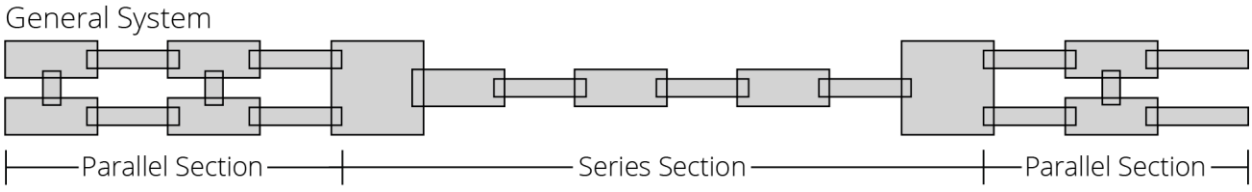


Source: Cal Poly SHMP Support Team

General Systems

Systems that have a combination of both series and parallel components are called general systems (see Annex Diagram 3.E). General systems can be analytically modeled (e.g., Song and Der Kiureghian, 2010), but the difficulty in accurately mapping the complexity of general systems and, more importantly, the difficulty in properly accounting for the component correlation can make modeling difficult. Starting with the simplest model that captures the key components will provide a basis for understanding the system. The model complexity can be increased to provide a more refined risk assessment. If the risk does not change significantly with increased complexity, then the simpler model accurately captures the key components. It is important to note that at larger scales most lifelines are general systems with series and parallel sections (see Annex Diagram 3.E).

Annex Diagram 3.E: A General System with a Series Section and Two Parallel Sections.



Source: Cal Poly SHMP Support Team

3.3.2. ADDITIONAL CONCEPTS

Other concepts beyond system structure influence overall lifeline performance. Within systems there can be many components, the links and nodes. These components can be interconnected or interrelated in various ways. This dependence between components is commonly termed correlation. Correlation can be seen in how multiple components resist adverse loading (e.g., the components all have a similar design or construction) and also in how the loading is applied across components (e.g., the loading consistently affects a large spatial area across numerous components). In a series system, the higher the correlated resistance is across components the more reliable the

system can be (Moss and Hollenback, 2015). On the other hand, the more components a series system has, the more likely the system is to fail. And if the system does fail, because of the correlation, interruption and downtime is likely to be longer.

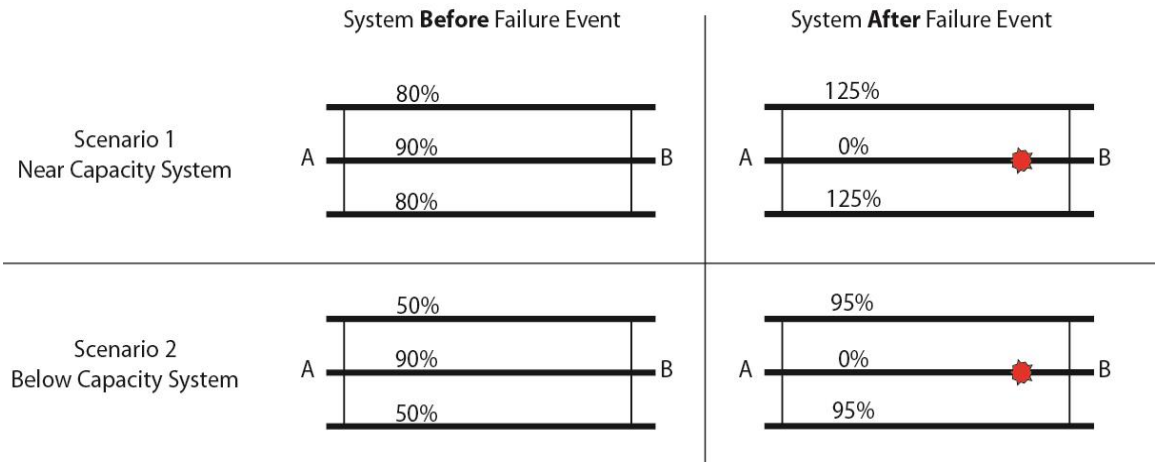
This discussion can be expanded to include interdependent/interrelated systems such as those highlighted in some of the case examples:

- A gasoline distribution system that is crimped by loss of electricity or transportation corridors
- A water distribution system that is down because of loss of electricity
- A communication system that is down due to severed land lines and loss of electricity
- A water system that is non-operational because a failed levee system has compromised the flow of fresh water

Analytical modeling of interconnected systems can be accomplished in some detail, but often a qualitative assessment is sufficient to determine the relative risk. The key in analyzing interconnected systems, either quantitatively or qualitatively, is in properly assessing the interdependence and redundancy.

The consequences of a system failure can be influenced by how near its capacity the system is functioning on a day-to-day basis. Take for example a network of interconnected roads that provide access from point A to point B and other points. This system can be considered a general system as there may be roads that are parallel and there may be interchanges that are in series. If this system is performing at or near capacity prior to some adverse loading situation, even a failure of a redundant component can result in system failure such as gridlock. If this system is running far below capacity, however, there is inherent resilience in the system to absorb some component failure and continue to function (See Annex Diagram 3.F). This relationship of system capacity to consequences adds a layer of complexity to systems analysis, making proper assessment of risk and reliability tricky.

Annex Diagram 3.F: Aerial View of Road System Operating Near and Below Capacity Before and After Failure Events

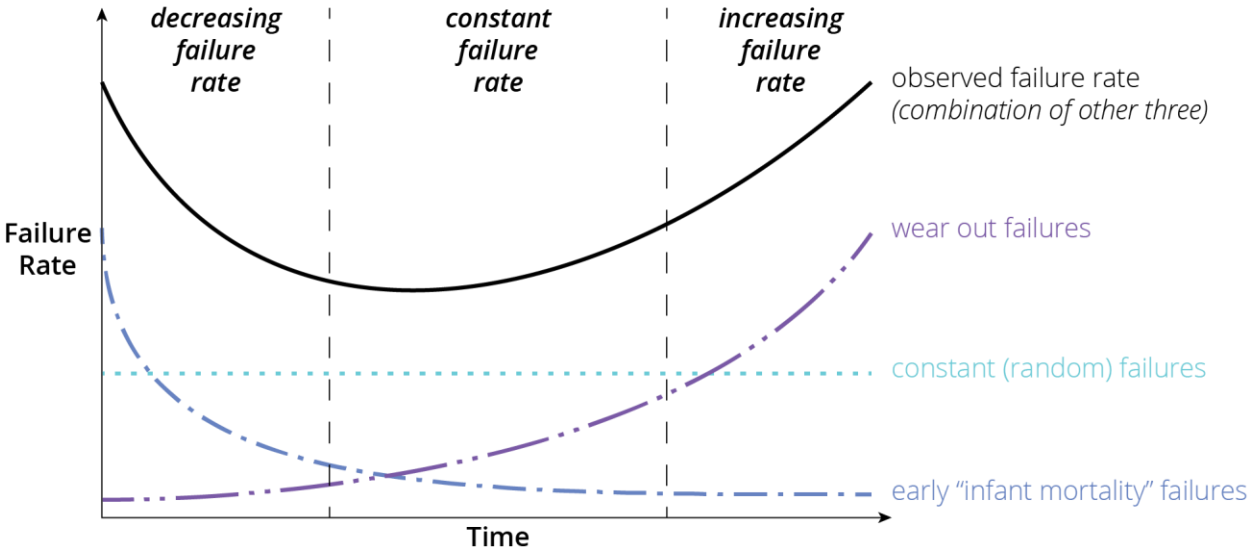


Source: Cal Poly SHMP Support Team

Engineered systems have functional lifespans during which they perform as intended, but beyond which they may not. In general, the engineering profession doesn't have sufficient understanding of how civil engineering materials change with time, and aging is not factored into long-term performance. Overdesign for aging is often not financial feasible for big infrastructure projects. Improvements in design and code requirements often do not impact existing infrastructure unless they are egregiously out of compliance and failure is imminent.

Failure of civil infrastructure generally follow the "bathtub" model of life expectancy. If there are flaws in design and construction, then "infant mortality" will result in early failure. If they make it past the initial phase then old age or "senescence" is often when failure occurs (see Annex Diagram 3.G). Most major lifelines in service today are "middle aged" and planning for aging and wear out failures should be part of the planning discussion.

Annex Diagram 3.G: Failure of Infrastructure as a Function of Time



Source: Cal Poly SHMP Support Team

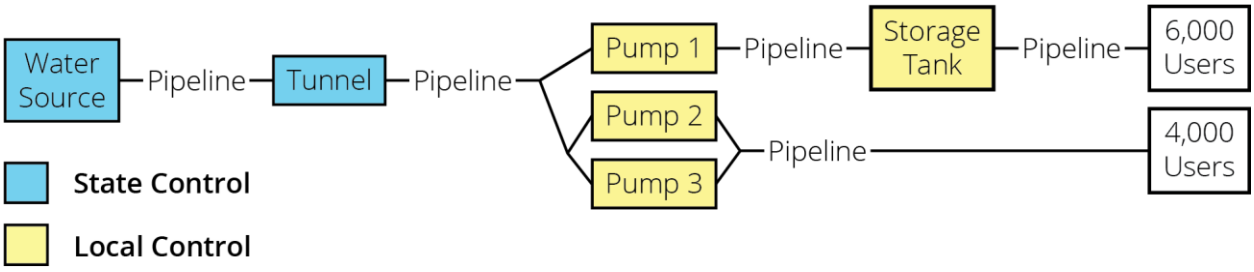
3.3.3. USING "DECISION TREES": A FICTIONAL EXAMPLE

An intuitive means of assessing system reliability is by using what is known as a "decision tree" to identify each failure scenario that exceeds a certain level of consequences. Each branch of the horizontal "tree" represents a separate scenario (see Annex Diagrams 3.H and 3.I). This allows for the capture of different scale systems failures, interconnected system failure, correlation of component resistance and load, and other unique characteristics of a system that can lead to failure.

The best means of describing a decision tree is by example, and the following example uses a water distribution system to illustrate. The fictional City Water Lifeline is controlled by a water distribution system at two scales: state and local. The city does not have direct control over the state delivery of water but must estimate the risk of the upstream water distribution problems at that scale. The probability of failure information at the state level could be based on a multi-hazard assessment produced by the state, while a local assessment could provide necessary information about locally controlled components.

In this example, the state controls the water source and a tunnel that provide water to the city. The city has direct control over the two primary pumps (Pumps 1 and 2), one backup pump (Pump 3), and a water tank. Pump 1 pushes water into a tank, and the time users will be without water is a function of how full the tank is when the pump breaks. The city installed a redundant pump (Pump 3) to supplement Pump 2 because the water service to those users (hospital, etc.) was deemed critical. The redundant pump may not be independent, however, and may be damaged in the same event as Pump 2.

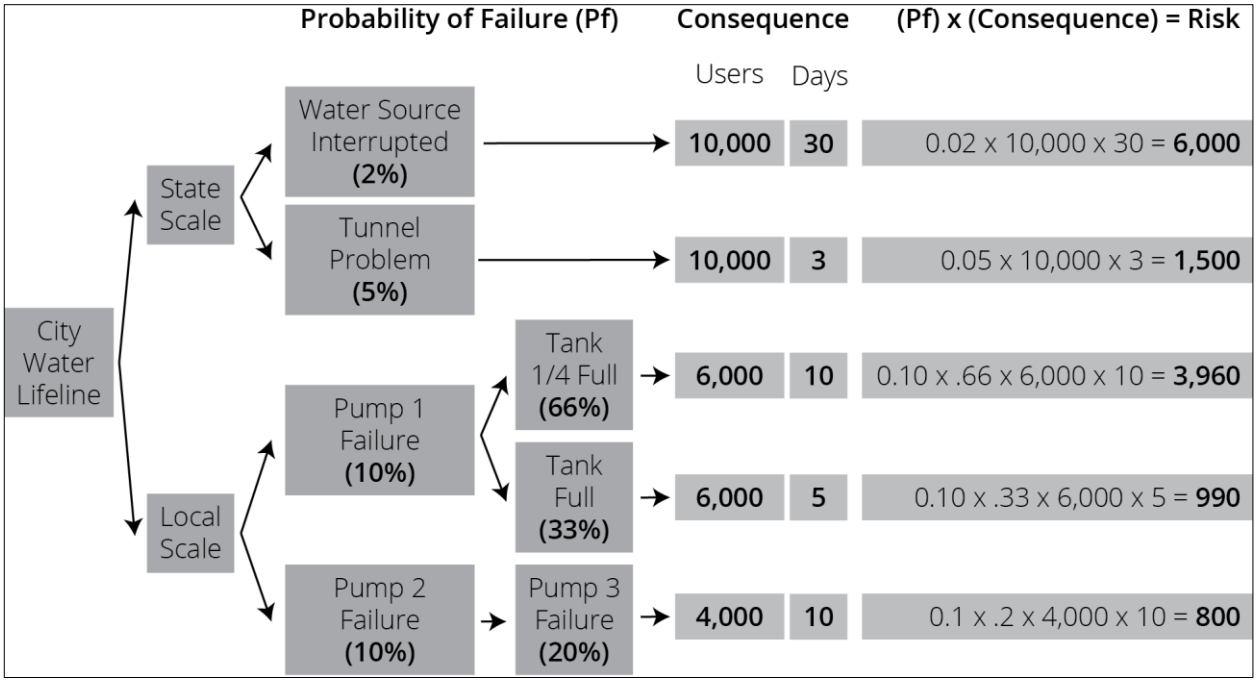
Annex Diagram 3.H: Conceptual Diagram of Fictional Water System



Source: Cal Poly SHMP Support Team

Consequences are assessed as the disruption of water to the number of users in the city and the number of days those users would be without water. Risk is the product of the probability of failure and the consequences assumed, in this case the number of users and the days those users are without water. As shown in Annex Diagram 3.H, the resulting risk values (here the probability-weighted user days) are a metric for ranking the potential failure scenarios to aid in the decision process of which hazard to address first.

Annex Diagram 3.I: Fault tree for fictional water system

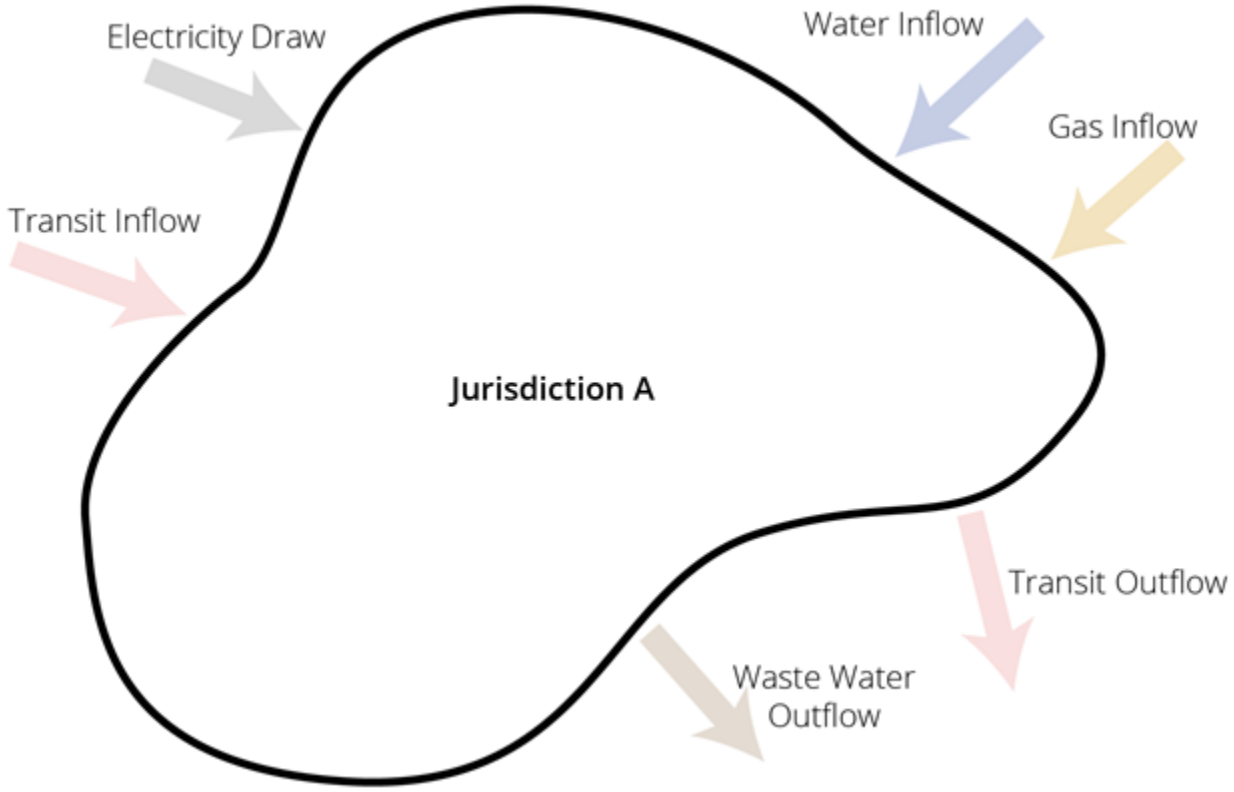


Source: Cal Poly SHMP Support Team

Based on the fictional example, the biggest concern for the city is the water source reliability at the state scale, mainly because the time to repair and return service is so long and all residents would be affected. This would be the obvious choice of where to start mitigating hazards on the existing water system. The probability of failure of this particular link could be explored further to determine which hazard is driving the risk and how best to mitigate the risk through redundancy, backup, or other means. At the local level, the most appropriate mitigation strategy may be the installation of a backup pump for Pump 1 or increase the tank capacity.

Local jurisdictions often control distribution systems but rely on statewide or regional systems (e.g., aqueducts, highways, transmission lines, etc.) to provide transmission level resources. The probability of lifeline outages is a summation of failures both inside and outside their local jurisdictions. Single jurisdictions are typically unable to effectively mitigate risk as they do not have control over risk outside their boundaries, or a separate special district or private utility may operate the local system. This concept is shown in Diagram 3.J, where a jurisdiction has mapped lifeline systems upstream and downstream that could impact reliability of service within the jurisdiction.

Annex Diagram 3.J: Lifeline Failures for Single Jurisdictions: A Combination of Local Failures and Failures of Upstream Systems



Source: Cal Poly SHMP Support Team

The multi-jurisdictional nature of lifelines and their many stakeholders can make them difficult to improve. The probability of lifeline outages is a summation of failures both inside and outside their local jurisdictions. Single jurisdictions are typically unable to effectively mitigate risk as they do not have control over risk outside their boundaries, or a separate special district or private utility may operate the local system. Potential impacts should be viewed both internally (local/regional) and externally (regional/state/federal).

This simplistic fictional example provides a decision tree for deconstructing a complex system so that a rough risk assessment can be performed. The quality of the risk assessment is a function of the structure of the decision tree, the probability of failure analyses for each branch of the tree, and the estimates of the consequences. These can always be improved upon with increasingly finer detail. The most important aspect of the risk assessment is documenting the relative risk between branches of the fault tree to aid in the mitigation decision process.

3.4. PATH FORWARD FOR LIFELINE RESILIENCE

Past failures of lifeline infrastructure and their cascading impacts provide the motivation to mitigate and reduce risk. The principles highlighted by the case studies and the key concepts of lifeline systems provide a framework to study systems.

For lifeline owners and operators, a successful approach to lifeline resilience requires:

1. Assessing hazard impacts on the system and the consequence for system users,
2. Developing an understanding of the system interdependencies and develop a common operating picture of impacts and consequences for other systems,
3. Determining if the risk is acceptable and determine what level of mitigation should be invested in to improve the performance,
4. Choosing a mitigation strategy to address unacceptable risks.

The first phase (described in *Annex Section 3.4.1*) is technical and is a function of quality data, and analytical methods. The second phase (described in *Annex Section 3.4.2*) requires cooperation and collaboration among many stakeholders to agree to share information among one-another. To date, this has been a sticking point for many efforts. *Annex Section 3.4.3* describes a new platform to facilitate these conversations among various stakeholders. The final phase (described in *Annex Section 3.4.4*) is political and requires a discussion of tradeoffs among decision-makers for lifeline operators.

3.4.1. ASSESSING LIFELINE SYSTEM RISK

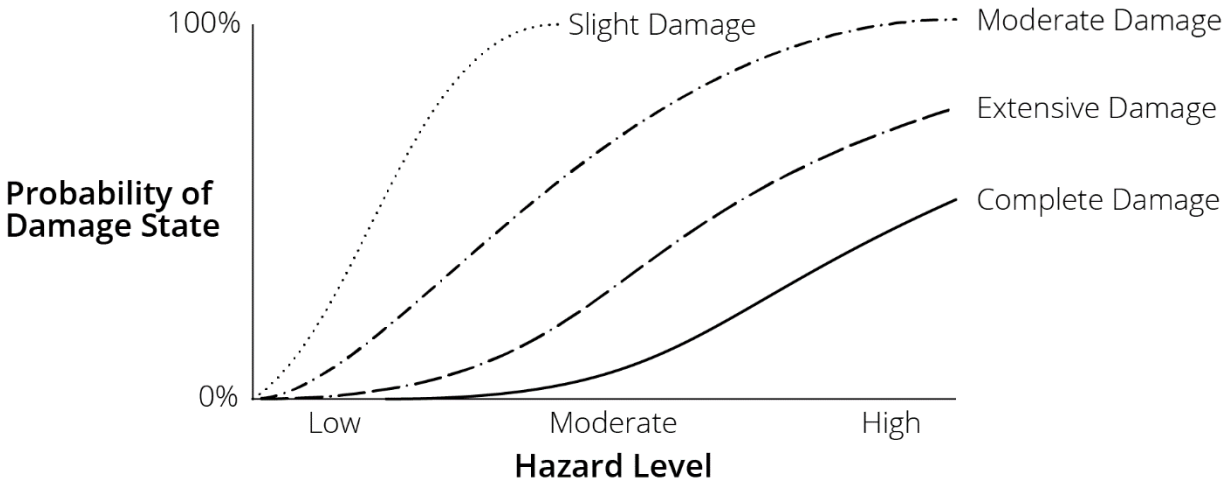
Lifeline assessments rely on quality data on the system, quality data on the hazards, and knowledge about the fragility of system components to different hazard conditions. After collecting these elements, a variety of tools, models, and analytical methods can be applied to characterize and assess the lifeline system risk.

System data quality varies widely between lifeline system operators. Some operators have Geographic Information System (GIS) mapping data for every element of their system with attribute information about the location, age, material, size, current condition, and other defining characteristics. Many operators have this information only on their largest components, but may not have it for smaller ones. Other low-resource system operators have very limited information about their system in an organized data management system.

Many valuable hazard mapping resources are available from state and federal agencies. For regions within the state there may be more granular, higher quality data to supplement maps available from federal and state agencies. The USGS, NOAA, and FEMA all offer a number of valuable hazard maps online, some of which map climate impacts, such as sea-level rise. Cal OES, CEC, OPR, CGS, CAL FIRE, and others offer internet mapping tools for hazards and climate-related impacts at the state level.

Most analyses are best supported by a GIS mapping system to pair lifeline system components with their respective hazard data. Using risk assessment literature, a fragility curve (illustrated in Annex Diagram 3.K) can be applied to system components to understand likely performance under adverse hazard loading. For specialized components, this may be more difficult to come by. A system-based approach will include concepts discussed in *Section 3.3* of this Annex. To best understand system performance, which is important for lifelines, the analysis must capture how the whole system will perform. This requires knowledge about each component, and also requires an understanding of which sections of a system are in series, and which portions are in parallel. Accounting for correlation between components and between hazard loading conditions will also increase the quality of the results.

Annex Diagram 3.K: Generic Fragility Curve Shows the Probability of Different Damage States at a Given Level of Hazard



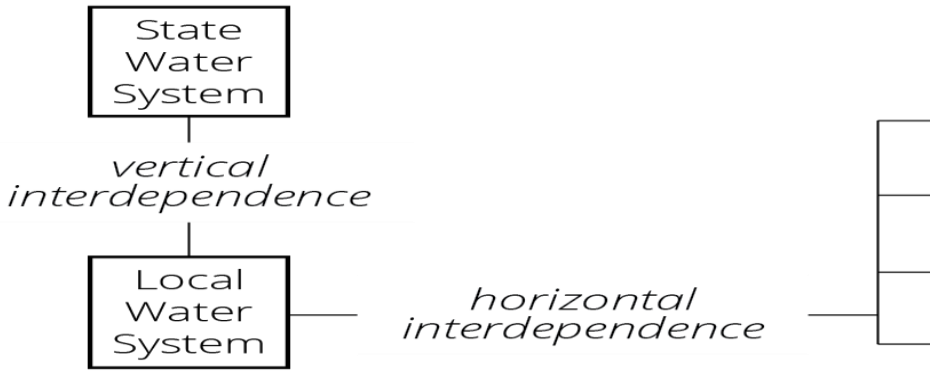
Source: Cal Poly SHMP Support Team

For lifeline system operators, having an understanding of the overall likelihood of damage of the system is a valuable first piece of information. Taking this information and developing outage scenarios that explore outage across time and geographies is necessary to properly study the full set of consequences. The consequences should not be limited to the lifeline operator, but should include societal impacts. Case histories of similar outages in past disasters can provide an understanding of outage impacts on other lifelines, businesses, and residents. Additionally, economists can be included in the analysis to better understand the impacts.

3.4.2. UNDERSTANDING OTHER SYSTEMS AND INTERDEPENDENCIES

Annex Section 3.4.1 explores the risk for an individual system in isolation but does not yet consider the potential for interdependencies between systems. Interdependencies can be categorized as vertical and horizontal – ideally both can be understood and incorporated into the overall assessment. Diagram 3.L uses a hypothetical local water system to illustrate vertical and horizontal interdependencies.

Annex Diagram 3.L: Lifeline Systems can have vertical (same system type) interdependencies, and horizontal (different system) interdependencies



Source: Cal Poly SHMP Support Team

Vertical interdependencies exist between like systems where there are varying phases of the system. For example, most water systems in California rely on multiple entities to operate a phase of the system. Many local water distributors that deliver water to homes and businesses only operate local pipelines, treatment facilities, and storage assets. These local distributors purchase water from regional, and or state systems that are owned and operated by completely different entities that provide water resources to the local distributor from a separate system.

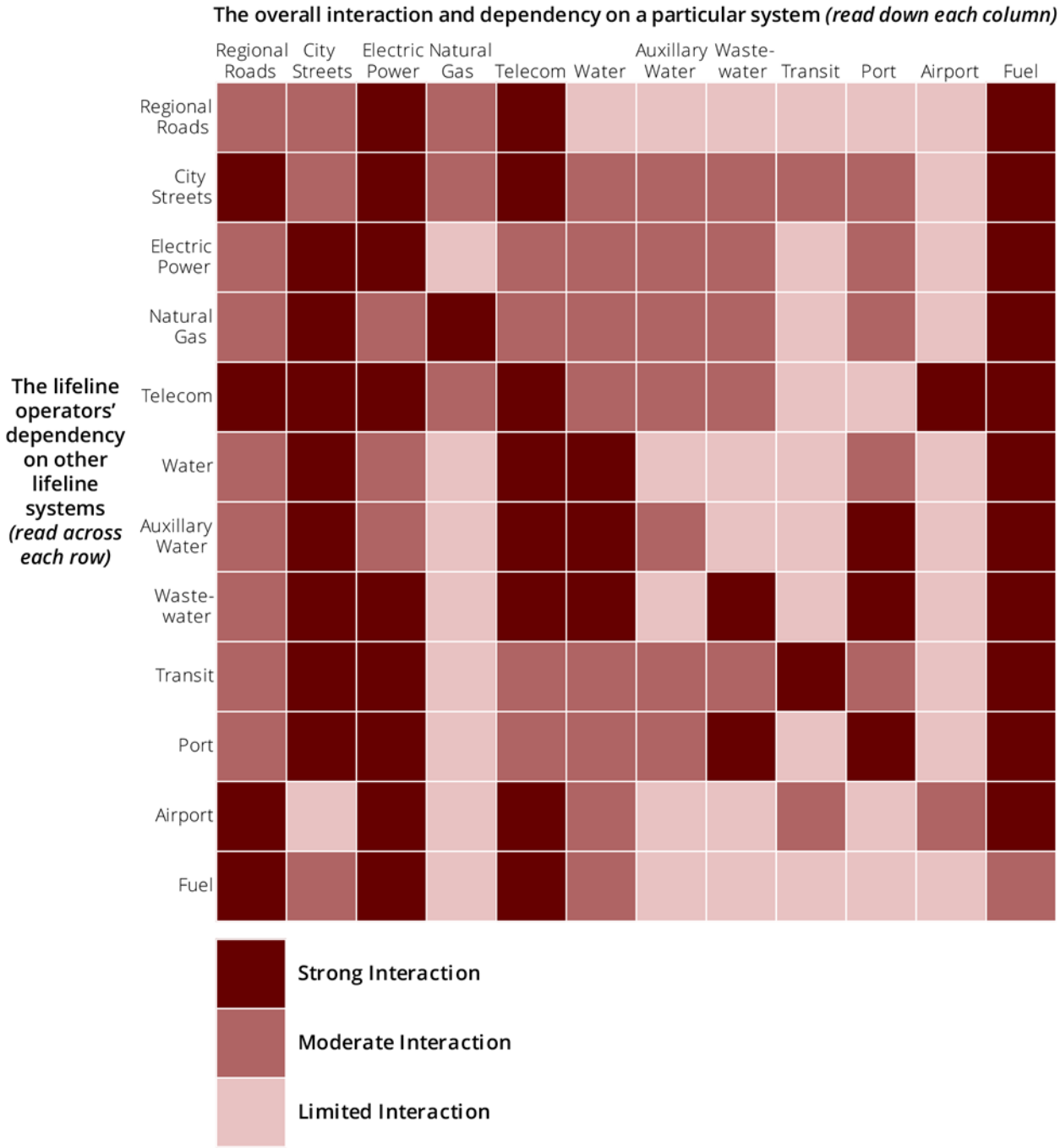
To develop a complete risk profile, it is important to understand the vertical interaction. As shown *in Annex Section 3.3.2*, an upstream system failure often has direct and sometimes immediate downstream impacts. Vertical dependencies are not unique to water. Electrical systems can have different entities that operate power generation, transmission, and distribution. It is critical for lifeline operators to trace systems back to the source and understand who else owns and operates reliant infrastructure. Having access to assessments completed by "upstream" system owners are invaluable for "downstream" systems interested in understanding their risk.

Horizontal interdependencies exist between different systems. For example, communication systems are directly reliant on the electric system to function. Following a disruptive event, communication systems that are undamaged may be unable to provide service if there is an electric outage. These interdependencies have been well studied. For most jurisdictions, there tend to be typical generic interdependencies among systems regardless of location in the state, although some conditions may vary from region to region. These interdependencies are also likely to change over time. As transportation mobility platforms electrify, the reliance on liquid fuel may be lessened, while the reliance on electricity may increase.

The City and County of San Francisco, as part of their Lifeline Council (discussed in *Annex Section 3.4.3*) produced an interdependencies matrix (see Annex Diagram 3.M) after interviewing lifeline operators within the County. The graphic illustrates strength of interaction between key lifeline systems.

To accurately assess an individual system that is interdependent on other systems requires other partners willing to share assessments and outage estimates for their systems. If partners are willing to share, this information can be incorporated into models to further estimate the impact a hazard may have on a system. This is especially powerful for a set of systems that agree on a common hazard scenario for their risk assessment.

Annex Diagram 3.M: An interdependencies matrix for major lifeline systems within the City and County of San Francisco (produced by the San Francisco Lifelines Council)



Source: San Francisco Lifelines Council, Lifelines Interdependency Study Report, April 17, 2014; https://sfgov.org/orr/sites/default/files/documents/Lifelines%20Council%20Interdependency%20Study.pdf

3.4.3. INFORMATION SHARING AND COORDINATION: LIFELINES COUNCIL AND CRITICAL LIFELINES WORKGROUP

The multi-jurisdictional and multi-stakeholder nature of lifelines can make understanding others' systems difficult, and limit the completeness of each entities assessment. To address this challenge, two groups, one in Southern California and one in San Francisco have developed platforms to share information among lifeline system operators to build a common operating picture. In both areas, stakeholder have set up initiatives (a workgroup in Southern California and a council in San Francisco), which hold quarterly meetings with senior managers in government (local, regional, state, federal) and utilities (public, special district, private) to share and discuss issues of lifeline resilience.

The efforts of both initiatives tend to focus on understanding the potential for, and consequence of, lifeline system interruption, and are aimed at understanding how natural hazards (earthquakes, fire, sea-level rise, etc.) could impact services. The stated goals of the initiatives are to share information about recovery plans, projects, and priorities; understand inter-system dependencies to enhance planning, restoration and reconstruction; and coordinate critical lifeline utility resilience efforts between public, private sector, and independent stakeholders.

To date, both initiatives have passed significant milestones. The Southern California Critical Lifelines Workgroup was involved in the Resilient Grid IV exercise which brought together stakeholders to practice emergency management procedures. A focus of the exercise was to determine how to share information among different stakeholders, test procedures for private lifeline operators to connect with local and state government, and to practice multi-agency priority setting to allocate resources and focus restoration efforts.

In 2014, the San Francisco Lifelines Council commissioned a Lifelines Interdependency Study which examined the interdependencies between different lifeline systems operating within the city and explored impacts in a magnitude 7.9 San Andreas earthquake. The report produced from the study provided the City with a workable understanding of key interdependency issues summarized in an interdependencies matrix (see Annex Diagram 3.M). The report summarized findings including recommended priorities and also offered potential courses of action for specific identified vulnerability issues.

For example, the report highlighted the vulnerability and consequence of the San Francisco seawall. The seawall which is vulnerable to seismic forces and increasingly sea-level rise impacts interacts with multiple local and regional transportation systems, major telecommunication systems, and electrical infrastructure. As a result of the report's identification of these multi-system vulnerabilities along the seawall, the City and County of San Francisco have made capital funding investment for the seawall a top priority.

The Lifelines Council and Critical Lifelines Workgroup are examples of collaboration and sharing among lifeline operators, which allows for more complete and informed lifeline assessments that account for interdependencies.

3.4.4. LIFELINE MITIGATION

After going through an assessment process, operators have information to explore mitigation opportunities that reduce direct losses in damage to their system, or in indirect losses to those that rely on their services. This process often requires action by decision makers, and in the case of some public systems can be driven by local or state ballot initiatives. Lifeline mitigation is often accomplished by:

1. Improving the lifeline provider's ability to restore services by making the system:

- Robust (retrofit and construct lifeline systems to a higher level to resist hazard forces, thereby decreasing the likelihood of failure)
- Repairable (accept that damage may occur but have quick repair strategies or temporary elements to provide limited services quickly after a disaster)
- Redundant (construct or develop a secondary system that can provide full or partial service while repairs to damaged components are made)

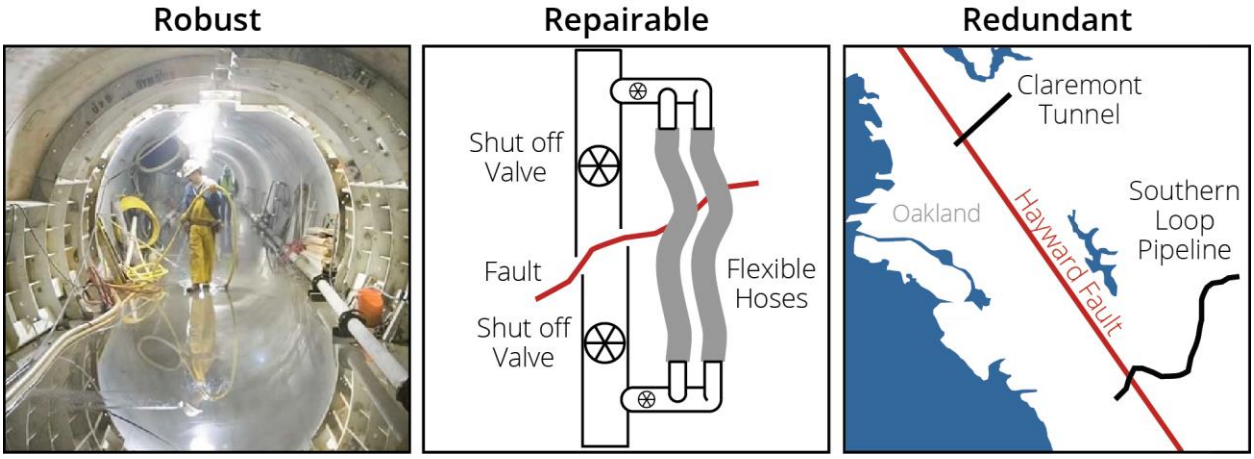
2. Improving the user's ability to function without lifeline services, by offering interim services:
- Of a sufficient quantity
- Of a sufficient quality
- Within a sufficient distance

Hazard mitigation is, to a considerable extent, a problem-specific process. Important details include not only the actual physical hazard and lifelines at risk but also the time-dependent political and social climate that exists around the hazard and risk. The following are selected examples that illustrate such specifics.

East Bay Municipal Utility District Seismic Improvement Program

In 1994, more than 90 percent of East Bay Municipal Utility District (EBMUD) customers supported a $189 million Seismic Improvement Program to strengthen the water system against major earthquakes (ABAG, 1998). The communities reliant on EBMUD water experienced brief outages in the 1989 Loma Prieta Earthquake and were affected by the 1991 Oakland Hills Fire that killed 29 people and burned over 3,000 homes (Eidinger, 2004). Residents were receptive to rate increases to improve the performance of their water systems. Since that time, EBMUD has completed two major projects to greatly improve system robustness. The first was a seismic strengthening of the Claremont Tunnel, which crosses the Hayward Fault underground. The $38 million tunnel is designed to function following a Hayward Fault earthquake despite a fault displacement upward of 2.5 meters (Diagram 3.N). The upgrade increased the robustness of the tunnel section. EBMUD also constructed a parallel water transmission bypass that crosses the fault at another location. The southern loop pipeline adds redundancy to the water transmission system (EBMUD, 2012). Finally, at the southern loop pipeline location, and at other areas where key pipelines cross the fault, EBMUD added valves on either side of the fault that would allow for the likely broken section to quickly be bypassed by temporary sections of pipe.

Annex Diagram 3.N: EBMUD's use of Robust, Repairable, and Redundant Lifeline Mitigation Framework



City of Berkeley Aboveground Water Supply System

In 2000, the City of Berkeley spent $9.6 million to develop an aboveground water supply system. The City was concerned that a future earthquake may simultaneously result in many fire ignitions (caused by electrical sparks and gas line breaks) as well as significant failures to the underground water fire suppression system (caused by ground failures). Concerned that fires could cause widespread damage following a future earthquake the City invested in the new aboveground water supply system. The aboveground system has vehicles lay flexible hose (Diagram 3.O) at 25mph from a water source to the fire. The system hooks up to either functioning water mains or portable pumps stationed at the wharf or a reservoir. The system reduces reliance on the underground system, which is vulnerable to liquefaction failures. While the underground system may have serious failures, aboveground water supply system

is designed to provide the Berkeley Fire Department with water to fight fires following an earthquake. The aboveground system is fairly independent and is not impacted to the same degree under the same disaster loading conditions as the underground one.

Demonstration of Berkeley Aboveground Water Supply System Deployment



Devil's Slide Tunnels

Devil's Slide between Pacifica and Half Moon Bay is a geologically unstable section along State Route 1. Landslides and rockfalls caused frequent road closures, resulting in large detours and economic losses for the communities north and south of Devil's Slide. In 1995, the road was closed for five months for $3 million in repairs. In 2006, the road was again closed for four months for $7 million in repairs. In March 2013, Caltrans completed two 4,200-feet-long tunnels that bypass the unstable section of Devil's Slide. By rerouting a portion of Route 1 inward, one of the most vulnerable sections was mitigated, increasing the likelihood that the route between Half Moon bay and Pacifica will be open in future rainy seasons.

For more information about the Devil's Slide Tunnels, see *Chapter 6, Section 6.2.4*.

Christchurch, New Zealand Temporary Water and Wastewater Service

In Christchurch, New Zealand, the community was able to withstand long outages of their water and wastewater systems by providing an interim service of sufficient quality and quantity within a sufficient distance. Portable toilets were placed on every block and portable showers were placed at community hubs while water and sewage systems were repaired (Diagram 3.O). The recovery strategy was successful in bridging the gap between the event and the restoration of the lifeline system, allowing individuals to stay in their homes with an acceptable level of interim service. In large events where the main system will require weeks or months to repair, service providers and governments should consider interim strategies that achieve an acceptable quantity and quality of service within a reasonable distance.

Community Shower Stations That Helped People Stay in Minimally Damaged Homes in Neighborhoods Where Water Lines and Other Infrastructure Were Damaged by Earthquake in Christchurch, New Zealand



Source: EERI, 2011

3.5. SUMMARY

For society to function properly lifelines must be operational, particularly after the various disasters that are integral part of living in California.

The primary goal of this annex is to steer the thinking about lifelines to encompass the concepts and tools of engineered systems. This includes:

- Evaluating the multi-scale aspects of lifelines,
- Considering correlation among system components (nodes and links),
- Identifying interconnectedness/interdependence of different lifelines;
- Overlaying multiple hazards on lifelines,
- Identifying real versus perceived redundancy within a system, and
- Assessing existing system capacity prior to disaster.

To improve overall lifelines resilience, lifeline operators and governments are encouraged to analyze their system risk to natural hazards, develop a common operating picture with interdependent systems, and consider a suite of mitigation options in addressing unacceptable risks.

3.6. RESOURCES

3.6.1. INFORMATION SOURCES

Antenna Search is a mapping system that has a large amount of antennas and communication towers mapped around any designated four-mile radius. (http://www.antennasearch.com/)

The California Department of Transportation has GIS layers for California highways and major roadways. (http://www.dot.ca.gov/hq/tsip/gis/datalibrary/gisdatalibrary.html)

The California Geological Survey (CGS) provides interactive California maps and other tools for identifying geologic hazards specific to the state. (http://www.conservation.ca.gov/CGS/)

Hazus has a database of infrastructure and hazard overlays that can be used for coarse first assessment of lifelines risk. The lifelines mapped in Hazus should be checked and verified before proceeding with analysis. (http://www.fema.gov/hazus)

Many local utility providers have their systems mapped in GIS and may be willing to share the information.

MyPlan has multiple hazard GIS layers that can be downloaded. The program also has population layers that may be helpful in understanding consequences. (http://myplan.calema.ca.gov/)

The National Pipeline Mapping System has GIS maps of gas and fuel transmission pipelines by county. (https://www.npms.phmsa.dot.gov/)

The United States Geological Survey (USGS) provides comprehensive maps and other tools for identifying all geologic hazards in the U.S. (http://www.usgs.gov/natural_hazards/)

3.6.2. REFERENCES USED IN THIS ANNEX

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APPENDIX A – 2018 STATE HAZARD MITIGATION TEAM ROSTER OF AGENCIES AND STAKEHOLDER ORGANIZATIONS

AECOM National Governments
Alameda County Office of Emergency Services
Alpine County Operational Area Inland Region IV
Air Resources Control Board (ARB)
Amador County Operational Area Inland Region IV
American Planning Association California Chapter
American Red Cross (Sacramento Chapter)
Association of Bay Area Governments
Association of Contingency Planners
Association of Environmental Professionals
Burbank Fire Corps
Business and Industry Council for Emergency Planning & Preparedness (BICEPP)
Business, Consumer Services, and Housing Agency
Business Executives for National Security (BENS)
Business Recovery Managers Association
Butte County Operational Area Inland Region III
California Adaptation Forum
California Association of Councils of Governments
Cahuilla Band of Indians
California Board of Forestry and Fire Protection
Calaveras Council of Governments
California Coastal Commission
California Conservation Corps
California Community Colleges
California Department of Community Services and Development
California Department of Conservation
California Department of Corrections and Rehabilitation
California Department of Education
California Department of Food and Agriculture
California Department of Forestry and Fire Protection (CALFIRE)
California Department of General Services
California Department of Housing and Community Development
California Department of Insurance
California Department of Public Health
California Department of Public Health, Environmental Health Tracking
California Department of Social Services
California Department of Technology Services
California Department of Transportation
California Department of Water Resources
California Earthquake Authority
California Emergency Services Association (CESA) – Sutter County
California Emergency Commission
California Energy Commission
California Environmental Protection Agency (CalEPA)
California Fire Safe Council
California Geological Survey
California Highway Patrol
California Military Department
California Natural Resources Agency

CalRecycle
California Ocean Protection Council/Coastal and Ocean (CAT)
California Ocean Science Trust
California Governor's Office of Emergency Services
California Public Utilities Commission
California Resiliency Alliance
California Polytechnic State University, San Luis Obispo
California Seismic Safety Commission
California Secretary of State- California State Archives
California State Archives
California State Association of Counties (CSAC)
California State Coastal Conservancy
California State Lands Commission
California State Parks
California State University System (CSU)
California State University, Office of the Chancellor
California Utilities Emergency Association (CUEA)
California Volunteers
Cambria Community Services District Fire Department
Cathedral City Fire Department
Central Valley Flood Protection Board (CVFPB) - Office of the Chief
Central Valley Regional Water Quality Control Board
Chemehuevi Indian Tribe
Chino Valley Fire District
Chula Vista Elementary School District
City of Aliso Viejo
City of Anaheim
City of Angels Camp
City of Bellflower
City of Big Bear Lake
City of Buena Park
City of Cerritos
City of Chino, Police Department
City of Chula Vista
City of Cloverdale
City of Corona, Fire Department
City of Costa Mesa Police Department
City of Cudahy
City of Culver City, Public Works Department
City of Diamond Bar
City of Downey
City of El Segundo, Fire Department
City of Glendale Fire Department
City of Grand Terrace
City of Hermosa Beach, Office of Emergency Services
City of Hesperia
City of Highland
City of Huntington Beach, Fire Department
City of Indio
City of Inglewood
City of Irvine
City of Laguna Beach, Police Department
City of Laguna Niguel

City of Lakewood
City of La Canada Flintridge
City of La Puente, Development Services Department
City of La Quinta
City of San Leandro
City of Lincoln
City of Loma Linda
City of Long Beach, Disaster Preparedness Bureau
City of Los Angeles
City of Manhattan Beach, Fire Department
City of Montclair
City of Montebello
City of Moreno Valley – Office of Emergency Management and Volunteer Service
City of Newark
City of Norwalk, Office of Emergency Management
City of Ontario
City of Orange
City of Pacifica
City of Pittsburg
City of Pomona
City of Rancho Cucamonga
City of Rancho Mirage
City of Rancho Santa Margarita
City of Roseville
City of Sacramento
City of San Clemente
City of San Gabriel
City of San Jose
City of San Mateo
City of San Rafael
City of Santa Ana
City of Santa Cruz
City of Santa Maria Fire Department
City of Santa Rosa
City of Seal Beach
City of Signal Hill
City of South Gate
City of Suisun
City of Suisun, Fire Department
City of Susanville
City of Torrance
City of Twentynine Palms
City of Union City
City of Vacaville
City of Vallejo
City of West Hollywood
Coachella Valley Association of Governments
Colusa County OA Inland Region III
Contra Costa Transportation Authority
Community Outreach Promoting Emergency (COPE) Preparedness
Council of Fresno County of Governments
Council of San Benito County Governments
County of Inyo

County of San Bernardino
County of San Bernardino Fire Protection District
County of Riverside
Crestline Village Water District
Delta Council
Delta Dental
Delta Protection Commission
Delta Stewardship Council
Del Norte County Office of Emergency Services
Department of General Services (DGS) - Emergency Management
Department of Insurance
Department of Pesticide Regulation (DPR)
Department of State Hospitals
Dewberry
Division of Real Estate Services
Division of the State Architect
East Bay Municipal Utility District
East Bay Regional Park District
Earthquake Engineering Research Institute (EERI)
El Dorado County OA Inland Region IV
Emergency Management, Resilience, and Recovery, Beverly Hills
Emergency Medical Services Authority (EMSA)
Energize Fresno
Environmental Justice Coalition for Water
Environmental Systems Research Institute (Esri), Public Safety
Federal Emergency Management Agency
Federated Indians Graton Rancheria
FEMA Regional Support Center
FEMA Region IX
FEMA Region IX Mitigation- Arizona
FEMA Region IX Risk Analysis Branch
Floodplain Management Association
Four Twenty-Seven Climate Solutions (427)
Fountain Valley Fire Department
Fresno County OA Inland Region III
Fresno County OA inland Region V
Glenn County OA Inland Region III
Glenn County Planning and Public Works Agency
Governor's Office of Planning and Research
Hemet Unified School District
Hi-Desert Water District
Humboldt County Association of Governments
Insurance Institute for Building and Home Safety (IIBHS)
Integrated Waste Management Board
Kern County OA Inland Region V
Kings County Association of Governments
Laguna Beach Unified School District
Lake County Metropolitan Transportation Authority
Lake County Office of Emergency Services
Lake Valley Fire Protection District
Lanterman Regional Center
Lassen County
Lassen County OA Inland Region III

League of California Cities
Livermore - Pleasanton Fire Department
Local Government Commission
Los Angeles County Metropolitan Transportation Authority
Los Angeles County Probation
Los Angeles Department of Water and Power
Los Angeles Superior Court
Los Angeles Unified School District
Los Angeles World Airports
Marin County Sheriff's Office
Marin County Office of Emergency Services
Mariposa County Operational Area Inland Region V
Mendocino County Office of Emergency Services
Mendocino Council of Governments
Merced County Association of Governments
Michael Baker Corporation
MMI Engineering
Modoc County Operational Area Inland Region III
Mono County
Monterey County Office of Emergency Services
Morongo Band of Mission Indians
National Fire Protection Association
National Oceanic Atmospheric Administration - Office for Coastal Management
Native American Heritage Commission
Natural Resources Conservation Services
Natural Resources Defense Council
Nature Conservancy
Nevada County Operational Area Inland Region IV
Nevada Department of Public Safety - Division of Emergency Management/ Homeland Security
Newberry Springs (Volunteer Fire Department)
Ocean Science Trust
Office of Correctional Safety
Office of Environmental Health Hazards Assessment
Office of Historic Preservation
Office of Statewide Health Planning and Development
Ocean Protection Council/Coastal and Ocean Climate Action Team
Orange County Child Support Services
Orange County Operational Area Inland Region III
Orange County Public Works
Orange County Sheriff's Department, Emergency Management Division
Oregon Health Authority
Orchard Dale Water District
Placer County OA Inland Region IV
Placer Group Sierra Club
Planning and Conservation League
Plumas County Operational Area Inland Region III
Public Agency Risk Managers Associates
Reclamation Board
Resilient Bay Area
Resources Legacy Fund
Riverside County
Rooted in Resilience
Rural County Representatives of California (RCRC)

Sacramento Area Council Governments
Sacramento County Department of Water Resources
Sacramento County Operational Area Inland Region IV
Sacramento Fire
Sacramento Metropolitan Air Quality Management District
Sacramento Municipal Utility District (SMUD)
Reclamation District 108 (Sacramento River West Side Levee District)
Santa Barbara County Office of Emergency Management
San Bernardino Valley Municipal Water District
San Bernardino Police Department
San Diego Regional Climate Collaborative
San Diego County Office of Emergency Services
San Fernando Police Department
San Francisco Bay Area Rapid Transit District
San Francisco Bay Area Conservation and Development Commission (BCDC)
San Francisco County Office of Emergency Services
San Joaquin County Operational Area Inland Region IV
San Joaquin County Office of Emergency Services
San Mateo County Office of Emergency Services
Santa Clara County Office of Emergency Services
Santa Clara Valley Water District
Santa Cruz County Office of Emergency Services
Sierra Club
Sierra County Operational Area Inland Region III
Sierra Nevada Conservancy
Siskiyou County Operational Area Inland Region IV
Shasta County
Shasta County Operational Area Inland Region III
Solano County Office of Emergency Services
Sonoma County
Spotlight 29 Casino
State Water Resources Control Board
Superior Court of California, County of Orange
Susanville Fire Department
Sutter County Operational Area Inland Region IV
Stanislaus County Office of Emergency Services
Stanislaus County Operational Area Inland Region IV
State Humane Association of California
State of Hawaii Emergency Management Agency
State of Nevada
State Water Resources Control Board (SWRCB) Division of Drinking Water Programs
Strategic Growth Council
Tehama County
Tehama County OA Inland Region III
The Center on Race, Poverty, and the Environment
The Ramona Band of Cahuilla, Tribal Office
The Reclamation Board- Environmental Services
Town of Apple Valley
Town of San Anselmo
Town of Yucca Valley
Trinity County
Tulare County Operational Area Inland Region V
Tuolumne County Operational Area Inland Region IV

Twentynine Palms Water District
Union of Concerned Scientists
United States Army Corps of Engineers
United States Bureau of Indian Affairs
United States Bureau of Land Management
United States Bureau of Reclamation- Pacific Region Office
United States Department of Homeland Security (DHS)
United States Forest Service
United States Fish and Wildlife Service
Unites States Geological Survey
University of California, Davis
University of California, Irvine Police Department
University of California, Office of the Secretary of the Regents
University of Nevada, Reno
University of Southern California (USC)
Vallejo Sanitation and Floor Control District
Viejas Tribal Government
Ventura County Sheriff's Office of Emergency Services
Volunteer Centers of California
West Cities Police Communications Center
Wildlife Conservation Board
Yolo County Operational Area Inland Region IV
Yuba County Operational Area Inland Region III
Zone 7 Water Agency (Livermore)

**Note: The SHMT roster listed above is current as of May 2018 and many not reflect team members added after that time.*

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APPENDIX B – STATE AGENCY FUNCTIONS: AGENCY RESPONSIBILITY MATRIX

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Business, Transportation & Housing Agency (BTHA) www.bth.ca.gov	Umbrella agency that oversees statewide transportation system, promotes job growth and economic development, increases affordable housing, and regulates building codes and sales.		
California Highway Patrol (CHP)www.chp.ca.gov	Serves and protects the public and prevents the loss of life, injuries, and property damage.	Responsible for protection of state employees and property	GC §14685
Department of Housing and Community Development (HCD)www.hcd.ca.gov	Provides policy and program leadership to expand and preserve safe and affordable housing opportunities and promotes strong communities for all Californians.	Requires mobile home earthquake bracing devices: test devices and issue certifications	SB 360 (1981)
		Manufactured Housing Program: mobile home inspection	Mobile Homes-Manufactured Housing Act of 1980, HSC, Div. 13, Pt. 2, §18000, et seq.; 25 CCR, Div. 1, Ch. 3, subchapter 2, §4000, et seq.
		Factory-Built Housing Program	HSC, Div. 13, Pt. 6, §19960, et seq.; 25 CCR, Div. 1, Ch. 3, subchapter 1, §3000, et seq.
		Office of Migrant Services: contracts with local governments to procure or construct housing and provide services for migrant agricultural workers	HSC, Div. 31, Pt. 2, Ch. 8.5, §§50710-50715
		Special Housing Programs for the Developmentally Disabled, Mentally Disordered, and Physically Disabled	HSC, Div. 31., Pt. 2, Ch. 7, §§50680-50689.5
		Residential Hotel Rehabilitation	HSC, Div. 13, Pt. 2, Ch. 3.3, §§50519-50522
		Multifamily Housing Program	HSC, Div. 13, Pt. 2, Ch. 6.7, §§50675-50675.14
		Assures protection of health, safety, welfare of all mobile home and special occupancy park residents and user	Mobile Home Park Act (HSC Div. 13, Park 2.1) & Special Occupancy Park Act (HSC Div. 13, Part 2.3)
		Uniformity in building standards	HSC, Div. 13, Pt. 1.5, Ch. 4, §17958, et seq.
		Accessibility requirements	24 CCR, Pt. 2 (CA Building Code)

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Proposes the adoption, amendment, or repeal of building standards to CA Building Standards Commission	HSC, Div. 13, Pt. 2.5, Ch. 4, §18935, et seq.
		State Housing Law authority	State Housing Law: Part 2.5, Chapter 4, commencing with §18935
Department of Transportation (DOT) www.dot.ca.gov	Oversees the planning, design, construction, maintenance of the State Highway System and related highway facilities.	Administers bond addressing emissions reduction, air quality improvement, transit system security, port security and disaster response	SB 1266 (2006)
		Prepares inventory of state-owned bridges that require strengthening to meet seismic safety standards	SB 2104 (1990)
		Seismic hazards consideration in design of highway infrastructure	
California Earthquake Authority (CEA) www.earthquakeauthority.com	Provides residential earthquake insurance.	Provides catastrophe residential property earthquake insurance	SB 1993; AB 3232; AB 2086 (1996); AB 331 (1997); SB 1716 (1997); AB 964 (1999); AB 1048 (2003); SB 430 (2008) and AB 886 (2009)
California Governor's Office of Emergency Services (Cal OES) www.caloes.ca.gov	Protects the public and the state from natural and man-made disasters through coordination and support for emergency managers, hazard mitigation, disaster assistance, and other programs.	Nonstructural Earthquake Hazards in CA Schools	SB 1122; GC §8587.7
		Flood Mitigation Assistance	44 CFR 78.5
		Hazard Mitigation Grant Program	44 CFR 206 and 13
		Local Hazard Mitigation Planning Program	DMA 2000, Section 322; Interim Final Rule of 2002; 44 CFR 201, as amended
		Pre-Disaster Mitigation Program	DMA 2000
		State Hazard Mitigation Plan	44 CFR 201

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Provides reimbursements for disaster-related costs including emergency response, emergency protective measures, and restoration of public infrastructure.	California Disaster Assistance Act; 19 CCR Div. 2, Ch. 6
		Emergency Services Act created Office of Emergency Services (originally established in 1950)	Emergency Services Act (1970); GC §8550, et seq.
		California State Warning Center	
		California Accidental Release Prevention (CalARP) Program: Prevents accidental release of regulated toxic and flammable substances	Risk Management Program; HSC §§25531-25543.3
		Establishes Steering Committee (for Tsunamis) and establishes Statewide Tsunami Hazard Mitigation Program	Tsunami Hazard Mitigation and Preparedness (AB 319)*
	Gathers and disseminates information critical to the protection of the state; creates state's comprehensive security strategy; and designs and implements critical state, regional and local programs.	Establishes CA Governor's Office of Homeland Security	The Homeland Security Act of 2002, Executive Order (2003)
		Critical Infrastructure Protection: Identifies and assures protection of critical infrastructure; provides timely warning of specific, imminent threat	Homeland Security Presidential Directive Number 7 (2003)
		Protected Critical Infrastructure Information (PCII): Encourages private industry to voluntarily share sensitive and proprietary business information with federal government	Homeland Security Presidential Directive Number 7 (2003)

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Buffer Zone Protection Plan (BZPP) Program: Facilitates reduction of vulnerabilities at critical infrastructure/key resources (CI/KR) sites by protecting area around site	Homeland Security Presidential Directive Number 7 (2003)
		California Homeland Security Exercise and Evaluation Program (CA-HSEEP): Provides financial and direct support to state and local agencies with development and implementation of an exercise and evaluation program to enhance and assess domestic preparedness	
		State Terrorism Threat Assessment Centers (STTACs): Provides statewide analysis products, information tracking, pattern analysis and other statewide intelligence products	
		Regional Terrorism Threat Assessment Centers (RTTACs): Maintains regional threat assessment, facilitates coordination with FBI field offices, facilitates inter-agency information sharing	
		Terrorism Liaison Officers: Local agency point of contact for all terrorism-related alerts, requests for information, warnings and other notifications from regional, state or federal homeland security agencies	
California Environmental Protection Agency (CalEPA) www.calepa.ca.gov	Umbrella agency that protects California's environment and public health.	Establishes minimum standard protocols for responding to pesticide drift emergencies	SB 391 (2004); HSC §25501
		Climate Action Team	Global Warming Solutions Act of 2006 (AB 32), Executive Order S-3-05

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Air Resources Board (ARB) www.arb.ca.gov	Promotes and protects public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants.		
		Toxic Air Contaminants Identification Program	Toxic Air Contaminants Identification & Control Act (AB 1807 [1983]; HSC §39600, et seq.)
		Air Toxic Hot Spots Program	Air Toxics "Hot Spots" Information & Assessment Act (AB 2588 [1987]; HSC §44300, et seq.)
Cal Recycle www.calrecycle.ca.gov	Manages generated waste, promotes waste reduction, and regulates the handling, processing, and disposal of solid waste.	Fosters partnerships with local agencies for integrated waste management planning, education and enforcement.	Integrated Waste Management Act (AB 939, 1989); 14 CCR, Chs. 3 through 5
		Operation and maintenance of solid waste facilities and waste tire hauling and storage, promote recycling of lubricating oil, and require recycled-content in paper products	PRC, Div. 30 - Waste Management; 14 CCR - California Waste Management Board (Chs. 3 through 5)
		Disaster Plan and Disaster Debris Management Plan	AB 2920 (1992); PRC §43035
Department of Pesticide Regulation (DPR) www.cdpr.ca.gov	Regulates pesticide sales and use; fosters reduced-risk pest management.	California Schools Integrated Pest Management Program	Healthy Schools Act of 2000 (AB 2260)
		Regulates the proper, safe, and efficient use of pesticides essential for production of food and fiber and for protection of public health and safety	Food and Agricultural Code §11501
		Fosters reduced-risk pest management	Food and Agricultural Code §11501
		Assures agricultural and pest control workers of safe working conditions where pesticides present	Food and Agricultural Code §11501
		Encourages development and implementation of pest management systems	Food and Agricultural Code §11501

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Department of Toxic Substances Control (DTSC) www.dtsc.ca.gov	Oversees statewide regulation of the generation, transport, treatment, storage, and disposal of hazardous waste; oversees the cleanup of sites contaminated with hazardous wastes and hazardous substances.	Hazardous substance release prevention, containment and mitigation; hazardous waste transportation; hazardous waste transfer, treatment and disposal facilities	Resource Conservation and Recovery Act (1976)
		Hazardous waste source reduction compliance	Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14)
		Brownfields cleanup and reuse program	California Land and Environmental Restoration and Reuse Act (SB 32 [2000])
		Biomonitoring Program: monitors toxic chemicals in bodies of Californians to target chemicals of concern	SB 1379 [2000]; HSC §105440, et seq.
		Green Chemistry: promotes design of chemical products and processes that reduce or eliminate use and generation of hazardous substances	California Safer Chemical Substitutes Act of 2005 (AB 990)
Office of Environmental Health Hazard Assessment (OEHHA) www.oehha.ca.gov	Develops and provides risk managers in state and local government agencies with toxicological and medical information relevant to decisions involving public health. †	Environmental Protection Indicators for California (EPIC)	
		California Accidental Release Prevention (CalARP) Program: Prevents accidental release of regulated toxic and flammable substances	Risk Management Program; HSC §§25531-25543.3
		Assessing Exposures and Health Risks at Existing and Proposed School Sites	HSC §901
		OEHHA Ecotoxicology Program	HSC §901
		PBDE Health Risks	HSC §108920, et seq.
		Toxic Air Contaminants Identification Program	Toxic Air Contaminants Identification & Control Act (AB 1807 [1983]; HSC §39600, et seq.)
		Air Toxic Hot Spots Program	Air Toxics "Hot Spots" Information & Assessment Act (AB 2588 [1987], HSC §44300, et seq.)
		Safe Drinking Water and Toxic Enforcement Act of 1986, Prop 65	Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop 65)

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Green Chemistry and Inherently Safer Technologies	California Safer Chemical Substitutes Act of 2005 (AB 990)
State Water Resources Control Board (SWRCB) www.waterboards.ca.gov	Preserves, enhances and restores the quality of California's water resources, and ensure proper allocation and efficient use. Regulates Public Water Systems to assure that they serve safe, clean, wholesome potable water reliably and adequately; for Emergency Management and Mitigation Responsibilities - Issues/requires the issuance of unsafe water alerts as necessary to protect public health from off-specification water, Assists Public Water Systems in response and recovery - inspections, guidance, funding; for Legislation.	Underground Storage Tank Cleanup	Barry-Keene Underground Storage Tank Cleanup Fund Act of 1989
		Santa Monica Bay Restoration Commission	through National Estuary Program (Clean Water Act §320)
		Prohibits discharge of substances from oceangoing ships under NPDES	Clean Water Act of 2005 (SB 771) California Safe Drinking Water Act (Health and Safety Code - Division 104 – Environmental Health PART 12 – Drinking Water CHAPTER 4 - California Safe Drinking Water Act Federal Safe Drinking Water Act (Title XIV of The Public Health Service Act: Safety of Public Water Systems)
California Health & Human Services Agency (CHHS) www.chhs.ca.gov	Umbrella agency that administers state and federal programs for health care, social services, public assistance and rehabilitation.	CHHS directly serves millions of Californians in health and human service programs, while touching the lives of all Californians through statewide efforts such as public health protection and emergency preparedness and response	California Government Code § 8560 &Exec Order W-9-91
California Department of Public Health (CDPH) www.cdph.ca.gov	CDPH is committed to responding to public and environmental health emergencies in a rapid, efficient, and coordinated manner to save lives, protect health and safety, and preserve the environment.	(The Director of CDPH may) Declare a health emergency in any jurisdiction affected by a public health threat.	HSC § 101080
		Provide oversight for clinical and public health laboratory operations. Maintain laboratory programs to perform microbiological, physical, and chemical analyses.	HSC § 100250 - 100255, HSC § 116390

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Develop and maintain a nuclear power plant emergency response program.	HSC § 114650 - 114655, HSC § 114662
		Provide for programs to effectively regulate, establish procedures, and permit maximum utilization of sources of ionizing radiation.	HSC § 114650 - 114655, HSC § 114662
		Establish standards for permitting at medical waste facilities.	CCR, Title 22, § 65600 - 65628
		Detail the administration, guarantees, packaging, labeling, and advertising of food products.	Sherman Food, Drug and Cosmetic Laws, HSC § 109875-111915
		Establish uniform sanitation standards for shellfish and shell stock intended for human consumption.	HSC § 112150-112285
		Investigate and control communicable disease within the state. Establish a list of reportable diseases and conditions.	HSC §120125, HSC 120140, HSC § 120130
		Set general acute care hospital requirements in accordance with the Centers for Disease Control guidelines.	HSC § 1288.7, CFR, Title 42, § 483.70
		Require every CDPH-licensed facility develop and implement a disaster and mass fatality plan.	CCR, Title 22, § 102417 (g) (9), 101174 (a)
		Pandemic Flu Plan	HSC §§120125-120140
		Conduct special investigations of the sources of morbidity and mortality and the effects of localities, employments, conditions and circumstances on the public health and perform other duties as may be required in procuring information for state and federal agencies regarding the effects of these conditions on the public health.	HSC § 100325
	Promotes equitable healthcare accessibility for California. †	Develops and regulates seismic performance standards for hospitals	Alquist Hospital Seismic Safety Act of 1983 (SB 1953), HSC §§130000-130070

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Office of Statewide Health Planning and Development (OSHPD) www.oshpd.ca.gov		Institutes plan review and field inspection of hospital buildings under construction	SB 961 (1982)
		Hospital Building Safety Board	SB 519
California Public Utilities Commission (CPUC) www.cpuc.ca.gov	Regulates privately owned electric, telecommunications, natural gas, water and transportation companies.	Encourages solar energy infrastructure in existing homes and businesses (joint program with CEC)	California Solar Initiative; SB 1 (2006)
		Addresses seismic design of Liquid Natural Gas (LNG) facilities	SB 1081 (1977)
California State Archives (CSA) www.sos.ca.gov/archives	Collects, catalogs, preserves, and provides access to the historic records of state government and some local governments. †	Preservation of state historical records	
California State Military Reserve (CSMR) http://www.calguard.ca.gov/CSMR http://www.calguard.ca.gov/casmr/	Assists in training the California National Guard; provides rapid response in the preparation, prevention, defense, and mitigation of natural and man-made threats to California.	Responds to natural disasters in California, such as earthquake damage assessment	
California State University System (CSU) www.calstate.edu	Provides high-quality, accessible, student-focused higher education at 23 campuses throughout state. †	Adopt retrofit guidelines for state buildings owned by CSU	AB 3313 (1990)

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
CaliforniaVolunteers http://californiavolunteers.org/	Administers the AmeriCorps, Citizen Corps, Cesar Chavez Day of Service and Learning programs, maintain the California Volunteer Marching Network. Guides policy development for the volunteer and service fields. Coordination of volunteer activities related to disaster response and recover. Increasing individual, family, and community preparedness.	Increase the number and impact of Californians engaged in service and volunteerism	Executive Order W-77-94; Executive Order S-04-06
Department of Corrections & Rehabilitation (CDCR) www.cdcr.ca.gov	Maintains efficient and cohesive correctional policy. †	Provides labor for vegetation management	
Department of Education (CDE) www.cde.ca.gov	Provides leadership, assistance, oversight, and resources for education of students at primary and secondary levels.	California Schools Integrated Pest Management Program	Healthy Schools Act of 2000 (AB 2260)
		Nonstructural Earthquake Hazards in CA Schools	SB 1122; GC §8587.7
		Guides schools in planning for earthquakes and other emergencies	Katz Act; Education Code §§35295-35297
		Guides school districts in preparation to respond to emergencies using Standardized Emergency Management System	Petris Bill; GC § 8607
Department of Food and Agriculture (CDFA) www.cdfa.ca.gov	Administers food safety oversight and inspection, responses to invasive animal and plant disease, and ensures an equitable and orderly marketplace for agricultural products.	Animal Health and Food Safety Services: Mitigate risks to CA's livestock and poultry industries. Animal Health Branch, Meat and Poultry Inspection Program, Milk and Dairy Food Safety Branch	3 CCR, Div. 2, et seq.
		California Animal Health and Food Safety Laboratory System	3 CCR, Div. 1, Ch. 3, §520, et seq.
		Meat and Poultry Inspection Services	3 CCR, Div. 9, Ch. 4, §18650, et seq.

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Makes state-owned fairgrounds available for emergency management preparedness, response, recovery and mitigation activities	
		Inspection Services: Mitigate the introduction of toxins and contaminants to the food chain	3 CCR, Div. 4, et seq.; 3 CCR, Div. 5, et seq.
		Integrated Pest Control	
		Plant Health and Pest Prevention Services and Disease Control Program: Administers statewide exterior exclusion program, interior exclusion quarantine programs, weed eradication and biological control programs	
		Pierce's Disease Control Program	3 CCR, Div. 4, Ch. 9, Art. 8, §6045, et seq.
Department of Insurance (CDI) www.insurance.ca.gov	Enforces many of the insurance-related laws of the state; regulates insurance industry's practices. †	Enforces statutory mandatory compliance with "mini" residential earthquake insurance policy	AB 1366; California Insurance Code §10089
Department of Social Services (DSS) (Disaster Services Bureau) www.dss.cahwnet.gov	Provide coordination, collaboration, and resource identification for mass care and shelter, to support the State of California's capabilities to minimize the humanitarian impact of disasters and other emergencies through all four phases of emergency management	Lead state department for EF-6	California Government Code § 8560 & Admin. Order by Cal OES, Executive Order W-9-91
		Establish Joint Field Offices (JFO) and Local Assistance Centers (LAC) in response to a disaster	California Government Code § 8560 & Admin. Order by Cal OES, Executive Order W-9-91
		Mass Care & Shelter: The lead state department to administer and maintain the federal National Shelter System (NSS)	Admin. Order by Cal OES, Executive Order W-9-91
		Volunteer Emergency Services Team (VEST): Recruiting and training state employee volunteers to increase disaster response capacity to assist in mass care and shelter operations	Admin. Order by Cal OES, Executive Order W-9-91

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Administer the Functional Assessment Service Team (FAST) Program. Local government employees and partnering community based organization (CBO) personnel are trained to assist in identifying and meeting essential functional needs so that people with disabilities and others with access and functional needs can maintain their health, safety, and independence in general population shelters during disasters.	Executive Order W-9-91
		Administer California's State Supplemental Grant Program (SSGP) to assist people who have suffered damage in a disaster area declared by the President when the federal assistance to Individuals and Household Program (IHP) is implemented	Welfare and Institutions Code Section 13600-13601 & Admin. Order by Cal OES, Executive Order W-9-91
		Lead state department in the Repatriation Program (provides repatriation assistance)	Social Security Act, Section 1113; 45 CFR 212.
Emergency Medical Services Authority (EMSA) www.emsa.ca.gov	Provides leadership in developing and implementing EMS systems throughout the state.	Provides medical resources to local governments in support of their disaster response; promotes disaster medical preparedness	HSC §§1797.150-151
Governor's Office of Planning & Research (OPR) www.opr.ca.gov	Provides legislative and policy research support for Governor's office; also assists in issues pertaining to land-use planning. †	Provides technical advisory to cities and counties on developing general plan, including Safety Element	AB 890; GC §65300, et seq.
		Provides technical advisory series that includes publication "Fire Hazard Mitigation and the General Plan"	GC §65300, et seq.

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Office of Historic Preservation (OHP) www.ohp.parks.ca.gov	Administers federal and state mandated historic preservation programs in California.	Provide information and technical assistance to local, state, and national/federal agencies and organizations to protect, stabilize, and rehabilitate historic structures impacted by disaster. Review and comment on publicly funded projects and programs that impact historic resources.	Public Resources Code Section 5024.6 The National Historic Preservation Act (NHPA; Public Law 89-665; 54 U.S.C. 300101 et seq.)
Resources Agency (CRA) www.resources.ca.gov	Umbrella agency for departments, boards and commissions and conservancies with shared goals to protect and conserve natural and human public state resources.		
California Conservation Corps (CCC) www.ccc.ca.gov	Improves the ecology of California's lands and rivers and contributes to the state's public safety while providing workforce development for young men and women. †	Provides critical front-line and logistical support for natural and manmade hazards	Public Resources Code §§14000-14406, Division 12.
California Coastal Commission (CCC) www.coastal.ca.gov	Administered the California Coastal Act through planning and permitting within the Coastal Zone to ensure conservation of coastal resources for current and future generations.	Works with local governments and project applicants to ensure development is safe from coastal hazards such as flooding and erosion over its anticipated lifetime	California Coastal Act of 1976 (Public Resources Code 30000 et seq.)
San Francisco Bay Conservation and Development Commission (BCDC) (http://www.bcdc.ca.gov/)			
California State Coastal Conservancy			

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
California Energy Commission (CEC) www.energy.ca.gov		Energy Emergency Response Plan - plan for possible electrical energy or fuel supply shortage	Public Resource Code §§25216.5(b) and 25700
		Green Building Initiative - reduce energy use in state-owned buildings by 20%, encourage private sector to reduce energy use	Executive Order S-20-04
	Administers statewide energy policy and planning	Reduce wasteful peak load energy consumption in residential and nonresidential buildings	AB 549
		California Solar Initiative - encourage solar energy infrastructure in new homes (joint program with CPUC)	SB 1 (2006)
		Reduce wildlife impacts from wind energy development (joint program with DFG)	PRC §§25210, 25213, 25218(e)
California State Lands Commission (CSLC)www.slc.ca.gov	Manages and protects important natural and cultural resources on public lands, through policies of environmental justice and public trust	Promotes public health, safety, and environment protection by regulating marine oil terminals and gas and thermal facilities, with focus on "prevention" including mitigation. Endeavors to take system safety approach to reduce human error, structural and mechanical failures. The Commission has authority to include mitigation measures in the leasing policies for land use.	Lempert- Keen -Sea-strand Oil spill Prevention and Response Act. Public Resources Code §8750 et seq.
		An independent program addresses removal of hazards from the surf zone within state jurisdiction.	Public Resources Code §6301 et seq.
		Regulates introduction of non-indigenous aquatic species into California Waters through oceangoing ships.	Public Resources Code §72001 et seq

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Delta Protection Commission (DPC) www.delta.ca.gov	Implements the Land Use and Resource Management Plan for the Primary Zone of the Delta.	Mandates designation of Primary and Secondary Zones within Delta region; creation of DPC; completion of Land Use and Resource Management Plan for Primary Zone	Delta Protection Act (SB 1866, 1992, as amended); PRC §297000, et seq.
		Makes policy recommendations for subsidence control	Delta Protection Act
		Makes policy recommendations for monitoring, maintenance, rehabilitation, and upgrading of levee system	Delta Protection Act
Department of Boating and Waterways (DBW) www.dbw.ca.gov	Develops convenient public access to the waterways and promotes on-the-water safety. †	Control of water hyacinth and Egeria densa in Sacramento-San Joaquin Delta	Harbors and Navigation Code § 64
Department of Conservation www.consrv.ca.gov	Provides services and information that promote environmental health, economic vitality, informed land use decisions and sound management of our state's natural resources.†	State Mining & Geological Board: Represents state interest in development of seismological and geological information pertaining to earthquake and other geological hazards	PRC §§660-678 (specifically §672)
California Geological Survey (CGS) www.consrv.ca.gov/cgs	Provides data, information, expert technical services and advice on seismic hazards, earthquake engineering, geology, mineral hazards and mineral resources	Strong Motion Instrumentation Program (SMIP): installation of monitoring devices to measure earthquake shaking	SB 1374 (1972)
		Alquist-Priolo Earthquake Fault Zoning Act: Prevents construction of buildings used for human occupancy on surface trace of active faults	Alquist-Priolo Earthquake Fault Zoning Act, Alquist-Priolo Special Studies Zone Act (SB 520, 1972); PRC §§2621-2630

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Seismic Hazard Zonation Program (SHZP): Establishes regulatory zones and issues appropriate seismic maps for non-surface fault rupture earthquake hazards; addresses liquefaction and seismically induced landslides; tsunami hazards will be addressed in 2018	Seismic Hazards Mapping Act (SB 3897, 1990); PRC §2690, et seq.
Department of Fish & Wildlife (CDFW) www.dfg.ca.gov	Maintains native fish, wildlife, plant species, and natural communities for their intrinsic and ecological value and their benefits to people.	Habitat protection, Natural Communities Conservation Planning	Natural Communities Conservation Planning Act; Fish and Game Code §200, et seq.
		Establish networks of marine protected areas in California waters	Marine Life Protection Act
		wildlife disease control	
		pollution control	
		fire control	
		flood control	
		vector control	
		conservation and mitigation banking, flood control	Sacramento-San Joaquin Wetlands Mitigation Bank Act of 1993; Fish & Game Code §1775, et seq.
		Comprehensive Environmental Response, Cleanup, and Liability Act (CERCLA) support	Comprehensive Environmental Response, Cleanup, and Liability Act (CERCLA, 1980)
		Natural Resource Damage Assessment and Restoration	CERCLA, Clean Water Act (1972/1977), Oil Pollution Act (1990)
		Military Base Realignment and Closure/Installation Restoration Services (BRAC/IR)	Ballast Water Management Act of 1999 (Marine Invasive Species Monitoring Program)
		"Keep Me Wild" campaign	
		Pike Eradication Proposal	
Office of Spill Prevention & Response (OSPR) www.dfg.ca.gov/ospr	Protects California's natural resources by preventing, preparing for, and responding to spills of oil and other deleterious materials.	Marine Invasive Species Monitoring Program	Lempert-Keene-Seastrand Oil Spill Prevention & Response Act; GC §§8574 and 8670, et seq.; PRC §8750, et seq.
		Oil spill prevention and response responsibilities	

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Department of Forestry & Fire Protection (CAL FIRE) www.fire.ca.gov	Protects the people of California from fires, responds to emergencies, and protects and enhances forest, range, and watershed values. †	Sudden Oak Death Syndrome Task Force	Plant Quarantine Manual (State Miscellaneous Ruling 3700), AB 2251
		Southern California Bark Beetle Infestation	Governor's Declaration of State Emergency (March 7th, 2003)
		Pitch Canker Task Force	SB 1712 (Sept. 21, 1998)
		Local Community Wildland Protection Plan Programs	Healthy Forests Restoration Act (HFRA)
		Fire Hazard Severity Zone (FHSZ) mapping	PRC §§4201-4204; 14 CCR, §1280
		Vegetation Management Plan (VMP)	SB 1704
		California Forest Improvement Program (CFIP)	California Forest Improvement Act of 1978; PRC §§4790-4799.05 or 14 CAC, Div. 1.5, Ch. 9.5, Articles 1-8
		Prop 40 Fuels Reduction Programs	Proposition 40, California Clean Water, Clean Air, Safe Neighborhood Parks and Coastal Protection Act of 2002; PRC §5096.659(g)
		Reforestation	SB 251
		Designate Hazardous Fire Areas	SB 1972 (1979); PRC §§4254, 4255, 4258, 4259, 4260, 4296.5
		Firework regulation in State Responsibility Area (SRA) fire hazard Zones	AB 799; PRC §§4258-4260
		Forest Stewardship Program	Cooperative Forestry Assistance Act of 1978, as amended; first enacted with 1990 Farm Bill
		Urban forestry health	California Urban Forestry Act of 1978; PRC §§4799.06-4799.12
		Firefighter training and standards	AB 669
		Defensible Space (100' reduction zone)	PRC §4291, et seq.
		Natural Hazard Disclosure for wildfire in SRA	AB 1812 (1989); PRC §4291, et seq.
		Minimum fire safety regulation in SRA	SB 1075 (1991); PRC §4290
		Very High Fire Hazard Severity Zones; Fire Hazard Zoning in Local Responsibility Area (LRA)	AB 337 (1992); GC §§ 51178-51188; HSC §13108.5

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Class A roof and Model Ordinance for defensibility of space and structures	AB 3819 (1995); GC §§51178.5, 51189; HSC §§13108.5, 13132.7; PRC §42205
		Class A, B, C roof and shingle testing timeline	HSC §13132.7
		LE-38 Program	
		WUI Building Standards	24 CCR, Part 2, California Building Code (Phase I, Phase II); 24 CCR, Part 9, California Fire Code; 24 CCR, Part 2, California Reference Standards Codes
		FireWise	Cooperative Forestry Assistance Act of 1978, as amended
		Natural Hazard Disclosure for wildfire in LRA and Very High Fire Hazard Severity Zones	AB 6X and 1195 (1998); Civil Code §1103, et seq.
		California Fire Alliance	National Fire Plan (2000)
Office of the State Fire Marshal (CAL FIRE/OSFM) www.osfm.fire.ca.gov	Protects life and property through development and application of fire prevention engineering, education, and enforcement. †	Expand fire safety building standards in areas with high fire risk to various components (not listed)	AB 1216 (2002); PRC §4291, GC §51189 SB 1241
		Proposes fire protection building standards for roofs, exterior walls, structure projections and structure openings	HSC §13108.5
		Lists wood roofing materials that have passed at least five years of the ten-year weather test; insurance companies honor replacement cost coverage for increased cost of fire retardant roofing materials	AB 423 (1999); HSC §13132.7
		Ensures fire safety of hospital buildings under construction	SB 961 (1982)
		Arson Task Force	AB 2336, as amended

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Department of Parks & Recreation (CA State Parks) www.parks.ca.gov	Protects natural and coastal resources, the state's biodiversity; provides quality recreational experiences	Charged with stewardship and protection of the lands, facilities and the public within the State Park System, to include all-hazard preparedness and mitigation	Public Resources Code 5003, 5008
Department of Water Resources (DWR) www.water.ca.gov	Operates and maintains the State Water Project; provides dam safety and flood control services, assists local water districts in water management and conservation activities, promotes recreational opportunities, and plans for future statewide water needs.	Disaster Preparedness and Flood Prevention - rebuilds and repairs California's most vulnerable flood control structures	Disaster Preparedness and Flood Prevention Bond Act of 2006 (Proposition 1E)
		Flood Protection Corridor Program: Funds nonstructural flood management protects	Safe Drinking Water, Watershed Protection and Flood Protection Act (Proposition 13)
		Stormwater Flood Control Grants	Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Prop 84)
		National Dam Safety Program: Provides training, technical assistance, research and support to states through incentive grant awards that encourage states to improve their programs	Dam Safety Act (1928), most recent reauthorization is Dam Safety and Security Act of 2002
		FloodSAFE California Initiative	
		Delta Risk Management Strategy: Evaluates potential impacts on water supplies from Delta based on projections for impacts from natural and man-made hazards	AB 1200; Water Code §139.2, et seq.
		Delta Vision Process	Proposition 84
		Drought Action Team	Admin. Order by OES, Executive Order W-9-91
		Governor's Proclamation of State of Emergency	Emergency Services Act (Government Code §8550, et seq.)
		State Water Plan; Water Quality Monitoring	
		Southern District (Division of Planning and Local Assistance) - Water Quality Evaluations	Water Code §229

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
		Authorize public and private water purveyors to declare water shortage emergency	Water Code §§350-358
		Provides financial assistance to local agencies for the development, control and conservation of water resources	Davis-Grunsky Act of 1960
		Urban Water Management Planning: Assesses water supply availability	Urban Water Management Planning Act (SB 610/SB 221, 2001, as amended); Water Code §§10610-10656
		California Bay-Delta Program (CALFED): Provides ecosystem protection for the Bay-Delta Estuary, improves quality and reliability of water supplies	California Bay-Delta Act of 2003
		Urban Streams Restoration Program	Proposition 84
		Floodplain Management Task Force	AB 1147 (2000)
		Flood Emergency Action Team formation	Executive Order (1997)
		San Joaquin Valley Drainage Implementation Program: Drainage management plan in SJ Valley	Memorandum of Understanding (1991)
Business, Consumer Services and Housing Agency (SCSA) www.bcsh.ca.gov	Umbrella agency responsible for civil rights enforcement, consumer protection, and professional licensure. Educates consumers and makes government more efficient, effective, and accountable for all California taxpayers. Dedicated to protecting consumers and delivering efficient, cost-effective, and responsive services to internal and external State Clients. †	Identity Theft Prevention, mortgage prevention workshops	Privacy Legislation: AB 22 (Torres) – Computer Hacking Penalties, AB 32 (Lieu) – Public Officials Online Personal Information, AB 130 (Jeffries) – Marriage Records, AB 524 (Bass) – Paparazzi, Publishers and Privacy, AB 1094 (Conway) – Disposal of Personal Information/Abandoned Records, SB 226 (Alquist) – Identity Theft Jurisdiction

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Building Standards Commission (BSC) www.bsc.ca.gov	Administers the processes related to adoption, approval, and implementation of state's building codes. †	Reviews and approves building standards proposed and adopted by state agencies	California Building Standards Law (1953); 24 CCR: "California Building Standards Code"
		Develop and adopt building retrofit guidelines for state buildings	AB 3313 (1990)
Seismic Safety Commission (SSC) www.seismic.ca.gov	Provides decision- makers and the general public with cost effective recommendations to reduce earthquake losses and speed recovery.	Commission established to advise Governor, Legislature, state and local governments on reduction of earthquake risk	Seismic Safety Commission Act (1975)
		Nonstructural Earthquake Hazards in CA Schools	SB 1122; GC §8587.7
		Prepare and administer Earthquake Loss Reduction Plan	California Earthquake Hazards Reduction Act; GC §8871, et seq.
		Compile update on status of local governments' compliance with Unreinforced Masonry Building Law	Unreinforced Masonry Building Law (1986); GC §8875
		Develop and adopt building retrofit guidelines for state buildings	AB 3313 (1990)
Department of General Services (DGS) www.dgs.ca.gov	Oversees services supporting state government normal operation, including the management of state properties and telecommunications. †	Field Act implementation	Field Act (1933), Education Code §17281
		ASCE 41-06: Seismic Rehabilitation of Existing Buildings	
Division of Real Estate Services	Maintains Statewide Property Inventory (SPI), a detailed inventory of the State's real property assets including land, structures/improvements, leased space, and State-owned space leased to others.	The Emergency Function 7 (EF7) Facilities Workgroup has determined that the SPI would be the proper database to be utilized by Cal OES and others during a disaster or catastrophic event. The DGS Real Estate Services Division, keeper of the SPI, has begun to update and enhance the inventory for this purpose.	GC §§11011.15-18
Division of the State Architect (DSA)	Provides policy, design and construction oversight, for K-12 schools and community colleges.	Field Act implementation	Field Act (1933), Education Code §17281
		Nonstructural Earthquake Hazards in CA Schools	SB 1122; GC §8587.7

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
www.dsa.dgs.ca.gov	Provides policy leadership and design and construction oversight, for K-12 schools and community colleges.	Ensures essential buildings are designed and constructed to minimize fire, seismic and wind hazards	Essential Services Building Act of 1986; HSC §16000, et seq.
		Ensures essential buildings comply with State Building Standards Code	SB 122 (1990)
		Develop and adopt building retrofit guidelines for state buildings	AB 3313 (1990)
Office of Public School Construction (OPSC) www.opsc.dgs.ca.gov	Administers the School Facility Program and other programs of the State Allocation Board.	Good Repair Standards: Interim Evaluation Instrument and Facilities Inspection System	SB 550 & AB 607
Department of Technology Services (DTS) www.dts.ca.gov	Provides IT services to state, county, federal and local government entities; technology center for the state.	Operational Recovery: Recover critical applications within 72 hours in event of disaster	State Administrative Manual §§4842.21 & 4843
The Reclamation Board (RB)	Controls flooding along the Sacramento and San Joaquin Rivers and their tributaries; maintains flood control infrastructure. †	Authority to designate floodways in Central Valley	23 CCR, Art. 5, §107
University of California (UC) www.universityofcalifornia.edu	Conduct research, teaching, and public service activities at ten campuses throughout the state. Provide healthcare and conduct teaching and research at five associated medical centers.	Adopt retrofit guidelines for state buildings owned by UC	AB 3313 (1990)
		California Animal Health and Food Safety Laboratory System	3 CCR, Div. 1, Ch. 3, §520, et seq.
		University of California Center for Pest Research	3 CCR, Div. 1, Ch. 3, §576, et seq.
		Establishes center for earthquake engineering and research (PEER)	SB 1864 (1996)
		Seismic retrofit or replacement of hospital facilities	Alquist Act (1983) SB 1953

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
California Department of Community Services and Development www.csd.ca.gov/	Administers federal programs to help low-income families achieve and maintain self-sufficiency, meet their home energy needs, and reside in housing free from the dangers of lead hazards.	Modernize our nation's infrastructure, enhance energy independence, expand educational opportunities, preserve and improve affordable health care, provide tax relief, and protect those in greatest need	The American Recovery and Reinvestment Act of 2009 (Recovery Act)
California Department of Education http://www.cde.ca.gov/index.asp	Oversees the state's diverse and dynamic public school system. Responsible for enforcing education law and regulations, and for continuing to reform and improve public elementary school programs, secondary school programs, adult education, some preschool programs, and child care programs.	Provides training, resources, and technical assistance in preparedness for, immediate response to, and mitigation of the aftermath of school safety crises. To assist school districts with the ongoing concerns of the mental health aspects of crisis planning and crisis response, and helping students to cope with tragic events. To emphasize health education, physical education, nutrition, and a healthier school environment.	Assembly Bill 537 - California Safety and Violence Prevention Act of 2000, Senate Bill 1234 – defined "gender" for purposes of identifying hate crimes and eliminating unlawful discrimination in public schools.

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
California State Parks http://www.parks.ca.gov/	To provide for the health, inspiration and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation.	Programs have evolved to include the use of warning signs, public information, education and interpretation (materials and programs), a broad spectrum of employee training, including boat patrol and enforcement and formal lifeguard services preventing and performing swimmer rescues. Park management, interpretation, maintenance, and law enforcement training. The Department employs over 700 peace officers to safeguard both visitors and the resources themselves. Rangers and lifeguards provide not only public safety law enforcement and aquatic rescue services; they also provide public education through interpretation.	The American Recovery Act, H. R. 2336, AB 32 (Global Warming Solutions Act of 2006), AB 811, SB 375, AB 2160, California's EO S-20-04

Agency	Agency Function	Emergency Management and Mitigation Responsibilities	Legislation
Native American Heritage Commission http://www.nahc.ca.gov/	Provides protection to Native American burials from vandalism and inadvertent destruction, provides a procedure for the notification of most likely descendants regarding the discovery of Native American human remains and associated grave goods, brings legal action to prevent severe and irreparable damage to sacred shrines, ceremonial sites, sanctified cemeteries and places of worship on public property, and maintains an inventory of sacred places.	Tribal governments, Indian organizations, and most likely descendants will become knowledgeable of effective mitigation measures, treatment, and disposition of Native American human remains and associated grave goods, protection of sacred places, and state and federal laws. Californians will come together to protect and preserve this valuable State heritage. Daily workload of the office includes review of environmental impact reports for projects on federal land and under state jurisdiction, negative declarations, mitigated negative declarations, and timber harvest plans. The cultural resource section of each report is reviewed for adequate mitigation and verification if appropriate local tribal groups have been contacted regarding the project. Reports are also checked against sacred lands file.	Government Code 65351: Native American Involvement in General Plan Proposals, 65352: Referral of Action on General Plan Changes to Native Americans, 65352.3- 65352.4: Consultation with Native Americans on General Plan Proposals, 12600-12612: Attorney General-Environmental Action, 65560, 65562.5: Consultation with Native Americans on Open Space, 25373, 37361: City/County Protection of Historic Resources Public Resources Code: 5097.95: State and local agency cooperation with the NAHC, 5020.5: State Historical Resources Commission, 5020.7: Public promotion of historical resource protection, 5024: State-owned historical resources, 5079.40-5079.44: Grants for historical resource preservation, 21083.2: California Environmental Quality Act- Archeological Resources, 21084.1: California Environmental Quality Act- Historic Resources, 65352.3- 65352.4: Consultation with Native Americans on General Plan Proposals, California Environmental Quality Act

† Description of agency function derived from agency website in lieu of survey response

Note: State agencies listed in bold in Appendix B are umbrella agencies. The state departments, boards, and offices listed in regular font below are affiliates under that umbrella agency.

* Pending legislation

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APPENDIX C – MULTI-AGENCY MITIGATION ACTION MATRIX

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
CREATING A STRATEGIC FRAMEWORK FOR MITIGATION			
Support Legislative Efforts that Formalize California's Comprehensive Mitigation Program *See Progress Summary 3.A* *See Progress Summary 3.B* *See Progress Summary 3.D* *See Progress Summary 3.E* *See Progress Summary 6.C* *See Progress Summary 7.C* *See Progress Summary 7.D* *See Progress Summary 8.A* *See Progress Summary 9.D* *See Appendix F-1*	Mitigation Legislation and Implementation	New: The Department of Water Resources funded a regional effort to support local flood management plans consistent with the Central Valley Flood Protection Plan. *Responsible Agency: DWR* New: In support of the Delta Reform Act, the Delta Stewardship Council launched the Delta Investment Strategy. *Responsible Agency: Delta Stewardship Council* New: The CAL FIRE / Office of the State Fire Marshal's Land Use Planning Program was established in June 2013 to implement the provisions in Senate Bill 1241 which require jurisdictions within designated Very High Fire Hazard Severity Zones (VHFHSZ) and Counties containing State Responsibility Area (SRA) review and update their general plan safety elements to address the risk of fire. *Responsible Agency: CAL FIRE, OSFM* New: SB 32, signed in September 2016, accelerated the State greenhouse gas emission reduction goal, and directed the development of enhanced rules and regulations for implementation. *Responsible Agency: California Air Resources Board.* New: The Sustainable Groundwater Management Act of 2014 commits California to local management of groundwater supplies with the goal of achieving sustainable management of groundwater basins through development and implementation of groundwater sustainability plans (GSPs) by local agencies within 20 years. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Strengthen Inter-agency Coordination Actions Including State, Regional, and Local Linkages *See Progress Summary 3.C* *See Progress Summary 3.D*	Establish Inter-agency Advisory Groups, Task Forces, and Work Groups to ensure vertical and horizontal integration and coordination of mitigation planning and implementation	Ongoing: SHMT Strategic Work Groups with multi-agency participation continue to inform the SHMP Updates. *Responsible Agency: Cal OES* New: The Fire Service Task Force on Climate Impacts was established in 2015 in response to Executive Order B-3-15. It builds on work done by the Blue Ribbon Fire Commission established following the 2013 wildfires. Membership includes local, state, and federal agencies and professional organizations. *Responsible Agency: Cal OES* New: In response to Executive Order B-30-15, the Technical Advisory Group (TAG) and Sub-TAGs were convened by the Office of Planning and Research (OPR). The group, representing multiple state, regional and local agencies as well as non-governmental organizations and the private sector, met from April 2016 through January 2017. The TAG produced guidance for state agencies. *Responsible Agency: OPR* New: Established in 2016, the Coastal and Ocean Resources Working Group for the Climate Action Team (CO-CAT) is charged with implementation of the Safeguarding California Plan and the California Climate Action Strategy. *Responsible Agency: California Ocean Protection Council* New: The Integrated Climate Adaptation and Resiliency Program (ICARP) was convened in 2016 through SB 246. ICARP produces a variety of tools and guidance to promote integration of climate change adaptation. *Responsible Agency: OPR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Broaden Public and Private Sector Mitigation Linkages *See Progress Summary 3.B* *See Progress Summary 6.L* *See Best Practices Highlight 9.B* *See Progress Summary 9.E*		New: The Delta Investment Strategy is a collaborative effort between state agencies, local reclamation districts, delta landowners, businesses, and other stakeholders. *Responsible Agency: The Delta Stewardship Council.* Ongoing: The Great California ShakeOut is an annual event involving public and private sector organizations, as well as local, regional, state, and federal agencies. Over 10 million individuals participated in the earthquake awareness and preparedness drill in 2017. *Responsible Agency: Cal OES* Ongoing: FireSafe Councils are community-based organizations that collaborate with the California Fire Alliance (CFA) and CAL FIRE to identify local fire prevention projects. Funding for implementation is accomplished through federal agency grants. *Responsible Agency: CFA, CAL FIRE* New: The State Water Efficiency and Enhancement Program (SWEEP) was initiated in response to the 2012-2016 statewide drought and the Executive Order accelerating the state's goal to reduce greenhouse gas emissions. SWEEP provides matching grant funds to agricultural operations. It provides a unique opportunity for government and the private enterprise to jointly reduce agricultural water and energy usage. *Responsible Agency: California Department of Food and Agriculture (CDFA), DWR, SWRCB* Ongoing: The California Solar Initiative is a partnership between the California Public Utilities Commission (CPUC), private utilities, and the general public. Its goal is to provide financial incentives to residential property owners, including low income, to install solar systems to reduce greenhouse gas emissions. *Responsible Agency: CPUC* New: The California Cybersecurity Task Force is a statewide partnership comprised of key stakeholders, subject matter experts, and cybersecurity professionals from California's public sector, private industry, academia, and law enforcement. Its primary mission is to reduce the likelihood and severity of cyber incidents that could cause damage to the state's economy, infrastructure, and computer networks. *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Assist Local Governments in Implementing Land Use Guidance and Best Practices for Reducing Vulnerability within High Hazard Zones. *See Progress Summary 3.E* *See Progress Summary 3.F* *See Best Practices Highlight 3.A* *See Progress Summary 7.H* *See Progress Summary 8.A*		Ongoing: Numerous cities and counties in California have integrated their LHMP's with their general plan safety elements as outlined in SB 2140. *Responsible Agency: Cal OES* New: The Land Use Planning Program was established within the Office of the State Fire Marshall (OSFM) in 2013. OSFM collaborates with the Board of Forestry and Fire Protection (BOF&FP) to assist local jurisdictions in addressing fire hazards in their general plans in accordance with SB 1241. OSFM produces guidance, reviews safety elements, and provides assistance with damage inspection and recovery following devastation from wildfires and floods. *Responsible Agency: OSFM, BOF&FP* New: SB 379 passed in 2015 requires local jurisdictions to include climate change in updates to their general plan. The Office of Planning and Research provided implementation guidance in the 2017 General Plan Guidelines. *Responsible Agency: OPR* New: The California Coastal Commission (CCC) published a guide in 2015 to help local jurisdictions address sea-level rise in local coastal programs and other plans. *Responsible Agency: CCC*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Incorporate Climate Change into Local, Regional, and Statewide Hazard Profiles, Risk Assessments, and Mitigation Plans. *See Progress Summary 4.B* *See Progress Summary 6.B* *See SHMP Hazard Assessments, Chapters 6-9*		New: SB 379 passed in 2015 requires local safety elements to include a climate change vulnerability assessment, measures to address vulnerabilities, and a comprehensive hazard mitigation and emergency response strategy. *Responsible Agency: OPR, Local jurisdictions* New: SB 246 passed in 2015 directed OPR to coordinate and maintain the State Adaptation Clearinghouse. The web-based clearinghouse provides state, regional, and local planners access to the most current planning and technical assistance resources. *Responsible Agency: OPR* New: The 2018 Update of the SHMP includes hazard specific discussions of potential climate change impacts within each of the affected natural hazards. *Responsible Agency: Cal OES, SHMT* New: The Safeguarding California Plan, updated in 2018, includes climate adaptation strategies for 5 natural and managed resource sectors. *Responsible Agency: Cal OES* New: Since 2015, portions of the Cal VIVA project assessment model have been used as the basis for a new project from the Fourth Climate Change Assessment called "Assessing Vulnerability and Improving Resilience of Critical Emergency Management Infrastructure in a Changing Climate" also known as "Project 6A". *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Enhance Collaboration on the Development and Sharing of Data Systems and Geographic Information Systems (GIS) Modeling *See Progress Summary 3.C* *See Progress Summary 3.G* *See Progress Summary 6.D.* *See Progress Summary 7.G*		Ongoing: MyPlan Internet Mapping Tool continues to provide GIS web-based mapping to support local planning. The California Department of Technology (CDT) will support updates to the MyPlan Tool. *Responsible Agency: Cal OES, CDT* Ongoing: GIS data for all state-owned facilities has been mapped in relation to estimated exposure to primary hazards. *Responsible Agency: Cal OES* New: The General Plan Guidelines Online Mapping Tool helps communities identify existing resources, including environmental, structures, infrastructure and demographics, and allows the upload of local data. *Responsible Agency: OPR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Enhance Collaboration on the Development and Sharing of Data Systems and Geographic Information Systems (GIS) Modeling *(continued)*		New: The California Air Resources Board (CARB) developed the Climate Action Portal Map (CAP-Map), an interactive web resource that is intended to share climate change actions and policies being implemented within California. *Responsible Agency: CARB* New: SB 246 passed in 2015 directed OPR to coordinate and maintain the State Adaptation Clearinghouse. The web-based clearinghouse provides state, regional, and local planners access to the most current climate change planning and technical assistance resources. *Responsible Agency: OPR* New: CalEnviroScreen was developed by the Office of Environmental Health Hazard Assessment (OEHHA) to identify disadvantaged communities as required by SB 525, passed in 2017. *Responsible Agency: OEHHA* New: The California Department of Public Health has developed an interactive data and mapping tool providing a snapshot of social determinants across the state that can be used to prioritize areas with social and economic disadvantage. *Responsible Agency: CDPH* New: The California Geologic Survey (CGS) developed a web-based tool to allow easy public access to Seismic Hazard Zone Maps. *Responsible Agency: CGS* New: The Department of Water Resources provides an interactive tool to identify all flood hazard areas in California not mapped under the FEMA National Flood Insurance Program. *Responsible Agency: DWR* New: The State Lands Commission (SLC) Sea-level Rise Viewer displays potential future sea-levels, compare scenarios, and includes the ability to overlay infrastructure, environmental and social economic data. It also includes a database of local coastal community plans. *Responsible Agency: SLC* New: CAL FIRE's Tree Mortality Map Viewer contains spatial information related to tree mortality, including location, removal projects, infrastructure, recreational facilities, and fire threat. *Responsible Agency: CAL FIRE*	

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Support and Coordinate Monitoring of Progress on State Goals and Objectives *See Progress Summary 9.F*	Set systematic near- and long-term mitigation targets and priorities	Ongoing: he California Energy Commission tracks progress California is making in meeting its clean energy goals. Examples of indicators tracked include: energy efficiency, statewide energy demand, zero-emission vehicles, and reliance on coal, renewable energy, and once-through cooling. *Responsible Agency: CEC* Ongoing: Mitigation Best Practices Highlights are included throughout the 2018 SHMP. Ongoing: Progress Summaries are highlighted throughout the 2018 SHMP. Completed: Cal VIVA III tested and refined the Cal VIVA II prototypical department plan and produced a template that can be used by departments and agencies within state government to systematically address critical building vulnerability and potential retrofits on a long-term basis. *Responsible Agency: State Departments & Agencies* New: Mitigation targets were established within state legislation: SB 32 passed in 2016 establishes a target for greenhouse gas emission reductions; and the Sustainable Groundwater Management Act of 2014 establishes a target date for completion of required local plans. *Responsible Agency: CARB, DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Expand Mitigation Project Loss Avoidance Tracking through the State Mitigation Assessment Review Team (SMART) System *See Progress Summary 3.H* *See Progress Summary 10.A*	Conduct post-disaster onsite review and documentation of loss avoidance of mitigation projects using SMART	New: SMART field assessments were conducted following the 2014 Napa Earthquake. In addition to Level I and II assessments, 2 structures were selected for a Level III assessment, which concluded that previous seismic mitigation projects were cost-effective. *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
CLIMATE CHANGE			
California Global Warming Solutions Act (SB 32)	Reduce greenhouse gas (GHG) emissions to 40% below 1990 levels by 2030.	New: SB 32, passed in 2016 updates the previous GHG emission standards established in 2008 under AB 32. In addition to accelerating GHG reductions, it requires the California Air Resources Board (CARB) to adopt rules and regulations in an open public process to achieve the most technically feasible and cost effective GHG reductions. *Responsible Agency: CARB* New: In 2017, CARB released an update to the 2008 Scoping Plan, building on key programs to reduce GHG emissions in the energy producing, transportation, agriculture and forestry sectors *Responsible Agency: CARB*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Interagency Coordination	Coordinate the activities of state agencies to improve air and water quality; protect natural resources and agricultural lands; increase the availability of affordable housing; improve infrastructure systems; promote public health; and, assist state and local entities in the planning of sustainable communities and meeting AB 32 goals. Provide technical support and feedback on climate change issues to be addressed in the 2009 CA Water Plan Update. Review and develop policy and operational recommendations associated with the effects of climate change on fire preparedness and response planning.	Ongoing: SB 732 was signed in September 2008, creating the cabinet-level Strategic Growth Council (STC). The Council has authority to distribute Proposition 84 funds. Projects funded by Proposition 84 funds must reduce greenhouse gases emissions on a permanent basis *Responsible Agency: Strategic Growth Council* Ongoing: The Climate Change Technical Advisory Group (CCTAG) was formed in 2009 to advise the Department of Water Resources (DWR) on the scientific aspects of climate change and the development of adaptation approaches for California's water sector. *Responsible Agency: DWR* New: The Fire Service Task Force on Climate Impacts was established in 2015 in response to Executive Order B-3-15. It builds on work done by the Blue Ribbon Fire Commission established following the 2013 wildfires. Membership includes local, state, and federal agencies and professional organizations. *Responsible Agency: Cal OES* New: In response to Executive Order B-30-15, the Technical Advisory Group (TAG) and Sub-TAGs were convened by the Office of Planning and Research (OPR). The group, representing multiple state, regional and local agencies as well as non-governmental organizations and the private sector, met from April 2016 through January 2017. The TAG produced guidance for state agencies. *Responsible Agency: OPR* New: Established in 2016, the Coastal and Ocean Resources Working Group for the Climate Action Team (CO-CAT) is charged with	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Interagency Coordination *(continued)*	Provide guidance for agencies to incorporate and integrate climate change into all planning and investment decisions. Ensure the state's ability to adapt to climate change impacts on ocean and coastal resources Facilitate coordination among state, regional and local agency efforts to adapt to the impacts of climate change Provide a venue for cross-sector collaboration and information sharing on development of the Safeguarding California plan.	implementation of the Safeguarding California Plan and the California Climate Action Strategy. *Responsible Agency: California Ocean Protection Council* New: The Integrated Climate Adaptation and Resiliency Program (ICARP) was convened in 2016 through SB 246. ICARP produces a variety of tools and guidance to promote integration of climate change adaptation. *Responsible Agency: OPR* New: The Safeguarding California Climate Action Team (SafeCAT) was established in 2017. It meets quarterly to provide updates on various adaptation-related efforts. `	
California Adaptation Strategy *See Progress Summary 4.A* *See Progress Summary 4.B* *See Table 4.I*	Communicate current and needed actions state government should take to build climate change resiliency.	New: The 2009 California Climate Adaptation Strategy (CAS) was updated as the 2014 Safeguarding California Plan to include energy and emergency management chapters. It was again updated as the Safeguarding California Plan: 2018 Update – California's Climate Adaptation Strategy. New: A set of four complementary Adaptation Planning Guides (APG), providing guidance to communities in addressing consequences of the (CAS) were finalized in 2012. The APG is being updated based on the 2018 CAS and an update is expected to be released in early 2019. *Responsible Agency: CNR, Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, Objectives 1, 2, 3, 4, 5, 7, 8

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
California Building Resilience Against Climate Change Effects Project (CalBRACE)	Enhance the California Department of Public Health's (CDPH) capability to plan for and reduce health risks associated with climate change.	New: The CalBRACE project provides resources and technical assistance for state and local public health departments to build climate adaptation capacity and enhance resilience at the local and regional levels. CalBRACE is funded by the Center for Disease Control (CDC). *Responsible Agency: CDPH* New: The Climate Change and Health Equity Program (CCHEP) works with local, state, and national partners to assure climate change mitigation and adaptation activities do not exacerbate health inequalities. *Responsible Agency: CDPH, Cal OES*	Goal 1, Objectives 1, 2, 5 Goal 4, Objectives 1, 3, 4, 5, 6, 7
Climate Change Assessment	Produce periodic scientific assessments on the potential impacts of climate change in California	Ongoing: The First Climate Change Assessment was released in 2006, focusing on potential impacts on key state resources. The Second Assessment, released in 2009, focused on economic impacts. The Third Assessment, released in 2012, made significant progress in projecting climate change impacts. The Fourth Assessment, scheduled for release in 2018, will be the first inter-agency effort to implement the Climate Change Research Plan which was published in 2015. *Responsible Agency: CNR* New: Climate Change and Emergency Management in California is part of the Fourth Assessment. It includes a Critical Facilities Vulnerability Assessment (CFVA, and a component addressing transportation adaptation. *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, Objectives 1, 2, 3, 4, 5, 6, 7
Local Planning for Climate Change *See Progress Summary 4.B* *See Table 4.I* *See Best Practices Highlight 4.A*	Incorporate climate change adaptation and greenhouse gas emission reductions into local planning processes.	New: The 2017 General Plan Guidelines published by OPR requires the inclusion of content on climate change and environmental justice within the General Plan, either as stand- alone elements or integrated into other elements. It also summarizes how a general plan or climate action plan can be consistent with CEQA Guidelines *Responsible Agency: OPR*	Goal 1, Objectives 2, 4, 5 Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Web Based Climate Change Tools	Provide a centralize source of climate change information and resources	New: SB 246 passed in 2015 directed OPR to coordinate and maintain the State Adaptation Clearinghouse. The web-based clearinghouse provides state, regional, and local planners access to the most current planning and technical assistance resources. *Responsible Agency: OPR* New: The California Air Resources Board (CARB) developed the Climate Action Portal Map (CAP-Map), an interactive web resource that is intended to share climate change actions and policies being implemented within California. *Responsible Agency: CARB*	Goal 1, Objective 1 Goal 4, Objectives 2, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
EARTHQUAKE AND GEOLOGIC HAZARD MITIGATION			
California Earthquake Loss Reduction Plan	Update the California Earthquake Loss Reduction Plan as required by the California Earthquake Hazards Reduction Act of 1986.	Ongoing: The most recent update, California Earthquake Loss Reduction Plan 2007-2011 was published in 2007 by the California Seismic Safety Commission (CSSC). *Responsible Agency: California Seismic Safety Commission (CSSC)* New: In June 2016 the CSSC, in partnership with the Pacific Earthquake Engineering Center (PEER), issued a report discussing findings and priority recommendations organized by focus areas of the California Earthquake Loss Reduction Plan. *Responsible Agency: California Seismic Safety Commission (CSSC)*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, Objective 5 Goal 4, All Objectives
Earthquake Zones of Required Investigation (Formerly Seismic Hazard Mapping) *See Progress Summary 6.C* *See Best Practices Highlight 6.C*	Ensure efficient, accurate, and reliable completion of the statewide Seismic Hazard Mapping Program	Ongoing: 10 years to complete. Since 2013, 10 additional quadrangle maps have been issued, bringing the total number of maps issued to 124, affecting 170 cities and 10 counties. Additionally, 21 new and revised Alquist-Priolo Earthquake Fault Zone Maps have been issued. *Responsible Agency: California Geological Survey (CGS)* New: Special Publication 42 addressing surface fault rupture was significantly revised in 2017. *Responsible Agency: California Geological Survey (CGS)*	Goal 1, All Objectives Goal 2, Objectives 1, 2, 3, 4 Goal, 3, Objective 5 Goal 4, Objectives 5, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
EQ Zapp: California Earthquake Hazards Zone Application *See Progress Summary 6.D*	Create an easily accessible online mapping tool that includes mapped earthquake fault zones, seismic hazard zones, and areas susceptible to ground failure.	New: The California Geologic Survey has launched the California Earthquake Hazards Zone Application (EQ Zapp), to allow anyone with a computer, tablet, or smartphone to conveniently check whether a property is in an earthquake hazard zone. *Responsible Agency: CGS* New: Prior to launching EQ Zapp CGS completely updated all the regulatory hazard zones, including A-P fault zones and Seismic Hazard Zones in 2017. *Responsible Agency: CGS*	Goal 1, Objectives 1, 3 Goal 2, Objective 1, 3 Goal 3, Objectives 4, 5 Goal 4, Objective 7
Uniform California Earthquake Rupture Forecast (UCERF)	Revise California earthquake probabilities; Prepare updated shaking hazard map of California.	Completed: UCERF III was completed in 2014. *Responsible Agency: CGS*	Goal 1, Objectives 1, , 4, 5 Goal 2, Objectives 1, 2, 3, 4, Goal 4, Objective 7
HAZUS Earthquake Loss Estimates *See Progress Summary 6.A*	Update statewide annualized losses	New: Using the latest HAZUS default data and the 2014 update of the USGS National Seismic Model, the California Geological Survey (CGS) updated statewide annualized losses for California in 2016. *Responsible Agency: CGS*	Goal 1, Objective 1 Goal 4, Objective 7
California Earthquake Early Warning System CEEWS) See Napa Earthquake Case Study	Rapidly detect the occurrence of an earthquake, estimate the level of ground shaking, and issue a warning before significant ground shaking begins.	New: In September 2013, SB 135 required Cal OES to develop a comprehensive statewide EEWS through public-private partnerships. The 2016-17 state budget provides $10 million in funding to support the installation of new seismic sensors and 4 permanent research positions. *Responsible Agency: Cal OES*	Goal 1, Objectives 1, 3, Goal 2, Objective 5, Goal 3, Objective 5 Goal 4, Objective 1, 6, 7
Delta Liquefaction Hazard	Map liquefaction hazard of native geologic materials in the Sacramento-San Joaquin Delta region	In progress: NEHRP funded project *Responsible Agency: CGS*	Goal 1, Objectives 1, 2 Goal 2, Objectives 1, 2, 3
LIDAR Fault Mapping	Examine the utility of high-resolution LIDAR topographic data for mapping active faults	In progress: NEHRP funded project *Responsible Agency: CGS*	Goal 1, Objectives 1, 2 Goal 2, Objectives 1, 2, 3

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Remote Sensing Fault Mapping	Examine the utility of airborne hyper-spectral remote-sensing imagery for mapping active faults	In progress: NASA funded project *Responsible Agency: CGS*	Goal 1, Objectives 1, 2 Goal 2, Objectives 1, 2, 3
California Vital Infrastructure Vulnerability Assessment *See Progress Summary 6.B*	Develop and test a methodology for assessing the vulnerability of state-owned building stock to seismic and other hazards and determine minimum retrofit measures to protect occupants from harm and facilitate recovery	Completed: All three increments of Cal VIVA have been completed, with final reports issued in 2013. *Responsible Agency: Cal OES* New: Portions of the Cal VIVA model were used for the Fourth Climate Change Assessment. *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, Objectives 2, 3, 4, 5, 6
State Building Retrofits *See Map 6.J*	Identify and retrofit seismically deficient state-owned buildings.	New: In 2017 a Seismic Risk Rating Study of California Superior Court Buildings was completed. One hundred forty-five structures identified as being at risk of collapse or causing a major risk to life were ranked and prioritized for seismic mitigation. *Responsible Agency: Judicial Council Program*	Goal 1, All Objectives Goal 2, Objectives 2, 3, 4, 6
CSU Retrofits	Reduce unacceptable seismic risk of existing buildings and manage current construction programs to limit future seismic risk.	Ongoing: The California State University System continues its vigorous program to reduce seismic risk to acceptable levels. As of budget year 2014-15, CSU has funded and implemented nearly $525 million in system-wide seismic retrofit projects. *Responsible Agency: California State University System(CSU)*	Goal 1, Objectives 4, 5 Goal 2, Objectives 2, 3, 5, 6
UC Retrofits *See Progress Summary 6.E* *See Best Practices Highlight6.A*	Conduct seismic review to identify and set priorities for hazard mitigation.	Ongoing: Between 1979 and 2016, the University of California System-Wide Seismic Safety Program has included seismic retrofit work in 329 structural improvement projects. *Responsible Agency: University of California (UC) Board of Regents*	Goal 1, Objectives 4, 5 Goal 2, Objectives 2, 3, 5, 6

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Seismic Evaluation of Single Family Dwellings *See Progress Summary 6.G* *See Progress Summary 6.H* *See Best Practices Highlight 6.F*	Develop comprehensive guidelines for evaluating and seismically retrofitting single-family dwellings Build a cadre of professionals qualified to perform seismic retrofit inspections and recommended retrofits	Ongoing: The first edition of the California Building Code (CBC) to establish standards for the retrofit of single-family dwellings with cripple walls less than 4 feet was adopted in 2010 and can be found in the 2016 CBC. Research is underway to establish standards for additional types of residential construction which may trigger revisions to further CBC updates. *Responsible Agency: CEA, BSC* Ongoing: In 2012, FEMA produced P-50, Simplified Seismic Assessment of Detached Single-Family Wood Frame Dwellings, and P-50-1 Seismic Retrofit Guidelines. Since 2015, over 250 seismic inspection professionals have completed the training. In 2016, CEA developed a web-based application based on P-50. *Responsible Agency: CEA*	Goal 1, Objectives 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 4, Objective 5, 6, 7, 8
California Earthquake Authority (CEA) Grants *See Progress Summary 6.G*	Provide financial support to homeowners to retrofit single family residences	New: The Earthquake Brace + Bolt (EBB) Program was initiated in 2013. The EBB provides up to $3000 per residential unit for seismic residential upgrading. Since 2013 the program has issued grants to 3,622 homeowners. Funding has been collectively provided through the CEA Loss Mitigation Fund, the State of California and through FEMA HMGP grants. *Responsible Agency: CEA*	Goal 1, Objectives 4,5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 4, Objectives 5, 6, 7, 8
Non-Ductile Concrete Buildings *See Progress Summary 6.F*	Implement retrofit programs for non-ductile concrete buildings subject to severe damage or collapse in an earthquake Voluntary program to canvass cities and counties throughout the state to determine how many pre-1976 non-ductile concrete buildings may exist within each jurisdiction.	New: In 2016 the City of Los Angeles passed a mandatory ordinance requiring the retrofit of all pre-1977 non-ductile concrete buildings. As of 2018, buildings are being identified and notices to comply are being sent to building owners, including a schedule for compliance. *Responsible Agency: Los Angeles Department of Building and Safety* Ongoing: In 2012/13 a new phase of the Concrete Coalition Project, supported by an HMGP grant, is focusing on developing tools that help decision-makers and engineers advance this field of endeavor. *Responsible Agency: EERI*	Goal 1, Objectives 2, 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 4, Objective 7, 8

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Unreinforced Masonry Buildings *See Best Practices Highlight 6.C*	Reduce the risk of life loss, injury, and collapse of unreinforced masonry buildings at the local level.	New: The state adopted seismic retrofit standards for URM buildings in the 2016 Building Standards Code. These standards have been adopted by 169 cities and counties. *Responsible Agency: Building Standards Commission* Ongoing: In response to the URM building law of 1986, the City of San Luis Obispo adopted a seismic building retrofit ordinance in 1997. The city identified 126 hazardous URMs. By 2015, all but 8 of the 126 buildings had been retrofit, with 2 partially retrofit and 6 under construction. *Responsible Agency: City of San Luis Obispo*	Goal 1, Objectives 2, 3, 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 4, Objective 1, 5, 6, 7, 8
Mobile Homes *See Progress Summary 6.I*	Adopt regulations to improve the structural and lateral stability of manufactured housing.	Ongoing: regulations became effective in April 2013 that apply the current California Residential Code structural standards to any alteration of a manufactured home built after 1958. *Responsible Agency: Department of Housing and Community Development (HCD)* New: An information flyer was developed jointly by Cal OES, FEMA, and EERI in 2015 and translated into Spanish in 2016. *Responsible Agency: Cal OES*	Goal 1, Objectives 2, 3, 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 4, Objectives 1, 5, 6, 7, 8
Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) *See Progress Summary 6.J*	construction, inspection, maintenance, and repair of marine oil terminals piers, wharves and other waterfront facilities	New: MOTEMS was updated in 2016. The MOTEMS Audit Manual was developed to assist marine oil terminal operators to comply with the revised standards. *Responsible Agency: California State Lands Commission (CSLC)*	Goal 1, Objectives 1, 3, 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 3, Objectives 1, 2, 3, 5 Goal 4, Objectives 1, 2, 3, 7, 8
Highway Bridge Retrofits *See Progress Summary 6.K*	Evaluate and seismically retrofit state highway bridges and overpasses to prevent collapse in major earthquakes.	In progress: By 2016, all but one of the 2,194 state bridges previously determined to need seismic retrofitting had been retrofitted. Anticipated completion is 2020 or 2021 *Responsible Agency: Caltrans*	Goal 1, Objectives 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 3, Objectives 1, 5 Goal 4, Objective 1
The Great California ShakeOut Earthquake Drill and Public Readiness Initiative S*ee Progress Summary 6.L*	Conduct statewide emergency preparedness. Mitigation and response activities to include multiple levels of government, the private sector, and the public.	Ongoing: The Great California ShakeOut is an annual event. Initiated in Southern California in 2008 with 5.5 million participants, the event was broadened to statewide in 2009. Nearly 10.6 million participated in the 2017 event. *Responsible Agency: Cal OES*	Goal 1, Objectives 1, 2,Goal 2, Objective 5 Goal 4, Objectives 1, 5, 6,

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Landslide Inventory Maps *See Map 6.V & 6.X* *Progress Summary 6.M*	Continue to map earthquake induced landslides through the Seismic Hazards Mapping Program	Ongoing: CGS continues to release maps of seismically induced landslides under the Seismic Hazards Mapping Act. CGS also makes available landslide inventory maps covering much of coastal California. These maps which have been being produced since the 1970's show locations of existing landslides and are now available on the CGS Landslide Inventory Viewer. *Responsible Agency: CGS*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, Objective 1 Goal 4, Objective 4, 7
Post-Fire Runoff & Debris Flows	Develop regional modeling to assess potential effects of post-fire runoff. Develop an early warning system for post-fire flash floods and debris flows.	New: In 2014, the Department of Water Resources issued a report entitled the Assessment of Post-Fire Runoff Hazards for Pre-Fire Mitigation Planning – Southern California. Regional modeling of burn areas around the state is being conducted by state and federal agencies. *Responsible Agency: California Department of Conservation* New: USGS and NOAA have developed a demonstration early warning system for recently burned areas in Southern California. *Responsible Agency: USGS, NOAA, Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, Objectives 1, 2, 4 Goal 4, Objective 1, 6, 7
Volcano Hazard Vulnerability Assessment		New: Preparation of assessment to provide broad perspective on the State's exposure and vulnerability to volcanic hazards by integrating existing volcanic hazard zones with geospatial data on at-risk populations, infrastructure, and resources. *Responsible Agency: USGS, CGS, Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, Objective 1 Goal 4, Objective 4, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
FLOOD HAZARD MITIGATION - RIVERINE, STREAM, AND ALLUVIAL FAN HAZARDS			
Flood Control System Deficiencies in Central Valley *See Progress Summary 5.O*	Produce a Descriptive Document to inventory the facilities and operations associated with State and Federal flood control works, and a Flood Control System Status Report to assess the status of that inventory.	In Progress: Underway. *Responsible Agency: DWR*	Goal 1, Objectives 1, 2, 4, 5 Goal 2, Objectives 2, 3, 5 Goal 3, Objectives 2, 4 Goal 4, Objective 5

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Flood Risk Mapping	Adopt a schedule for mapping flood risk areas in the Central Valley and prepare/approve levee flood protection zone maps. Provide yearly notices to owners of property in a levee flood protection zone.	Ongoing: Legislation requires DWR to make the maps available to the public by June 2013. *Responsible Agency: DWR*	Goal 1, Objectives 1, 2, 5, 6 Goal 2, Objective 5 Goal 4, Objective 7
Land Use Planning and Management *See Progress Summary 7.A* *See Progress Summary 7.G*	Control future development in floodplains and flood-prone areas, in conformance with the CVFPP.	Ongoing: Implementation of SB 5 requiring cities and counties within Sacramento-San Joaquin Valleys to address new flood protection standards when considering new development. *Responsible Agency: DWR* Completed: As required by SB 1278, DWR developed and released 200-year informational floodplain maps for 10 urban communities in the Sacramento-San Joaquin Valley. SB 1278 also extended the deadlines for local adoption of general plans and zoning ordinances consistent with the CVFPP. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Flood Legislation Planning Assistance *See Progress Summary 7.A*	Provide planning assistance to local governments in implementing the five flood legislation bills passed in 2007.	Completed: Two documents were prepared in 2007 to assist local governments in complying with legislated requirements: California Flood Legislation Summary and California Flood Legislation Companion Reference. The third document, Local Land Use Planning: Handbook for Communities Implementing Flood Legislation – October 2010 describes legislation requirements affecting city and county local planning responsibilities. *Responsible Agency: DWR*	Goal 1, Objectives 2, 6 Goal 2, Objectives 1-6 Goal 3, Objectives 1, 3, 4 Goal 4, Objectives 1, 2, 4, 5, 6

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Flood Management *See Progress Summary 5.Q*	FloodSAFE California, launched in 2006 is a multi-faceted program to improve public safety through integrated flood management.	Ongoing: The FloodSAFE Strategic Plan: Public Draft was released in May 2008. It contains twelve Foundational Objectives with target dates for completion extending to 2025. *Responsible Agency: DWR* New: The Flood Risk Notification Program is part of the FloodSAFE California Initiative. In September 2010, DWR provided the first annual written notice of flood risks to each landowner whose property is protected by certain levees. *Responsible Agency: DWR* New: In 2013 DWR and the US Army Corps of Engineers published the report "California's Flood Future" to look at statewide flood risk. *Responsible Agency: DWR*	Goal 1, Objectives 1, 2, 6 Goal 2, Objectives 1, 2, 3, 5 Goal 3, Objectives 3, 4 Goal 4, Objectives 1, 5, 7
California's Flood Future *See Progress Summary 7.E* *See Figure 7.C* *See Map 7.E* *See Map 7.F*	Assess statewide exposure to flood risk, identify, and address the barriers to improved flood management.	New: California's Flood Future: Recommendations for Managing the State's Flood Risk was developed by DWR in partnership with the .S. Army Corps of Engineers as a companion plan to the 2013 California Water Plan Update. The document concludes with 7 recommendations for state and federal assistance to reduce the risk and consequences of flooding. *Responsible Agency: DWR* New: DWR is developing a companion report Investing in California's Flood Future: An Outcome-Driven Approach to Flood Management, to guide future capital flood management and risk reduction projects. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Flood Management System Planning and Programs *See Progress Summary 7.B* *See Progress Summary 7.D* *See Progress Summary 7.E* *See Figure 7.B*	Improve flood management across the state.	Ongoing: California's Flood Management System includes 5 integrated program areas: Flood Management Planning; Floodplain Risk Management; Flood Risk Reduction Projects; Flood System Operations and Maintenance; and, Flood Emergency Response. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Central Valley Flood Protection Plan (CVFPP) *See Progress Summary 7.C* *See Progress Summary 7.D*	Update and implement recommendations and planning requirements outlined in the CVFPP.	New: The CVFPP is California's strategic blueprint to improve flood risk management in the Central Valley. The first plan was adopted in 2012. The 2017 Update was officially adopted in August 2017 by the Central Valley Flood Protection Board and serves as a long-range plan that guides the State's participation in managing flood risk in the Central Valley. It will guide investments in multi-benefit flood projects over the next 30 years. *Responsible Agency: DWR* New: Following adoption of the 2012 Plan, DWR completed six Regional Flood Management Plans (RFMP) for regions in the Central Valley in 2015, and recommendations were incorporated into the 2017 CVFPP Update. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
California Water Plans *See Progress Summary 7.E*	Ensure reliable water supplies and foundational actions for sustainable water use in California.	New: The 2018 update of the California Water Plan will identify specific outcomes and metrics to track performance, prioritize near-term State actions and investments, recommend financing methods having more stable revenues, and inform water deliberations and decisions as they unfold. The final plan is scheduled for adoption by the end of 2018. *Responsible Agency: DWR* New: The California Water Plan Update 2018 Envisioning Sustainable Water Resources brochure presents the Water Plan's vision of sustainability. *Responsible Agency: DWR* New: The California Water Action Plan, first developed in response to the drought in 2014, was updated in 2016. The plan describes actions for increasing flood protection and the need for integrated regional flood management projects. *Responsible Agency: DWR* New: The Delta Reform Act of 2009 created the Delta Stewardship Council, an independent state agency, to provide a more reliable water supply for California and enhancing the Delta's ecosystem. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
NFIP Compliance	Work with local floodplain managers to promote participation in and ensure compliance with the NFIP to update community's FIRM	New: The 2015 International Building Code and International Residential Building Code, both of which have been adopted in California, now incorporate standards for the design and construction of buildings in flood hazard zones. All provisions are meet or exceed NFIP minimum requirements. *Responsible Agency: CBSC, local building departments* Ongoing: As of 2017, 97% of California communities (527 throughout the state) participate in the NFIP. Ongoing: FEMA implemented the new CRS Coordinator's Manual beginning April 2013. Each participating CRS community will need to meet the new criteria. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
FLOOD HAZARD MITIGATION - SEA-LEVEL RISE, COASTAL FLOODING AND EROSION HAZARDS			
Sea-level Rise Guidance *See Progress Summary 7.H*	Provide guidance on factors to consider in projecting sea-level rise, potential impacts, and adaptation strategies.	New: In April 2018, the Ocean Protection Council (OPC) released new update of the State's Sea-Level Rise Guidance. *Responsible Agency: OPC* New: In April 2017, the Ocean Protection Council (OPC) released a new guidance document entitled Rising Seas in California: An Update on Sea-Level Science. The document synthesizes the state of sea-level rise in California and provides the basis for the current update of the State's Sea-Level Rise Guidance which was approved in April 2018. *Responsible Agency: OPC, CNRA, OPR, CEC* Ongoing: In 2015, the California Coastal Commission (CCC) published the California Coastal Commission Sea-level Rise Policy Guidance. The guide outlines six steps to address sea-level rise for local coastal planning. *Responsible Agency: CCC* New: The California Coastal Commission's draft 2017 Residential Adaptation Policy Guidance document focuses on climate adaptation and residential communities. *Responsible Agency: CCC*	Goal 1, Objectives 1, 2, 4 Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
State Agency Adaptation Planning *See Best Practices Highlight 7.A* *See Figure 7.H* *See Figure 7.I*	Assess vulnerability of state assets to sea-level rise and develop adaptation strategies to address potential impacts.	New: Caltrans is preparing initial vulnerability assessment and adaptation studies for each of its districts. The first was prepared for District 1 in 2014. The District 4 assessment was released in early 2018 and focuses on climate change threats along the state highway system in the San Francisco Bay Area. *Responsible Agency: Caltrans*	Goal 1, Objectives 1, 4, 5 Goal 2, Objectives 1, 3, 4, 5, 6 Goal 3, Objective 3 Goal 4, Objectives 2, 3

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
San Francisco Bay Conservation and Development District (BCDC) Climate Change Planning Program *See Progress Summary 7.J*	Provide scientific information and planning resources to Bay Area local jurisdictions.	Ongoing: BCDC launched ART Portfolio, a place to find planning guidance, tools, and information that have been developed, tested, and refined by the Adapting to Rising Tides Program to address the specific challenges of climate change. BCDC continues to partner with local, state, and federal agencies to develop and disseminate sea-level rise information and planning tools. *Responsible Agency: (BCDC)*	Goal 1, Objectives 1, 2, 4, 5 Goal 2, Objectives 2, 3, 5 Goal 3, Objectives 2, 3, 4, 5 Goal 4, Objectives 1, 2, 3, 4, 5, 6, 7
Local Climate Adaptation Planning *See Progress Summary 7.I* *See Best Practices Highlight 7.B* *See Best Practices Highlight 7.C* *See Best Practices Highlight 7.D* *See Figure 7.J*	Support sea-level rise adaptation planning by local jurisdictions.	New: In October 2016, the Department of Water Resources (DWR) published a document entitled National Flood Insurance Program in California Quick Guide Coastal Appendix: Planning for Sea-level Rise. The document supports floodplain managers in addressing potential sea-level rise impacts for their communities *Responsible Agency: DWR* New: The Local Coastal Program/Local Assistance Grant Program provides funds to support local governments in completing or updating their Local Coastal Programs (LCPs). The program has awarded 45 grants since its inception in FY 2013/14. *Responsible Agency: CCC*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
FLOOD HAZARD MITIGATION - TSUNAMI AND SEICHE HAZARDS			
Reducing Tsunami Hazards and Risks *See Progress Summary 6.D*	Support and provide matching funds for development of improved technologies and methodology to assess tsunami risk	New: Post-event survey teams and questionnaires were used to gather information about the impacts and response to two significant teletsunamis which occurred in 2010 and 2011. New products and planning tools will be developed to improve tsunami preparedness as a result of these analyses. Ongoing: CGS received funding from NOAA for continued refinement of the inundation maps and to investigate the feasibility of tsunami hazard maps for purposes of land-use planning Responsible Agency: CGS	Goal 1, Objectives 1, 2 Goal 2, Objectives 1, 2, 3, 4, 5 Goal 4, Objectives 1, 2, 3, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Understanding Tsunami Probability *See Progress Summary 7.K* *See Progress Summary 7.L* *See Map 7.R*	Improve the understanding of tsunami hazards in California through coordinated research.	New: In 2014 a statewide assessment of geological evidence was conducted to locate evidence of past tsunamis. Evidence was found in several locations for events occurring in 1700, 1946, and 1964. New: The State Tsunami Program is working to complete a new set of tsunami inundation maps based on probabilistic analyses, with some maps to be completed in 2018 through the Probabilistic Tsunami Hazard Program (PTHA). New: in 2016, 33 Maritime Tsunami Response Playbooks were developed to provide harbor officials with hazard risk information. Responsible Agency: CGS	Goal 1, Objective 1 Goal 4, Objectives 6, 7
Tsunami Mitigation and Preparedness Planning *See Progress Summary 7.K* *See Progress Summary 7.L*	Develop loss estimation models to compute potential impacts from tsunamis. Provide site-specific harbor and pier improvements, engineering recommendations, and cost-benefit assessments. Develop planning and technical assistance resources to support tsunami evacuation planning.	New: FEMA has developed a new tsunami loss estimation model for HAZUS that can be used by state and local agencies to assess potential impacts to their community and establish mitigation and preparedness priorities. Responsible Agency: FEMA, state and local jurisdictions New: The State Tsunami Program is working with the State Lands Commission to complete Pier and Harbor Improvement Reports for all at risk harbors and piers. Responsible Agency: CGS, SLC New: Maritime Response Playbooks provide local jurisdictions and harbor officials with maps and guidance about which areas to evacuate or avoid during a tsunami. Responsible Agency: CGS	Goal 1, All Objectives Goal 2, All Objectives Goal 3, Objectives 1, 3, 5 Goal 4, Objectives 1, 4, 5, 6, 7
Tsunami Building Codes See Progress Summary 7.L See Progress Summary 7.M	Address tsunami loads and develop design standards for critical and essential facilities	New: The PTHA maps produced by CGS will form the basis of a new section in the California Building Code (CBC). If adopted by the Building Standards Commission in the current building code cycle, they will be included in the 2019 version of the CBC. Responsible Agency: CGS, CBSC	Goal 1, Objectives 3, 5 Goal 4, Objective 8

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
FLOOD HAZARD MITIGATION – LEVEE FAILURE HAZARDS			
Levee Evaluation and Repair *See Progress Summary 7.O*	Evaluate and upgrade aging and deteriorating levees along the Sacramento and San Joaquin River Valleys and Delta. Funding is provided through Propositions 84 and 1E.	Ongoing: To date, nearly 250 levee repair sites have been identified with repairs to more than 100 critical sites completed. *Responsible Agency: DWR* Ongoing: DWRs Levee Evaluation Program includes the Urban Levee Geotechnical Evaluations (ULE) Project and the Non-Urban Levee Evaluations (NULE) Project. Two Geotechnical Reports were produced from these evaluations, by April 2015. *Responsible Agency: DWR* New: The Urban/Non-Urban Levee Evaluations Cost Analysis Tool helps flood managers develop accurate estimates for levee repair. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, Objectives 2, 3, 4, 6 Goal 3, All Objectives Goal 4, Objectives 1, 2, 3, 5, 7
Delta Levees Program *See Progress Summary 7.P* *See Progress Summary 7.Q* *See Best Practices Highlight 7.F*	Provide funding to local agencies in the Sacramento-San Joaquin for levee maintenance and improvement and for habitat mitigation and enhancement.	Ongoing: The Delta Levees Program addresses approximately 1100 miles of levees and supports the efforts with local agencies in the Delta. In 2016 significant levee projects were completed on New Hope Tract, Bouldin Island, Bacon Island, and elsewhere. *Responsible Agency: DWR*	Goal 1, Objectives 2, 3, 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 3, All Objectives Goal 4, Objectives 1, 5, 8
Local Levee Assistance *See Best Practices Highlight 7.E*	Provide funding to local agencies outside the Sacramento-San Joaquin Delta	New: DWR established this program to assist local agencies with flood risks throughout the state. *Responsible Agency: DWR*	Goal 1, Objectives 2, 3, 4, 5 Goal 2, Objectives 2, 3, 4, 5, 6 Goal 3, All Objectives Goal 4, Objectives 1, 5, 8
Cascading Hazards Evaluation *See Progress Summary 7.N*	Review and evaluate earthquakes and high water as hazards to Delta levees.	New: In July 2016 the Delta Independent Science Board convened a workshop. The potential for liquefaction due to earthquakes and potentially higher water levels due to climate change were identified as primary issues. *Responsible Agency: Delta Independent Science Board*	Goal 1, Objectives 1, 5 Goal 2, Objective 5 Goal 4, Objectives 2, 3, 5, 6
FLOOD HAZARD MITIGATION – DAM FAILURE HAZARDS			
Inspection and Remediation	Inspect dams on an annual basis to identify high hazard dams and need for remediation.	Ongoing: DWR's Division of Dam Safety (DSOD) inspections as of August 2017, indicates there are 474 dams ranked as High Hazard, and 196 as Extremely High Hazard. As of September 2017, 97 dams have been identified as needing remediation. Responsible Agency: DSOD	Goal 1, All Objectives Goal 2, Objectives 2, 3, 5, 6 Goal 3, Objective 2, 3, 4 Goal 4, Objectives 5, 6, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Emergency Action Plans (EAPs)	Create EAPs based on updated inundation maps for dams having high or extremely high hazard ratings.	New: Senate Bill 92, signed into law in 2017, requires, Cal OES to review and approve EAPs upon DSOD approval of dam inundation maps prepared by dam owners. *Responsible Agency: Cal OES*	Goal 1, Objective 1 Goal 2, Objective 5 Goal 4, Objectives 1, 4, 6, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
WILDFIRE HAZARD MITIGATION			
Legislation for Local Wildfire Hazard Planning *See Progress Summary 8.A*	Incorporate wildfire hazards into development and land use planning.	Ongoing: SB 1241, passed in 2012 requires wildfire updates to general plans, mandatory findings for subdivision approvals in SRA's and VHFHSZs, and CEQA checklist updates for wildfire safety. *Responsible Agency: CAL FIRE, OPR*	Goal 1, Objectives 2, 3, 4, 6 Goal 2, Objectives 1, 2, , 4, 5 Goal 3, Objectives 1, 3 Goal 4, Objectives 2, 4, 5, 7, 8
Fire Hazard Severity Zones *See Progress Summary 8.C* *See Best Practices Highlight 8.A*	Map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors to define the application of various mitigation strategies to reduce risk.	Ongoing: CAL FIRE updated SRA and LRA Very High Fire Hazard Severity Zones (VHFHSZ) Maps for the state in draft form in 2014, officially released in 2017. An on-line viewer reflects annual updates to SRA and LRA VHFHSZs. *Responsible Agency: CAL FIRE*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Strategic Fire Plan *See Progress Summary 8.D*	The Strategic Fire Plan forms the basis for assessing California's complex and dynamic natural and man-made environment and identifies a variety of actions to minimize the negative effects of wildland fire.	Completed: The 2010 Strategic Fire Plan was approved in June 2010. It contains seven goals that may be implemented within any timeframe based on available funding. *Responsible Agency: CAL FIRE, State Board of Forestry* New: A Work Group has been formed to prepare the 2018 update of the Strategic Fire Plan. *Responsible Agency: CAL FIRE, State Board of Forestry*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Forest and Range Assessment	Identify and evaluate wildland fire hazards and the associated values and assets at risk. Facilitate the sharing of all analyses and data collections across all ownerships for consistency in type and kind	Ongoing: FRAP and USFS Region 5 are now preparing for the 2015 assessment, which is scheduled for completion in July 2018. The updated 2015 Assessment will revisit the topics from the 2010 Assessment as well as revive the inclusion of Montreal Process Criteria and Indicators to assess our progress toward or away from sustainable forestry. *Responsible Agency: CAL FIRE*	Goal 1, Objectives 1, 2, Goal 3, Objectives 1, 3, 5 Goal 4, Objectives 1, 2, 5, 7
FireSafe Councils	Increase awareness, knowledge and actions implemented by individuals and communities to reduce human loss and property damage from wildland fires, such as defensible space, fire prevention and fire safe building standards	Ongoing: As of 2017, there are 92 nationally recognized FireSafe communities in California. Ongoing: In 2012 CAL FIRE, Firewise, and California Fire Safe Council signed an MOU to allow CFSC to act as the State Liaison for Firewise Communities in California. *Responsible Agency: CAL FIRE, CFSC*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Post-Fire Assessment	Address post-fire responsibilities for natural resource recovery including watershed protection, reforestation, and ecosystem restoration	Ongoing: Implementation of Governor's Executive Order S-07-08 which requires the Governor's Office of Emergency Services, California Resources Agency, and the California Environmental Protection Agency to provide post-fire assessment services to citizens living near burned areas on State, local, tribal, or private lands. The State Emergency Assessment Teams (SEAT), coordinates with the U.S. Forest Service Burn Area Emergency Response (BAER) Teams. *Responsible Agency: Cal OES, CNRA, Cal EPA*	Goal 1, Objectives 1, 2, 4, Goal 2, Objectives 2, 3, 5, Goal 3, Objectives 3, 4Goal 4, Objectives 1, 5, 6, 7
Community Wildfire Protection Plans (CWPP)	Identify hazardous fuel reduction treatment priorities, recommend measures to reduce structural ignitability and address issues such as wildfire response, hazard mitigation, community preparedness and structure protection	Ongoing: CWPPs are produced in collaboration with public fire agencies and affected non-governmental interests (especially local community residents). *Responsible Agency: CAL FIRE*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives, Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
AGRICULTURAL AND SILVICULTURAL PESTS AND DISEASES HAZARD MITIGATION			
Initiatives and Technology *See Progress Summary 9.A*	Mitigating the spread of invasive pests	Ongoing: The California Firewood Task Force has focused on promoting the Buy It Where You Burn It campaign since 2011 to increase public awareness about invasive tree pests being transported via long distance firewood movement. Ongoing: CDFA's "Report a Pest" app allows the public to access the CDFA database and invasive species experts to identify the presence of invasive species. *Responsible Agency: CDFA*	Goal 1, Objectives 1, 2, 3 Goal 2, Objectives 5 Goal 3, All Objectives Goal 4, Objectives 2, 5, 6, 7
AIR POLLUTION HAZARD MITIGATION			
Air Quality/Pollution Monitoring *See Progress Summary 9.B*	CalEnviroScreen Reduce pollutant exposures to improve community health	New: The Office of Environmental Health Hazards Assessment (OEHHA) developed and maintains the CalEnviroScreen mapping tool to help identify California communities disproportionately impacted by sources of pollution. *Responsible Agency: OEHHA* New: The California Environmental Health Tracking Program, along with academic partners, initiated a community-based effort to place air monitoring equipment to identify pollution "hot spots" *Responsible Agency: CDPH*	Goal 1, Objective 1, 2, Goal 3, Objective 5 Goal 4, Objective 5, 7
Air Pollution Planning	Incorporate Environmental Justice into General Plans	New: Senate Bill 1000 passed in 2016 requires cities and counties with disadvantaged communities to identify objectives and policies to reduce pollution exposure in their General Plan Updates. *Responsible Agency: OPR, cities, counties*	Goal 1, Objective 2, 3, 5 Goal 2, Objective 1,2, 3 Goal 3, Objective 5 Goal 4, Objective 1, 4, 5
AQUATIC INVASIVE SPECIES HAZARD MITIGATION			
Marine Invasive Species Act *See Progress Summary 9.C*	Reduce the introduction of invasive species transported through vessel ballast water	Ongoing: Vessels arriving in California ports are required to submit a Ballast Water Management Report. Between 2014 and 2016, the rate of compliance was over 96%. Additionally, regulations to manage biofouling were implemented in 2017. *Responsible Agency: State Lands Commission*	Goal 1, Objectives 1, 2, 3 Goal 2, Objectives 5 Goal 3, All Objectives Goal 4, Objectives 2, 5
DROUGHTS AND WATER SHORTAGES HAZARD MITIGATION			

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
State Water Efficiency and Enhancement Program (SWEEP) *See Best Practices Highlight 9.B*	Reduce agricultural water usage through installation of more efficient irrigation practices.	New: SWEEP, a competitive grant program, was initiated in 2014. To date it has resulted in an estimated water savings of 58,000 acre feet. *Responsible Agency: CDFA, DWR, SWRCB*	Goal 1, Objectives 2, 4 Goal 2, Objective 3 Goal 3, Objectives 2, 3, 4, 5 Goal 4, All Objectives
Water Supply *See Best Practices Highlight 9.A*	Improve potable water supply to areas dependent on well water	New: In response to the 2012-2016 drought, East Porterville, a socially vulnerable community, was connected to a permanent source of potable water, eliminating its reliance on groundwater supplies in future droughts. *Responsible Agency: DWR*	Goal 1, Objectives 1, 2, 4 Goal 2, Objectives 1, 2, 3, 5 Goal 3, Objective 4 Goal 4, Objectives 1, 3, 5, 6, 8
Groundwater Management Plan *See Progress Summary 9.D*	Strengthen local control and management of groundwater basins.	New: The Sustainable Groundwater Management Act was passed into law in September 2014. It requires local jurisdictions with medium and high priority basins to develop Groundwater Sustainability Plans within 20 years. *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, Objectives 1, 2, 3, 5 Goal 3, Objectives 1, 2, 3, 4 Goal 4, Objectives 1, 2, 3, 4, 5, 6, 7
Local Storm Water Management *See Best Practices Highlight 9.C*	Capture storm water and redirect it for ground water recharge which will offset increased groundwater use during drought years.	New: Los Angeles County is in the process of updating the county's stormwater infrastructure in order to capture an additional 33 billion gallons of storm water flowing out to the ocean and redirect it for groundwater recharge. The program's goal is to improve and optimize the county's existing flood protection and water conservation systems through a capital improvement program for new infrastructure. *Responsible Agency: Los Angeles County*	Goal 3, Objectives 2, 3, 4 Goal 4, Objectives 1, 2, 3
California Drought Contingency Plan	Minimize drought impacts by improving agency coordination and enhancing monitoring and early warning capabilities.	Ongoing: The Drought Contingency Plan was updated in 2016. It builds on strategies and actions contained in the 2010 Plan and directs water operations in response to the 2012-2016 drought. *Responsible Agency: DWR*	Goal 1, Objectives 1, 2, 6 Goal 2, Objectives 32, 5 Goal 3, Objectives 2, 3, 4 5 Goal 4, Objectives 1, 2, 3, 5, 6, 7, 8
California Water Plan	Develop a comprehensive approach to addressing drought hazard mitigation over the long-term to serve as the state's blueprint for integrated water management and sustainability.	Ongoing: The California Water Plan was updated in 2013, and supports the Governor's Water Action Plan *Responsible Agency: DWR*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Safe Drinking Water Plan for California	Assess the overall quality of the state's drinking water, identify problems, and recommend improvements.	New: The State Water Resources Control Board (SWRCB) submitted an update of the Safe Drinking Water Plan for California to the Legislature in June 2015. The plan focuses on the 2% of the state's water system consumers without safe drinking water. *Responsible Agency: SWRCB*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
ENERGY SHORTAGE HAZARD MITIGATION			
Existing Buildings Energy Efficiency Action Plan	Double the energy efficiency savings of existing buildings by 2030	New: The California Energy Commission (CEC) adopted the first version of the Existing Buildings Energy Efficiency Plan in 2015, and the first update in 2016, in response to SB 350. *Responsible Agency: CEC*	Goal 1, Objectives 1, 4 Goal 2, Objectives 2, 3, 5, 6 Goal 3, Objectives 2, 3, 5 Goal 4, All Objectives
Regional Energy-Savings Efforts *See Progress Summary 9.H*	Implement effective energy saving programs on a regional basis.	New: The Bay Area Regional Energy Network (BAYREN), covers nine counties in the San Francisco Bay Area representing 20% of the state population. BayREN provides planning, technical, and financial assistance funded through the Public Utilities Commission. *Responsible Agency: PUC, ABAG*	Goal 1, Objectives 1, 4 Goal 2, Objective 2, 3, 5 Goal 3, Objectives 2, 3, 5 Goal 4, All Objectives
Solar and Energy Storage for Resiliency *See Best Practices Highlight 9.C*	Integrate solar and energy storage into response planning	New: San Francisco's Solar Resilient initiative goal is to create a roadmap for using solar energy as a viable tool for energy security in the event of an emergency. The objective is to integrate solar energy and energy storage into the City's Emergency Response Plans. *Responsible Agency: City and County of San Francisco*	Goal 1, Objective 1, 4 Goal 2, Objective 5 Goal 3, Objectives 2, 3, 5 Goal 4, Objectives 1, 2, 3, 4, 5, 6
California Solar Initiative *See Progress Summary 9.E*	Reduce the cost of solar generating equipment to reduce use of fossil fuels for power generation.	Ongoing: The CSI program has several funding programs to stimulate the installation of solar systems on residential structures. By the end of 2015, 3,886 megawatts of solar capacity had been installed at over 488,541 sites. *Responsible Agency: CPUC*	Goal 1, Objective 2, 4, 5 Goal 2, Objective 2, 3 Goal 3, Objectives 2, 3, 5, Goal 4, Objectives 1, 8
Clean Energy *See Progress Summary 9.F*	Progress Tracking	Ongoing: The California Energy Commission tracks progress California is making in meeting its clean energy goals. Examples of indicators tracked include: energy efficiency, statewide energy demand, zero-emission vehicles, reliance on coal, renewable energy, and once-through cooling. *Responsible Agency: CEC*	Goal 3, All Objectives
CALEAP	California Local Energy Assurance Planning	Completed: Energy assurance planning has been incorporated into other California Energy Commission initiatives, such as EPIC. *Responsible Agency: CEC*	Goal 2, Objective 6 Goal 3, Objectives 2, 3, 5, 7 Goal 4, Objectives 1, 3, 5, 7, 8

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Clean Energy Jobs Act *See Progress Summary 9.G*	Improve energy efficiency in K-12 schools	Ongoing: Proposition 39 was approved by California voters in November 2012. From December 2013 through December 2016, a total of 869 projects using $282 million in Proposition 39 funds had been completed or were under construction. *Responsible Agency: California Department of Education, California Energy Commission, California Public Utilities Commission*	Goal 1, Objective 4 Goal 2, Objectives 2, 3, 5 Goal 3, Objectives 2, 3, 4, 5 Goal 4, Objectives 3, 5, 8
EPIDEMIC/PANDEMIC/VECTOR BORNE DISEASES HAZARD MITIGATION			
Mosquito Borne Diseases *See Progress Summary 9.I*	Surveillance and control of mosquito borne diseases	New: Published the 2017 annual update of the California Mosquito-Borne Virus Surveillance and Response Plan to enhance the state's capability to track and control a number of mosquito-borne diseases. *Responsible Agency: CDPH*	Goal 1, Objectives 1, 2 Goal 3, Objectives 2, 4 Goal 4, Objectives 2, 5, 6
EXTREME HEAT HAZARD MITIGATION			
Extreme Heat Vulnerability *See Map 9.Q*	Identify areas of the state most vulnerable to climate impacts	New: Developed a climate vulnerability index and combined 19 indicators into an overall climate vulnerability score, as part of the Third California Climate Change Assessment. *Responsible Agency: CNR*	Goal 1, Objectives 1, 2 Goal 4, Objectives 1, 2, 3
Extreme Heat Vulnerability	Identify vulnerable populations	New: The CalBRACE extreme heat indicator describes certain populations that may have greater difficulty preparing for extreme heat. *Responsible Agency: CDPH*	Goal 1, Objectives 1, 2 Goal 4, Objective 5
Planning for Extreme Heat Emergencies *See Best Practices Highlight 9.D* *See Progress Summary 9.J*	Prepare at the local and state level to respond to extreme heat emergencies.	New: In June 2014, Cal OES issued a revised version of the Contingency Plan for Excessive Heat Emergencies. *Responsible Agency: Cal OES* New: SB 296, passed in 2012, required the California Environmental Protection Agency (CalEPA) to develop an Urban Heat Index. Released in 2015, the Index provides a quantifiable score for each urban census tract. *Responsible Agency: CalEPA*	Goal 1, Objectives 1, 2 Goal 4, Objectives 1, 2, 5, 6
Climate Change and Extreme Heat	Reduce health risks associated with increased temperatures due to climate change	Completed: Released in 2017, the Heat Committee of the Climate Action Team's Public Health Work Group developed "Preparing for Extreme Heat in California: Guidance and Recommendations". *Responsible Agency: CDPH, Cal EPA*	Goal 1, Objectives 1, 2 Goal 4, Objectives 1, 2, 3, 4, 5, 6, 7
Heat Research *See Progress Summary 9.J*	Quantify the extent and severity of an urban heat island in California	Completed: This project being undertaken jointly by the Governor's Office of Planning & Research and Cal EPA is to develop a method to quantify the average temperature increase in California communities due to the Urban Heat Island Effect. *Responsible Agency: OPR, Cal EPA*	Goal 1, Objectives 1, 2 Goal 4, Objectives 2, 3, 5, 6, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
TREE MORTALITY HAZARD MITIGATION			
Tree Mortality Assessment *See Table 9.Q*	Reduce the risk to the public and infrastructure by identifying and removing dead and dying trees.	New: The Governor established the interagency Tree Mortality Task Force in October 2015 to address public safety hazards associated with the state's epidemic tree mortality. *Responsible Agencies: Multiple* New: The Task Force Action Plan identified 10 high hazard zones where tree mortality coincides with critical infrastructure. Caltrans is working with landowners to perform tree removal work. *Responsible Agency: Caltrans*	Goal 2, Objectives 2, 4, 5 Goal 3, Objectives 2, 3, 4 Goal 4, Objectives 1, 2, 3, 4, 5
Tree Mortality Grant Program	Remove dead and dying trees that pose a threat to public safety and reduce wildfire threat.	New: CAL FIRE awarded over $15 million for 2016 and 2017 under the State Responsibility Area Fire Prevention Program and the Tree Mortality Grant Program. *Responsible Agency: CAL FIRE*	Goal 1, Objective 1, 2 Goal 2, Objectives 4, 5 Goal 3, Objectives 2, 3, 4 Goal 4, Objectives 1, 2, 3, 5, 6
HAZARDOUS MATERIALS RELEASE HAZARD MITIGATION			
Refinery Safety	Improve public and worker safety through enhanced oversight of refineries and strengthen emergency preparedness	New: In 2017 refinery safety regulations were changed to improve worker and community safety. *Responsible Agencies: Cal OES and Cal OSHA.*	Goal 1, Objectives 1, 2, 3, 4 Goal 2, Objectives 2, 3, 5 Goal 3, Objective 5 Goal 4, Objectives 5, 6
OIL SPILL HAZARD MITIGATION			
Oil Spill Planning *See progress Summary 9.K*	Prevent and mitigate the effects of oil spills impacting both land and water environments.	New: The most recent version of the State Oil Spill Contingency Plan was released in 2017. *Responsible Agency: Office of Spill Prevention and Response* New: The 2015-2020 Strategic Plan requires the State Lands Commission develop regulatory requirements to identify systemic risks at marine oil terminals. *Responsible Agency: SLC*	Goal 1, Objectives 1, 2, 4 Goal 2, Objectives 1, 2, 3, 5 Goal 3, Objectives 3, 4, 5 Goal 4, Objectives 2, 6
NATURAL GAS PIPELINE HAZARD MITIGATION			
Gas Pipeline Safety See *Progress Summary 9.L*	Improve gas pipeline safety practices	New: In 2013, PG&E established a gas control center to monitor operation of its transmission pipelines and distribution mains. In 2017 it developed a Gas Safety Plan. *Responsible Agency: PG&E, PUC*	Goal 1, Objectives 1, 2, , 4, 5, Goal 2, Objectives 1, 2, 3, 5, 6 Goal 3, Objective 5 Goal 4, Objective 5, 6, 7

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
TRAIN ACCIDENTS RESULTING IN EXPLOSIONS AND/OR TOXIC RELEASES HAZARD MITIGATION			
Rail Safety	Examine rail safety concerns related to the transport of crude oil.	New: The Governor convened an Interagency Working Group in 2014 which collaborated to identify and map areas along oil train routes with potential high vulnerability and identified the location of hazmat response teams. The Working Group also published a Preliminary Findings and Recommendations Report in June 2014. *Responsible Agency: Cal OES*	Goal 1, Objectives 1, 2 Goal 2, Objectives 1, 5 Goal 3, Objective 5 Goal 4, Objective 5, 6, 7
WELL STIMULATION AND HYDRAULIC FRACTURING HAZARDS HAZARD MITIGATION			
State Regulation of Well Stimulation	Regulate well stimulation procedures and identify/limit impacts.	September 2013. The California Department of Natural Resources completed a report on well stimulation treatments in 2015. Five state agencies as well as a national laboratory are involved in oversight and regulatory activities. *Responsible Agency: CNRA*	Goal 1, Objectives 1, 2, Goal 2, Objective 5 Goal 3, Objectives 2, 3, 4, 5 Goal 4, Objectives 4, 5, 8
TERRORISM HAZARD MITIGATION			
Homeland Security Strategy	Reduce the impact of human-made disaster events through a coordinated effort of capacity-building for state and local agencies.	New: The Homeland Security Advisory Committee (HSAC) was created in 2016 to advise the Cal OES Director on a 2017-2020 Homeland Security Strategy. *Responsible Agency: Cal OES*	Goal 1, Objectives 1, 2, 3, 4 Goal 2, Objective Goal 3, Objective Goal 4, Objectives 1, 6, 7
Homeland Security Grant Programs	Prioritize and allocate federal funding resources to support California's Homeland Security Strategy.	New: Homeland Security Grant expenditures from 2012-2016 total more than $500 million. *Responsible Agency: Cal OES*	Goal 1, Objectives 1, 2, 3, 4 Goal 2, Objective Goal 3, Objective Goal 4, Objectives 1, 6, 7, 8
CYBER THREATS HAZARD MITIGATION			
Cyber Security Policy	Adopt a Program Management Framework (PMF) that protects highest value assets through a management and risk-based approach.	New: The PMF provides a simplified set of 30 objectives for state agencies to use as a focus area for building, assessing, and managing their security programs. *Responsible Agency: California Department of Technology (CDT)*	Goal 2, Objective 6
Annual Vulnerability Assessments	Coordinate 35 vulnerability assessments each calendar year.	New: AB 670, passed in 2015 requires CDT to coordinate independent security assessments of state agencies every two years. *Responsible Agency: CDT*	Goal 1, Objective 1 Goal 2, Objective 6

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Security Audit Program	Measure the effectiveness of security policies and guidelines.	New: In 2016, the program was piloted in six state entities. *Responsible Agency: CDT*	Goal 2, Objective 6
State Emergency Plan	Establish cross-agency collaboration to address cyber security threats.	New: Added CA-ESF 18 as a new Emergency Support Function that recognizes cyber security as an emerging hazard. *Responsible Agency: Cal OES*	Goal 2, Objective 6
Cyber Security Integration Center (CISC) & Task Force	Reduce the likelihood and severity of cyber incidents that could damage the economy, critical infrastructure, or public and private sector computer networks, through state agency coordination.	New: In 2013, Cal OES and CDT initiated the Cyber Security Task Force to address the growing need for integrated action. *Responsible Agency: Cal OES* New: In 2015 Executive Order B-34-15 designated Cal OES to lead the CISC. *Responsible Agency: Cal OES* New: In 2016, Cal OES co-located the CISC with the State Threat Assessment Center (STAC) to ensure collaboration and communication across threats. *Responsible Agency: Cal OES*	Goal 2, Objective 6
Protecting Critical Power Grid Infrastructure	Protect power grid integration from cyber threats.	New: In 2014, the PUC funded CES-21, California Energy Systems for the 21st Century to address the growing need for integrated action. *Responsible Agency: California Public Utilities Commission*	Goal 2, Objective 6

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
LOCAL HAZARD MITIGATION PLANS			
Planning and Technical Assistance *See Section 5.1*	Identify and communicate with local governments to promote local hazard evaluation and mitigation planning and to assist in developing local hazard mitigation plans Increase the number of LHMPs in the state through enhanced planning and technical assistance.	Ongoing: Cal OES, FEMA RIX, and local and tribal jurisdictions coordinated efforts to address the influx of LHMPs submitted and needing approval between Fall 2017 and Spring of 2018. As a result of these efforts, the number of successful approved and/or approved pending adoption LHMPs helped to significantly increase the state's planning coverage from 42.7 percent in July 2017 to 73.8 percent as of June 1, 2018. *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
Planning and Technical Assistance *See Section 5.1* *Map 2.E*	Provide technical assistance, guidance, resources, and tools to local governments for all aspects of local hazard mitigation planning	Ongoing: LHMP Training Workshops continue to be offered around the State. *Responsible Agency: Cal OES* Ongoing: MyPlan, a multi-agency collaborative effort provides hazard maps for use by local jurisdictions in developing their LHMPs. *Responsible Agency: Cal OES*	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives
Planning and Technical Assistance *See Section 1.2.3* *See Section 1.3* *See Section 4.3.1*	Establish consistent definitions for common concepts, such as critical facilities, loss estimates, risk assessment, and hazard types.	New: The Hazard Mitigation Division conducts LHMP training on a statewide basis which includes information on standardized definitions for common concepts. *Responsible Agency: Cal OES*	Goal 1, Objectives 1, Goal 3, Objective 1 Goal 4, Objective 2, 7
Integration of Local and State Mitigation Efforts *See Progress Summary 3.E* *See Section 5.3.2.6*	Encourage local jurisdictions to take advantage of the financial benefits of AB 2140 by either creating integrated LHMP Safety Elements or by adopting their LHMP as an annex to their Safety Element (SE).	Ongoing: Outreach program to local agencies regarding implementation of AB 2140 is provided through both formal and informal technical training and assistance. As of May 2017, 41 jurisdictions have integrated their LHMP's and SE's. An additional 82 jurisdictions refer to their LHMP in their SE. *Responsible Agency: Cal OES, OPR*	Goal 1, Objectives 3 Goal 2, Objectives 2, 3 – Goal 3, Objective 1 Goal 4, Objectives 1, 2, 3, 4

Integration of Local and State Mitigation Efforts *See Progress Summary 3.A* *See Progress Summary 3.C* *See Progress Summary 3.F* *See Progress Summary 4.A* *See Progress Summary 7.G* *See Progress Summary 7.I* *See Progress Summary 8.A* *See Progress Summary 8.B* *See Progress Summary 9.D* *See Section 5.3*	Prepare resource materials to assist local governments in achieving consistency with other hazard mitigation and land use plans, and to comply with state legislative requirements.	New: The Central Valley Flood Protection Plan was adopted, implementing previous flood mitigation and general plan legislation. *Responsible Agency: Cal OES, OPR* New: Legislation was adopted requiring localities in certain fire hazard zones to incorporate fire risk in general plan safety elements. In Progress: Cal OES is working with the Governor's Office of Planning and Research (OPR) to incorporate information on hazard mitigation planning into General Plan Guidelines. *Responsible Agency: Cal OES, OPR* Completed: DWR has published the Delta Vision Report identifying a long-term plan and program for managing the Delta levee, water supply and use, and environmental issues. *Responsible Agency: DWR* New: The Sustainable Groundwater Management Act was passed into law in September 2014. It requires local jurisdictions with medium and high priority basins to develop Groundwater Sustainability Plans within 20 years. *Responsible Agency: DWR* New: The 2017 General Plan Guidelines published by OPR requires the inclusion of content on climate change and environmental justice within the General Plan, either as stand- alone elements or integrated into other elements. It also summarizes how a general plan or climate action plan can be consistent with CEQA Guidelines. *Responsible Agency: OPR* New: In response to Executive Order B-30-15, the Technical Advisory Group (TAG) and Sub-TAGs were convened by the Office of Planning and Research (OPR). The group, representing multiple state, regional and local agencies as well as non-governmental organizations and the private sector, met from April 2016 through January 2017. The TAG produced guidance for state agencies. *Responsible Agency: OPR* New: The Integrated Climate Adaptation and Resiliency Program (ICARP) was convened in 2016 through SB 246. ICARP produces a variety of tools and guidance to promote integration of climate change adaptation. *Responsible Agency: OPR* New: The CalBRACE project provides resources and technical assistance for state and local public health departments to build climate adaptation capacity and enhance resilience at the local and regional levels.	Goal 1, All Objectives Goal 2, All Objectives Goal 3, All Objectives Goal 4, All Objectives

		Responsible Agency: CDPH New: SB 246 passed in 2015 directed OPR to coordinate and maintain the State Adaptation Clearinghouse. The web-based clearinghouse provides state, regional, and local planners access to the most current planning and technical assistance resources. *Responsible Agency: OPR* New: The California Air Resources Board (CARB) developed the Climate Action Portal Map (CAP-Map), an interactive web resource that is intended to share climate change actions and policies being implemented within California. *Responsible Agency: CARB* Completed: A Flood Legislation Handbook has been developed by DWR to assist local governments in complying with land use planning requirements of AB 162 and other recent flood legislation. *Responsible Agency: DWR* New: In April 2017, the Ocean Protection Council (OPC) a new guidance document entitled Rising Seas in California: An Update on Sea-Level Science. The document synthesizes the state of sea-level rise in California and provides the basis for the current update of the State's Sea-Level Rise Guidance which was approved in April 2018. *Responsible Agency: OPC, CNRA, OPR, CEC* Ongoing: In 2015, the California Coastal Commission (CCC) published the California Coastal Commission Sea-level Rise Policy Guidance. The guide outlines six steps to address sea-level rise for local coastal planning. *Responsible Agency: CCC* Completed: As required by SB 1278, DWR developed and released 200-year informational floodplain maps for 10 urban communities in the Sacramento-San Joaquin Valley. SB 1278 also extended the deadlines for local adoption of general plans and zoning ordinances consistent with the CVFPP. *Responsible Agency: DWR* Ongoing: SB 1241, passed in 2012 requires wildfire updates to general plans, mandatory findings for subdivision approvals in SRA's and VHFHSZs, and CEQA checklist updates for wildfire safety. Planning and technical assistance is provided through the OSFM Land Use Planning Program. *Responsible Agency: OSFM, CAL FIRE, OPR*	

Program Area	Mitigation Action	2018 Progress	Goals and Objectives Addressed
		Ongoing: CAL FIRE updated SRA and LRA Very High Fire Hazard Severity Zones (VHFHSZ) Maps for the state in draft form in 2014, officially released in 2017. An on-line viewer reflects annual updates to SRA and LRA VHFHSZs. *Responsible Agency: CAL FIRE* Completed: Revised Fire Hazard Severity Zone Maps have been developed by the Board of Forestry for adoption by local governments. *Responsible Agency: CAL FIRE and Board of Forestry*	

APPENDIX D– PROGRESS TRACKING OUTREACH PLAN

Progress Tracking OUTREACH PLAN

SHMP Implementation Monitoring and Progress Review 2013-2018

This Outreach Plan is intended to track ongoing implementation and review progress of hazard mitigation activities identified in the 2013 State Hazard Mitigation Plan (SHMP), as well as other current HM efforts, through outreach to State Hazard Mitigation Team agencies; other state agencies involved in HM; local and regional emergency managers; and local jurisdictions.

OUTREACH PLAN GOALS:

The outreach is an ongoing effort, intended as an ongoing "dialogue" between the SHMP preparers, the SHMT, and various entities currently involved in hazard mitigation efforts. While intended to track implementation and progress, this outreach effort will also contribute to active information sharing and cross sector communications as the outreach team communicates with individuals involved in HM activities, sharing information from one individual to the next during the outreach process.

The outreach effort will also allow for 1) dissemination of information regarding upcoming SHMP update activities and deadlines and 2) requests to individuals for feedback and participation in the update process.

Outreach goals stem from the requirements listed in the FEMA State Mitigation Plan Review Guide (effective March 2016) and California's commitment to continued progress in hazard mitigation efforts around the State.

- Outreach Goal 1: *To track and monitor mitigation progress around the state.*
- Outreach Goal 2: *To maintain contact and coordinate with state and local agencies undertaking mitigation projects.*
- Outreach Goal 3: *To communicate mitigation progress between agencies and promote HM communication across sectors.*
- Outreach Goal 4: *To obtain feedback from state and local agencies on the effectiveness of their HM projects.*

LINKAGE TO STATE MITIGATION PLAN REVIEW GUIDE ELEMENTS

Section 3 of FEMA's State Mitigation Plan Revie Guide (guide) provides detailed guidance in the form of "elements" linked to a specific regulation within 44CFR §201. While considered the minimum requirements for what must be included in a state mitigation plan, these elements provide a good outline for SHMP outreach efforts. Following are the elements directly related to outreach, implementation, and progress tracking which this outreach plan addresses:

- Element S2: *Does the plan describe how the state coordinated with other agencies and stakeholders?*
- Element S17: *Is there a description of the method and schedule for keeping the plan current*
- Element S18: *Does the plan describe the systems for monitoring implementation and reviewing progress?*

OUTREACH TASK 1: CURRENT SHMT MEMBER CONTACT

Purpose: Many members of the SHMT are affiliated with agencies involved with hazard mitigation efforts and will have current information regarding their agencies' HM programs as well as current related policies, legislation, directives, etc, which require certain HM actions by the agency. The goal of our outreach efforts includes tracking these HM actions to assess implementation; as well as communicating information provided through interviews with other agencies; and gathering data that may feed into SHMP update efforts.

Actions:

1) Using current SHMT roster, make calls to "interview" contacts for HM activities.
2) Prioritize outreach first to agencies involved with HM for the "big three" (EQ, Flood, Fire) plus Climate Change related.
3) Second priority to all other hazards following the order presented in chapter 6 of the 2013 SHMP
4) Prioritize outreach calls to agencies/stakeholders of the following sectors:
    - Emergency management
    - Economic development
    - Land Use and development
    - Housing
    - Health and social services
    - Infrastructure
    - Natural and cultural resources
5) Confirm SHMT contact is still active with SHMT, and if not, obtain information for new contact individual.
6) Interview regarding HM. With info from interview, complete HM update form, email to member for confirmation.
7) Provide update of upcoming SHMP update schedule and milestones.
8) Catalog update summary by date.

OUTREACH TASK 2: PROGRESS SUMMARY UPDATES

Purpose: Track progress summaries from 2013 SHMP and prepare a 2016 update to be used as basis for 2018 SHMP update. A total of 62 progress summaries were included in the 2013 SHMP. (*Note – this may overlap with Outreach Task 1.)*

Actions:

1) Contact project representatives via phone (or email).
2) Conduct phone interview regarding project status versus reporting in the 2013 SHMP.
3) Prepare written update summary and email to project rep for confirmation.
4) Catalog update summary by date.

OUTREACH TASK 3: LOCAL JURISDICTION CONTACT

Purpose: While local jurisdictions are required to generally report on grant funded projects, the goal of this outreach is to look for success stories and also understand challenges jurisdictions faced and how they overcame them, which may not come across in grant reporting, that could benefit other jurisdictions to hear about.

Actions:

1) Using Cal OES HMGP recipient list, develop a list of local jurisdictions to contact.
2) "Interview" local jurisdiction contacts about their a) successes, b) challenges, c) lessons learned.
3) Prepare summary of each interview, select potential candidates to be added as "Best Practices" feature in 2018 SHMP and/or consider a new feature called "Hazard Mitigation Lessons Learned".

4) Catalog project summary by date.

OUTREACH TASK 4: ADDING NEW SHMT MEMBERS/EXPANDING STAKEHOLDER CONTACTS

Purpose: To ensure maximum inclusion of stakeholder groups and encourage and input by groups previously not represented in the SHMT for the 2018 SHMP update process.

Target groups for outreach and inclusion with SHMT:

- County Emergency Managers
- Major City Emergency Managers (SF, LA, SD, SAC, OAK, SB, FRES, BAKO, etc)
- All Local Jurisdictions - LHMP Contact Person(s) and emergency managers
- Local and regional planners
- California Special Districts Association and special districts
    - ABAG – Association of Bay Area Governments
    - SCAG – Southern California Association of Governments
    - Other special districts
- Local Government Commissions
- Councils of Governments
- Tribal Emergency Managers
- Faith based disaster assistance groups
- Land Conservancies
- Other "grassroots" organizations
- Utilities
- Organizations/Agencies addressing Climate Change and Regional Climate Change Collaborative Entities
    - Office of Environmental Health Hazard Assessment (OEHHA)
    - Climate Resolve (UCLA)
    - LARC – Los Angeles Regional Climate Collaborative
- Other groups from the following sectors:
    - Economic development
    - Land Use and development
    - Housing
    - Health and social services
    - Infrastructure
    - Natural and cultural resources

OTHER GENERAL OUTREACH TASKS:

Purpose: The intent of these general outreach efforts is to maintain contact with the SHMT and stakeholders so that they are aware of the progress of HM around the state and also continued implementation tracking and update efforts.

Tasks:

1) Monthly (or quarterly) emails to SHMT – intended to maintain contact with the team and let them know of upcoming actions.
2) Newsletter – intended to document feature HM progress and maintain contact with team.

RESULTS OF OUTREACH TASKS

Purpose: As part of the ongoing implementation tracking effort results of all outreach efforts will be officially summarized in a document with standard information fields (contact name, date of interview, interviewer name, specific hazard, project name, project details) and maintained as part of the SHMP.

Actions:

1) Prepare written summaries of each communication.
2) Confirm details of summary with individual interviewed via email.
3) Maintain "catalog" of these HM update summaries by year/quarter.
4) Reference each year's updates as an annex amendment to the adopted 2013 SHMP.
5) Use catalog of summaries to start 2018 SHMP update process.

SCHEDULE

October 2016-March 2017:	Outreach Task 1
February-April 2017:	Outreach Task 2
February-April 2017:	Outreach Task 3
May-December 2017:	Outreach Task 4

Last Updated November 1, 2016

Progress Tracking - OUTREACH PLAN

SHMP Implementation Monitoring and Progress Review 2013-2018
OUTREACH CALLS

INTERVIEW QUESTIONS TO STATE AGENCIES OR SHMT MEMBERS:

1) What is current status of programs previously discussed in 2013 SHMP?

2) Does your agency have any new hazard mitigation programs/projects? If yes:

    a. What hazard is being addressed,
    b. What is timeline for project,
    c. What is source of funding (federal grant funding or state funding),
    d. Are other agencies involved in the project?
    e. What does the project hope to accomplish? Project goals?
    f. If program is completed, did it meet its goals?

3) Do you have any hazard mitigation project success stories that should be featured as a special "best practices" article in the 2018 SHMP or in an upcoming issue of our new HM newsletter?

4) How do your current hazard mitigation activities align with the four goals (and/or objectives) of the 2013 SHMP?

5) How do your HM activities meet or respond to requirements of recent HM legislation (last 10 years)?

6) What are your agency's HM priorities?

7) How have your HM priorities changed since the 2013 SHMP was published?

8) How do your future HM priorities align with the 2013 SHMP goals?

9) Does your agency follow an overall plan for mitigation efforts? If yes, how do your current mitigation actions align with the goals of that plan?

10) Do you have any maps/photos/exhibits/documents that should be used or referenced in the 2018 SHMP update?

INTERVIEW QUESTIONS TO COGS:

1) What hazard mitigation services has your COG provided in the last 5 years?
    a. Regional data collection services?
    b. Regional hazard mapping services?
    c. Regional hazard assessment services?
    d. Direct technical assistance to your member cities and counties?

2) How many LHMPs do you consider your COG to be the primary author of?

3) What is the total population served by your COG in 2015?

4) How do your services align with the SHMP four goals and objectives

5) In the next 3-7 years what programs or services will you be putting HM activities funding and staffing toward?

INTERVIEW QUESTIONS FOR LOCAL GRANT FUNDED PROJECT CONTACTS:

(Assumes the basic premise of the project is already known through grant reports submitted by the local jurisdiction):

1) Is your HM project still in process or complete? If not completed yet, do you anticipate completing on schedule, or when?

2) Did your project proceed as anticipated?

3) What were the biggest challenges your project faced?

4) What were the best lessons learned from the project?

5) What advice would you share with other jurisdictions getting to start a HMGP project, based on your jurisdiction's experience?

6) Does your jurisdiction ever coordinate HM with other agencies or jurisdictions?

7) What are your jurisdiction's HM priorities?

8) How do your priorities align with the 2013 SHMP goals?

9) Do you have any maps/photos/exhibits/documents that should be used or referenced in the 2018 SHMP update?

10) Does your agency follow an overall plan for mitigation efforts? If yes, how do your current mitigation actions align with the goals of that plan?

11) What HM projects does your jurisdiction hope to do in the next 3-7 years?

Last Updated November 1, 2016

State of California Hazard Mitigation

Progress Tracking Interview Report

DATE OF INTERVIEW:

PERSON CONDUCTING INTERVIEW:

CONTACT INFORMATION

INTERVIEW CONTACT PERSON:

CONTACT PERSON EMAIL AND PHONE NUMBER:

AGENCY INFORMATION

CONTACT AGENCY:

SUMMARY OF CONTACT AGENCY CAPABILITIES:

WHICH OF THE FOLLOWING DESCRIBES THIS AGENCY:

a. Emergency management
b. Economic development
c. Land use and development
d. Housing
e. Health and social services
f. Infrastructure
g. Natural and Cultural Resources

PROGRAM INFORMATION

HAZARD ADDRESSED BY PROGRAM:

PROGRAM NAME AND DESCRIPTION:

OTHER AGENCIES INVOLVED IN PROGRAM:

PROGRAM LOCATION(S):

PROGRAM FUNDING SOURCE:

PROGRAM START DATE:

PROGRAM END DATE:

PROGRAM GOALS/OBJECTIVES:

DID PROGRAM MEET ITS GOALS?:

IS PROGRAM PART OF AN OVERALL MITIGATION PLAN BY AGENCY?

CHALLENGES/OBSTACLES FACED BY PROGRAM:

SUCCESSES ACHIEVED BY PROGRAM:

SHMP LINKAGE INFORMATION

IF PROGRAM PART OF AN OVERALL MITIGATION PLAN BY AGENCY, IS SUCH OVERALL MITIGATION PLAN LINKED TO SHMP OR OTHER MITIGATION PLANS?

LINKAGE WITH SHMP/SHMP GOALS :

LINKAGE TO STATE LAW OR POLICY:

OTHER INFORMATION

INTERVIEW SUMMARY:

OTHER COMMENTS:

ACTION ITEMS:

Last Updated November 1, 2016

APPENDIX E – CALIFORNIA DISASTER HISTORY, 1950-2018

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
December 2017 California Wildfires & Debris Flows	Fire	Fires	DR-4353 GP 2017-12	2017	Santa Barbara, Ventura Los Angeles, San Diego, Santa Barbara, Ventura	12/07/2017	1/02/2018	21		
December 2017 California Wildfires	Fire	Fires	EM-3396	2017	Los Angeles, Riverside, San Diego, Santa Barbara, Ventura		12/08/2017	Reported under Thomas Fire (FM-5224)		
Lilac 5 Fire	Fire	Fires	FM-5228 GP 2017-12	2017	San Diego	12/07/2017	12/07/2017			
Skirball Fire	Fire	Fires	FM-5227 GP 2017-12	2017	Los Angeles	12/07/2017	12/06/2017			
Rye Fire	Fire	Fires	FM-5226, GP 2017-12	2017	Los Angeles	12/07/2017	12/05/2017			
Creek Fire	Fire	Fires	FM-5225GP 2017-12	2017	Los Angeles	12/07/2017	12/05/2017			
Thomas Fire	Fire	Fires	FM-5224	2017	Santa Barbara, Ventura		12/05/2017	2		
Inyo and Mono Snowmelt	Snowmelt		GP 2017-11	2017	Inyo, Mono	`				
October 2017 California Wildfires	Fire	Fires	DR-4344GP 2017-09	2017	Butte, Lake, Mendocino, Napa, Orange, Sonoma, Yuba, Nevada, Solano	10/09/2017	10/09/2017			
Canyon 2 Fire	Fire	Fires	FM-5223	2017	Orange, Riverside		10/09/2017			
Patrick Fire	Fire	Fires	FM-5222	2017	Napa, Sonoma		10/09/2017			
Sulphur Fire	Fire	Fires	FM-5221	2017	Lake		10/09/2017			
Nuns Fire	Fire	Fires	FM-5220	2017	Sonoma		10/09/2017	3		
Redwood/Potter Fires	Fire	Fires	FM-5219	2017	Mendocino		10/09/2017	9		
La Porte Fire	Fire	Fires	FM-5218	2017	Butte		10/09/2017			
Lobo Fire	Fire	Fires	FM-5217	2017	Nevada		10/09/2017			
Cascade Fire	Fire	Fires	FM-5216	2017	Butte, Yuba		10/09/2017	4		
Tubbs Fire	Fire	Fires	FM-5215	2017	Napa, Sonoma		10/09/2017	22		
Atlas Fire	Fire	Fires	FM-5214	2017	Napa, Solano		10/09/2017	6		
Alamo and Whittier Wildfires	Fire	Fires	GP 2017-08	2017	Santa Barbara					
Canyon Fire	Fire	Fires	FM-5213	2017	Orange, Riverside		9/25/2017			
Pier Fire	Fire	Fires	FM-5205	2017	Tulare		9/05/2017			
Mission Fire	Fire	Fires	FM-5204	2017	Madera		9/04/2017			
Railroad Fire	Fire	Fires	FM-5202	2017	Madera, Mariposa		9/02/2017			
La Tuna Fire	Fire	Fires	FM-5201	2017	Los Angeles		9/02/2017			

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Ponderosa Fire	Fire	Fire	GP 2017-10	2017	Butte	9/01/2017				4,562
Helena Fire	Fire	Fires	FM-5199 GP 2017-07	2017	Trinity	8/31/2017	9/01/2017			9,688,890
Modoc County Wildfires	Fire	Fires	GP 2017-06	2017	Modoc	8/02/2017				46,542
Detwiler Fire	Fire	Fires	FM-5192, GP 2017-04	2017	Mariposa	7/18/2017	7/17/2017			
Wall Fire	Fire	Fires	FM-5189, GP 2017-05	2017	Butte	7/09/2017	7/09/2017			
February 2017 Storms	Flooding and Mudslides	Storms	DR-4308, GP 2017-03	2017	Alameda, Alpine, Amador, Butte, Calaveras, Colusa, Contra Costa, Del Norte, El Dorado, Glenn, Humboldt, Kings, Lake, Lassen, Marin, Mariposa, Modoc, Mono, Monterey, Napa, Nevada, Plumas, Sacramento, San Benito, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Tuolumne, Yolo, Yuba, Tule River Tribe	3/07/2017	4/01/2017	8		(DR-4308) 119,834,925 (GP 2017-03) 331,137
Late January 2017 Storms	Flooding and Mudslides	Storms	DR-4305	2017	Alameda, Calaveras, Contra Cost, El Dorado, Inyo, Kern, Los Angeles, Mendocino, Modoc, Mono, Napa, Orange, Riverside, Sacramento, San Diego, San Luis Obispo, San Mateo, Santa Barbara, Santa Cruz, Trinity, Tuolumne, Yolo	2/10/2017	3/16/2017			14,320,716
Potential Failure of Oroville Dam Emergency Spillway	Other		EM-3381	2017	Butte, Sutter, Yuba		2/14/2017			

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
January 2017 Storms	Flooding and Mudslides	Storms	DR-4301	2017	Alameda, Amador, Butte, Calaveras, Contra Costa, El Dorado, Humboldt, Inyo, Lake, Lassen, Marin, Mendocino, Merced, Mono, Monterey, Napa, Nevada, Placer, Plumas, Sacramento, San Benito, San Luis Obispo, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Solano, Sonoma, Sutter, Trinity, Tuolumne, Yolo, Yuba		2/14/2017			39,956,354
December 2016 Storms	Storms	Storms	GP 2016-05	2016	Del Norte	1/23/2017				274,823
Cedar Fire	Fire	Fires	FM-5150	2016	Kern, Tulare		8/22/2016			1,441,015
Blue Cut Fire	Fire	Fires	FM-5147	2016	San Bernardino		8/16/2016			2,266,434
Chimney Fire	Fire	Fires	FM-5146	2016	Lake		8/14/2016			52,798,980
Clayton Fire	Fire	Fires	FM-5145, GP 2016-04	2016	Madera	9/15/2016	8/14/2016			(FM-5145) 13,579,947, (GP 2016-04) 14,826,022
Pilot Fire	Fire	Fires	FM-5144	2016	San Bernardino		8/08/2016			3,187,835
Goose Fire	Fire	Fires	FM-5140	2016	Fresno		7/31/2016			6,538,221
Soberanes Fire	Fire	Fires	FM-5137	2016	Monterey		7/28/2016	1		2,267,213
Sand Fire	Fire	Fires	FM-5135	2016	Los Angeles		7/23/2016	1		5,128,119
Sage Fire	Fire	Fires	FM-5132	2016	Los Angeles		7/09/2016			1,993,954
Erskine Fire	Fire	Fires	FM-5131, GP 2016-03	2016	Kern	6/24/2016	6/23/2016	2		(FM-5131) 4,433,146, (GP 2016-03) 26,610,979
Fish Fire	Fire	Fires	FM-5129	2016	Los Angeles		6/21/2016			1,394,208
Border 3 Fire	Fire	Fires	FM-5128	2016	San Diego		6/19/2016	2		12,759,142
Old Fire	Fire	Fires	FM-5124	2016	Los Angeles		6/05/2016			1,923,392
Valley & Butte Fires	Fire	Fires	DR-4240, GP 2015-03	2015	Calaveras, Lake	8/27/2015	9/22/2015	Reported under individual fires below		(DR-4240) 242,803,440, (GP 2015-03) 2,401,287
Valley Fire	Fire	Fires	FM-5112	2015	Napa, Sonoma		9/12/2015	4		3,029,711
Butte Fire	Fire	Fires	FM-5111	2015	Amador		9/10/2015	2		3,191,496
Rocky Fire	Fire	Fires	FM-5093	2015	Madera	8/02/2015			30,857,410	
Wragg Fire	Fire	Fires	FM-5091	2015	Napa, Solano, Yolo		7/23/2015			13,934,643
North Fire	Fire	Fires	FM-5089	2015	San Bernardino		7/17/2015			851,448
Round Fire	Fire	Fires	GP 2015-01	2015	Mono	2/26/2015				5,607,764

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
December 201										
Applegate Fire	Fire	Fires	FM-5082	2014	Placer		10/08/2014			4,199,623
King Fire	Fire	Fires	FM-5081	2014	El Dorado, Placer		9/17/2014			17,367,831
Boles Fire	Fire	Fires	FM-5079	2014	Siskiyou	10/06/2014	9/15/2014			5,327,462
Courtney Fire	Fire	Fires	FM-5078	2014	Madera		9/14/2014			3,440,104
South Napa Earthquake	Earthquake	Earthquake	DR-4193, GP 2014-02	2014	Napa, Solano, Sonoma	8/24/2014	9/11/2014	1	285	(DR-4193) 33,897,764 (GP 2014-02) 233,042
Bridge Fire	Fire	Fires	FM-5077	2014	Mariposa		9/05/2014			3,340,241
Oregon Fire	Fire	Fires	FM-5076	2014	Trinity		8/25/2014			1,960,046
Way Fire	Fire	Fires	FM-5075	2014	Kern		8/19/2014			2,566,094
Junction Fire	Fire	Fires	FM-5074	2014	Madera		8/19/2014			3,469,116
Day Fire	Fire	Fires	FM-5070	2014	Modoc		8/03/2014			9,800,752
Bald Fire	Fire	Fires	FM-5069	2014	Lassen, Shasta		8/03/2014			2,060,557
Oregon Gulch Fire	Fire	Fires	FM-5068							
GP 2014-04	2014	Siskiyou	10/06/2014	8/02/2014			(FM-5068) 1,137,283, (GP 2014-04) 11,621,359			
Eiler Fire	Fire	Fires	FM-5067	2014	Shasta		8/02/2014			8,062,197
Butts Fire	Fire	Fires	FM-5057	2014	Napa		07/02/2014			5,180,771
Cocos Fire	Fire	Fires	FM-5055, GP 2014-01	2014	San Diego	05/14/2014	05/14/2014			(FM-5055) 10,313,305, (GP 2014-01) 2,131,397
Poinsettia Fire	Fire	Fires	FM-5054	2014	San Diego	05/14/2014	05/14/2014			1,459,862
Colby Fire	Fire	Fires	FM-5051	2014	Los Angeles		01/16/2014			
Rim Fire	Fire	Fires	DR-4158, GP 2013-02	2013	Mariposa, Tuolumne	10/23/2013	12/13/2013			(DR-4158) 24,465,538, (GP 2013-02) 174,688
Inyo July 2013 Storms	Storms	Storms	GP 2013-01	2013	Inyo	9/30/2013				3,837,141
Clover Fire	Fire	Fires	FM-5050	2013	Shasta		9/10/2013	1		4,558,433
Rim Fire	Fire	Fires	FM-5049	2013	Mariposa	10/23/2013	8/23/2013			469,673
Silver Fire	Fire	Fires	FM-5041	2013	Riverside		8/12/2013			5,721,361
Falls Fire	Fire	Fires	FM-5040	2013	Riverside		8/06/2013			1,715,016
Powerhouse Fire	Fire	Fires	FM-5025	2013	Los Angeles		6/02/2013			2,023,801
Springs Fire	Fire	Fires	FM-5024	2013	Ventura		5/02/2013			8,332,445
Summit Fire	Fire	Fires	FM-5023	2013	Riverside		5/02/2013			2,221,604
Shockey Fire	Fire	Fires	FM-5021	2012	San Diego		9/24/2012	1	3	108,959
Ponderosa Fire	Fire	Fires	FM-5007	2012	Shasta, Tehama		8/19/2012		7	477,537
Wye Incident	Fire	Fires	FM-5004	2012	Lake		8/13/2012		3	84,613
Comanche Complex	Fire	Fires	FM-2971	2011	Kern		9/11/2011		6	6,472,957

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Keene Complex	Fire	Fires	FM-2970	2011	Kern		9/11/2011			3,996,343
Canyon Fire	Fire	Fires	FM-2961	2011	Kern		9/05/2011			8,787,604
Hill Fire	Fire	Fires	FM-2955	2011	San Bernardino		9/02/2011			1,280,591
Tuolumne Feb 2011 Storms	Storms	Storms	GP 2011-03	2011	Tuolumne					509,329
March 2011 California Tsunami	Tsunami	Earthquake	DR-1968	2011	Del Norte, Monterey, Santa Cruz	3/11/2011	4/18/2011	1	1	39,617,379
Modoc Jan 2011 Storms	Storms	Storms	GP 2011-01	2011	Modoc	3/03/2011				385,788
December 2010 Statewide Storms	Storms	Storms	DR-1952	2010 - 2011	Inyo, Kern, Kings, Madera, Mariposa, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Tulare	12/21/2010, 12/23/2010, 12/24/2010, 12/30/2010	1/26/2010			66,318,201
Via Scott Incident	Other		GP 2010-16	2010	San Diego	12/01/2010				73,981
Richmond Sinkhole	Other	Storms	GP 2010-15	2010	Contra Costa					10,586,339
November Storms	Storms	Storms	GP 2010-14	2010	Calaveras, Tuolumne	11/30/2010, 12/09/10				160,280
Contaminated Drinking Water Supply	Other		GP 2010-13	2010	San Bernardino	11/20/2010				0
Galleria Incident	Fire	Fires	GP 2010-12	2010	Placer	10/22/2010				478,119
Canyon Fire	Fire	Fires	FM-2858	2010	Kern	9/15/2010	9/15/2010		7	883,828
Glenview Fire (San Bruno Explosion)	Fire (Explosion)	Fires (Explosion)	FM-2856 (GP 2010-09)	2010	San Mateo	9/09/2010	9/09/2010			
Yuba County Wildfires	Fire	Fires	GP 2010-08	2010	Yuba	8/28/2010				34,829
Post Fire	Fire	Fires	FM-2852	2010	Kern	8/25/2010	8/24/2010			1,664,357
Crown Fire	Fire	Fires	FM-2851	2010	Los Angeles		7/29/2010			6,565,808
West Fire	Fire	Fires	FM-2850	2010	Kern	7/27/2010	7/27/2010			5,833,041
Bull Fire	Fire	Fires	FM-2849	2010	Kern	7/27/2010	7/26/2010			631,156
Pacific Storm Drain Outfall	Storms	Storms	GP 2010-04	2010	San Mateo					896,520
Baja Earthquake	Earthquake	Earthquake	DR-1911	2010	Imperial	4/05/2010	5/07/2010			39,384,403
2010 Severe Winter Storms	Flood, debris & mud flows	Storms	DR-1884	2010	Calaveras, Imperial, Los Angeles, Riverside, San Bernardino, Siskiyou	1/21/2010, 1/22/2010, 1/27/2010	3/08/2010	2	*	37,056,584
Humboldt Earthquake	Earthquake	Earthquake	GP 2010-01	2010	Humboldt	01/12/2010				11,966,685
Santa Cruz County Storms	Flood	Storms	GP 2009-13	2009	Santa Cruz County					4,483,715
Sheep Fire	Fire	Fire	FM 2841	2009	San Bernardino County		10/4/2009			1,500,883

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Imperial County Storms	Flood	Storms	GP 2009-10	2009	Humboldt County	9/18/2009				458,749
Guiberson Fire	Fire	Fire	FM 2839	2009	Ventura County		9/22/2009		10	10,869,516
Pendleton Fire	Fire	Fire	FM 2836	2009	San Bernardino County		9/1/2009		1	4,383,907
Oak Glen Fire	Fire	Fire	FM 2833	2009	San Bernardino County		8/31/2009		4	5,247,456
49er Fire	Fire	Fire	FM 2832	2009	Orange County		8/31/2009			1,196,092
San Bernardino Fire	Fire	Fire	GP 2009-09	2009	San Bernardino County					95,020
Big Meadow Fire	Fire	Fire	GP 2009-07	2009	Mariposa County	8/29/2009				21,299
Monterey County Wildfires	Fire	Fire	GP 2009-06	2009	Monterey County	8/28/2009				37,991
LA County Wildfires	Fire	Fire	GP 2009-05	2009	Los Angeles County			0	6	9,286,724
Station Fire	Fire	Fire	FM 2830	2009	Los Angeles County		8/28/2009	2	23	19,053,328
PV Fire	Fire	Fire	FM 2828	2009	Los Angeles County		8/28/2009	0	0	317,175
Yuba Fire	Fire	Fire	FM 2825	2009	Nevada County, Yuba County		8/15/2009		41	10,013,956
Lockheed Fire	Fire	Fire	FM 2824	2009	Santa Cruz County		8/13/2009		10	23,977,717
Fresno Drought	Drought	Drought	GP 2009-02	2009	Fresno County	6/19/2009				0
Jesusita Fire	Fire	Fire	FM 2817	2009	Santa Barbara County		5/6/2009		0	32,588,540
November 2008 Winds/Wildfires	Fire	Fire	GP 2008-11	2008	San Bernardino County	11/18/2008				164,663
Freeway Complex	Fire	Fire	FM 2792	2008	San Bernardino County		11/15/2008		0	
November 2008 California Wildfires	Fire	Fire	FEMA DR-1810-CA	2008	Los Angeles, Orange, Riverside, and Santa Barbara counties		11/18/2008	0	28	221,219
Wildfires	Fire	Fire	GP 2008-10	2008	San Bernardino County	10/13/2008				82,985,527
Sesnon Fire	Fire	Fire	FM 2789	2008	Los Angeles County, Ventura County		10/13/2008			2,634,935
Marek Fire	Fire	Fire	FM 2788	2008	Los Angeles County		10/12/2008			6,060,351
Gladding Fire	Fire	Fire	FM 2786	2008	Placer County		9/1/2008			3,227,824
Firestorms and Flooding	Fire	Fire	GP 2008-09	2008	Los Angeles County	4/27/2008				
Twentynine Palms Thunderstorms	Flood	Storms	GP 2008-08	2008	San Bernardino County					4,629
Ridgecrest Thunderstorms	Flood	Storms	GP 2008-07	2008	Kern County					0
Cathedral City Flooding	Flood	Storms	GP 2008-06	2008	Riverside County					0
Inyo Severe Thunderstorms	Flood	Storms	GP 2008-05	2008	Inyo County	7/15/2008				352,789
Modoc Storms	Flood	Storms	GP 2008-04	2008	Modoc County					909,499

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Central Valley Drought	Drought	Drought	GP 2008-03	2008	Calaveras, Kern, Madera, Merced, Sacramento, San Joaquin, Stanislaus, Tulare counties	6/12/2008				0
2008 Mid-Year Fires								15	*	
(excluded EM-3287)	Fire	Fire	GP 2008-02	2008	Humboldt County	6/28/2008			1	4,394,159
2008 Mid-Year Fires	Fire	Fire	EM-3287	2008	Butte, Kern, Mariposa, Mendocino, Monterey, Plumas, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Trinity counties		6/28/2008			
Wild Fire	Fire	Fire	FM 2776	2008	Napa County		6/22/2008		10	330,856,351
Martin Fire	Fire	Fire	FM 2772	2008	Santa Cruz County		6/11/2008		1	1,275,377
Humboldt Fire	Fire	Fire	FM 2771	2008	Butte County		6/11/2008		16	3,714,441
Ophir Fire	Fire	Fire	FM 2770	2008	Butte County		6/10/2008	15	*	18,134,595
Summit Fire	Fire	Fire	FM 2766	2008	Santa Clara, Santa Cruz counties		5/22/2008		1	44,903
Santa Anita Fire	Fire	Fire	FM 2763	2008	Los Angeles County		4/27/2008			13,980,269
2008 January Storms	Flood	Storms	GP 2008-01	2008	Alameda, Butte, Colusa, Del Norte, El Dorado, Glenn, Kings, Mendocino, Nevada, Placer, Sacramento, San Francisco, Sierra, Sutter, Yolo, Yuba counties	1/5/2008				2,570,876
Martin's Ferry Bridge	Other	Bridge Damage	GP 2007-16	2007	Humboldt County	12/21/2007				8,871,077
Bay Area Oil Spill	Other	Accident	GP 2007-15	2007	Alameda, Contra Costa, Marin, San Francisco, San Mateo, Solano, Sonoma counties	11/9/2007				0
2007 Southern CA Fires	Fire	Fire	FEMA DR-1731-CA	2007	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Ventura counties		10/21/2007	10	139	198,562,023
I-5 Major Collision	Road Damage	Accident	GP 2007-13	2007	Los Angeles County	10/14/2007				66,465
Mount Soledad Landslide	Landslide	Landslide	GP 2007-12	2007	San Diego County	10/3/2007				7,509,266
Angel Fire	Fire	Fire	FM 2729	2007	San Diego County		9/15/2007			4,444,159
Imperial Microburst	Flood	Storms	GP 2007-11	2007	Imperial County	9/16/2007				1,232,315
Butler 2 Fire	Fire	Fire	FM 2728	2007	San Bernardino County		9/15/2007			4,944,213

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Canyon Fire	Fire	Fire	FM 2708	2007	Los Angeles County		7/8/2007			517,152
Zaca Fire	Fire	Fire	GP 2007-09	2007	Santa Barbara County, Ventura County	8/18/2007			43	4,265,384
Needles Rainstorm	Flood	Storms	GP 2007-08	2007	San Bernardino County	7/25/2007				345,508
Inyo Complex	Fire	Fire	FM 2706	2007	Inyo County		7/6/2007			772,241
Creek Fire	Fire	Fire	FM 2702	2007	Shasta County		6/29/2007		3	178,678
Angora Fire	Fire	Fire	FM 2700	2007	El Dorado County		6/24/2007			947,668
2007 Drought	Drought	Drought	GP 2007-05	2007	Kings County, Riverside County	6/19/2007				0
Island Fire (Catalina)	Fire	Fire	FM-2694	2007	Los Angeles		5/10/2007			
Griffith Park Brush Fire	Fire	Fire	FM-2691	2007	Los Angeles		5/8/2007			2,508,441
241 Fire	Fire	Fire	FM-2683	2007	Orange		3/11/2007			1,622,014
2007 Severe Freeze	Freeze	Freeze	DR-1689	2007	Fresno, Imperial, Kern, Los Angeles, Monterey, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Tulare, Ventura counties		3/13/2007			2,700,400
Shekell Fire Complex	Fire	Fire	2006-13	2006	Ventura	12/4/2006				105,849
Esperanza Fire	Fire	Fire	2006-09	2006	Riverside	10/26/2006		5	17	11,083,665
Day Fire	Fire	Fire	2006-08	2006	Ventura	9/24/2006				2,050,612
Orchard Fire	Fire	Fire	FM-2676	2006	Riverside	9/19/2006	9/16/2006			315,525
Junction Fire	Fire	Fire	FM-266, DC 2006-07	2006	Trinity		7/29/2006			3,168,140
Major Levee Erosion	Flood	Levee break	DC 2006-06	2006	Trinity	9/19/2006				43,913
Horse Fire	Fire	Fire	FM-2656	2006	San Diego		7/24/2006		23	2,121,800
Lake Tahoe Sewage Spill	HazMat	Sewage spill	SBA-10224	2006	El Dorado					
Sawtooth Fire Complex	Fire	Fire	2006-05	2006	San Bernardino	7/13/2006		1	17	12,346,391
Corcoran Water Well Failure	Facility	Water Well Failure	2006-04	2006	City of Corcoran (Kings County)	6/23/2006				362,988
Ferguson Rockslide	Landslide	Landslide	SBA-10535	2006	Mariposa (Merced River)					

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
2006 June Storms	Flood	Storms	DR-1646	2006	Alameda, Amador, Calaveras, El Dorado, Lake, Madera, Marin, Merced, Napa, Nevada, Placer, San Joaquin, San Mateo, Santa Cruz, Sonoma, Stanislaus, Tuolumne counties + statewide HM		6/5/2006			45,219,721
2006 April Storms	Flood	Storms	2006-03	2006	Fresno, Kings, Mariposa, Tulare	4/10/2006				11,227,273
Levee Erosion	Flood	Levee break	DC 2006-02	2006	City of East Palo Alto (San Mateo County)	3/28/2006				551,736
Sierra Fire	Fire	Fire	FM-2630	2006	Orange, Riverside		2/6/2006		8	161,790
2005/06 Winter Storms	Flood	Storms	DR-1628	2005 2006	Alameda, Alpine, Amador, Butte, Colusa, Contra Costa, Del Norte, El Dorado, Humboldt, Lake, Lassen, Marin, Mendocino, Napa, Nevada, Placer, Plumas, Sacramento, San Joaquin, San Luis Obispo, San Mateo, Santa Cruz, Sierra, Siskiyou, Solano, Sonoma, Sutter, Trinity, Yolo, Yuba counties + statewide HM		2/3/2006			203,050,747
2005-06 Winter Storms	Flood	Storms	2006-01	2005	Fresno, Kings, Shasta, Tulare counties	1/12/2006				1,275,237
Hurricane Katrina Evacuations	Economic	Hurricane	EM-3248	2005	All 58 counties		9/13/2005			763,576
Extreme Rainfall	Flood	Storms	DC 2005-06	2005	Sierra County	11/7/2005				504,323
School Fire	Fire	Fire	FM-2586	2005	Ventura County		11/18/2005			4,468,439
Border #50 Fire	Fire	Fire	FM-2585	2005	San Diego County		10/6/2005			3,406,702
Woodhouse Fire	Fire	Fire	FM-2584	2005	Riverside County		10/5/2005		3	1,040,087
Severe Thunderstorms and Flash Flooding	Flood	Storms	DC 2005-06	2005	California City (Kern), City of Needles & Town of Yucca Valley (San Bernardino)	9/26/2005				615,945
Topanga Fire	Fire	Fire	FM-2583	2005	Los Angeles, Ventura		9/28/2005			19,787,415
Sundevil Fire	Fire	Fire	FM-2582	2005	San Diego		9/5/2005		31	233,530
Manton Fire	Fire	Fire	FM-2580	2005	Tehama, Shasta		8/26/2005			4,048,525
Quartz Fire	Fire	Fire	FM-2571	2005	Madera		7/25/2005			1,428,429
Rain and Flooding (Modoc)	Flood	Storms	GP 2005-04	2005	Modoc	5/1/2005				295,809

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
March Storms and Landslide (San Mateo)	Flood	Storms	GP 2005-05	2005	San Mateo	3/1/2005				337,252
2005 March Flooding (Mariposa)	Flood	Flood	GP 2005-03	2005	Mariposa	3/1/2005				2,758,943
2005 Floods Excluded from DR-1585	Flood	Storms	GP 2005-02	2005	Kern, San Bernardino, San Diego, Santa Barbara	2/1/2005				8,055,058
2005 February Storms	Flood	Storms	DR-1585	2005	Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Ventura	3/16/2005	4/14/2005			101,189,489
2005 January Winter Storms	Flood	Storms	DR-1577, GP2005-01	2005	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, Ventura, Kern (HM only)	1/12/2005	2/4/2005			281,765,975
Death Valley Flood	Flood	Flood	DC 2004-08	2004	Inyo	11/1/2004				186,052
Old Hwy Fire	Fire	Fire	FM-2555	2004	Mariposa		9/13/2004		3	2,691,934
Geysers Fire	Fire	Fire	FM-2554	2004	Sonoma		9/4/2004		19	2,434,325
Pattison Fire	Fire	Fire	FM-2553	2004	Calaveras		9/4/2004		2	3,625,196
Bear Fire (Mariposa)	Fire	Fire	FM-2552	2004	Mariposa		9/3/2004			1,118,783
Lake Fire	Fire	Fire	FM-2548	2004	Shasta	8/23/2004	8/14/2004			204,470
French Fire	Fire	Fire	FM-2547	2004	Shasta	8/23/2004	8/14/2004		20	14,608,538
Oregon Fire	Fire	Fire	FM-2545	2004	Butte		8/11/2004		3	822,904
Bear Fire (Shasta)	Fire	Fire	FM-2544	2004	Shasta	8/23/2004	8/11/2004		10	7,612,263
Stevens Fire	Fire	Fire	FM-2541	2004	Placer		8/8/2004		9	3,469,004
Calaveras Complex	Fire	Fire	FM-2540	2004	Calaveras		8/8/2004		14	4,656,887
Deep Fire	Fire	Fire	DC 2004-06	2004	Tulare	8/1/2004				
Crown Fire	Fire	Fire	FM-2535	2004	Los Angeles		7/21/2004			2,604,924
Foothill Fire	Fire	Fire	FM-2534	2004	Los Angeles		7/18/2004			4,319,501
Melton Fire	Fire	Fire	FM-2533	2004	Riverside		7/17/2004			2,715,200
Hollow Fire	Fire	Fire	FM-2532	2004	El Dorado		7/14/2004			179,440
Lakeview Fire	Fire	Fire	FM-2530	2004	Riverside		7/14/2004			74,349
Mataguay Fire	Fire	Fire	FM-2529	2004	San Diego		7/14/2004		7	2,084,052
Pine Fire	Fire	Fire	FM-2528	2004	Los Angeles		7/14/2004			9,028,675
Gaviota Fire	Fire	Fire	FM-2519	2004	Santa Barbara		6/5/2004		44	6,143,627
San Joaquin Levee Break	Flood	Levee break	DR-1529	2004	San Joaquin	6/4/2004	6/30/2004			27,214,428
Cerritos Fire	Fire	Fire	FM-2517	2004	Riverside		5/4/2004		10	5,816,297
Eagle Fire	Fire	Fire	FM-2516	2004	Riverside		5/4/2004		8	6,257,005
Pleasure Fire	Fire	Fire	FM-2515	2004	Riverside		4/26/2004			
Daly City Flooding	Flood	Flood	DC 2004-02	2004	San Mateo	2/1/2004				337,614

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Snowstorm (Trinity)	Snow	Storms	DC 2004-01	2004	Trinity	1/1/2004				1,122,549
San Simeon Earthquake	Earthquake	Earthquake	DR-1505	2003	San Luis Obispo, Santa Barbara	12/23/2003	1/13/04			64,558,853
Flash flooding	Flood	Storms	GP 2003-04	2003	Los Angeles	11/14/2003				903,275
Whitmore Fire	Fire	Fire	FM-2508	2003	Shasta		10/28/2003			1,999,031
California Wildfires	Fire	Fire	DR-1498	2003	Ventura, Los Angeles, San Bernardino, Riverside, San Diego	10/26/2003	10/27/2003	24	246	177,515,291
Mountain Fire	Fire	Fire	FM-2507**	2003	Riverside		10/26/2003			
Paradise Fire	Fire	Fire	FM-2506**	2003	San Diego		10/26/2003			
Cedar Fire	Fire	Fire	FM-2505**	2003	San Diego		10/26/2003			
Simi Fire	Fire	Fire	FM-2504*	2003	Ventura		10/26/2003			
Old Fire	Fire	Fire	FM-2503*	2003	San Bernardino		10/25/2003			
Verdale Fire	Fire	Fire	FM-2502*	2003	Los Angeles, Ventura		10/25/2003			
Grand Prix Fire	Fire	Fire	FM-2501*	2003	San Bernardino		10/23/2003			
Pass Fire	Fire	Fire	FM-2500*	2003	Riverside		10/21/2003			
Bridge Fire	Fire	Fire	FM-2497	2003	San Bernardino		9/5/2003			784,529
Locust Fire	Fire	Fire	FM-2491	2003	Riverside		8/19/2003			1,319,887
										***fires above*
2003 August Storms	Flood	Storms	DC 2003-02	2003	Imperial, Inyo, San Bernardino		8/1/2003			4,126,902
Canyon Fire	Fire	Fire	FM-2487	2003	Riverside		7/25/2003			3,681,947
Railroad Fire	Fire	Fire	FM-2475	2003	Riverside		7/3/2003			276,200
Tejon Fire	Fire	Fire	FM-2474	2003	Kern		6/29/2003			1,323,296
Sawmill Fire	Fire	Fire	FM-2473	2003	Kern		6/27/2003			946,806
Bark Beetle Infestation	Economic	Insect pest	GP 2003	2003	San Bernardino, San Diego, Riverside	3/7/2003				
Pacific Fire	Fire	Fire	FM-2466	2003	Los Angeles		1/7/2003			2,017,043
State Road Damage	Road damage	Flood	GP 2003	2003	Alameda, Colusa, Contra Costa, Del Norte, Humboldt, Lake, Marin, Mendocino, Napa, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma, Trinity	1/1/2003				
Exotic Newcastle Disease Epidemic	Agricultural	Disease	GP 2003	2003	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Ventura	1/3/2007				
Late Storm '02	Flood	Storms	DC 2003-01	2003	Humboldt, Mendocino, Trinity	1/1/2003				5,875,940
Mexican Fruit Fly (San Diego)	Agricultural	Insect pest	GP 2002	2002	San Diego	12/1/2002				
Croy Fire	Fire	Fire	FM-2465	2002	Santa Clara		9/25/2002			8,700,329
Williams Fire	Fire	Fire	FM-2464	2002	Los Angeles		9/23/2002			6,028,991

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Sierra Fire	Fire	Fire	FM-2463	2002	Placer		9/19/2002			720,595
Leona Fire	Fire	Fire	FM-2462	2002	Los Angeles		9/3/2002			2,410,655
Squirrel Fire	Fire	Fire	FM-2461	2002	Shasta		9/3/2002			2,931,942
Pines Fire	Fire	Fire	FM-2456	2002	San Diego		7/30/2002			26,820,605
Deer Fire	Fire	Fire	FM-2450	2002	Kern		7/21/2002			926,099
Louisiana	Fire	Fire	FM-2433	2002	San Bernardino		6/27/2002			1,445,999
BlueCut Fire	Fire	Fire	FM-2425	2002	San Bernardino		6/17/2002			1,256,818
Copper Fire	Fire	Fire	FM-2417	2002	Los Angeles		6/6/2002			2,927,981
Antonio Fire	Fire	Fire	FM-2405	2002	Orange		5/13/2002			467,678
Gavilan Fire	Fire	Fire	FM-2396	2002	San Diego		2/11/2002			3,035,562
Trinity Wildfire	Fire	Fire	DC 2001-05	2001	Trinity	9/1/2001				242,935
Calaveras Wildfire	Fire	Fire	GP 2001-04	2001	Calaveras	9/10/2001				6,693,498
Modoc/Siskiyou Drought	Drought	Drought	GP 2001-03	2001	Modoc, Siskiyou	5/4/2001				14,858,480
Rio Dell Water Shortage	Economic	Drought	GP 2001-02	2001	City of Rio Dell					
(Humboldt County)	3/16/2001				2,523,425					
2001 March Storms	Flood	Storms	DC 2001-01	2001	Los Angeles, San Luis Obispo, Santa Barbara	3/1/2001				9,353,703
Energy Emergency	Economic	Greed	GP 2001	2001	All 58 counties	1/1/2001				
Napa Earthquake	Earthquake	Earthquake	DR-1342	2000	Napa	9/6/2000	9/14/2000			17,700,867
Windstorms	Wind	Storms	DC 2000-02	2000	Los Angeles	4/1/2000				78,081
Millbrae Landslide	Landslide	Landslide	DC 2000-01	2000	San Mateo	2/1/2000				8,206,349
Mudslides (San Bernardino)	Landslide	Landslide	DC 99-04	1999	San Bernardino	7/26/1999				67,272,822
1999 August Fires	Fire	Fire	EM-3140	1999	Butte, Humboldt, Napa, Plumas, San Bernardino, Shasta, Tehama, Trinity, Tuolumne, Yuba	8/26/1999	9/1/1999			1,154,573
Sonoma Road Failure	Road damage	Flood	GP 99-03	1999	Sonoma	3/29/1999				396,521
Beaumont Wind Storms	Wind	Storms	DC 99-02	1999	San Bernardino	2/1/1999				4,019
Avenal Water Pipeline Failure	Facility	Pipeline rupture	DC 99-01	1999	City of Avenal (Kings County)	2/1/1999				256,609
1998 Freeze	Freeze	Freeze	GP 98-02, DR-1267	1998	Fresno, Kern, Kings, Madera, Merced, Monterey, Riverside, Tulare, Ventura	12/29/1998	2/9/1999			17,481,385
1998 Winter Storms	Flood	Storms	GP 98-01	1998	Siskiyou, Shasta, Kings, Madera	2/26/1998, 4/16/1998, 5/15/1998				

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1998 El Nino Floods	Flood	Storms	DR-1203	1998	Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Fresno, Glenn, Humboldt, Kern, Kings, Lake, Los Angeles, Marin, Mendocino, Merced, Monterey, Napa, Orange, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Siskiyou, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Tulare, Ventura, Yolo, Yuba, Del Norte	Proclaimed	2/9/1998	17		385,141,192
Floods (Orange)	Flood	Flood	97-04	1997	Orange	12/10/1997				
Fires (Yuba)	Fire	Fire	97-02	1997	Yuba	10/1/1997				
1997 January Floods	Flood	Storms	DR-1155	1997	Alpine, Amador, Butte, Colusa, Del Norte, El Dorado, Glenn, Humboldt, Lake, Lassen, Modoc, Napa, Nevada, Plumas, Sacramento, San Joaquin, Sierra, Siskiyou, Solano, Sonoma, Sutter, Tehama, Trinity, Yuba, Calaveras, Madera, Mono, Monterey, Placer, San Benito, San Luis Obispo, San Mateo, Santa Cruz, Shasta, Stanislaus, Tuolumne, Yolo, Contra Costa, Fresno, Marin, Tulare, Mariposa, Merced, Santa Clara, Alameda, San Francisco, Kings, Mendocino	1/2/97 - 1/31/97	1/4/1997	8		194,352,509
1996 Southern California Firestorms	Fire	Fire	EM-3120	1996	Los Angeles, Orange, San Diego, Ventura	10/1/1996	Emergency Dec only		5	12,589,808
1996 Severe Fires	Fire	Fire	96-04	1996	Los Angeles, Orange, San Diego, City of San Buenaventura (Ventura)	10/22/1996				
Lake County Fire	Fire	Fire	DC 96-03	1996	Lake	8/1/1996				

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Torrential Winds and Rain	Flood	Storms	GP 96-01	1996	Humboldt, Mendocino, Plumas, Sacramento, San Francisco, San Mateo, Santa Cruz, Shasta	1/2/1996				
Humboldt County Flooding	Flood	Flood	GP 96-02	1995	Humboldt	12/95				
Vision Fire (Marin)	Fire	Fire	DC 95-05	1995	Marin	10/95				
1995 Late Winter Storms	Flood	Storms	DR-1046	1995	All counties except Del Norte	Proclaimed	1/10/1995	17		132,040,111
1995 Severe Winter Storms	Flood	Storms	DR-1044	1995	Los Angeles, Orange, Humboldt, Lake, Sonoma, Butte, Colusa, Contra Costa, Del Norte, Glenn, Kern, Lassen, Mendocino, Modoc, Monterey, Napa, Placer, Plumas, San Luis Obispo, Santa Barbara, Santa Clara, Santa Cruz, Tehama, Ventura, Yolo, Yuba, Alpine, Amador, Nevada, Riverside, Sacramento, San Bernardino, San Mateo, Shasta, Sutter, Trinity, San Diego, Alameda, Marin, Fresno, Kings, El Dorado, Madera, Solano, Siskiyou	1/6/95 - 3/14/95	1/13/1995	11		221,948,347
1994 Humboldt Earthquake	Earthquake	Earthquake	GP 94-03	1994	Humboldt	12/29/1994	Not declared			1,300,000
Mediterranean Fruit Fly (Ventura)	Agricultural	Insect pest		1994	Ventura	10/7/1994	Not declared			
San Luis Obispo Fire - Hwy 41	Fire	Fire	GP 94-02	1994	San Luis Obispo	8/24/1994	Not declared		12	6,382,235
Salmon fisheries	Economic	Unknown	DR-1038	1994	Del Norte, Humboldt, Mendocino, Sonoma	5/20/1994	9/20/1994			30,300,000
Northridge Earthquake	Earthquake	Earthquake	DR-1008	1994	Los Angeles, Ventura, Orange	1/17/94, 1/24/94	1/17/1994	57	11,846	6,115,103,071
Mediterranean Fruit Fly (Riverside)	Agricultural	Insect pest		1993	Riverside	12/93	Not declared			
1993 Southern California Firestorms	Fire	Fire	DR-1005	1993	Los Angeles, Ventura, San Diego, Orange, Riverside, San Bernardino	10/27/93, 10/28/93	10/28/1993	4	162	83,032,567
Klamath Earthquake	Earthquake	Earthquake	DC 93-03	1993	Modoc	10/93				

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
New River Pollution	HazMat	Sewage spill	DC	1993	Imperial	10/6/1993	Not declared			
Tornado	Tornado	Tornado	DC 93-02	1993	Imperial	9/10/1993	Not declared			
Tijuana River Pollution	HazMat	Sewage spill	DC	1993	San Diego	9/10/1993	Not declared			
Flash flooding	Flood	Flood	DC 92-06 - 92-09	1993	San Bernardino	1/93				
1992 Late Winter Storms	Flood	Storms	DR-979	1992	Alpine, Los Angeles, Humboldt, Napa, Santa Barbara, Culver City (Los Angeles County), City of Los Angeles (Los Angeles County), Contra Costa, Mendocino, Sonoma, Fresno, Imperial, Madera, Monterey, San Bernardino, Sierra, Tehama, Trinity, Tulare, Modoc, Orange, Riverside, Lassen, Siskiyou, Plumas, San Diego	1/7/93 - 2/19/93	1/15/1993	20	10	226,018,111
Fountain Fire	Fire	Fire	DR-958	1992	Calaveras, Shasta	8/21/1992	8/29/1992		8	38,152,133
Landers/Big Bear Earthquake	Earthquake	Earthquake	DR-947	1992	Riverside, San Bernardino, Los Angeles	6/28/1992	6/28/1992	1	402	15,579,530
1992 Humboldt Earthquake	Earthquake	Earthquake	DR-943	1992	Humboldt	4/25/1992	5/5/1992		356	17,829,642
Los Angeles Civil Unrest	Civil Unrest	Civil Unrest	DR-942	1992	Los Angeles	4/29/1992	5/22/1992	53	2,383	122,431,732
Point Loma Sewage Spill	HazMat	Sewage spill	GP	1992	San Diego, City of Chula Vista, City of Coronado, San Diego	2/6/92, 2/7/92	Not declared			
1992 Winter Storms	Flood	Storms	DR-935	1992	Los Angeles, Ventura, City of Los Angeles, Kern, Orange, San Bernardino	2/12/92, 2/19/92	2/25/1992	5		53,897,542
Sweet potato Whitefly	Agricultural	Insect pest		1991	Imperial, Riverside		Not declared			12,700,000
East Bay Hills Fire	Fire	Fire	DR-919	1991	Alameda County	10/20/1991	10/22/1991	25	150	56,996,503
Sierra Madre Earthquake	Earthquake	Earthquake	GP 91-04	1991	Los Angeles	7/5/1991	Not declared	1	30	33,500,000
1991 Heavy Rains	Flood	Storms	GP 91-01 - 91-03	1991	San Bernardino, San Diego	4/1/1991				

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1990 Freeze	Freeze	Freeze	DR-894	1990	Santa Cruz, Fresno, Glenn, Imperial, Kern, Mendocino, Monterey, Riverside, San Benito, San Bernardino, San Diego, San Mateo, Santa Barbara, Santa Clara, Solano, Sonoma, Tulare, Ventura, Alameda, Butte, Colusa, Los Angeles, Madera, Marin, Merced, Napa, San Joaquin, San Luis Obispo, Sutter, Yolo, Yuba, Stanislaus, Tehama	12/19/90-1/18/91	2/11/1991			856,329,675
Santa Barbara Drought	Drought		GP 1990	1990	Santa Barbara	11/13/1990	Not declared			
Finley Fire/ Yosemite Fire	Fire	Fire	GP 90-01, GP 90-02	1990	Mariposa, Kern, Tehama	8/13/90, 8/14/90	Not declared	1	84	548,000,000
1990 Drought	Drought	Drought		1990	City of Santa Barbara (Santa Barbara County)	7/17/1990	Not declared			
Santa Barbara Fires	Fire	Fire	DR-872	1990	Los Angeles, Santa Barbara, Riverside, San Bernardino	6/28/90, 6/29/90	6/30/1990	3	89	4,061,861
Mexican Fruit Fly	Agricultural	Insect pest	GP 1990	1990	Los Angeles, San Diego	5/14/1990	Not declared			
Mediterranean Fruit Fly (Riverside)	Agricultural	Insect pest	GP 1990	1990	Riverside	4/18/1990	Not declared			
Upland Earthquake	Earthquake	Earthquake	GP 89-07	1990	Los Angeles, San Bernardino	3/9/90, 3/13/90	Not declared		38	12,034,150
1990 Severe Storms	Flood	Storms	GP 989-06	1990	Butte, Nevada	2/22/1990	Not declared	1	17	11,500,000
Mediterranean Fruit Fly	Agricultural	Insect pest	GP 1989	1989	Orange, Mariposa	11/20/1989	Not declared			
Loma Prieta Earthquake	Earthquake	Earthquake	DR-845	1989	Alameda, Monterey, San Benito, San Mateo, Santa Clara, Santa Cruz, San Francisco, Contra Costa, Marin, City of Isleton (Sacramento County), City of Tracy (San Joaquin County), Solano	10/18/89 - 10/30/89	10/18/1989	63	3,757	888,662,382
Mediterranean Fruit Fly (San Bernardino)	Agricultural	Insect pest	GP 1989	1989	San Bernardino	10/3/1989	Not declared			
Mediterranean Fruit Fly (Santa Clara)	Agricultural	Insect pest	GP 1989	1989	Santa Clara	9/6/1989	Not declared			

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Mediterranean Fruit Fly (Los Angeles)	Agricultural	Insect pest	GP 1989	1989	Los Angeles	8/9/1989	Not declared			
Fires (Los Angeles)	Fire	Fire	GP 88-03	1988	Los Angeles	12/9/1988	Not declared		2	12,400,000
Forty-Niner Fire	Fire	Fire	FM-2071	1988	Nevada		9/13/1988			
Fires (Forty-Niner, Miller, Fern)	Fire	Fire	DR-815	1988	Shasta, Solano, Yuba, Nevada	9/11/88-9/20/88	9/13/1988			
Wildland Fires (Calaveras)	Fire	Fire	GP 88-01	1988	Calaveras	7/21/1988	Not declared			
Mediterranean Fruit Fly	Agricultural	Insect pest	GP 1988	1988	Los Angeles	7/21/1988	Not declared			
Fire and Wind Driven Waves	Fire	Fire		1988	City of Redondo Beach (Los Angeles County)	6/15/1988	Not declared			25,000,000
1988 Fires	Fire	Fire	GP 87-07	1988	Los Angeles	5/88				
1988 Storms	Flood	Storms	GP 87-06	1988	Santa Barbara, City of San Buenaventura					
(Ventura County)	1/26/1988	Not declared			49,416,200					
Coastal Storms	Flood	Storms	DR-812	1988	Los Angeles, Orange, San Diego, San Bernardino, Ventura	1/21/1988	2/5/1988			
Imperial County Earthquake	Earthquake	Earthquake	GP 87-03	1987	Imperial	11/23/1987	Not declared		94	2,638,833
Wildfires/ Flooding/ Mud Slides	Fire	Fire	GP 87-01	1987	San Diego	11/19/1987	Not declared			5,371,150
Whittier Earthquake	Earthquake	Earthquake	DR-799	1987	Monterey Park (Los Angeles County), City of Whittier (Los Angeles County), Los Angeles, Orange	10/2/87 - 10/5/87	10/7/1987	9	200+	358,052,144
Stanislaus Fire Complex	Fire	Fire	FM-2065	1987	Mariposa		9/2/1987			
1987 Wildland Fires	Fire	Fire	GP	1987	Colusa, Del Norte, Butte, Fresno, Humboldt, Inyo, Kern, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Nevada, Placer, Plumas, Riverside, San Bernardino, Shasta, Sierra, Siskiyou, Trinity, Tulare, Tuolumne	9/10/87, 9/3/87	Not declared	3	76	18,000,000
Acorn Fire	Fire	Fire	GP	1987	Alpine	8/3/1987	Not declared		3	8,500,000
Mediterranean Fruit Fly	Agricultural	Insect pest	GP	1987	Los Angeles	8/25/1987	Not declared			

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Del Monte Fire	Fire	Fire	GP	1987	Monterey	5/1/1987	Not declared		8	15,000,000
Earthquake (Riverside)	Earthquake	Earthquake	GP 86-02	1986	Riverside	10/86				
Plane Crash	Air Disaster	Manmade		1986	City of Cerritos (Los Angeles County)	8/31/1986	Not declared	82	2	
Heavy Rains	Flood	Storms		1986	Monterey, Siskyou	3/26/1986	Not declared			400,000
1986 Storms	Flood	Storms	DR-758	1986	Humboldt, Napa, Sonoma, Glenn, Lake, Marin, Modoc, Sacramento, Santa Clara, Santa Cruz, Solano, Yuba, Alpine, Amador, Butte, Calaveras, Colusa, El Dorado, Lassen, Mendocino, Nevada, Placer, Plumas, San Joaquin, Sierra, Sutter, Tehama, Tuolumne, Yolo, Fresno, Madera, San Mateo, Alameda, Contra Costa, Del Norte, Trinity, Mono, San Benito, Shasta	2/18-86 - 3/12/86	2/18/1986	13	67	407,538,904
Wheeler Fire	Fire	Fire		1985	Ventura	10/14/1985	Not declared	1	2	
Hydrilla Infestation	Invasive Species	Aquatic Plant Pest		1985	Shasta	9/13/1985	Not declared			
Hidden Valley Lake Fire	Fire	Fire	FM-2055	1985	Lake		7/11/1985			
Lexington Fire	Fire	Fire	FM-2054	1985	Santa Clara		7/11/1985			
1985 Statewide Fires	Fire	Fire	DR-739	1985	San Diego, City of Los Angeles (Los Angeles County), San Luis Obispo, Monterey, Santa Clara, Santa Cruz, Ventura	7/1/85 - 7/11/85	7/18/1985	3	470	64,845,864
1984 Floods	Flood	Flood	GP 84-02, GP 84-03	1984	Inyo, Mono		9/1/1984			
1984 Storms (Kern)	Flood	Storms	GP 84-01	1984	Kern		Not declared			1,600,000
Morgan Hill Earthquake	Earthquake	Earthquake	EM-4043	1984	Santa Clara		4/25/1984		27	7,265,000
High Tides / Storms	Flood	Storms	GP 83-06	1984	Contra Costa	1/1/1984				
Bradford Levee Failure	Flood	Levee break	GP 83-05	1983	Contra Costa, Alameda	12/9/83, 1/18/84	Not declared			10,909,785
Mexican Fruit Fly	Agricultural	Insect pest		1983	Los Angeles	11/4/1983	Not declared			

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
San Bernardino Flooding	Flood	Flood	84-01	1983	San Bernardino	11/83				
1983 Summer Storms	Flood	Storms	DR-690	1983	Inyo, Riverside, San Bernardino	8/29/1983	8/29/1983	3		34,689,155
Colorado River Flooding	Flood	Flood	DR-687	1983	Riverside, San Bernardino, Imperial	6/23/83, 6/28/83	7/1/1983			4,640,315
Coalinga Earthquake	Earthquake	Earthquake	DR-682	1983	Fresno	5/2/1983	5/3/1983		47	31,076,300
River Junction Storms	Flood	Storms	83-02	1983	San Joaquin	3/83				
High Winds	Wind	Storms	83-01	1983	Yuba, Los Angeles	3/83				
1983 Floods	Flood	Flood	82-19	1983	Los Angeles	3/83				
Winter Storms	Flood	Flood	DR-677	1982	Contra Costa, San Joaquin, Sacramento, Marin, San Mateo, Los Angeles, San Diego, Alameda, Orange, San Benito, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Sonoma, Ventura, Trinity, Colusa, Lake, Mendocino, Monterey, San Luis Obispo, Solano, Yolo, Butte, Glenn, Kern, Kings, San Bernardino, Sutter, Tehama, Merced, Del Norte, Fresno, Madera, Napa, Placer, Riverside, Stanislaus, Tulare, Humboldt, Mariposa, Nevada, Yuba	12/8/82-3/21/83	2/9/1983			523,617,032
High Tides and Rains	Flood	Storms		1982	Contra Costa, Sacramento, San Joaquin	12/8/1982	Not declared			6,964,998
Rain and Flooding (Imperial)	Flood	Storms	DC 82-17	1982	Imperial	12/82				
Rains Causing Agricultural Losses	Agricultural	Storms	GP	1982	Fresno, Madera, Merced, Monterey, Kern, Tulare, Sacramento, San Joaquin, Solano, Stanislaus, Yolo	10/26/1982	Not declared			345,195,974
Dayton Hills Fire	Fire	Fire	GP	1982	Los Angeles, Orange, Ventura	10/10/1982	Not declared			19,277,102
1982 Heavy Rains	Flood	Storms	GP 82-16	1982	Inyo	9/27/1982	Not declared			6,161,320
McDonald Island Levee Break	Flood	Levee break	DR-669	1982	McDonald Island (San Joaquin County)	8/24/1982	8/24/1982			11,561,870
Orange Fire	Fire	Fire	DR-657	1982	Orange	4/21/1982	4/21/1982			50,877,040

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Heavy Rains and Flooding	Flood	Storms	DC 82-03	1982	Amador, Calaveras, Madera, Mono, Sacramento, Santa Clara, Santa Cruz, Sierra, Yuba	4/1/1982				
1982 Winter Storms	Flood	Storms	DR-651	1982	Alameda, Santa Clara, Solano, San Joaquin, Contra Costa, Humboldt, Marin, San Mateo, Santa Cruz, Sonoma	1/5/82 - 1/9/82	1/7/1982	33	481	273,850,000
Strong Winds & Fire	Fire	Fire	82-01	1981	Humboldt	10/81				
1981 Mediterranean Fruit Fly Infestation	Agricultural	Insect pest		1981	Contra Costa, Los Angeles, San Benito, Stanislaus, Santa Cruz, San Mateo	8/8/81 - 9/25/81	Not declared			22,000,000
Atlas Peak Fire	Fire	Fire		1981	Napa	6/24/1981	Not declared			31,000,000
Major Brush Fire	Fire	Fire	GP	1981	Napa	6/1/1981				
Imperial County Earthquake	Earthquake	Earthquake	DC 81-02	1981	Imperial	4/1/1981				
Wave Action & High Tides	Flood	High Tides	DC 81-01	1981	San Mateo	3/81				
1980 Mediterranean Fruit Fly Infestation	Agricultural	Insect pest	GP-1980 Medfly	1980	Alameda, Santa Clara	12/1/1980				
1980 Southern California Fires	Fire	Fire	DR-635	1980	San Bernardino, Los Angeles, Orange, Riverside	11/18/1980, 11/25/80	11/18/1980			64,795,200
Jones Tract Levee Break	Flood	Levee break	DR-633	1980	San Joaquin	9/30/1980	9/30/1980			21,510,956
Owens Valley Earthquake	Earthquake	Earthquake		1980	Mono	5/28/1980	Not declared		9	2,000,000
1980 April Storms	Flood		80-01 - 80-25	1980	Alpine, Amador, El Dorado, Inyo, Lake, Marin, Monterey, Placer, Plumas, San Mateo, Santa Cruz, Sierra, Solano, Stanislaus, Tuolumne, Calaveras	4/1/1980				
1980 March Storms	Flood	Storms		1980	Stanislaus, Monterey, Solano, Santa Cruz	3/5/1980	Not declared			
1980 Winter Storms	Flood	Flood	DR-615	1980	Santa Barbara, Los Angeles, Orange, Riverside, Ventura, San Bernardino, San Diego	2/21/80, 2/7/80, 2/19/80	2/21/1980			
Delta Levee Break	Flood	Levee break	EM-3078	1980	Contra Costa, Sacramento, San Joaquin	1/23/1980	1/23/1980			17,388,013

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Gasoline Shortage	Economic	OPEC		1979	Alameda, Contra Costa, Los Angeles, Marin, Monterey, Orange, Riverside, San Francisco, San Diego, Santa Clara, Santa Cruz, San Mateo, Ventura, San Bernardino, Sonoma	5/8/79 - 11/13/79	Not declared			
Imperial Earthquake	Earthquake	Earthquake	DR-609	1979	Imperial	10/16/1979	10/16/1979		91	21,197,250
1979 Fires	Fire	Fire		1979	Santa Barbara, Ventura, Los Angeles, El Dorado	9/28/79, 9/21/79, 9/20/79	Not declared			9,970,119
1979 Severe Storms (Riverside)	Flood	Storms	DR-594	1979	Riverside	7/26/1980	7/27/1979			25,867,100
Excessive Rains	Flood	Storms		1979	Riverside					
1979 Storms and Floods (San Diego)	Flood	Storms	DC 79-01	1979	San Diego	2/1/1979				
1978 Los Angeles Fire	Fire	Fire	EM-3067	1978	Los Angeles	10/24/1978	10/29/1978	1		61,279,374
Laguna Landslide	Landslide	Landslide	DR-566	1978	City of Laguna Beach (Orange County)	10/5/1978	10/9/1978			16,595,000
PSA Air Crash	Air Disaster	Manmade		1978	City of San Diego (San Diego County)	1/15/1979	Not declared	150		
Inyo County Flooding	Flood	Flood	GP 78-13	1978	Inyo	9/1/1978				
Santa Barbara Earthquake	Earthquake	Earthquake		1978	Santa Barbara	8/15/1978	Not declared		65	12,987,000
1978 Winter Storms	Flood	Storms	DR-547	1978	Inyo, Mono, San Diego, San Luis Obispo, Kings, Monterey, Kern, Los Angeles, Orange, Riverside, San Bernardino, Santa Barbara, Tulare, Ventura	3/9/78, 2/27,78, 2/13/78	2/15/1978	14	21	117,802,785
Heavy rains excluded	Flood	Storms	DC 78-06-11	1978	Santa Clara, Solano, Sonoma, Tuolumne, Colusa	2/13/1978				
1978 Storms	Flood	Storms	GP 78-03/04	1978	Humboldt, Mendocino, Santa Cruz	1/27/78, 1/20/78	Not declared			6,126,409
Heavy Rains (Marin)	Flood	Storms	DC 78-02	1978	Marin	1/1/1978				
1978 Storms and Flooding	Flood	Storms	GP 78-01/03	1978	Riverside, San Diego	1/26/1978				

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1977 Storms	Flood	Storms	GP 77-05	1977	San Diego, Kern, Humboldt, City of Arvin (Kern County)	1/10/78, 12/23/77, 1/22/77, 12/21/77	Not declared			38,009,035
Heavy Rainstorms	Flood	Storms	DC 77-03/04	1977	Imperial, Mendocino, Riverside	10/1/1977				
Threat of Floods	Flood	Fire	GP	1977	Monterey, Riverside	9/8/1977	Not declared			6,110,000
Imperial County Flooding	Flood	Storms	GP 77-02	1977	Imperial	8/23/1977	Not declared			28,498,469
Desert Hot Springs Heavy Rains	Flood	Storms	DC 77-01	1977	Imperial	8/31/1977				
Scarface Fire	Fire	Fire	FS-2028	1977	Modoc		8/1/1977			
Sycamore Fire	Fire	Fire		1977	Santa Barbara	7/27/1977	Not declared			25,540,755
1977 Heavy Rains and Windstorms	Flood	Storms	DC 76-03/04	1977	San Bernardino	1/1/1977				
1976 High Winds and Flooding	Flood	Storms	DR-521	1976	Imperial, Riverside, San Bernardino, San Diego	9/13/76, 9/22/76	9/21/1976			120,132,771
1976 Heavy Rains and Windstorms	Flood	Storms	DC 76-02	1976	San Diego	9/1/1976				
1976 Drought	Drought	Drought		1976	Alpine, Calaveras, Colusa, Fresno, Glenn, Madera, Merced, San Diego, San Joaquin, Solano, Stanislaus, Sutter, Tuolumne, Alameda, Butte, Contra Costa, Kings, Los Angeles, Riverside, San Luis Obispo, Tulare, Yolo, Amador, Monterey, Napa, Nevada, San Benito, San Bernardino, Tehama, San Mateo, Marin	2/9/76, 2/13,76, 2/24/76, 3/26/76, 7/6/76	Not declared			2,664,000,000
1975 Fires	Fire	Fire		1975	Los Angeles	11/24/1975	Not declared			19,486,960
Heavy Rain and Snow (Kern)	Flood	Storms	DC 75-04	1975	Kern	11/1/1975				
Butte Earthquake	Earthquake	Earthquake	DC 75-03	1975	Butte		8/1/1975			
Heavy Rain and Snow (El Dorado)	Flood	Storms	DC 75-01	1975	El Dorado	2/1/1975				
1974 Storms	Flood	Storms	DR-432	1974	Mendocino	4/23/1974	5/7/1974			4,475,900

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
Gasoline Shortage	Economic	OPEC		1974	Alameda, Contra Costa, Los Angeles, Orange, Riverside, San Mateo, Solano, Santa Clara, Ventura	2/28/74, 3/4/74, 3/10/74	Not declared			
Storms (Santa Cruz)	Flood	Storms		1974	Santa Cruz	2/28/1974	Not declared			763,267
1974 Storms	Flood	Storms	DR-412	1974	Humboldt, Shasta, Siskiyou, Trinity, Glenn, Mendocino, Tehama	1/17/74, 1/18/74	1/25/1974			35,192,500
Boulder Fire	Fire	Fire		1973	San Diego	12/12/1973	Not declared			215,700
1973 Fires	Fire	Fire		1973	Los Angeles	7/16/1973	Not declared			1,300,000
Eucalyptus Tree Freeze	Freeze	Freeze	DR-373	1973	Alameda, Contra Costa	4/4/1973	5/25/1973			
Southern Pacific Railroad Fires and Explosions (Roseville)	Fire	Explosion		1973	Sacramento, Placer	4/30/1973	Not declared		37	2,925,000
Storms and Floods (San Mateo)	Flood	Storms		1973	City of Pacifica (San Mateo County)	4/11/1973	Not declared			700,000
Storms and Floods (Mendocino)	Flood	Storms		1973	Mendocino	3/15/1973	Not declared			1,523,200
1973 Freeze	Freeze	Freeze		1973	Butte	2/28/1973	Not declared			300,000
1973 Storms and Floods	Flood	Storms		1973	Colusa, Glenn, Napa, Placer, Sutter, Yuba	2/28/1973	Not declared			1,864,000
1973 High Tides	Flood	High Tides		1973	Ventura	2/1/1973	Not declared			1,027,000
Coastal Flooding	Flood	Storms	DR-364	1973	Marin, San Luis Obispo, City of South San Francisco (San Mateo County), Santa Barbara, Solano, Ventura	1/23/73, 1/30/73, 2/8/73, 2/28/73	2/3/1973			17,998,250
1972 Heavy Rains and Mud Slides	Flood	Storms		1972	Monterey	10/24/1972	Not declared			720,000
1972 Severe Weather	Flood	Storms		1972	Sutter	9/3/1972	Not declared			2,004,300
1972 Freeze (Lake)	Freeze	Freeze		1972	Lake	7/13/1972	Not declared			357,000
1972 Drought	Drought	Drought		1972	Glenn, San Benito, Santa Clara	7/3/1972	Not declared			8,000,000
Andrus Island Levee Break	Flood	Levee break	DR-342	1972	Sacramento	6/21/1972	6/27/1972			23,681,630

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1972 Freeze	Freeze	Freeze		1972	Fresno, Kings, Tulare, Merced, Kern, Madera, San Benito, Stanislaus, El Dorado, Tehama, Placer, Nevada, San Joaquin, Colusa, Siskiyou, Modoc, Santa Clara	4/17/72, 5/22/72, 5/31/72	Not declared			111,517,260
Exotic Newcastle Disease Epidemic	Agricultural	Disease		1972	Los Angeles, Orange, Riverside, San Bernardino, San Diego, Ventura, Santa Barbara	4/10/72, 5/22/72	Not declared			10,000,000
1972 Continuing Storms	Flood	Storms	DR-329	1972	Del Norte, Humboldt	2/28/1972, 3/28/72	4/5/1972			6,817,618
1972 Storms	Flood	Storms	DR-316	1972	Santa Barbara	1/3/1972	2/11/1972			2,660,000
1971 Fires	Fire	Fire		1971	Santa Barbara	10/13/1971	Not declared	4		9,000,000
1972 High Tides	Flood	High Tides		1971	Ventura	5/19/1971	Not declared			250,000
San Fernando Earthquake	Earthquake	Earthquake	DR-299	1971	Los Angeles	2/9/1971	2/9/1971	58	2,000	483,957,000
Fires (Riverside)	Fire	Fire		1970	Riverside	12/22/1970	Not declared			3,200,000
1970 Fires	Fire	Fire	DR-295	1970	City of Oakland (Alameda County), Los Angeles, Ventura, San Diego, Kern, San Bernardino, Monterey, Riverside	9/24/70, 9/28/70, 10/1/70, 10/2/70, 10/20/70, 11/14/70	9/29/1970	19		223,611,000
1970 Storms and Floods	Flood	Storms		1970	Contra Costa	4/10/1970	Not declared			
1970 Freeze	Freeze	Freeze		1970	Napa, Sonoma, Mendocino, San Joaquin, Lake	5/1/70, 5/19/70, 6/8/70, 6/10/70, 7/24/70	Not declared			19,749,200
1970 Landslide (Los Angeles)	Landslide	Storms		1970	City of Los Angeles (Los Angeles County)	3/10/1970	Not declared			8,500,000
1970 Riots	Civil Unrest	Civil Unrest		1970	Santa Barbara	2/26/1970	Not declared		12+	300,000
Fire (Tuolumne)	Fire	Fire		1970	City of Sonora (Tuolumne County), Tuolumne	2/26/1970	Not declared			2,300,000
1970 Landslide (Oakland)	Landslide	Storms		1970	City of Oakland					
(Alameda County)	2/10/1970	Not declared			11,500,000					

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1970 Northern California Flooding	Flood	Flood	DR-283	1970	Butte, Colusa, Glenn, Lake, Lassen, Marin, Modoc, Plumas, Shasta, Siskiyou, Tehama, Trinity, Sutter, Yuba, Del Norte, Alameda, El Dorado, Mendocino	1/27/1970, 2/3/1970, 2/10/1970, 3/2/1970	2/16/1970			27,657,478
Berkeley Riots	Civil Unrest	Civil Unrest		1969	City of Berkeley					
(Alameda County)	2/5/1969	Not declared		20						
Santa Barbara Oil Spill	HazMat	Offshore Oil Platform spill		1969	Coastal Areas of Southern California					
(Santa Barbara Channel)		Not declared								
1969 Freeze	Freeze	Freeze		1969	San Diego	2/5/1969	Not declared			10,000,000
1969 Storms	Flood	Storms	DR-253	1969	Los Angeles, San Luis Obispo, Fresno, Inyo, Riverside, San Bernardino, Santa Barbara, Tulare, Ventura, Amador, El Dorado, Kern, Kings, Madera, Modoc, Mono, Monterey, Orange, Placer, Sacramento, San Joaquin, Shasta, Solano, Stanislaus, Tuolumne, Mariposa, Merced, Calaveras, San Benito, Sierra, Contra Costa, Humboldt, Mendocino, Sonoma, Plumas, Tehama, Yuba, Butte, Marin, Yolo	1/23/69, 1/25,69, 1/28/69, 1/29/69, 2/8/69, 2/10/69, 2/16/69, 3/12/69	1/26/1969	47	161	300,000,000
Heavy Snow Runoff	Flood	Snow melt	DR-227	1969	Kings	1/28/1996	8/15/1969			2,812,500
1968 Riots	Civil Unrest	Civil Unrest		1968	City of Richmond (Contra Costa County)	8/2/1968	Not declared			
Woodson Fire	Fire	Fire		1967	Los Angeles, Orange, San Diego, Ventura	1/7/1967	Not declared			11,345,000
1966 Landslides	Landslide	Landslide		1966	Redwood City	12/16/1966	Not declared			100,000
1966 Winter Storms	Flood	Storms	DR-223	1966	Kern, Riverside, Tulare, San Bernardino, San Luis Obispo, Monterey, City of Escondido (San Diego County), Inyo	12/9/66, 12/13/66, 12/16/66, 12/23/66	1/2/1967			28,761,041
1966 Riots	Civil Unrest	Civil Unrest		1966	San Francisco	9/27/1966	Not declared		42	
1966 Rains	Flood	Storms	DR-212	1966	Humboldt	1/14/1966	1/22/1966			6,918,000

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1965 Heavy Rainfall	Flood	Storms	DR-211	1965	Riverside, San Bernardino, Ventura, San Diego	11/24/65, 11/26/65, 12/23/65	12/7/1965, 1/3/1966			21,843,739
1965 Fires	Fire	Fire		1965	Marin, Napa, Placer, Solano, Sonoma	9/18/1965	Not declared			
1965 Riots	Civil Unrest	Civil Unrest		1965	Los Angeles	8/14/1965	Not declared	32	874	44,991,000
1965 Landslide	Landslide	Landslide		1965	City of Los Angeles (Pacific Palisades area), Los Angeles County	6/21/1965	Not declared			6,488,600
Flooding and Landslides	Flood	Storms		1965	City of Burbank, Los Angeles	1/5/1965	Not declared			
1964 Late Winter Storms	Flood	Storms	DR-183	1964	Del Norte, Humboldt, Shasta, Mendocino, Colusa, Glenn, Lassen, Plumas, Sierra, Siskiyou, Sonoma, Sutter, Tehama, Trinity, Amador, Butte, El Dorado, Modoc, Nevada, Placer, Yuba, Alpine, Lake, Sacramento, Yolo, Marin	12/22/64, 12/23/64, 12/28/64, 1/5/65, & 1/14/65	12/29/1964			213,149,000
1964 Tsunami (Marin)	Tsunami	Earthquake		1964	Marin	9/15/1964	Not declared			
Fires and High Winds	Fire	Fire		1964	Napa, Sonoma, Santa Barbara	9/22/64, 9/23/64, & 9/25/64	Not declared			16,500,000
1964 Storms	Flood	Storms		1964	Los Angeles	4/3/1964	Not declared			1,610,300
1964 Tsunami										
(Del Norte)	Tsunami	Earthquake	Unknown	1964	Del Norte	3/28/1964	4/1/1964	12		10,000,000
Weldon Fire	Fire	Fire		1964	Los Angeles	3/16/1964	Not declared			2,000,000
1964 Heavy Rains	Flood	Storms		1964	Humboldt	2/10/1964	Not declared			1,407,000
Baldwin Hills Dam Failure	Flood	Dam Failure	DR-161	1963	Los Angeles	12/16/1963	12/21/1963			5,233,203
High Tides and Heavy Surf	Flood	High Tides		1963	Orange, City of Redondo Beach		Not declared	5		500,000
1963 Floods and Rains	Flood	Storms	Unknown	1963	Alpine, Nevada, Placer, Plumas, Sierra, Amador, Colusa, El Dorado, Glenn, Lake, Lassen, Tehama, Santa Clara, Santa Cruz, Siskiyou, Yolo, Tulare, Mono, Trinity, Yuba	2/7/63, 2/26/63, 2/29/63, & 4/22/63	145 (2/25/63)			

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1963 Floods	Flood	Storms		1963	Northern California (boundaries of San Luis Obispo, Ventura, Los Angeles, and San Bernardino counties to the Oregon State Line)	2/14/1964	Not declared			
1962 Floods and Rains	Flood	Storms		1962	Alameda, Butte, Contra Costa, Modoc, Napa San Mateo, Sierra, Sutter, Yuba, Placer, Trinity, Lassen	10/17/62, 10/25/62, 10/30/62, & 11/4/62	10/24/1962			4,000,000
Fires and Explosions	Fire	Fire		1962	Alameda	9/14/1962	Not declared	1	12	500,000
Flood and Rainstorm	Flood	Storms	DR-122	1962	Los Angeles, Ventura	2/16/62 and 2/23/62	3/6/1962			
Bel Air Fires	Fire	Fire	DR-119	1961	Los Angeles (Bel Air area)		11/16/1961		103	
1961 Widespread Fires	Fire	Fire		1961	Amador, Butte, El Dorado, Napa, Nevada, Placer, San Diego, Sonoma, Tehama	9/8/1961	Not declared			5,696,813
1961 Widespread Fires (Madera)	Fire	Fire		1961	Madera		Not declared	2		
High Tides and Waves	Flood	Storms		1961	Ventura	1/16/1961	Not declared			
1960 Widespread Fires	Fire	Fire		1960	Lassen, Plumas, Shasta, Sierra, Tehama	8/16/1960	Not declared			3,075,000
1960 Major Fires	Fire	Fire		1960	Los Angeles, San Bernardino	7/21-22/60	Not declared		12	10,000,000
1959 Heavy rains	Flood	Storms		1959	Tokay grape producing areas of Northern California	9/17/1959	Not declared	2		100,000
Potential Flood Damage and Landsides as a Result of Fires	Flood	Fire	CDO 59-01	1959	Los Angeles	1/8/1959	Not declared			
1958 April Storms & Floods	Flood	Storms		1958	Statewide	4/2/1958	4/4/1958	13	several	24,000,000
1958 February Storms & Floods	Flood	Storms	CDO 58-03	1958	Northern California (Southern boundaries of Santa Cruz, Santa Clara, Stanislaus, Tuolumne, Alpine counties to the Oregon border)	2/26/1958	Not declared			
High Tides	Flood	High Tides	CDO 58-02	1958	City of Imperial Beach, San Diego County	1/31/1958	Not declared			
Newton Fires (Monrovia Fires)	Fire	Fire	CDO 58-01	1958	Los Angeles	1/3/1958	Not declared	1	23	
Heavy Rains	Flood	Storms		1957	Cherry-producing areas of Northern California	Not Proclaimed	Not declared		2	6,000,000

Disaster Name	Disaster Type	Disaster Cause	Disaster #	Year	Counties and Cities Declared	State Proclamation	Federal Declaration	Deaths*	Injuries*	Cost of Damage ($)*
1956 Fires	Fire	Fire	DR-65	1956	Los Angeles (Malibu area), Ventura		12/29/1956	1	Several hundred	70,000,000
1955 Floods	Flood	Flood	DR-47	1955	Statewide	12/22/1955	12/23/1955	74		200,000,000
Fire, Flood, and Erosion	Flood	Flood	DR-28	1954	Los Angeles, San Bernardino	Not Proclaimed	Federal funds made available			
1950 Floods	Flood	Flood	OCD 50-01	1950	Statewide	11/21/1950	Not declared	9		32,183,000

**Death, injury and cost data pending*
Source: Cal OES

APPENDIX F – HAZARD MITIGATION LEGISLATION REFERENCED IN THE 2018 SHMP

To obtain full text of California legislation, conduct a search on the California Legislation Information website: http://leginfo.legislature.ca.gov/

2018 LEGISLATION

Senate Bill 100 (climate)

2017 LEGISLATION

Assembly Bill 398 (climate)
Assembly Bill 2800 (climate change and state infrastructure)

Senate Bill 1 (transportation)
Senate Bill 109 (Greenhouse Gas Reduction Fund)
Senate Bill 525 disadvantaged communities)
Senate Bill 1278 (flood)

2016 LEGISLATION

Assembly Bill 1550 (climate with focus on disadvantaged communities)
Assembly Bill 1613 (Greenhouse Gas Reduction Fund)
Assembly Bill 2722 (climate and social equity)

Senate Bill 32 (climate)
Senate Bill 380 (natural gas storage)
Senate Bill 438 (earthquake)
Senate Bill 859 (Greenhouse Gas Reduction Fund)
Senate Bill 1000 (environmental justice)
Senate Bill 2800 (climate change)

2015 LEGISLATION

Assembly 670 (information technology security)
Assembly Bill 1071 (supplemental environmental projects)
Assembly Bill 1171 (regional transportation)
Assembly Bill 1482 (climate)

Senate Bill 88 (water resources and social equity)
Senate Bill 246 (climate)
Senate Bill 350 (Clean Energy and Pollution Reduction Act)
Senate Bill 379 (climate)
Senate Bill 380 (natural gas storage)

2014 LEGISLATION

Assembly Bill 52 (Tribal communities)
Assembly Bill 1471 (water quality)
Assembly Bill 1739 (groundwater)

Senate Bill 1168 (groundwater)
Senate Bill 1319 (groundwater)

2013 LEGISLATION

Assembly Bill 127 (fire)
Assembly Bill 217 (solar electricity)

Senate Bill 4 (oil and gas)
Senate Bill 135 (earthquake)
Senate Bill 743 (transportation)

2012 LEGISLATION

Assembly Bill 296 (transportation)
Assembly Bill 578 (pipeline safety)
Assembly Bill 861 (public utility)
Assembly Bill 1241 (fire)
Assembly Bill 1965 (flood)

Senate Bill 200 (delta levee maintenance)
Senate Bill 535 (climate change)
Senate Bill 1090 (disadvantaged communities)
Senate Bill 1241 (local hazard mitigation planning in SRA and VHFHSZ)
Senate Bill 1278 (flood)

2011 LEGISLATION

Senate Bill 90 (earthquake; amendment to HFSSA)
Senate Bill 244 (disadvantaged communities)
Senate Bill 836 (renewable energy)

2010 LEGISLATION

Senate Bill 1070 (flood)

2009 LEGISLATION

Assembly Bill 1175 (toll facilities)

Senate Bill x7-6 (groundwater)
Senate Bill 499 (earthquake; amendment to Alquist Hospital Facilities Seismic Safety Act)

2008 LEGISLATION

Senate Bill 375 (transportation)
Senate Bill 732 (established Strategic Growth Council for water quality and flood control)

2007 LEGISLATION

Assembly Bill 5 (flood)
Assembly Bill 70 (flood)
Assembly Bill 156 (flood)
Assembly Bill 162 (flood)
Assembly 1470 (solar technology)

Senate Bill 5 (flood)
Senate Bill 17 (flood)
Senate Bill 97 (analyzation of GHG emissions)

2006 LEGISLATION

Assembly Bill 32 (climate)
Senate Bill 1661 (earthquake; amendment to Alquist Hospital Facilities Seismic Safety Act)
Assembly Bill 2140 (general Plans: safety element)

PRE-2006 LEGISLATION

Assembly Bill 144 (funding for Bay Area toll bridge)
Assembly Bill 304 (2005) (earthquake)
Assembly 1165 (2005) (energy resources)
Assembly Bill 1553 (2001) Environmental Justice)
Assembly Bill 1965 (2000) (flood)

Senate Bill 60 (1997) (earthquake)
Senate Bill 226 (1997) (earthquake)
Senate Bill 547 (1986) (earthquake)
Senate Bill 1369 (2003) (fire)

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APPENDIX G– EARTHQUAKE HAZARD MITIGATION LEGISLATION, 1933-2017

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Dam Safety Act	1929	Dam Safety	Institution / Regulation	After the 1928 collapse of the Saint Francis Dam in Ventura County killed more than 450 people, California passed the Dam Safety Act to regulate the construction and maintenance of all non-federal dams. DWR's Division of Safety of Dams administers the Dam Safety Act and periodically inspects dams to ensure their safety. Fees paid by dam owners fund the Division's work.	
Field Act [AB 2342]	1933	School seismic safety	Regulation	In 1933, one month after the Long Beach Earthquake destroyed 70 schools, seriously damaged 120 others, and caused minor damaged to 300 more, California passed the Field Act to ensure seismic safety in new public schools. The Act establishes regulations for the design and construction of K-12 and community college buildings. The Division of the State Architect within DGS enforces the Field Act. The Field Act requires all new school building construction to be designed based on high level building standards adopted by the state; plans and specifications prepared by state-registered designers.	Education Code §17281, et seq.
Riley Act [AB 2391]	1933	General building safety	Institution / Regulation	Following the 1933 Long Beach Earthquake, the state also passed the Riley Act which requires local governments to have building departments that issue permits for new construction and alterations to existing structures and conduct inspections. Permit fees paid by building owners generally fund the work of local building departments. The Act also set minimum seismic safety requirements that have since been incorporated into all building codes; set minimum seismic safety requirements.	AB 2391

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Garrison Act	1939	School seismic safety	Regulation	Requires school boards to assess building safety of pre-Field Act schools; ordered modernization of non-Field Act compliant structures	
California Environmental Quality Act (applies to all natural and other hazards)	1970	Environmental quality	Regulation	Requires environmental review of "discretionary" development projects. If significant impacts are found, an environmental impact report (EIR) is required, together with mitigation of significant impacts.	Resources Code §21000, et seq., http://ceres.ca.gov/ceqa/stat
Hospital Safety Act	1971	Seismic Safety	Regulation	The loss of emergency functions and hospital collapses due to the 1971 San Fernando Earthquake prompted passage of the Hospital Seismic Safety Act of 1973. This Act regulates the design, construction, and alteration of hospitals for the protection of life and property and so that they will remain functional after disasters. OSHPD enforces this Act.	
Strong Motion Instrumentation Act [SB 1374]	1972	Earthquake monitoring	Program	The state passed the Strong Motion Instrumentation Act in 1972 in response to the extensive damage to buildings and bridges caused by the 1971 San Fernando Earthquake. The earthquake highlighted the need for more data on strong ground shaking during earthquakes and on the response of structures to the shaking. Establishes statewide network of strong motion instruments to gather vitals of earthquake data-gathering instruments for the engineering and scientific communities for essential structures; requires Division of Mines and Geology to monitor instruments. Data obtained from the strong motion instruments is used to recommend changes to building codes, assist local governments in the development of their general plans, and help emergency response personnel in the event of a disaster.	PRC §§2700-2709.1

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Seismic Safety General Plan Element [SB 519] (applies to all natural hazards)	1972	Seismic safety policy	Policy	Requires city and county general plans to include a seismic safety element	GC §65302
Alquist-Priolo Earthquake Fault Zoning Act [SB 520]	1972	Seismic zone mapping	Program / Regulation	The state passed the Alquist-Priolo Earthquake Fault Zoning Act in 1972 to mitigate the hazard of surface faulting to structures built for human occupancy. The law was another response to the 1971 San Fernando Earthquake, which produced extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act requires the state geologist to prepare maps of major fault traces and zones. The Act also prohibits construction of new buildings used for human occupancy on the surface trace of active faults and requires geologic site investigation prior to issuance of building permit.	PRC §§2621-2630
State Capitol Seismic Evaluation [SCR 84]	1972	Seismic evaluation			
Alquist Hospital Facilities Seismic Safety Act of 1973 [SB 352, SB 519]	1973	Essential building seismic safety	Regulation / Institution	Regulates the design, construction, and alteration of hospitals; set seismic safety standards for new hospitals; created an advisory Hospital Building Safety Board	HSC §129675, et seq.
Seismic Safety Commission Act	1975	Seismic safety policy	Institution	This Acct establishes independent commission to advise Governor, Legislature, state and local governments on reduction of earthquake risk. The mission of CSSC is “to provide decision makers and the general public with cost-effective recommendations to reduce earthquake losses and expedite recovery from damaging earthquakes.” The commission is also	Business and Professions Code §1014

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
				responsible for implementing the California Earthquake Hazards Reduction Act, which requires CSSC to "prepare and administer a program setting forth priorities, funding sources, amounts, schedules, and other resources needed to reduce statewide earthquake hazards."	
Highway Emergency Fund [AB 387]	1975	Infrastructure repair	Program	Establishes Highway Emergency Fund to provide assistance to local jurisdictions for repair or replacement of highways damaged by earthquakes	
Seismic design of LNG facility [SB 1081]	1975	Essential facility seismic safety	Regulation	Requires seismic design of a liquefied natural gas terminal be addressed by PUC	
Earthquake hazard reduction program [SB 1279]	1978	Seismic hazard mitigation	Policy	Directs CSSC to assess policy and program implications of earthquake prediction and to develop seismic safety program and financing plan for the state. CSSC issued its first comprehensive earthquake hazard mitigation plan, Guiding Action: Goals and Policies to Strengthen Earthquake Safety in California, in 1979. The CSSC prepared a strategic seismic safety program and financing plan, Earthquake Hazards Management: An Action Plan for California, in 1982. After the passage of the California Earthquake Hazard Reduction Act of 1986, CSSC prepared California at Risk, a series of comprehensive five-year programs for earthquake mitigation.	
Mobile home bracing devices [SB 360]	1980	Seismic hazard mitigation	Regulation / Program	Requires mobile home bracing devices; required HCD to administer program, test devices, issue certifications	
Hospital inspections [SB 961]	1980	Seismic evaluation	Program		

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Earthquake insurance [AB 2865]	1983	Earthquake insurance	Regulation / Policy	Requires insurance companies to offer earthquake insurance; [repealed concurrent causation theory for earthquake damage]	Insurance Code §§100-124.5; Insurance Code §§1063.50-1063.68
Alquist Hospital Facilities Seismic Safety Act of 1983 [SB 1953]	1983	Essential building seismic safety	Policy / Regulation	Requires design and construction standards for hospitals; requires that after Jan. 1, 2008 any general acute care hospital building determined to be at potential risk of collapse or poses a risk of significant loss of life be used only for nonacute care	HSC §§130000-130070
Earthquake Education Act [SB 1893]	1983	Education and preparedness	Program		PRC §2805, et seq.
Earthquake preparedness [AB 2662]	1983	Education and preparedness	Program		
California Earthquake Hazard Reduction Act [SB 548]	1985	Seismic hazard mitigation	Program	After the 1985 Mexico City Earthquake, in 1986 California passed the Earthquake Hazards Reduction Act, which called for a coordinated state program to implement new and expanded activities to significantly reduce earthquake threat. The program is coordinated by CSSC, which is required to specify priorities, funding sources and amounts, schedules, and other resources. Although historically funded by the state general fund, since the 2003-2004 fiscal year, the program was funded by fees imposed on property insurance companies. The Act authorizes CSSC to develop a statewide plan to reduce earthquake hazards.	GC §8870, et seq.
Unreinforced Masonry Building Act	1986	General building seismic safety	Program	In response to the 1983 Coalinga Earthquake, in 1986 the state legislature enacted the Un-reinforced Masonry Building Law, which requires local governments in high seismic regions (within Seismic Zone 4) of California to inventory un-reinforced masonry buildings, establish mitigation programs, and report progress to the CSSC.	GC §§8875-8875.10

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Essential Services Building Seismic Safety Act of 1986 [SB 122]	1986	Essential building seismic safety	Regulation	Also in response to the 1985 Mexico City Earthquake, in 1986 the state passed the Essential Services Building Seismic Safety Act to require enhanced regulatory oversight by local governments during the design and construction of new essential service facilities. The Division of the State Architect within DGS enforces this Act. The Act sets seismic safety design and review standards for critical facilities such as police and fire stations and emergency communications and operations facilities; enforced by DSA	HSC §16000, et seq.
Katz Act	1987	School seismic safety	Regulation	Requires all private schools to develop disaster plans and en earthquake emergency procedure system	Education Code §§35295-35297
SB 920	1989	Government building seismic safety	Policy	Requires CSSC to develop a state policy on acceptable levels of earthquake risk for new and existing state-owned buildings by January 1, 1991	Revenue and Taxation Code §74.5
Bridge Seismic Retrofit Program [SB 2104]	1990	Essential facility seismic safety	Program	Requires Caltrans to prepare an inventory of all state-owned bridges which require strengthening or replacement to meet seismic-safety standards, and prepare plan and schedule for completion.	
Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990 [Prop 122]	1990	Essential building seismic safety	Program / Institution	Proposition 122 was passed by voters in June 1990 after the 1989 Loma Prieta Earthquake revealed vulnerabilities in state-owned and essential services buildings. The bond measure authorized the state to issue $300 million in general obligation bonds for the seismic retrofit of state and local government buildings ($250 million for state-owned buildings and $50 million for partial financing of local government essential services facilities). The Seismic and Special Programs Section of the DGS Real Estate Services Division administers Proposition 122 grant programs.	GC §§8878.50-8878.52

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Seismic Hazards Mapping Act	1990	Seismic hazard mapping	Program	The Seismic Hazards Mapping Act, passed in 1990, directs the Department of Conservation to identify and map areas prone to liquefaction, earthquake-induced landslides, and amplified ground shaking; tsunami hazards were added to the act in 1992. The purpose of the Act is to reduce the threat to public safety and to minimize the loss of life and property by identifying and mitigating these seismic hazards. The Act requires geotechnical investigations to identify hazards and formulate mitigation measures before permitting most developments within mapped Zones of Required Investigation.	PRC §§2690-2699.6
	1990	Essential building seismic safety	Policy	Establishes seismic safety standards for ambulatory surgical centers; requires fixed medical equipment (floor, roof or wall mounted) to be installed using services of licensed architect or structural engineer; and requires inspection every five years	HSC §1226.5
Private Schools Act	1990	School seismic safety	Enhancement	Extends Field Act to new private schools	
AB 631	1990	Manufactured/Mobile home bracing devices	Enhancement	Requires HCD to adopt regulations governing the installation of earthquake-resistant bracing systems on manufactured homes or mobile homes	HSC §18613.5, et seq.
AB 1890	1990	Water heater bracing devices	Regulation	Requires new and replacement water heaters to be braced and anchored	HSC §§19210-19214
AB 3313	1990	Seismic retrofit guidelines	Regulation	Requires DSA and Building Standards Commission to develop and adopt seismic retrofit guidelines for state buildings, including those owned by CSU and UC	
Executive Order D-86-90	1990	Executive Order	Program	Requires Caltrans to prepare plan to review and retrofit transportation structures; requests UC and requires CSU to give priority consideration	

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
				to seismic safety in allocation of funds for construction projects	
Charter Schools Act	1992	School seismic safety	Retraction	Makes Field Act provisions optional for charter schools	
Hospital Seismic Retrofit and Replacement Program [SB 1953]	1994	Essential building seismic safety	Enhancement	The state legislature passed Senate Bill 1953 after the 1994 Northridge Earthquake revealed vulnerabilities in older hospitals. The law requires hospitals to undertake non-structural retrofits of emergency and surgical rooms by 2002 and collapse-avoidance retrofits by 2008. Establishes timeline and guidelines for hospitals and achieve full compliance with the Alquist Hospital Seismic Safety Act by 2030. OSHPD enforces this Act.	SB 1953
Marine Oil Terminal Program	1994	Essential facilities seismic safety	Program	After the 1994 Northridge Earthquake, the State Lands Commission received a hazard mitigation grant from FEMA to develop standards for the evaluation, retrofit, and maintenance of new and existing marine oil terminals. In 2003, the Commission issued its proposed regulations and plans to hold hearings prior to their consideration for adoption. The proposed regulations would help limit the potential and size of oil releases after earthquakes and tsunamis by requiring upgrades of older terminals. Fees to be paid by marine oil terminal owners would fund the state's oversight of this program.	
California Earthquake Authority [AB 13, SB 1993]	1996	Earthquake insurance	Institution	Creates the California Earthquake Authority; authorized CEA to issue policies of basic residential earthquake insurance	Insurance Code §§10089.5-10089.54
AB 425	1997	School seismic safety	Retraction	Authorizes community college district to acquire for use any offsite facility constructed prior to Jan. 1, 1998 that meets structural requirements of the 1976 UBC, but does not meet requirements of Education Code §81130 if it has	Education Code §§81149, 81530.5

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
				gone through an inspection by a structural engineer whose report is reviewed by DGS	
AB 865	1997	School seismic safety	Retraction	Authorizes school district to lease a commercial building prior to Jan. 1, 2003 that does not meet the requirements of the Field Act provided that the building was constructed in accordance with seismic safety standards for commercial buildings within earthquake zones	Education Code §17285
AB 300	1999	School seismic safety	Program	Requires DGS to conduct inventory of public school buildings that are concrete tilt-up or have non-wood frame walls that do not meet requirements of 1976 UBC by Dec. 31, 2001	Education Code §17317
SB 1122	1999	School seismic safety	Program	Requires OES, in cooperation with State Department of Education, DGS and SSC to develop an educational pamphlet for use by K-14 personnel to identify and mitigate risks posed by nonstructural earthquake hazards	GC §8587.7
AB 2791	2000	School and essential facility seismic safety	Policy / Regulation	Authorizes DGS to issue a stop work order when construction on a public school, community college, or essential services facility is not being performed in compliance with Field Act	Education Code §§17307.5, 81133.5; HSC §16017.5
SB 1729	2000	School seismic safety	Policy / Regulation	Requires geological and soil engineering studies by competent personnel if prospective school site is located within boundaries of special studies zone or within an area designated as geologically hazardous in safety element	Education Code §17212, et seq.
AB 656	2001	Essential building seismic safety	Regulation	Authorizes, for county-owned general acute care hospital buildings, a 1-year extension of Jan. 1, 2002 deadline for Non-structural performance Category-2 requirements until if hospital is removed from general acute care service and completion of specified replacement by Jan. 1, 2003	HSC §§130063.1-2
SB 1898	2003	Seismic gas valve shut-off device	Policy / Regulation	Authorizes local governments to adopt ordinances requiring installation of earthquake	HSC §§19180-83; HSC §§19200-05

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
				sensitive gas shutoff devices in buildings due to motion caused by an earthquake; allows DSA to establish a certification procedure for installation	
AB 3032	2003	URM building retrofit	Policy	Exempts owners of retrofitted URM buildings from compliance with posted entry-area earthquake warning signs	GC §§8875.8, 8875.9
AB 3033	2003	URM building retrofit	Policy	Prohibits a city or county from imposing additional non-seismic building improvements to retrofit of URM building if building or site conditions unrelated to the improvements	AB 3033
AB 216	2005	Essential facility seismic safety	Program	Allocates $143 million for BART Tube Seismic Strengthening	Streets & Highways Code §30914(c)(21)
AB 144	2005	Toll-bridge retrofit	Program	Authorizes retrofit of state-owned toll bridges using seismic toll surcharge	Streets & Highways Code §188.4
AB 304	2005	"Soft Story" buildings	Policy	Soft-story residential buildings are multi-story wood-frame structures that may have inadequately braced lower stories that may not be able to resist earthquake motion. AB 304 encourages cities and counties to address the seismic safety of soft-story residential buildings and encourages local governments to initiate efforts to reduce the seismic risk in vulnerable soft-story residential buildings. AB 304 requires the seismic retrofit of these buildings to comply with a nationally recognized model code relating to the retrofit of existing buildings or substantially equivalent standards. The bill replaces the word "reconstruction" with "seismic retrofit" in provisions governing earthquake hazardous building reconstruction and defines seismic retrofit for purposes of provisions governing earthquake protection.	HSC §19610-19616
SB 167	2005	Essential facility seismic safety	Policy	Exempts hospitals subject to state seismic standards for hospitals from 2008 deadline if	HSC §130030, §130070

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
				governing body agrees to comply with 2030 standards by 2020.	
Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006 [Proposition 1B]	2006	Essential facility seismic safety	Program	Provides $125 million funding for seismic retrofit work on local bridges, ramps, and overpasses; establishes Local Bridge Seismic Retrofit Account	GC §8879.23(i)
AB 127	2006	Community College Facilities	Policy	Gives Community Colleges the option to comply with California building code or the Field Act	§81052
SB 135	2013	Earthquake early warning system	Program	Directed the Governor's Office of Emergency Services, in collaboration with other relevant institutions and government agencies, to create an early warning system to provide a short alarm before the main force of an earthquake hits. Prohibited the use of General Fund dollars in the development of the warning system.	
SB 438	2015	Earthquake early warning system	Policy	Eliminated the prohibition of the General Fund as a source of funding for the earthquake early warning system. Created the California Earthquake Early Warning Program and the California Earthquake Early Warning Advisory Board within the Governor's Office of Emergency Services.	
SB 494	2015	California Earthquake Safety Fund	Program	Created the California Earthquake Safety Fund and would require moneys in the fund be used for seismic safety and earthquake-related programs, including the earthquake early warning system, upon annual appropriation by the Legislature.	

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APPENDIX H– FLOOD HAZARD MITIGATION LEGISLATION, 1933-2017

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Flood Control Law of 1946	1946	Flood control infrastructure cost sharing	Policy	Establishes state interest in and cooperation with the federal government in construction of flood control projects	Water Code §12800, et seq.
Cobey-Alquist Flood Plain Management Act	1965	Floodplain management	Program / Regulation	Authorizes review of floodplain management plans, establishes floodplain regulations, and regulates designated floodway use and reimbursement costs for federal flood control projects	Water Code §§8400-8415, §8401(c)
California Emergency Services Act	1970	Property disclosure	Regulation	Establishes disclosure obligations of seller or agent of seller of property in special flood hazard area, or in area of potential flooding	GC §§8589.3, 8589.4
Executive Order B-30-77	1977	Essential building flood safety	Program	Floodplain management for state buildings	Exec. Order B-30-77
Flood Emergency Action Team	1997			Creates Flood Emergency Action Team	Exec. Order
California Watershed Protection and Flood Prevention Law [AB 793]	1999				Water Code §12850
Floodplain Management Task Force [AB 1147]	2000	Floodplain management strategy	Institution	Recommends creation of the Flood Emergency Action Team to recommend floodplain management strategies designed to reduce flood losses and maximize the benefits of floodplains	AB 1147
Safe Drinking Water, Watershed Protection and Flood Protection Act [Proposition 13, AB 1584]	2000	Local flood control projects	Program	Provides funding to local agencies for locally sponsored, federally authorized flood control projects; provides funding for Flood Protection Corridor Program and flood control mapping	Proposition 13
Water Code §128		Flood disaster response	Policy	Enables DWR to respond to flood damage to property of general or state interest	Water Code §128
Flood Control Law		Flood control infrastructure construction	Policy	Allows any city to incur indebtedness to finance the construction of flood control infrastructure	Water Code §8000

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002					
[Proposition 50]	2002	Flood control infrastructure improvement	Program	Allocates funding available for grants for planning and implementation of multipurpose flood control programs; eligibility for funding dependent on project being designed to improve flood management	Water Code §79651(h)
Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 [Proposition 84]	2006	Critical flood control infrastructure evaluation	Program	Allocates $275 million in funding for levee inspection and evaluation; map floodplains including rural areas with potential for urbanization and high density urban areas; improve effectiveness of emergency response; provides funding for critical immediate flood control needs throughout state; provides funding for assistance to local land-use planning	PRC §75030, et seq.
Disaster Preparedness and Flood Prevention Bond Act of 2006 [Proposition 1E, AB 140]	2006	Flood control infrastructure improvement	Program	Allocates $3.0 billion in funding for evaluation, repair, reconstruction, or replacement of flood control infrastructure; improve or add flood control facilities; reduce risk of levee failure in Delta; develop flood hazard maps	PRC §5096.8, et seq.
AB 162	2007	Land Use Requirements	Policy	Requires cities and counties to address flood-related matters in the land use, conservation, safety, and housing elements of their general plans	GC §65302, 65303.4, 65352, 65584.04, 65584.06, 65300.2, and 65302.7.
AB 70	2007	Flood Liability	Policy	Requires that a city or county may be required to contribute a fair and reasonable share of the increased flood liability caused by its unreasonable approval of developments following the failure of a state flood control project	Water Code §8307

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
SB 5	2007	Central Valley Flood Protection Plan	Policy	Requires the Department of Water Resources and the Central Valley Flood Protection Board to prepare and adopt a Central Valley Flood Protection Plan by 2012, and establishes flood protection requirements for local land-use decisions consistent with the Central Valley Protection Plan	GC §65007, 65302.9, 65860.1, 65865.5, 65962, and 66474.5. HSC §50456. Water Code §8200, 9600
SB 1278	2012	Central Valley Flood Protection	Policy	Requires local governments in the Central Valley to amend general plans by July 2015 in accordance with Central Valley Flood Protection Plan. Requires local governments to make findings that property in undetermined risk areas have met the urban level of flood protection. Exempts DWR flood plain maps from CEQA and state endangered species act.	Amends Sec. 65302.9, 65860.1 of the Government Code, and Section 9610 of the Water Code
AB 1965	2012	Flood mapping	Policy	Requires DWR, on or before July 2, 2013, to release flood plain map and available data on water surface elevation of flooding in urban areas, as specified (Sacramento-San Joaquin Valley). Exempts maps from OAL review and approval, and limits DWR liability based upon the reasonable exercise or performance of discretionary or ministerial function	Amends Sec. 65007 of the Government Code
SB 753	2013	Central Valley Flood Protection	Policy	Clarified and expanded enforcement authority of the CVFPB with regard to encroachments onto facilities of the SPFC.	
SB 5	2017	Flood control infrastructure improvement	Policy	Placed Proposition 68 on June 2018 ballot which includes $550 million for these flood management areas: Delta ($50 million), Central Valley ($350 million), multi-benefit projects ($300 million), storm water/mudslide flood projects ($100 million), and urban multi-benefit projects ($100 million).	

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
SB 92	2017	Dam safety	Policy	Bolstered certain dam safety provisions in the California Water Code and Government Code which affects how DWR Division of Safety of Dams oversees dam safety in cooperation with the California Office of Emergency Services. DWR has updated the classification of the public safety risk of all state jurisdictional dams based on downstream hazard potential and reviews of critical appurtenant structures. For significant, high, and extremely high hazard dams under state jurisdiction, DWR will approve inundation maps prepared by dam owners for the failure of the dam and identified critical appurtenant structures under various failure scenarios unique to the dam and shall make approved dam failure inundation maps publicly available. For all dams under state jurisdiction that are not low hazard dams, Emergency Action Plans will be required utilizing these inundation maps. The California Office of Emergency Services shall review and approve the Emergency Action Plan based on the approved dam inundation map(s) prepared by the dam owner.	California Water Code 6160 and 6161
AB 1270	2017	Dam safety	Policy	Requires annual inspections for dams deemed to be high hazards, sets standards for inspections, and requires periodic review of dams' original design and construction records. It also requires inspectors to consult periodically with independent experts and makes inspection reports public.	California Water Code 6102.5 and 6103

APPENDIX I – WILDFIRE HAZARD MITIGATION LEGISLATION, 1933-2017

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Organic Act	1887			Set aside National Forest Reserves	
State Fire Responsibility Act	1965	State Areas of Responsibility	Policy	Requires State Board of Forestry to classify all lands in state in which financial responsibility of preventing and suppressing fires is primarily the responsibility of the state; defines SRA land	PRC §4125
Z'berg Nejedly Forest Practice Act	1973	Forest resource improvement	Policy	Restores, enhances, and maintains productivity of timberlands while giving consideration to their varied public benefits; exempts certain vegetation management practices related to fuel reduction and establishing fuel breaks	PRC §4511, et seq., 4584(j)
California Forest Improvement Act of 1978	1978	Forest resource improvement	Program	Allows (DFW) to enter into agreements with eligible landowners to undertake forest resource improvement work; establishes practices that will improve long-term quality of forested lands in terms of timber productivity, retention of soil cover and value for wildfire	PRC §§4790-4799.05
Designate Hazardous Fire Areas [SB 1972 - Campbell)]	1979	Fire hazard zone designation	Policy / Regulation	Designates hazardous fire areas, regulates the use of fireworks and other hazardous materials within these designated areas; fire prevention reduction standards on railroad right of way	PRC §§4254, 4255, 4258, 4259, 4260, 4296.5
SB 78 - Ayala	1981	Fire hazard classification; building regulations	Policy / Regulation	Establishes State Responsibility Area (SRA) fire hazard classification and zoning, roof and attic openings, and HCD roofing regulations	PRC §4291.5; HSC §13108.5
SB 799 - Mello	1981	Firework regulation	Regulation	Bans the use of fireworks in SRA Fire Hazard Zones	PRC §§4254-4255, 4258-4260
	1989	Safety element review	Policy / Regulation	Requires State Board of Forestry to review the safety element of counties which contain state responsibility areas and make appropriate recommendations	PRC §4128.5
Natural Hazard Disclosure requirements [AB 1812 - Cortese]	1989	Natural hazard disclosure	Policy / Regulation	Requires Natural Hazard Disclosure for wildfire in SRA	PRC §4291, et seq.
Minimum fire safety regulation in SRA [SB 1075 - Rogers)]	1991	Minimum fire safety	Policy / Regulation	Sets minimum fire safety regulation in SRA	PRC §4290

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Very High Fire Hazard Severity Zones; Fire Hazard Zoning in Local Area of Responsibility (LRA) [AB 337 - Bates]	1992	Fire hazard zone designation	Policy / Regulation	Establishes designation of Fire Hazard Zoning in Local Responsibility Area (LRA)	GC §§51178-51188; HSC §13108.5
AB 3819 - Brown	1995	Fire hazard building safety	Policy / Regulation	Class A roof and Model Ordinance for defensibility of space and structures	GC §§51178.5, 51189; HSC §§13108.5, 13132.7; PRC §42205
AB 747 - Brown	1995	Fire hazard building safety	Policy / Regulation	Sets timeline for testing of Class A, B, C roof and shingles	HSC §13132.7
AB 1195 - Torlakson	1997	Fire hazard zone designation	Institution	Requires local agencies to designate Very High Fire Hazard Severity Zones upon recommendation from CAL FIRE; creates the Emergency Response Training Advisory Committee	Civil Code §§2079.11, 1102.6c, GC §§8589.3-8589.5, 51179, 51183.5, PRC §§2621.9, 2694, 2696, 4125, 4136
Natural Hazard Disclosure for wildfire in LRA and Very High Fire Hazard Severity Zones [AB 6X, AB 1195]	1998	Natural hazard disclosure	Regulation	Establishes disclosure obligations of seller or agent of seller of property in LRA and Very High Fire Hazard Severity Zones; facilitated by Natural Hazard Disclosure Statement	Civil Code §1103, et seq.; GC §51183.5
AB 423	1999	Fire hazard building safety	Policy	Lists wood roofing materials that have passed at least five years of the ten-year weather test; insurance companies honor replacement cost coverage for increased cost of fire retardant roofing materials	HSC §13132.7
California Clean Water, Clean Air, Safe Neighborhood Parks and Coastal Protection Act of 2002 [Proposition 40, AB 1602]	2002	Fuel reduction program	Program	Establishes program with goal to reduce wildland fuel loadings that pose threat to watershed resources and water quality	PRC §5096.3
AB 1216	2002	Fire hazard building safety	Regulation	Expands fire safety building standards in areas with high fire risk to various components (not listed)	PRC §4291, GC §51189
Governor's Blue Ribbon Fire Commission	2003	Review of fire response	Program	Reviews firefighting effort of Southern California wildfires; presents recommendations to policy makers that will promote fire safe environment in WUI	
Defensible Space regulations [SB 1369]	2004	Fire hazard building safety	Regulation	Requires persons in SRA to maintain additional firebreak by removing all brush, flammable vegetation or combustible growth located 30 to 100 feet from building or structure or to property line	PRC §4291(b)

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
Forest Fire Protection Act of 2004 [AB 2420]	2004	Forest resources	Policy	Authorized the Board of Forestry and Fire Protection to create a Healthy Forest Fire Prevention Exemption which would exempt from the requirements of the Forest Practice Act the harvesting of trees and other commercial forest products for the purpose of reducing the rate of fire spread, fire duration and intensity, fuel ignitability, and ignition of tree crown	PRC §4584
SB 502	2005	Weed and vegetation	Policy	Broadened the types of vegetation that homeowners in very high fire risk areas may retain when conducting fire safe clearances around their homes	GC §51182, HSC §14875, PRC §4291
SB 1084	2005	Forest practices	Policy	Established several new fire prevention strategies designed to reduce the threat of wildfire and enhance wildfire suppression resources	PRC §4442.6, 4464, 4475.5, 4476, 4480
SB 841	2006	Fire protection: fire breaks	Policy	Allows a landowner to remove any or all vegetation within 300 feet of specific structures, including hospitals, adult residential care facilities, schools, above ground storage tanks, and hazardous materials facilities, for the purpose of constructing a firebreak or other appropriate vegetation management techniques	PRC §4291.3
		Fire Hazard Severity Zones	Policy	Directs the California Department of Forestry and Fire Protection (CAL FIRE) to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These zones, referred to as Fire Hazard Severity Zones (FHSZs), define the application of various mitigation strategies to reduce risk associated with wildland fires. State Responsibility Areas (SRAs) were originally mapped in 1985 and last updated in 2007.	PRC §4201-4204 Government Code 51175-89

Legislation	Adoption Date	Subject	Type of Legislation	General Provisions	Citation
SB 1595	2008	Fuels management: forest	Policy	Amended defensible space requirements that separate structures from surrounding vegetation and other potential wildfire fuels (recast these requirements in terms of fuels management instead of vegetation management). Required the Department of Forestry and Fire Protection (CAL FIRE) to develop a guidance document on fuels management, and added certain wind events to the fire modeling for CAL FIRE's designation of a very high fire hazard severity zones as specified that are deemed major causes of wildfire spread	GC §51175; PRC §4202
AB 2859	2008	Public resources: fire prevention	Policy	Facilitated and increased fuel treatment and clearance by exempting certain treatment activities	PRC §4527, 4716
Wildfire Prevention Assistance Act of 2008 [AB 1883]	2008	Fire: inmate crews and non-profit organizations	Policy	Authorizes CAL FIRE to enter into a contract with a non-profit organization for the purposes of using inmate crews for fire prevention work	PRC §4953
SCR 80	2008	Fire safe councils	Resolution	Resolution adopted in State Senate Rules Committee, recognizes California Fire Safe Councils as one of state leading community-based wildfire preparedness organizations	Resolution Statutes Chapter 116
SB 1241	2012	Local wildfire hazard planning	Policy	Mandates wildfire planning responsibilities to local agencies through requirements regarding 1) wildfire updates to general plans; 2) mandatory findings for subdivision approvals in state responsibility areas (SRAs) and very high fire hazard severity zones (VHFHSZs); and 3) California Environmental Quality Act (CEQA) checklist updates for wildfire safety.	GC §65302, §65302.5, §51177
Senate Bill 109	2017	Budget Act of 2017, Funding Wildfire Mitigation	Budget Allocation	Allocates $220 million from the Greenhouse Gas Reduction Fund to CAL FIRE to address fire protection and resource management to mitigate wildfire. The funds appropriated to CAL FIRE are intended to be used for state and local healthy forest and fire prevention programs and projects that improve forest health and reduce greenhouse gas emissions caused by uncontrolled wildfires, including, but not limited to, vegetation management, forest overgrowth reduction, biomass energy generation, and measures to ensure future wildfires are more consistent with historic regenerative fire regime.	

APPENDIX J – TOP 10 CALIFORNIA REPETITIVE LOSS COUNTIES (BY TOTAL PAYMENT) SUMMARY FOR 2017

RANK	County Name	Total Payments	Losses
1	SONOMA COUNTY	$14,459,027.40	84
2	SACRAMENTO COUNTY	$3,493,233.74	18
3	NAPA COUNTY	$3,400,511.89	19
4	LAKE COUNTY	$1,932,269.89	23
5	MARIN COUNTY	$1,775,553.77	17
6	ORANGE COUNTY	$1,566,960.13	14
7	VENTURA COUNTY	$961,027.19	2
8	SANTA CRUZ COUNTY	$870,860.55	11
9	SOLANO COUNTY	$720,862.16	4
10	MONTEREY COUNTY	$712,764.84	6
	Top Ten RL Total	*$29,893,071.56*	*198*
	State RL Total	*$34,391,238.81*	*240*
	Percent State Total	*86%*	*83%*

Source: Cal OES PDFM Program

APPENDIX K – TOP 10 CALIFORNIA SEVERE REPETITIVE LOSS COUNTIES (BY TOTAL PAYMENT) SUMMARY FOR 2017

RANK	County Name	Total Payments	Losses
1	SONOMA COUNTY	$25,890,063.53	168
2	LOS ANGELES COUNTY	$4,352,364.05	29
3	LAKE COUNTY	$2,843,481.57	23
4	MARIN COUNTY	$2,926,282.69	23
5	NAPA COUNTY	$3,701,700.46	21
6	SAN DIEGO COUNTY	$1,776,475.24	13
7	SACRAMENTO COUNTY	$2,630,155.62	13
8	SANTA CRUZ COUNTY	$1,335,298.47	11
9	ORANGE COUNTY	$1,114,848.77	7
10	VENTURA COUNTY	$1,532,655.21	7
	Top Ten SRL Total	*$48,103,325.61*	*315*
	State SRL Total	*$56,328,665.68*	*374*
	Percent State Total	*85%*	*84%*

Source: Cal OES PDFM Program

APPENDIX L – MITIGATION GRANTS NOI AND SUBAPPLICATION PROCESSES

From Funding Opportunity to Close Out: An Overview of Typical Steps in the Life of a Grant

For California jurisdictions and subapplicants, the entire process for most HMGP, PDM, and FMA grants will entail the following overall steps:

1. FEMA announces Notice of Funding Opportunity (NOFO) for grant funding provided after a declared disaster or by congressional appropriation
2. Cal OES HMGP or PDM/FMA programs create documents that announce the grant opportunity and open a filing period for subapplicant submittals of a Notice of Interest (NOI). Cal OES sends out notification to interested parties and posts information on the Cal OES mitigation web page.
3. Submitted NOIs are reviewed for eligibility by Cal OES grants staff. Eligible subapplicants are notified.
4. Subapplication training and technical assistance is offered by Cal OES grants staff (jointly with FEMA grants staff).
5. Subapplication submission period for local jurisdictions to submit to Cal OES (by mail for HMGP subapplications and through eGrants for PDM/FMA subapplications).
6. Cal OES grants staff reviews, scores and ranks subapplications.
7. If subapplications are not complete, Cal OES sends a letter to the subapplicant requesting more information.
8. Cal OES forwards recommended subapplications to FEMA (HMGP only)
9. Cal OES develops full grant application to FEMA with subapplications accepted (PDM/FMA only)
10. State application submittal to FEMA – for nationwide competitive grants (PDM/FMA only)
11. FEMA review and evaluation - nationwide competitive grants (PDM/FMA only)
12. Grant/Subgrant award – the subapplicant becomes the subrecipient
13. Project work (period of performance). Subrecipients submits quarterly reports. Cal OES generates quarterly reports to FEMA
14. Subrecipient completes project.
15. Grant/Subgrant closeout. Cal OES sends letter requesting closeout documents. Subrecipient submits closeout documents. Once all completed closeout documents are received, Cal OES submits closeout documents to FEMA. FEMA closes project.

Example 6-page instruction document for filing a Notice of Interest for Pre-disaster Mitigation (PDM) or Flood Mitigation Assistance (FMA) Grants

Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES

PRE-DISASTER AND FLOOD MITIGATION ASSISTANCE GRANT PROGRAMS

INSTRUCTIONS FOR FILING A NOTICE OF INTEREST (NOI)

Please read the following instructions prior to completing the Notice of Interest (NOI). The NOI can be found at http://www.caloes.ca.gov/cal-oes-divisions/hazard-mitigation/pre-disaster-flood-mitigation

DEADLINE: The Cal OES deadline to submit an NOI is Friday, August 4, 2017.

Accurate and complete answers are required to determine eligibility and expedite the review process. NOIs must be submitted electronically and each section must be answered in the space provided. Please direct any questions regarding completion of the NOI to PDFM@caloes.ca.gov.

Introduction

Federal funding is provided under the Robert T. Stafford Emergency Assistance and Disaster Relief Act (Stafford Act). FEMA's 2017 NOFO provides information on federal funding priorities and limits, criteria and other critical information related to this funding cycle. Please pay close attention to critical State information from OES regarding NOI and subapplication deadlines and criteria that all jurisdictions must follow to apply for funding.

The Unified Hazard Mitigation Assistance (HMA) Guidance provides information on applicant and activity eligibility as well as other requirements, including performance period, cost-effectiveness, environmental review, and required documentation. The HMA Guidance is available at https://www.fema.gov/hazard-mitigation-assistance-program-guidance. Please review all eligibility requirements before submitting an NOI.

Submission of an NOI is the first step in the Pre-Disaster Mitigation (PDM) or the Flood Mitigation Assistance (FMA) Program subapplication approval process. Cal OES will review each NOI for eligibility and consistency with established 2017 PDM and FMA priorities.

The Notice of Interest Form

An NOI is required for each proposed project or plan submitted. All NOIs are reviewed for eligibility by OES. Jurisdictions submitting an eligible NOI will be notified and invited to submit a subapplication for the 2017 PDM and/or FMA funding cycle. Cal OES will only accept NOIs/subapplication for mitigation activities selected through this process

The following provides detailed guidance on completing the NOI form:

1. Program (select one):	Select the type of program PDM or FMA
2. This NOI is for a (select one):	Select one. Identify if your NOI describes a planning or project activity.
3. Eligible Subapplicant Type:	Select one. Eligible subapplicants include city, state, county or special district. *Tribal governments submit directly to FEMA. If your entity does not fall into one of these categories, you are not eligible to apply for PDM or FMA funding, but may be sponsored by an eligible entity.
4. Hazard Type:	Select one. Use "Multi-Hazard" for planning activities.
5. Mitigation Activity Type:	Select one. Cal OES will only accept NOIs describing eligible activities.
6. Climate Resilient Mitigation:	Does this activity incorporate climate resilient mitigation activities and/or encourage the integration of adaptation measures into local planning and development practices? Climate Resilient Mitigation Activities (CRMA) may include Aquifer Storage and Recovery (ASR), Floodplain and Stream Restoration (FSR), and Flood Diversion and Storage (FDS); and pre- or post-wildfire mitigation activities or any mitigation action that utilizes green infrastructure approaches.
7. Activity Costs:	PDM Program: The federal share for project NOIs must not exceed $4,000,000. For local hazard mitigation plans, the funding limits are $125,000 for a single jurisdiction new or updated plan, and $250,000 for a multi-jurisdiction new or updated plan. PDM Subapplicant Cost Share: Cost share is required under this program. Federal funding is available for up to 75 percent of the eligible activity costs. The remaining 25 percent of eligible activity costs must come from non-Federal sources. FMA Program: There is no established federal funding share set for the FMA program. FMA Subapplicant Cost Share: Federal funding is available for up to 75 percent of the eligible activity costs. FEMA may contribute up to 100 percent Federal cost share for Severe Repetitive Loss (SRL) properties. FEMA may contribute up

	to 90 percent Federal cost share for Repetitive Loss (RL) properties.
8. Benefit Cost Analysis (BCA)	FEMA will only consider applications that use a FEMA-approved methodology to demonstrate cost-effectiveness. Planning and Management cost sub-applications do not require a BCA. FEMA provides BCA software (Version 5.3.0) that allows subapplicants to calculate the BCA. Written materials and training are also available. The FEMA BCA software utilizes the OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.* For BCA policies, overviews, and software, see http://www.fema.gov/benefit-cost-analysis .
9. Have the Cost-Sharing Funds been secured?	**NOTE:** The letters of commitment for cost share must be in place at the time of subapplication submittal.
10. Activity Title/Name:	Provide a name that clearly reflects the proposed activity. The name selected in the NOI must match the name used if an application is submitted.
11. Population:	For Planning NOIs: Identify the population of the jurisdiction applying for the planning grant using current census data. For multi-jurisdictional plans identify the total population of all jurisdictions covered by the plan and list the name of each jurisdiction. For Project NOIs: Identify the population that will directly benefit from the proposed project implementation.
12. Activity Location:	For Planning NOIs: Identify a central location and address for the lead agency. For Project NOIs: Provide the latitude and longitude in degrees (six decimal places) defining the activity location. If the activity involves more than one location, provide the latitude and longitude at the center of the proposed project area and a general description of the project area.
13. Describe the problem to be mitigated:	Describe the need for this activity. The problem statement must include a description of the hazards being addressed, i.e. fire, flood, earthquake, drought, etc. Planning NOIs must specify the geographic area and the jurisdictions that will be addressed by the plan. Include hazards types and the population of the geographic area served by the plan.

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Project NOIs must identify the natural hazard and the risk to the facility that is being considered. Include historical information on damages and the reoccurrence interval of that hazard.

14. Scope of Work:

The scope of work must include the following:

For Planning NOIs: The scope of work must include the following:

a) Specify if the proposal is for a new Local Hazard Mitigation Plan (LHMP) or an update to a current LHMP.

b) Specify if the LHMP is for a single jurisdiction or multiple jurisdictions and list the jurisdictions that will be incorporated into the plan.

c) If the proposed activity is a plan update, the NOI must clarify whether the plan being updated was previously funded by a hazard mitigation grant.

d) The NOI must also provide information on the planning process, data collection and risk assessment process, and plan approval and adoption process. The NOI should also discuss other mitigation activities/initiatives taken by the applicant in preparation for the planning activity.

e) The LHMP must incorporate climate resilient mitigation activities and/or encourage the integration of adaptation measures into local planning and development practices.

f) Provide information on whether the plan being updated was previously in compliance with AB 2140 and if the plan was adapted to the Safety Element of a General Plan.

g) In a separate paragraph, the NOI must provide information on the planning capabilities of the applicant based on previous successful grant compliance/completion.

For Project NOIs: The scope of work must include the following:

a) A purpose statement that demonstrates the proposed project will reduce the risk from the effects of natural hazards to life, property, essential services, or critical facilities. Identify all the benefits that will result from the project's implementation.

b) A project description that is clear and concise, and includes the location of the proposed project, the

proposed conceptual design, the means of implementation, and the basic dimensions of the project and the project area.

c) A statement of the level of protection of the proposed project versus the existing level of protection.
d) A description of any existing engineering drawings or any environmental documents that relate to the project and describe any possible impacts to the environment or historic structures from the project's implementation.
e) For flood projects or any project in the FEMA mapped floodplain, identify if the project location(s) on a FEMA flood map and state the flood zone designation, document the community's participation in the National Flood Insurance Program (NFIP), and determine if any of the structures have flood insurance or are on FEMA's severe repetitive loss list.
f) A description of the project life and the long-term maintenance requirements.

15. Performance Period:	Indicate the length of time, in months, needed to complete the activity. The 2017 NOFO will provide dates of the PDM/FMA Period of Performance.
16. National Flood Insurance Program	All subapplicant's for the FMA program must be participating in the NFIP, and must not be withdrawn or suspended.
17. Duplicate Programs:	Indicate if this activity is eligible for funding from another federal program such as the United States Army Corps of engineers, FEMA Public Assistance Program, or the US Department of Agriculture/Department of the Interior Healthy Forest Reform Act of 2002.
18. Local Hazard Mitigation Plan Requirement	Not required for planning activities. Provide a narrative that identifies how the proposed activity is consistent with your LHMP. Be specific; identify the page number and/or section number from your plan. Include a narrative that quantifies the criticality of the project with respect to the overall population of the community
19. LHMP Approval Date:	Identify the date subapplicant's Local Hazard Mitigation Plan (LHMP) was approved by FEMA.

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20. Subapplicant Name:	Provide the name of the subapplicant applying for grant funds. Subapplicant names must be consistent with the FIPS#.
21. Subapplicant Address:	Provide the mailing address for the sub- applicant. Include city, county, state and zip code.
22. Name of Person Completing NOI:	Provide the first and last name of the person completing the NOI.
23. FIPS #:	Provide the Federal Identification Processing System number for the subapplicant. If the subapplicant does not have or know their FIPS number, contact Cal OES.
24. DUNS #:	Provide the Data Universal Numbering System number for the subapplicant. If the subapplicant does not have or know their DUNS number, call Dunn & Bradstreet at 1-866-705-5711.
25. Legislative Districts:	Provide only the number of the legislative districts listed. If the project site is located in a different district than the subapplicant address, please provide both.
26. Subapplicant Authorized Agent (AA):	The person(s) authorized by the subapplicant's governing body to act on behalf of the subapplicant to execute an NOI for the purpose of obtaining federal financial assistance. Provide the position title or name of the person(s) that will serve in this position. Forms used to designate the AA will be provided upon sub-grant approval. The AA will also be required to sign standard assurances to accept grant funds. Provide the first and last name, title, address, phone and fax numbers and e-mail address.
27. Project Manager/Working Contact:	The person Cal OES will contact with questions and/or requests for information. Provide the first and last name, title, address, phone and fax numbers and e-mail address.
28. Project Manager/Working Contact (Alternative):	The person Cal OES will contact with questions and/or requests for information when the primary contact is not available. Provide the first and last name, title, address, phone and fax numbers and e-mail address.

If you have any questions or comments, please contact the Pre-Disaster and Flood Mitigation Assistance Division at: PDFM@caloes.ca.gov or at (916) 845-8150.

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Example PDM/FMA Planning Grant NOI Consistency and Subapplication Review and Ranking Checklist

	Reviewer's Name:			**Review Date:**		
	Peer Review:	**1st**		**2nd**		
	Applicant Name:					
	Name of Plan:					
	FIPS number verified:					
	Cal OES No.			**MANAGER REVIEW**		

	YES	**NO**	
1			**Was an NOI submitted for this application and approved?**
2			**SOW in application is consistent with NOI?**
3			**The SOW describes the Plan will result in a FEMA approvable and Local adopted plan.**
4			**All planning activities are clearly identified and defined per HMA pg 60; Includes deliverables, tasks and schedule.**
5			**Climate Change Assessment / Resilient Mitigation Activities (CRMA) will be included**
6			**Requested Fed share does not exceed $125,000 (single jurisdiction) or $250,000 (multiple jurisdictions)** **Amount**
7			**Submitted Crosswalk (Updates only)**
8			**Submitted a letter of commitment for each identified participating jurisdiction**
9			**A current local matching funds commitment letter is submitted? Date funds are available:**

CONTINUE ONLY IF ALL ANSWERS ARE "YES"- Explanations / clarifications regarding "No"

R A N K I N G F A C T O R S

	Points				
a.		**Small Impoverished Community? -1pt**			
		Did subapplicant provide verification of small, impoverished community?	**Yes**	**No**	
b.		**New multi-jurisdictional County Plan - 7 pts**	**Number**		
		New multi-jurisdictional Non County - 6 pts	**Number**		
		Updated multi-jurisdictional plan - 5 pts	**Number**		**PLAN EXPIRATION DATE**
c.		**New single jurisdictional - 4 pts**			
		Updated single jurisdictional plan - 3 pts	**PLAN EXPIRATION DATE**		
d.		**The SOW, budget and budget narrative, work schedule are complete, connected and consistent - 3 pts**			
e.		**The LHMP will be adopted into the Safety Element of the General Plan (AB 2140)- 1 pt**			
f.		**The Jurisdiction demonstrates capability to complete the planning process: Planner/ Sufficient Management Team, etc.- 2 pts**			
g.		**The Planning Team, Process and Outreach efforts includes coordination and participation with key stakeholder groups.- 3 pts**			
	0	**TOTAL POSSIBLE POINTS**			

Use the REMARKS area below to discuss overall credibility and completeness of application

REMARKS

Revised 10-2-17

Risk Analysis:

The application must specify the geographic area that will be addressed by the planning activity and the population of that geographic area. The application must contain information on the hazards common to the geographic area and should included historical information on the recurrence of those hazards within the last five years. The information on hazards should be supported by the Cal OES "My Plan" website at http://myplan.caloes.ca.gov/ depicting the severity of hazards in the targeted area.

The hazard mitigation planning scope of work (SOW) must describe the development of a hazard mitigation plan that complies with the requirements identified in 44 CFR Part 201. See attached reference guide (worksheet tab) for additional information

Example PDM/FMA Project Grant NOI Consistency and Subapplication Review and Ranking Checklist

Reviewer's Name:				**Review Date:**	
Peer Review:	**1st**		**2nd**		
Applicant Name:					
Name of Project:					
FIPS no. verified:					
Cal OES No.:			**MANAGER REVIEW:**		

	Yes	No	Eligibility Criteria: All must be "Yes"			
1			Was an NOI submitted for this application and approved?			
2			SOW in application is consistent with NOI.			
3			Project must have a BCR of 1.0 or greater.	BCR is?		
4			Does applicant have a FEMA-approved LHMP currently in place?	Date approved?		
5			Is the proposed project consistent with the current LHMP?			
6			Requested federal share does not exceed $4 million (PDM only).	$		
7			Is there a new local matching fund commitment letter attached to application? Date Funds Available			
8			The project must reduce risk to an identified hazard(s). Verified?			
9			Environmental Section Review. EVERY applicable question on application is answered?			
10			Did the sub applicant provide the FEMA EHP Checklist with the application?			
			FMA Project Applications:			
11			All properties included in project must be NFIP Insured. Verified?			
12			Subapplicant must participate in NFIP (and not suspended). Verified?			
			Eligible Points Ranking Criteria			
		a.	BC Ratio: 1 - 3 = 3 pts. 4 - 6 = 4 pts. 7 or more = 5 pts.			
		b.	The project is located in a high hazard area. *Verify on My Plan 2 pts.			
		c.	**For All Flood Projects - Is project area compliant with EO 11988 1 pt.			
		d.	The project protects/enhances a vulnerable critical facility or infrastructure. 2 pts.			
		e.	Is the LHMP adopted as part of Safety Element of General Plan (AB 2140 compliant) 1 pt.		Yes	No
			Project Description:			
		f.	Does the project description include a detailed explanation of how the SOW elements will be accomplished? 1 pt.			
		g.	The SOW, budget and budget narrative, work schedule are complete, connected, feasible and consistent 3pts.			
		h.	Is there a thorough description of methodology and alternatives for selecting this project? 1 pt.			
		i.	Does subapplicant demonstrate sufficient capability and staff to manage the project? 2 pts.		Yes	No

FEMA PDM Priorities:

j.		Does the proposed project include Climate Resilient Mitigation Activities (CRMA)? 6 pts. If yes, state the mitigation activity, e.g. (flood diversion, green infrastructure methods, floodplain restoration		
k.		Is the subapplicant a small, impoverished community? 5pt. Did subapplicant provide verification of small, impoverished community?	Yes	No
l.		Is this a non-flood mitigation/non-acquisition/elevation/mitigation reconstruction? 4 pts.		
m.		Is this an acquisition, elevation or mitigation reconstruction projects? 3 pt.		
n.		Is this purchasing a generator for a critical facility as identified in LHMP? 2 pt.		

FEMA FMA Priorities:

o.		Community Flood Mitigation: A) Advanced Assistance can be used to develop mitigation strategies and obtain data to prioritize, select, and develop community flood hazard projects for future funding. and/or B) Community Flood Mitigation Projects that benefit communities with high participation and favorable standing in the NFIP. 10pts		
p.		Projects that will mitigate flood damage to at least 50 percent of structures included in the subapplication that meet the definition of a Severe Repetitive Loss (SRL) property. At least two separate NFIP claim payments have been made with the cumulative amount of such claims exceeding the market value of the insured structure. 6pts.		
q.		Projects that will mitigate flood damage to at least 50 percent of structures included in the sub-application that meet the definition of a Repetitive Loss (RL) property: Have incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25% of the market value of the structure at the time of each flood event. 4 pts.		
r.		Projects that will mitigate flood damage for at least 50 percent of structures included in the sub-application that meet the definition of a SRL property: four or more separate NFIP claim payments have been made with the amount of each claim exceeding $5,000 and with the cumulative amount of claims payments exceeding $20,000. 3 pts.		
s.		Projects that will mitigate flood damage for the largest number of NFIP-insured properties at the neighborhood level 2 pts.		

State Extra Points:

t.		Does Community participate in the Community Rating System (CRS) for flood - 1 pt. What is the ranking?	Yes	No
u.		Is the Flood Plan adopted into Safety Element of General Plan (2007 Legislation) 1 pt.	Yes	No

Total pts.		65 TOTAL POSSIBLE POINTS	2 STATE EXTRA POINTS POSSIBLE

Use the REMARKS area below to discuss overall credibility and completeness of application and BCA.

Remarks:

Example HMGP Grant NOI Consistency and Subapplication Review and Scoring Checklist

Subapplicant General Information

DR #	
Reviewers Name (Cal OES and FEMA)	
Review Date	
Subapplicant	
Activity Type	
Regular, 5% or Plan	
Project Name	
FEMA Project Number	
Cal OES Project Number	
FIPS	
Total Project Cost	
Fed share	
Non-fed share	

Initial Eligibility Criteria

	Criteria	**Reviewer Notes**
	Did Cal OES receive the subapplication by the deadline/post-marked by the deadline?	
	Does project have a BCR equal to or greater than 1.0?	
	Does subapplicant have a FEMA-approved LHMP or one in progress?	
	Is the proposed project consistent with the current LHMP?	
	Is the federal share requested within the State established threshold?	
	Is Period of Performance 36 months or less?	
	Was an NOI submitted for this subapplication and determined to be eligible?	
	Is Statement of Work (SOW) in subapplication consistent with NOI?	

	Criteria	Reviewer Notes
	Were TWO (2) identical hard copies with CDs of subapplication and all attachments submitted?	
	Is subapplication complete, including: SOW, Budget, Work Schedule, EHP, Alternatives?	

Other Eligibility Criteria

	Criteria	Reviewer Notes
	Is the subapplicant an eligible applicant (state, local government, special district, PNP)?	
	Does the project address a repetitive problem or a problem that poses a significant risk to public health and safety if left unsolved?	
	When completed, will this project contribute to a long-term standalone solution of the identified problem?	
	Are project activities clearly identified in the SOW?	
	Are there two other alternatives identified other than the Proposed Action (can include No Action and one other)?	
	Was appropriate BCA module used and are all BCA inputs (other than default) documented appropriately?	
	Do the budget line items reflect elements identified in the scope of work? If not, explain.	
	Do budget items represent eligible and reasonable costs?	
	Does the budget include items (such as large lump sums, equipment exceeding $5,000, etc.) needing additional information?	
	Does the project duplicate other Federal Programs (PA, NRCS, USACE, etc.)?	
	Is the project located in a Special Flood Hazard Area?	
	Has work begun on the project?	
	Is the match letter sufficient (signed by official, source of funding identified and eligible and date funds available)?	
	Does the application include photos and maps?	
	Has subapplicant signed application?	

Cal OES Scoring Criteria

	Yes=1 point No=0 points	**Criteria (all are Y or N unless otherwise stated)**
A		Benefit Cost Ratio 1.0-2.9 = 1 point 3.0-4.9 = 2 points 5.0+ = 3 points
B		Benefit Cost documentation, consistency and credibility
C		SOW, Budget and Work Schedule consistent?
D		Budget Narrative included?
E		Project description and dimensions provided?
F		Photos included (per project site)?
G		Maps and clear identification of project location?
H		Staging location identified?
I		Engineering Drawings/Technical Drawings included?
J		Maintenance Addressed?
K		Environmental Questionnaire (Cal OES) complete?
L		FEMA EHP Checklist provided and complete?
M		Evidence of EHP consultation with state or Federal Agency?
N		Flood project? (flood disaster)
O		Project in a declared county?
P		Does the project include Climate Resiliency Mitigation Actions (CRMA)?
Q		The subapplicant has never received HMGP funding before. If no, provide: DR# Cal OES#
TOTAL		Total Points Possible = 19. Tie goes to the greater benefit cost ratio!

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APPENDIX M – MITIGATION GRANTS MANAGEMENT AND CLOSEOUT PROCESSES

Example 6-page Site Performance Assessment form used by hazard mitigation grants staff during site visits

Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES

SITE VISIT PERFORMANCE ASSESSMENT

Program: ☐ **Hazard Mitigation Grant Program - HMGP** **HMGP Disaster#**_____
☐ **Pre-Disaster Mitigation Program - PDM** **PDM Year#**_____
☐ **Flood Mitigation Assistance Program - FMA** **FMA Year#**_____

Cal OES Project ID# _____ **Date(s) of site visit**:_____

Subrecipient: _____

Project title: _____

Project manager: _____

Federal share: $_____ **Non-Federal share: $**_____

Total project award: $ $ 0 **Reimbursed funds to date: $**_____

Type of visit: ☐ Kick-off ☐ Subrecipient self-assessment
☐ In-process ☐ Other: _____
☐ Completion/Close-out certification

Persons interviewed during site visit:

NAME	TITLE	AGENCY

_____ _____
Name, Cal OES Project Reviewer Name, Cal OES Manager

_____ _____ _____ _____
Signature, Cal OES Project Reviewer Date Signature, Cal OES Manager Date

Site Visit Performance Assessment Report Project # _____

1. PROJECT SUMMARY

Instructions: Describe the project details and attach pictures taken during site visit.

2. SCOPE OF WORK STATUS - Title 2 CFR § 200.210(d) and Title 2 CFR § 200.308(b)

Instructions: Secure a current copy of the project work schedule (example: Gantt Chart).

	Yes	No	N/A	Unsure
a) Any work changes to the project since the original application was awarded?	☐	☐	☐	☐
i. If yes, was a change in scope of work request submitted and approved by Cal OES/FEMA?	☐	☐	☐	☐
b) Describe the progress being made toward achieving the project milestones and objectives?				

Provide additional information and potential areas of concern covered in this section:

3. COST-SHARE (MATCH) REQUIREMENTS - Title 2 CFR § 200.306(b)(1)

Instructions: Inform the Subrecipient of the required cost-share supporting documentation that must be retained as described in Title 2 CFR § 200.306(b)(1).

	Yes	No	N/A	Unsure
a) What is the source of the cost-share funds or In-kind match? _____ Cash: $_____ In-kind: $_____				
b) Is the local cost-share/match requirement being met? *Document any actual/potential barriers identified.*	☐	☐	☐	☐
c) Is adequate source documentation retained to support the current cash or in-kind cost-share contributions?	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section:

Site Visit Performance Assessment Report Project # _____

4. FINANCIAL MANAGEMENT REVIEW - Title 2 CFR § 200.302(3), Title 2 CFR § 200.403-405 and Title 2 CFR § 200.501.

Instructions: Secure the responses from an individual knowledgeable about the financial record system.

	Yes	No	N/A	Unsure
a) Is a financial management system maintained that accurately identifies grant expenditures? *Please describe system in comments below.* *Example: Grant specific general ledger workbook detailing each expenditures purpose, invoice #, payee, amount, check #, and date of the transaction.*	☐	☐	☐	☐
b) Are the expenditures supported by sufficient source documentation, including original records, invoices, receipts, and proof of payment?	☐	☐	☐	☐
c) Are any of the costs being reimbursed by Cal OES/FEMA also being reimbursed by another Federal grant?	☐	☐	☐	☐
d) Was an HMA program specific audit performed per Title 2 CFR § 200.501? *Non-Federal entities that expend $750,000 or more in Federal awards during a fiscal year must have a single or program-specific audit conducted for that year.*	☐	☐	☐	☐
e) Is the Subrecipient familiar with Sub-award close-out procedures? *FEMA HMGP Sub-award Close-out FAQ help sheet.*	☐	☐	☐	☐
f) If a contractor is hired with grant funds, is there a process to monitor/verify the contractor is following Federal guidelines per Title 2 CFR § 200.501(g)? *Describe the monitoring system below.*	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section:

5. QUARTERLY PROGRESS REPORTS & REIMBURSEMENT REQUESTS - Title 2 CFR § 200.328(b)(1) and FEMA Quarterly Progress Report FAQs help sheet

Instructions: Review submission of progress and quarterly reports for timeliness. Document reasons/barriers preventing timely submission (if applicable).

	Yes	No	N/A	Unsure
a) Does the Subrecipient understand the reporting requirements of the quarterly progress reports and reimbursement requests?	☐	☐	☐	☐
b) Has the Subrecipient met all quarterly progress report due dates?	☐	☐	☐	☐
c) Is there system that supports the information reported on the progress reports and reimbursement requests?	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section

Site Visit Performance Assessment Report Project # _____

6. GRANT FUNDED PERSONNEL - Title 2 CFR § 200.430(i)(1)

Instructions: Secure an example of the timesheets the Subrecipient utilizes.

	Yes	No	N/A	Unsure
a) Were detailed personnel activity reports (timesheets) used for each grant funded position? *This includes management, paid staff, and volunteers.*	☐	☐	☐	☐
b) Do the timesheets display detailed grant related activities performed for each grant funded employee?	☐	☐	☐	☐
c) Are timesheets for paid staff and volunteers signed and approved by a supervisor?	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section:

7. PROCUREMENT POLICIES - Title 2 CFR § 200.318-320

Instructions: Retain copy of the Subrecipient's written procurement policy.

	Yes	No	N/A	Unsure
a) Is a written procurement procedures policy maintained?	☐	☐	☐	☐
b) Is the Subrecipient familiar with the procurement requirements for the following:				
i. *Micro-purchases? – Less than $3,500*	☐	☐	☐	☐
ii. *Small purchase procedures? – Less than $150,000*	☐	☐	☐	☐
iii. *Sealed bids? – $150,000 or more*	☐	☐	☐	☐
iv. *Competitive proposals? – $150,000 or more*	☐	☐	☐	☐
v. *Non-competitive proposals? – Rarely allowable*	☐	☐	☐	☐
See Hazard Mitigation Procurement Guidance and Procurement Checklist.				
c) Were full and open competition procedures followed prior to the awarding of the contract(s)? *Examples: Invitations for bids, formal advertising, unreasonable requirements were not placed on potential contractors, and solicitation from minority businesses as required by Title 2 CFR §200.319 and Procurement Checklist.*	☐	☐	☐	☐
d) Were the contractors/sub-contractors verified not to be suspended or debarred from participating in a Federal contracts by self-certification or by reviewing www.Sam.gov?	☐	☐	☐	☐
e) Is a documented price/cost analysis maintained for each service contract awarded and equipment item(s) purchased with grant funds? *(If applicable) Records need to support the reasons why the contractor(s), service provider(s), and equipment item(s) were selected. See FEMA Cost/Price Analysis Guide.*	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section:

Site Visit Performance Assessment Report Project # _____

8. CONTRACT PROVISIONS/CLAUSES – Title 2 CFR § 200.323, Title 2 CFR § 200.433, Title 2 CFR § 200 Appendix II *and Required Contract Clauses.*

Instructions: Inform the Subrecipient of the required contract provisions for product and service contracts.

	Yes	No	N/A	Unsure
a) Do the contracts include all the required contract provisions and clauses? *Examples: Address debarment and suspension, EEO, anti-lobbying, acceptance of all Federal regulations and policies, termination procedures and all others as required. See Required Contract Clauses guidance.*	☐	☐	☐	☐
b) Are time and materials or cost-plus-fee/percent contracts utilized? *(Not allowed)*	☐	☐	☐	☐
c) Are all estimated contingency provisions removed from the contracts?	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section:

9. ENVIROMENTAL/HISTORIC PRESERVATION REVIEW

Instructions: Secure the responses from an individual knowledgeable about the Environmental/Historic Preservation process.

	Yes	No	N/A	Unsure
a) Did any of the grant funded activities trigger an EHP review? *If yes, please explain.*	☐	☐	☐	☐
b) Were the descriptions and supporting documents provided to FEMA for the EHP review maintained?	☐	☐	☐	☐
c) Was an EHP triggering activity started before receiving authorization from FEMA?	☐	☐	☐	☐

Provide additional information and potential areas of concern covered in this section:

Site Visit Performance Assessment Report Project # _____

10. CONCLUSION

Instructions: Indicate project status, potential environmental/historical compliance issues, recommendations, and summary of observations made during the site review.

Attached Documents:

- ☐ #_____ Site visit pictures
- ☐ Project work schedule
- ☐ Timesheet example
- ☐ Written procurement policy
- ☐ Environmental and/or Historical Preservation documents
- ☐ Other: _____

APPENDIX N – GIS RISK EXPOSURE ANALYSIS METHODOLOGY

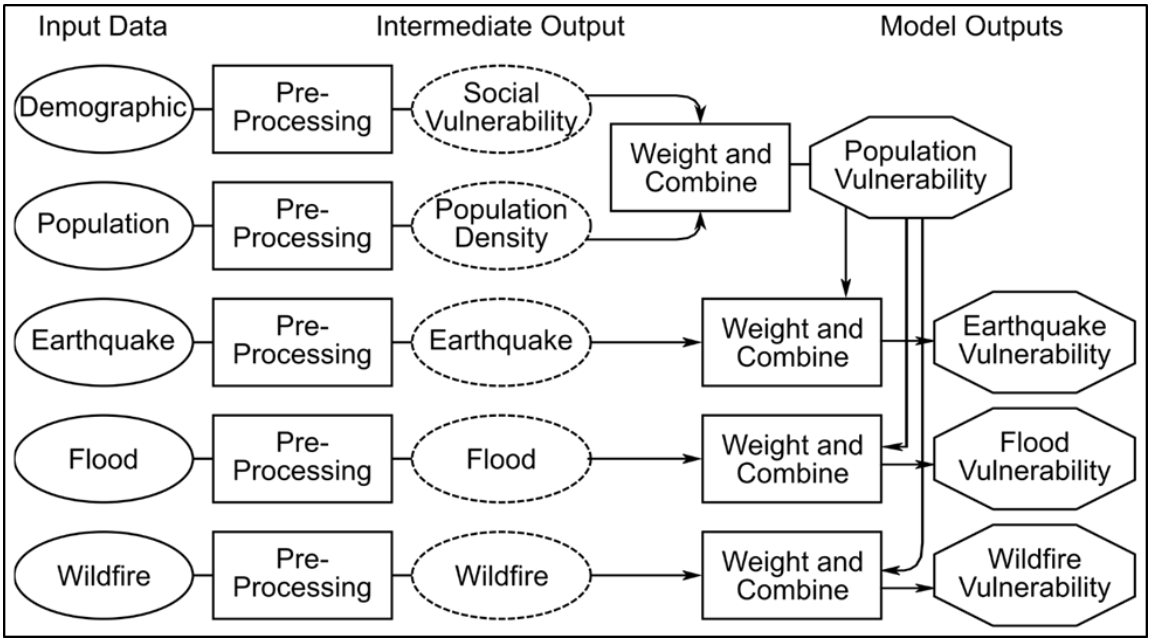
Introduction

The risk assessment included a hazard vulnerability analysis for the state. This involved spatially integrating data related to multiple natural hazards with a social vulnerability model based on derived from multiple socio-economic and demographic indicators. For the purposes of this annex, social vulnerability represents the cumulative influence that socio-economic and demographic characteristics exert on differential hazard outcomes. This annex provides an overview of the methods used to conduct the analysis.

Methodological Overview

Figure M.1 shows the general hazard vulnerability analysis beginning with acquiring input social and hazard data for each location in an approximately 1 kilometer grid covering the State. Social vulnerability and population density outputs were weighted and combined to create a final population vulnerability output. The population vulnerability output was then weighted and combined with each of the hazard layers to create earthquake, flood, and wildfire vulnerability outputs. A more detailed description of the methodology used to create the social vulnerability index, as well as the specific population and hazard event pre-processing and model-weighting approaches is included below.

Appendix Figure N.1: Conceptual Work Flow for Base Map Processing



Social Vulnerability

A subset of the GIS Technical Advisory Working Committee developed the index used to represent social vulnerability in this analysis. This work group chose to use a hierarchical modeling approach to develop its social vulnerability index. Hierarchical approaches use a conceptual model to identify the sub-indices that comprise social vulnerability, and the indicators associated with each sub-index. The framework provided by the conceptual model guides the selection of variables used to construct the vulnerability index. Appendix Table N.1 shows the conceptual model developed for this analysis, including the sub-indices, indicators, and the specific variables used to represent each indicator.

Appendix Table N.1: Social Vulnerability Index Conceptual Model and Associated Variables

Sub-Index	Indicator	Variable
Differential Access to Resources and Information	Poverty/ Income	Annual housing costs to income ratio
	Education	Percent of the population 25 or older without a high school diploma or equivalent
	Housing Tenure	Percent renter occupied housing units
	Gender	Percent female population
	Food Access	Modified Retail Food Environment Index (mRFEI)
Cultural or Linguistic Isolation	Linguistic Isolation	Percent of population 5 or older who speak English less than very well
	Minority Status	Percent non-white or Hispanic population
Access and Functional Needs	Disability	Percent of population with a disability
	Long-term care facility residents	Beds in licensed long-term care facilities per person
	Age	Percent of population 65 or older, or younger than 5
	Vehicle Access	Percent of households with no available vehicles

The variables in Appendix Table N.1 were collected for each ZIP Code Tabulation Area (ZCTA, a rough approximation of ZIP codes used by the US Census Bureau) in the State. The mRFEI variable used to represent food access was adapted from the methodology used by the Centers for Disease Control[340] so that it could be calculated using 2014 ZIP Code Business Statistics data from the US Census Bureau. Information on the number of beds in licensed long-term care facilities was obtained from the Office of Statewide Health Planning and Development.[341] All other variables were from the 2015 American Community Survey 5-year estimate datasets.[342]

All input variables were processed to insure that higher values corresponded to higher vulnerability, and were then rescaled so that values for each variable ranged between a minimum of zero and a maximum of one. Weights for the variables within each sub-index, as well as weights for sub-indices overall, were generated using an Analytical Hierarchy Process (AHP) approach. In this approach, members of the social vulnerability working group completed surveys in which they were asked to rate the relative importance of each pair of variable in each sub-index. Respondents then rated the relative importance of each pair of sub-indices.

The geometric mean across all respondents was then calculated for each pair-wise comparison, and this information was used to generate weights for the variables in each sub-index as well as for the sub-indices. The final variable weights shown in Appendix Table N.2 were generated by multiplying each variable weight by the weight for the sub-index in which it was located. Rescaled input variables for each ZCTA were then multiplied by the appropriate weight, and the resulting values were summed to create the final social vulnerability index values.[343]

[340] Centers for Disease Control. 2011. Census Tract Level State Maps of the Modified Retail Food Environment Index (mRFEI). Available online at: ftp://ftp.cdc.gov/pub/Publications/dnpao/census-tract-level-state-maps-mrfei_TAG508.pdf. Last accessed 30 May 2017.

[341] OSHPD. 2017. Long-Term Care Facilities licensed as of December 31, 2016. Datafile: LTCListing_Dec2016.xlsx. Available online at: http://www.oshpd.ca.gov/documents/HID/FacilityList/LTCListing_Dec2016.xlsx. Last Accessed 26 Jan 2017.

[342] Various approaches were used to replace missing values, including the use of spatial lag/local average values.

[343] It is important to note that due to the changes in the methodology used to calculate the social vulnerability index, it is not appropriate to compare values between this and the social vulnerability indices used in previous SHMPs.

Appendix Table N.2: Social Vulnerability Model Weights

Indicator	Model Weight
Poverty/Income	0.190
Disabilities	0.126
Food Access	0.105
Education	0.093
Linguistic Isolation	0.090
Vehicle Availability	0.087
Age	0.072
Minority Status	0.071
Long-term care facility residents	0.069
Housing tenure	0.054
Gender	0.043

The subjective decisions made in the construction of composite indicators influence the resulting values. Uncertainty analyses, in which thousands of alternative indices are built using varying approaches, are used to understand the influence of these subjective decisions on the resulting index values. For this analysis, reasonable alternatives were identified for the set of indicators used to represent each sub-index, the method used to rescale the input variables, and the variable weights used.

Four thousand ninety six[344] iterations of the model were ran using varying combinations of these alternatives. The absolute value of the difference between the baseline index rank for each ZCTA and the index rank for each of the alternative models was calculated, and the average value of these differences was used to assess the degree to which changes in index construction impacted the resulting index values.

The average absolute difference in ranks was 180.9. Given that the maximum possible change in ranks was 1770, this represents an average change of about 10% of the maximum possible. This seems a relatively small average change, suggesting that the social vulnerability model is fairly robust to the changes in index construction considered in the uncertainty analysis. This leads to increased confidence in the performance of the index.

Population and Hazard Event Data Pre-processing

General pre-processing steps were applied to each input dataset to prepare them for use. This primarily included steps to fit each dataset to the approximately 1 kilometer grid (more precisely a 30 second x 30 second) used in the analysis. Additional pre-processing steps applied to individual input layers are described below.

Population

Population distribution was represented using LandScan 2015 data. LandScan contains an estimate of "ambient population" for every location in a 30 second x 30 second (approximately 1 kilometer) grid covering the state. These data were used to calculate the population density for each grid cell within the state. This was done by dividing the LandScan population estimate by the area of each grid cell in kilometers.

Flood

Statewide flood hazards were represented in this analysis using FEMA DFIRM data where available. These data were not, however, available for the entirety of Alpine, Placer, and San Francisco Counties, and for portions of Sutter and Siskiyou Counties. Preliminary DFIRM data were therefore used to represent flood hazards in Placer and San Francisco Counties. Information from the preliminary DFIRM data for San Francisco County was used to replace existing DFIRM data in where there was limited overlap between the two. Portions of Sutter and Siskiyou Counties

[344] The number of scenarios required for the uncertainty/sensitivity analysis using a SOBOL sampling method implemented in the SimLab uncertainty/sensitivity analysis software, as per Tate, E. 2012. Social Vulnerability indices: a comparative assessment using uncertainty and sensitivity analysis. Natural Hazards. 63(2):325-347 and Saisana M, Saltelli A, Tarantola S. 2005. Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators. J Roy Stat Soc 168(2):307–323

that lacked DFIRM data, as well as the entirety of Alpine County, were considered to be in flood zone D for the purposes of this analysis. Finally, numerical values were assigned to various locations based on either the DRFIRM flood zone or zone subtype fields. These values are shown in Appendix Table N.3.

Appendix Table N.3: Flood Data Numerical Values

Flood Zone	Assigned Value
A, AE, AH, AO, A99, V, VE	5
X500 (flood zone X and zone subtype of: 0.2 PCT ANNUAL CHANCE FLOOD HAZARD, 0.2 PCT ANNUAL CHANCE FLOOD HAZARD CONTAINED IN CHANNEL, or AREA WITH REDUCED FLOOD RISK DUE TO LEVEE)	3
X (remainder of flood zone X)	2
D	1
Open Water, Area Not Included	0

Wildfire

Wildfire hazards were represented in the analysis using draft Fire Threat 2014 data from CAL FIRE. Numerical values for use in the vulnerability index were assigned to different fire threat categories as shown in Appendix Table N.4.

Appendix Table N.4: Fire Threat Data Numerical Values

Fire Threat Level	Assigned Value
Extreme	5
Very High	4
High	3
Moderate	2
Low or None	1
Undetermined, No Data	No Data

General Modeling Outputs

Once the preceding general and specific pre-processing steps were completed, each intermediate output (social vulnerability, population density, earthquake hazard, flood hazard, and wildfire hazard) was rescaled so that their minimum values equaled zero and their maximum values equaled 1. These intermediate outputs were then combined to create the six final model outputs. These included:

1. Population Vulnerability
2. Earthquake Vulnerability
3. Flood Vulnerability
4. Wildfire Vulnerability

These outputs were calculated by multiplying the appropriate data layers by the assigned weight and summing the results. Appendix Table N.5 gives a summary of the input layers and weights used to generate each final output.

Appendix Table N.5: Input Data Layers and Weights Used to Generate Final Model Outputs

Final Model Output	Data Layers	Assigned Weights
Population vulnerability	Social vulnerability Population density	1/3 2/3
Earthquake vulnerability	Earthquake hazard Population vulnerability	0.5 0.5
Flood vulnerability	Flood hazard Population vulnerability	0.5 0.5
Wildfire vulnerability	Wildfire hazard Population vulnerability	0.5

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APPENDIX O – SHMP ACRONYM LIST

A

AB – Assembly Bill
ABAG – Association of Bay Area Government
ACAMS – Automated Critical Asset Management System
ACP – Asian Citrus Psyllid
ACS – American Community Survey
ADA – Americans with Disabilities Act
AEL – Annualized earthquake loss
AELR – Annualized earthquake loss ratio
AFFED – Alluvial Fan Floodplain Evaluation and Delineation
AFTF – Alluvial Fan Task Force
AGPA – Associate Governmental Program Analyst
AISC – American Institute of Steel Construction Seismic Provisions
ALS – Automated Ledger System
ANSS – Federal Advanced National Seismic System
APA – Approved pending adoption
APCD – Air Pollution Control Districts
APG – California Adaptation Planning Guide
APSA – Aboveground Petroleum Storage Act
AQMD – Air Quality Management Districts
ARB – Air Resources Board
ARC – American Red Cross
ARCCA – Alliance of Regional Collaboratives for Climate Adaptation
ARFVTP – Alternative and Renewable Fuel and Vehicle Technology Program
ARP – Average return periods
ART – Adapting to Rising Tides
ASCE – American Society of Civil Engineers

B

BAER – Burn Area Emergency Response
BAM – Best Available Maps
BAU – Business As Usual
BayREN – Bay Area Regional Energy Network
BCA – Benefit Cost Analysis
BCR – Benefit Cost Ratio
BCDC – San Francisco Bay Conservation and Development Commission
BCSH – California Business Consumer Services and Housing Agency
BDCP – Bay Delta Conservation Plan
BDPL – Bay Division Pipeline
BIA – Bureau of Indian Affairs
BICEPP – Business and Industry Council for Emergency Planning and Preparedness
BLM – Bureau of Land Management
BMP – Best Management Practices
BOC – Business Operations Center
BoF – California Board of Forestry
BP3 – Best Practice Pilot Program
BSC – Building Standards Commission
BSE – Bovine spongiform encephalopathy
BUOC – Business and Utility Operations Center

C

CA-ESFs – California Emergency Support Functions
CAGs – Community Assistance Grants
CAIRS – California Al Incident Reporting System
CAISO – California Independent System Operator
CalARP – California Accidental Release Prevention
CalBRACE – California Building Resilience Against Climate Effects
Cal-CSIC – California Cybersecurity Integration Center
Cal DOJ – California Department of Justice
CalEMA – California Emergency Management Agency
CalEPA – California Environmental Protection Agency
CALFED – Collaboration among State and Federal Agencies to Improve California's Water Supply
CAL FIRE – California Department of Forestry
Cal OES – California Governor's Office of Emergency Services
CalOSHA – Division of Occupational Safety and Health
CalREP – California Radiological Emergency Preparedness
CalSTA – California State Transportation Agency
Caltrans – California department of Transportation
Cal VIVA – California Vital Infrastructure Vulnerability Assessment
CAPSS – Community Action Plan for Seismic Safety
CAR – Communities at Risk
CARB – California Air Resources Board
CARES – California Animal Response Emergency System
CAS – Climate Adaptation Strategy
CASGEM – California Statewide Groundwater Elevation Monitoring Program
CAT – Climate Action Team
CBC – California Building Code
CBSC – California Building Standards Commission
CCC – California Coastal Commission
CCHEP – Climate Change and Health Equity Program
CCIC – Central California Intelligence Center
CCLU – Climate Change Land Use and Infrastructure
CCP – Citizen Corps Program
CCR – California Code of Regulations
CCTAG – Climate Change Technical Advisory Group
CCTC – California Cyber Training Complex
CDC – Centers for Disease Control and Prevention
CDFW – California Department of Fish
CDEC – California Data Exchange Center
CDFA – California Department of Food and Agriculture
CDOJ – California Department of Justice
CDPH – California Department of Public Health
CDPH OHE – California Department of Public Health's Office of Health Equity
CDPR – California Department of Parks and Recreation
CDSS – California Department of Social Services
CDT – California Department of Technology
CEA – California Earthquake Authority
CEBC – California Existing Building Code
CEC – California Energy Commission
CEQA – California Environmental Quality Act
CERT – Community Emergency Response Team

CEPA – California Environmental Protection Agency
CESA – California emergency Services Association
CES-21 – California Energy Systems for the 21st Century
CFA – California Fire Alliance
CFAA – Cooperative Forestry Assistance Act
CFDA – California Department of Food and Agriculture
CFF – California's Flood Future
CFIP – California Forest Improvement Program
CFR – Code of Federal Regulations
CFSC – California Fire Safe Council
CGS – California Geological Survey
CHHS – California Health and Human Services
CHBC – California Historical Building Code
CHP – California Highway Patrol
CID – Center for Infectious Disease
CI/KR – Critical Infrastructure and Key Resources
CIP – Critical Infrastructure Protection Unity
CIRB – Construction Industry Research Board
CISAC – California Invasive Species Advisory Committee
CISN – California Integrated Seismic Network
CMSC – California Maritime Security Council
CNRA – California Natural Resources Agency
COG – Continuity of Government
CO-CAT – Coastal and Ocean Resources Working Group for the Climate Action Team
COOP – Continuity of Operations
CoSMoS – Centralization of Supply Management Operations
CP – California Polytechnic State University, San Luis Obispo
CPG – Comprehensive Preparedness Guide
CPUC – California Public Utilities Commission
CRMP – California Residential Mitigation Program
CRS – Community Rating System
CSD – Department of Community Services and Development
CSI – California Solar Initiatives
CSLC – California State Lands Commission
CSSC – California Seismic Safety Commission
CSSG – Community Safety and Sustainability Group
CSTI – California Specialized Training Institute
CSU – California State University
CSURMA – CSU Risk Management Authority
CUEA – California Utilities Emergency Association
CUPAS – Certified Unified Program Agencies
CVFED – Central Valley Floodplain Evaluation and Delineation
CVFPB – Central Valley Flood Protection Board
CVFPP – Central Valley Flood Protection Plan
CVP – Central Valley Project
CWAP – Clean Water Action Plan
CWCG – California Wildfire Coordination Group Interagency Prevention Committee
CWP – California Water Plan Update
CWPPs – Community Wildfire Protection Plans

D

DCDC – Division of Communicable Disease Control

DCP – Drought Contingency Plan
DCPP – Diablo Canyon Power Plant
DFG – (California Department of Fish and Wildlife)
DFW – Department of Fish and Wildlife
DGS – Department of General Services
DHCS – Department of Health Care Services
DHS – Department of Homeland Security
DIR – Department of Industrial Relations
DLIS – Delta Levees Investment Strategy
DMA – Disaster Mitigation Act
DMA2K/DMA 2000 – Disaster Mitigation Act of 2000
DOD – Department of Defense
DOGGR – Division of Oil, Gas, and Geothermal Resources
DOI – Department of the Interior
DOT – Department of Transportation
DRMS – Delta Risk Management Study
DRU – Disaster Resistant University
DSA – Division of the State Architect
DSC – Delta Stewardship Council
DTSC – Department of Toxic Substances Control
DWR – Department of Water Resources

E

EAP – Emergency Action Plan (for dam safety)
ECA – Earthquake Country Alliance
ECAA-ED – Energy Conservation Assistance Act which includes the Education Subaccount
ECL – Emergency Classification Levels
EDIS – Emergency Disaster Information System
EERI – Earthquake Engineering Research Institute
EIR – Environmental Impact Report
EJ – Environmental Justice
EMAP – Emergency Management Accreditation Program
EMSA – Emergency Medical Services Authority
ENSO – El Nino Southern Oscillation
EO – Executive Order
EOM – Emergency Operations Manual
EORP – Emergency Operations Response Plan
EPA – Environmental Protection Agency
EPCRA – Emergency Planning and Community Right-to-Know Act
EPZ – Emergency Planning Zones
EQIP – Environmental Quality Incentives program
ERBS – Earthquake-Resistant Bracing Systems
ESC – Emergency Services Coordinator
ESRI (Arc GIS Server) – Environmental Systems Research Institute
ETS – Engineered tie-down systems

F

FAST – Functional Assessment Service Team
FCP – Flood Corridor Program
FEMA – Federal Emergency Management Agency
FEMA LAS – FEMA Loss Avoidance Study
FEMA RIX – FEMA Region IX
FERC – Federal Energy Regulatory Commission
FFMP – Flash Flood Monitoring and Prediction
FHSZs – Fire Hazard Severity Zones
FIRM – Flood Insurance Rate Map
FLAME Act – Federal Land Assistance, Management, and Enhancement Act
FMA – Flood Mitigation Assistance Program
FMAG – Fire Management Assistant Grant
FMD – Foot and Mouth Disease
FMP – Floodplain Management Plan
FPCP – Flood Protection Corridor Program
FRAs – Federal Responsibility Areas
FRAP – Fire Resource and Assessment Program
FSC – local Fire Safe Councils
F0-F12 – Fujita Tornado Scale

G

GAR – Geotechnical Assessment Report
GAR – Governor's Authorized Representative
GDR – Geotechnical Data Reports
GER – Geotechnical Evaluation Report
GGRF – Greenhouse Gas Reduction Funds
GHG – Greenhouse Gas
GIF – Geospatial Innovation Facility
GIS – Geographic Information System
GIS TAWC – GIS Technical Advisory Committee
GOR – Geotechnical Overview Report
GOV – Government Code
GPG – General Plan Guideline
GP – General Plan
GPMT – General Plan Guidelines Data Mapping Tool
GPS – Global Positioning Status
GSAs – Groundwater Sustainability Agencies
GSPs – Groundwater Sustainability Plans
GWh – Gigawatt hours

H

HAZUS – Hazards United States
HCD – California Department of Housing and Community Development
HCP – Habitat Conservation Plan
HFRA – Healthy Forests Restoration Act
HFSSA – Hospital Facilities Seismic Safety Act
HI – Heat Index
HLP – Huanglong Bing
HM – Hazard Mitigation
HMA – Hazard Mitigation Assistance

HMG – Hazard Mitigation Grants
HMGP – Hazard Mitigation Grant Program
HMIS – Hazardous Material Inventory Statements
HMMP – Hazardous Material Management
HSAC – Homeland Security Advisory Committee
HSGS – Homeland Security Grant Section
HSGP – Homeland Security Grant Program
HSS – Homeland Security Strategy
HUD – Department of Housing and Urban Development
HVA – Hazard Vulnerability Assessment

I

IA – Individual Assistance
IBC – International Building Code
ICARP – Integrated Climate Adaptation and Resilience Program
ICS – Incident Command System
IEPR – Integrated Energy Policy Report
IFC – International Fire Codes
IMP – Implementation and Maintenance Plan
IMS – Internet Mapping Service
IMT – Internet Mapping Tool
InSAR – Interferometric Synthetic Aperture Radar
IPCC – Intergovernmental Panel on Climate Change
ISCC – Invasive Species Council of California
ISO – Independent System Operator

J

JFO – Joint Field Office
JPA – Joint Powers Agreement
JRIC – Joint Regional Intelligence Center

K

KSHB – Kuroshio Shot Hole Borer
kW – Kilowatt

L

LAC – Los Angeles County Fire Department
LADBS – Los Angeles Department of Building and Safety
LADWP – Los Angeles Department of Water and Power
LAFD – Los Angeles City Fire Department
LARC – Los Angeles Regional Collaborative for Climate Adaptation and Sustainability
LCP – Local Coastal Programs
LEA – Local educational agencies
LEBLS – Lower Elkhorn Basin Levee Setback
LECPs – Local Emergency Planning Committees
LHD – Local health department
LHIP – Landslide Hazard Identification Program
LHMP – Local Hazard Mitigation Plan
LLAP – Local Levee Assistance Program
LNG – Liquid Natural Gas

LNGTEMS – LNG Terminal Engineering and Maintenance Standards
LOC (earthquake)
LPDM – Legislative Pre-Disaster Mitigation
LRA – Local Responsibility Areas
LUP – Land use plan
LVC – Lassen Volcanic Center
LWDA – Labor Workforce Development Agency

M

MASH – Multi-family Affordable Solar Housing
MFD – Marine Facilities Division
MGM – Mitigation Grant Management
MISA – Marine Invasive Species Act
MMC – Multi-hazard Mitigation Council
MMI – Modified Mercalli Intensity
MMRS – Metropolitan Medical Response System
MMS – Minerals Management Services
MMT – Million metric tons
MOA – Memorandum of Agreement
MOTEMS – Marine Oil Terminal Engineering and Maintenance Standards
MOUs – Memorandum of Understandings
MPOs – Metropolitan planning organizations
MW – Megawatts
mRFEI – Modified Retail Food Environment Index

N

NASA – National Aeronautics and Space Administration
natech – natural disaster which triggers a technological accident
NCCP – Natural Community Conservation Plan
NCEI – National Centers for Environmental Information
NCIPP – National Critical Infrastructure Prioritization Program
NCP – National Contingency Plan
NCRIC – Northern California Regional Intelligence Center
NCSS – Northern California Seismic System
NEHRP – National Earthquake Hazard Reduction Program
NEPA – National Environmental Policy Act
NFIA – National Flood Insurance Act
NFIF – National Flood Insurance Fund
NFIP – National Flood Insurance Program
NFIRS – National Fire Incident Reporting System
NGA – Next Generation Attenuation
NGPSA – Natural Gas Pipeline Safety Act
NHDs – Natural Hazard Disclosures
NH3 – Ammonia
NID –National Inventory of Dams
NIMS – National Incident Management System
NIS – Network Information Services
NMF – National Mitigation Framework
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Agency
NOAA CSC – National Oceanic and Atmospheric Administration Coastal Services Center

NOI – Notice of Intent
NOI – Notice of Interest
NOX – Nitrogen oxide
NPC – Non-structural Performance Category
NPP – Nuclear power plant
NPS – National Park Service
NRC – National Resource Council
NRC – Nuclear Regulatory Commission
NRCS – Natural Resources Conservation Service
NTHMP – National Tsunami Hazard Mitigation Program
NTSB – National Transportation Safety Board
NTWC – National Tsunami Warning Center
NULE – Non-Urban Levee Evaluations
NWS – National Weather Service

O

OAFN – Office for Access and Functional Needs
OCIAC – Orange County Intelligence Assessment Center
OCOF – Our Coast Our Future
OCS – Outer Continental Shelf
OEHHA – Office of Environmental Health Hazard Assessment
OEM – Office of Emergency Management
OFSM – Office of the State Fire Marshal
OHA – Office of Health Affairs
OHE – Office of Health Equity
OIE – World Organization for Animal Health
OMB – Office of Management and Budget
OMC – Operations and Maintenance Center
OMRR&R – Operations, maintenance, repair, rehabilitation, and replacement
OPA – Oil Pollution Act
OPC – Ocean Protection Council
OPR – California Governor's Office of Planning and Research
OPS – Office of Pipeline Safety
ORNL –
OSFM – Office of the State Fire Marshal
OSHPD – Office of Statewide Health Planning and Development
OSPR – Office of Spill Prevention and Response
OTC – Once-Through Cooling

P

PA – Participating Agencies
PA – Public Assistance
PAGs – Protection Action Guides
PDD – National Presidential Policy Directives
PDF – Portable document file
PDM – Pre-Disaster Mitigation Program
PEER – Pacific Earthquake Engineering Research Center
PERI – Public Entity Risk Institute
PETS – Pet Evacuation and Transportation Standards Act
PGA – Peak Ground Acceleration
PG&E – Pacific Gas and Electric Company
PHMSA – Pipeline and Hazardous Materials Safety Administration

PIANC – Permanent International Association of Navigation Congresses
PIER – Public Interest Energy Research
PIH – Poison-by-inhalation
PIOP – Pandemic Influenza Operational Plan
PIPA – Pipeline and Informed Planning Alliance
PIPES Act – Pipelines and Enhancing Safety
PM_{10} – Airborne particle mas with aerodynamic diameter less than 10Aum
$PM_{2.5}$ – Airborne particle mas with aerodynamic diameter less than 2.5Aum
PNSN – Pacific Northwest Seismic Network
Policy AC – Policy Advisory Committee
PPD – Presidential Policy Directive
PPD-21 – Presidential Policy Directive-21
ppm – Parts per million
PRC – Public Resources Code
PSEP – Pipeline Safety Enhancement Program
PSHA – Probabilistic seismic hazard analysis
PSHB – Polyphagous Shot Hole Borer
PSM – Process Safety Management
PTC – Positive train control
PTHA – Probabilistic Tsunami Hazard Analysis
PUC – California Public Utilities Commission
PV – Photovoltaics

Q

QR – Quick response

R

RACER – Remedial Alternatives and Cost Estimate Report
RCRC – Rural County Representatives of California
RCRC – Regional Council of Rural Counties
RCP – Regional Contingency Plan
RCP – Representative Concentration Pathways
RD&D – Research, Development, Demonstration, and Deployment
RFMP – Regional Flood Management Plans
Risk MAP – Risk Mapping, Assessment, and Planning
RL – Repetitive Loss
RMP – Risk Management Plan
ROG – Reactive Organic Compounds
RPU – Radiological Preparedness Unit
RRT – Regional Response Team
RSIA08 – Railroad Safety Improvement Act of 2008
RTP – Regional Transportation Plan

S

SAC-SJ – Sacramento-San Joaquin
SAFCA – Sacramento Area Flood Control Agency
SAFER – Seismic Action Plan for Facilities Enhancement and Renewal
SAFRR – Science Application for Risk Reduction
SAS – Self-anchored suspension
SASH – Single-Family Affordable Homes

SB – Senate Bill
SBA – Small Business Administration
SCAT – Shoreline Cleanup and Assessment Techniques
SCC –State Coastal Conservancy
SCEC – Southern California Earthquake Center
SCS – Sustainable Communities Strategy
SCSN – Southern California Seismic Network
SDF – Special District Facility
SDG&E – San Diego Gas and Electric
SD-LECC – San Diego Law Enforcement Coordination Center
SEATs – State Emergency Assessment Teams
SEMS – Standardized Emergency Management System
SEP – State of California Emergency Plan
SEP – Supplemental environmental projects
SERA – Special Emergency Response and Assistance
SFA – State Fire Assistance
SFHA – Special Flood Hazard Areas
SFM – State Fire Marshal
SFP – Spent fuel pool
SGC – Strategic Growth Council
SGMA – Sustainable Groundwater Management Act
SHELDUS – Spatial Hazard Events and Losses Database for the United States
SHM – Seismic Hazard Mapping
SHMP – State Hazard Mitigation Plan
SHMT – State Hazard Mitigation Team
Sierra CAMP – Sierra Climate Adaptation and Mitigation Partnership
SILC – State Independent Living Council
SIOSC – State Interagency Oil Spill Committee
SLC – State Lands Commission
SLO – San Luis Obispo
SLR – Sea-level Rise
SMART – State Mitigation Assessment Review Team
SoCal Gas – Southern California Gas
SONGS –San Onofre Nuclear Generating Station
SOX – Sulphur Oxides
SPC – Structural Performance Category
SPFC – State Plan on Flood Control
SPUR – San Francisco Bay Area Planning and Urban Research Association
SRA – State Responsibility Area
SRAFPF – State Responsibility Area Fire Prevention Fund
SRL – Severe Repetitive Loss
SSIA – State Systemwide Investment Approach
STAC – State Threat Assessment Center
STAS – State Threat Assessment System
SUV – Sport utility vehicle
SV – Social Vulnerability
SWEEP – State Water Efficiency and Enhancement Program
SWP – State Water Project
SWRCB – State Water Resource Control Board
S2S – Sub-seasonal to Seasonal

T

TAC – Technical Advisory Council
TACs – Toxic Air Contaminants
TAG – Technical Advisory Group
TEA21 – Transportation Equity Act of the 21st Century
THIRA – Threat Hazard Identification and Risk Assessment
TIH – Toxic-by-inhalation
TLOs – Terrorism Liaison Officers
TM – Tree Mortality
TMTF – Tree Mortality Task Force
TNC Coastal Resilience
TRB – Transportation Research Board
Tribal AC – Tribal Advisory Committee
TRPA – Tahoe Regional Planning Agency

U

UASI – Urban Security Initiative
UC – University of California
UCERF – Uniform California Earthquake Rupture Forecast
UFRR – Urban Flood Risk Reduction
UICDS – Unified Incident Command and Decision Support
ULE – Urban Levee Geotechnical Evaluations
UMC – Uniform Minimum Credit
UOC – Utility Operations Center
UPAAG – Unified Program Administration Advisory Group
URAMP – Utilities Regional Assessment of Mitigation Priorities
URT – Unified Reporting Tool
URM – Unreinforced Masonry Act
USACE – U.S. Army Corps of Engineers
USBR – United States Bureau of Reclamation
USC – University of Southern California
USCG – United States Coast Guard
USDA – United States Department of Agriculture
US DOT – U.S. Department of Transportation
USFS – United States Forest Service
USFWS – United States Fish and Wildlife Service
USGS – U.S. Geological Survey
USGS CalVO – United States Geological Survey California Volcano Observatory

V

VBDS – Vector-Borne Disease Section
VHFHSZs – Very High Fire Hazard Severity Zones
VMP – Vegetation Management Program
VNS – Volcano Notification Service
VOC – Volatile Organic Compounds

W

WEE – Western Equine Encephalomyelitis Virus
WFLC – Wildland Fire Leadership Council
WIFFS – Western Institute for Food Safety and Security
WIPP – Waste Isolation Pilot Plant
WG – Working Group
WIC – Women, Infants, and Children
WNV – West Nile Virus
WSIP – Water System Improvement Program
WUI – Wildland-Urban Interface

Z

ZEV – Zero-emission vehicles

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ANNEX 2 – PUBLIC SECTOR FUNDING SOURCES

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2.1. INTRODUCTION

Substantial public sector financial support is available for hazard mitigation efforts in California. This annex is a reference point for agency and program funds, as well as potential funding mechanisms available for local jurisdiction use. The annex is not inclusive, as funding changes annually, as do program requirements, thus it is intended as a starting point to identify funding sources that support implementation of local and regional mitigation, adaptation, and resiliency programs.

Federal agencies include the Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), Department of Housing and Urban Development (HUD), U.S. Bureau of Land Management (BLM), U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service and the U.S. Department of Agriculture (USDA). State funds are being spent for mitigation by various agencies including Cal OES, California Earthquake Authority, CAL FIRE, Department of Transportation, Department of Housing and Community Development and the Department of Water Resources. Special districts, cities, and counties use bond funds, general funds, and sales tax funds to conduct "hard" projects that make the built environment more resilient as well as to take community emergency preparedness actions. Hundreds of millions of dollars are provided by government at federal, state, and local levels.

There are also important movements by the non-profit and community-based organizational sectors to promote mitigation awareness and training at the local level. These include statewide, regional, and local multi-stakeholder coalitions, as well as single-purpose local social service providers.

2.2. FEDERAL FUNDING SOURCES

Federal assistance for mitigation efforts is available through many programs and agencies. These include the Federal Emergency Management Agency (FEMA), Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), The Department of Housing and Urban Development (HUD), Bureau of Land Management (BLM), U.S. Department of Agriculture (DOA), Department of Homeland Security (DHS), and various other health, economic, and research agencies. California uses many of these programs as part of its comprehensive mitigation efforts. The following discussion provides a brief description of federal mitigation funding sources and technical assistance programs that are available through each agency. Included in the description tables in *Section 2.2*, are examples of funding availability from previous years which are intended to provide a snapshot of program and agency funding that has been available.

For further contact information and projected expenditures, visit the website listed for the particular program of interest. In addition, it is highly recommended that all funding sources listed in this section be evaluated in conjunction with those listed in The Catalog of Federal Domestic Assistance (CFDA) under the sub-category "Disaster Prevention and Relief."

2.2.1. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA provides a multiplicity of funding opportunities for mitigation, disaster relief, education, and training. Primary federal FEMA funding sources include Pre-Disaster Mitigation (PDM) grants, Hazard Mitigation Grant Program (HMGP) grants, and Flood Mitigation Assistance (FMA) grants, as discussed in *Chapter 10*. Annex Table 2.A identifies the extent of each of these FEMA mitigation support programs from 2013 to 2016. The total amount obligated through these programs for this time period is $48,804,844.

Annex Table 2.A: FEMA Mitigation Program Funds, 2013-2016

FEMA Grant Program	Obligated $	Number of Projects	Counties Served
FMA	$5,683,594	2	1
HMGP	$40,177,815	50	29
PDM	$2,943,435	29	18
Total	***$48,804,844***	***81***	***48***

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

As of July 2018, Cal OES HMGP grants staff are processing subapplications for NOI's determined to be eligible for HMGP funding, with over $9.8 million in HMGP funding already obligated for 2017.

Notices of Interest Submitted and Approved (obligations pending) for 2017, as of May 2018

FEMA Grant Program	NOIs Submitted	NOIs Approved	Grants Obligated	Obligated $
FMA	30	11	0	$0
HMGP*	854	611	32, others pending	$9,812,361 *with additional funding pending*
PDM	146	86	2	$135,483
Total	***1,030***	***708***	***34 others Pending***	***$9,947,844***

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

** Includes DR-4301 ($2,521,397), DR-4305 ($848,925), DR-4308 ($904,395), DR-4344 ($298,724) totaling over $6 million pending*

Primary FEMA hazard mitigation programs are outlined in Annex Table 2.B and some eligibility criteria are identified in the "Notes" column. Additional eligibility requirements and further information is available on the program website.

Annex Table 2.B: Major FEMA Mitigation Funding Sources

Program	Details	Eligibility	Example of Funding Availability
Flood Mitigation Assistance (FMA) Program	Provides resources to assist states, tribal governments, territories, and local communities in their efforts to reduce or eliminate the risk of repetitive flood damage to buildings and structures insurable under the National Flood Insurance Program. More Information available: https://www.fema.gov/media-library-data/1499793315357-c31fef3839ece1533d9fccfe5caee71d/FMA_FactSheet_FY2017_508.pdf	All 50 states, the District of Columbia, Federally recognized Tribal governments, American Samoa, Guam, Northern Marina Islands, Puerto Rico, and the U.S. Virgin Islands. Local Governments are considered sub-applicants and must apply to their applicant state/territory. Applicants and Sub applicants must have a FEMA approved mitigation plan as of the application deadline in order to apply for mitigation projects.	Nationally for FY 2017 $160,000,000: $70,000,000 has been prioritize for community flood mitigation proposals and $90,000,000 available for FMA if all funding is used. Maximum federal share for FMA planning sub-applications is as follows: $100,000 for community flood mitigation advance assistance $10,000,000 for community flood mitigation project $50,000 for technical Assistance for states/territories when $1,000,000 was awarded in FY16, and $100,000 per applicant for mitigation planning with a maximum of $50,000 for state plans and $25,000 for local plans.
Hazard Mitigation Grant Program (HGMP)	Provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. More information available: https://www.fema.gov/media-library-data/1441133724295-0933f57e7ad4618d89debd1ddc6562d3/FEMA_HMA_Grants_4pg_2015_508.pdf	States, territories and federally recognized tribal governments are eligible. Each state, territory, and federally recognized tribal government shall designate one agency to serve as the Applicant for each HMA program.	Hazard Mitigation Grant Program funding is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. The amount of HMGP funding available to the Applicant is based upon the total Federal assistance provided by FEMA for disaster recovery under the Presidential major disaster declaration(s) and will vary from year to year.

Program	Details	Eligibility	Example of Funding Availability
National Flood Insurance Program (NFIP)	Enables property owners to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. http://www.fema.gov/national-flood-insurance-program Applicants must live in a community that participates in the National Flood Insurance Program (NFIP) to qualify for National Flood Insurance Eligibility info: https://www.fema.gov/national-flood-insurance-program-community-status-book	States, localities, and individuals. Renters, homeowners, and business owners with property located in an NFIP-participating community, can purchase a policy. (Flood insurance from the NFIP is only available in one of the 22,000 participating communities around the U.S.)	Flood coverage limits for a standard flood policy are: Coverage Limit: One to four-family structure:$250,000 One to four-family home contents:$100,000 Other residential structures: $500,000 Other residential content: $100,000; Business structure: $500,000 Business contents: $500,000 Renter contents: $100,000
Pre-Disaster Mitigation (PDM) Program	Provides funds for hazard mitigation planning and the implementation of mitigation actions/ efforts to implement a sustained pre-disaster natural hazard mitigation program. http://www.fema.gov/pre-disaster-mitigation-grant-program Local governments are eligible sub-applicants and can sponsor applications on behalf of homeowners to submit to the applicant)	All 50 states, the District of Columbia, federally recognized Tribal Governments, American Samoa, Guam, Northern Mariana Islands, Puerto Rico, the U.S Virgin Islands, and universities are eligible to apply.	Nationally, for FY 2017: PDM Grant Program is $90,000,000. All 50 states, the District of Columbia, Federally recognized Tribal Governments, American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the U.S Virgin Islands are eligible to receive an allocation of 1% of the appropriation or $575,000; 105 of the appropriated PDM funding, or $10 million, will be set aside for Federally recognized Tribal applicants to receive an allocation of $575,000 per tribe. No applicant may receive more than 15%, or $15 million of the appropriated PDM funding. Ten percent ($10 million) set aside for recognized tribal areas- $575,000 per tribe.

Source: California Governor's Office of Emergency Services (Cal OES) HMA program

2.2.2. ENVIRONMENTAL PROTECTION AGENCY (EPA)

The EPA makes available funds for water management and wetlands protection programs that help mitigate against future costs associated with hazard damage. Annex Table 2.C lists these funding sources.

Annex Table 2.C: EPA Mitigation Funding Sources

Program	Details	Eligible Applicants/Notes	Funding Availability
Clean Water Act Section 319 Grants	Supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. http://water.epa.gov/polwaste/nps/cwact.cfm Clean Water Act Section 319(h) funds are provided only to designated state and tribal agencies to implement their approved nonpoint source management programs. State and tribal nonpoint source programs include a variety of components, including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and regulatory programs. Each year, EPA awards Section 319(h) funds to states in accordance with a state-by-state allocation formula that EPA has developed in consultation with the states. States submit their proposed funding plans to EPA. If a state's funding plan is consistent with grant eligibility requirements and procedures, EPA then awards the funds to the state. (https://www.epa.gov/nps/319-grant-current-guidance)	States, territories, and tribal governments Funds are provided only to designated state and tribal agencies to implement their approved nonpoint source management programs. EPA awards funds to states in accordance with a state-by-state allocation formula that EPA has developed in consultation with the states.	Nationally for FY 2017: $167.9 million source: https://www.epa.gov/nps/319-grant-program-states-and-territories
Clean Water State Revolving Funds	Established as a financial assistance program for a wide range of water infrastructure projects. States have the flexibility to fund a range of projects that address their highest priority water quality needs. The program provides loans to construct municipal wastewater facilities, control nonpoint sources or pollution, build decentralized wastewater treatments systems, create green infrastructure projects, protect estuaries, and fund other water quality projects. More information available: https://www.epa.gov/cwsrf/learn-about-clean-water-state-revolving-fund-cwsrf	States and Puerto Rico Project eligibility includes: -construction of publicly owned treatment works - nonpoint source - national estuary program projects - decentralized wastewater treatment systems - storm water -water conservation, efficiency, and reuse -watershed pilot projects -energy efficiency -water reuse	Building on a federal investment of $42 billion, the state CWSRFs have provided mora than $126 billion to communities through 2017. States have provided more than 38,440 low-interest loans.

Program	Details	Eligible Applicants/Notes	Funding Availability
		Security measures at publicly owned treatment works -technical assistance	
Wetland Program Development Grants	Provides applicants an opportunity to conduct projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys and studies relations to the causes, effects, extent, prevention, reduction and elimination of water pollution http://water.epa.gov/grants_funding/wetlands/grantguidelines/index.cfm https://www.epa.gov/sites/production/files/2017-05/documents/wetland_dev._grants_fact_sheet.pdf	States, territories, localities, universities, tribal governments, national non-profits, NGOs may apply for projects with the U.S.	Expects a total allocation of approximately $3,000,000 every two years. With individuals awards between $50,000 and $500,000. Funding is only available every other year.

2.2.3. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

NOAA is the major source for mitigation funding related to coastal zone management and other coastal protection projects. Annex Table 2.D lists these funding sources.

Annex Table 2.D: NOAA Mitigation Funding Sources

Program	Details	Eligible Applicants/Notes	Funding Availability
Coastal Services Center Grant Opportunities	Supports coastal communities that are environmentally and economically sustainable, and climate adaptation and mitigation. https://coast.noaa.gov/funding/archive.html	Regional ocean partnerships, tribal governments and state, local, and territory governments, institutions of higher learning, and non-profit and for-profit organizations	Check website
Coastal Resilience Networks Grants	Communities use the Grants to develop projects that save lives, protect property, reduce damage to infrastructure, and benefit ecosystems and the economy. These projects connect agencies and organization across regions, include a variety of public and private section partnership, and require a nonfederal dollar match. More information available: https://www.coast.noaa.gov/data/resilience/factsheet-resilience-grants.pdf https://coast.noaa.gov/resilience-grant/	States, territories, local or county governments, non-profit organizations, regional authorities, and institutions of higher education. Provides funding to projects located along the regions of the Pacific Islands, Gulf of Mexico, and West Coast to become more resilient to the threats posed by coastal hazards, including storms, flooding, sea-level rise, and climate change.	Federal funding granted since 2015: $35.8 million, match funding: $22.3 million. Award amounts range from $500,000 to $1 million for projects lasting up to 36 months. Cost sharing through cash or in-kind matches is expected.

Program	Details	Eligible Applicants/Notes	Funding Availability
Coastal Zone Management Program	The National Coastal Zone Management Program works with coastal states and territories to address coastal issues including climate change, ocean planning, and planning for energy facilities and development. The program is a voluntary partnership between the federal government and U.S. coastal and Great Lakes states and territories authorized by the Coastal Zone Management Act (CZMA). To protect, restore, and responsibly develop coastal communities and resources. https://coast.noaa.gov/czm/about/	All 35 coastal and Great Lakes states and territories (with the exception of Alaska) participate in the National Coastal Zone Management Program.	In FY 2017, NOAA invested $70 million. Federal funding was matched by nearly $57 million from state and local governments and others. Funding Summary: https://coast.noaa.gov/czm/media/funding-summary.pdf https://coast.noaa.gov/czm/media/funding-summary.pdf
Coastal and Marine Habitat Restoration (NOAA Habitat Conservation), National Marine Fisheries Service Programs	Supports restoration projects that use a habitat-based approach to rebuild productive and sustainable fisheries, contribute to the recovery and conservation of protected resources, and promote healthy ecosystems and resilient communities. See program website for details on Habitat Blueprint, Coastal Ecosystem Resiliency Program, Coastal and Marine Habitat Restoration Grant Programs. https://www.fisheries.noaa.gov/grant/coastal-and-marine-habitat-restoration-grants	Funding for institutions of higher education, non-profits, commercial (for profit) organizations, U.S. territories, and state, local and tribal governments	Various grant program totaling approximately $10.5 million. Minimum of $100,000 and a maximum of $4million per project over a three-year award period.
National Tsunami Hazard Mitigation Program	A Federal and State program designed to assist coastal communities with tsunami preparedness, response, mitigation, and recovery planning activities. http://nws.weather.gov/nthmp/ https://www.fema.gov/media-library/assets/documents/5949	Provides funding to Cal OES and CGS to assist coastal communities with tsunami preparedness, response, mitigation, and recovery planning activities. http://nws.weather.gov/nthmp/	$5,892,849 for projects and support to make coastal communities safer from tsunamis during FY17.

2.2.4. U.S. ARMY CORPS OF ENGINEERS (USACE) AND U.S. FISH AND WILDLIFE SERVICE (FWS)

USACE and the U.S. Fish and Wildlife Service offer funding and technical support for programs designed to protect floodplains, wetlands, and watersheds (see Annex Table 2.E).

Annex Table 2.E: Funding and Technical Assistance for Wetlands and Floodplains

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
USACE/ Planning Assistance to States (PAS)	Funds studies dealing with water resource issues related to: Water supply and demand, water quality, environmental conservation/restoration, wetlands evaluation, dam safety/failure, flood damage reduction, flood plain management, coastal zone management/protection, and harbor/port. http://www.nao.usace.army.mil/Business-With-Us/Flood-Plain-Management/PAS/	50 percent Federal-50 percent non-Federal basis Eligible applicants are states, eligible Indian tribes, local governments or other non-federal entities.	The Planning Assistance to States Program is cost shared on a 50 percent federal-50 percent non-federal basis up to $500,000 annually. Typically, individual studies, of which there may be more than one per state or tribe per year, generally cost $25,000 to $75,000
USACE/ Flood Plain Management Services (FPMS)	Technical support for effective floodplain management. http://www.nae.usace.army.mil/Missions/Public-Services/Flood-Plain-Management-Services/	General technical assistance efforts under this program includes determining: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural flood plain resources; and flood loss potentials before and after the use of flood plain management measures. State, regional, local government, or Indian tribe can request Corps of Engineers assistance under this program.	Efforts under this program are generally conducted at 100 percent Federal expense, except in those instances where the requestor is another Federal agency or a private party. In those cases the work is conducted on a 100 percent cost recovery basis.

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
USACE/ Environmental Laboratory Environmental Programs	Guidance for implementing environmental programs such as ecosystem restoration and reuse of dredged materials. http://www.usace.army.mil/Missions/Environmental.aspx USACE environmental programs are in partnership with other federal and state agencies, non-governmental organizations, and academic institutions.	See website	Varied assistance, funding and permitting services.
FWS/Coastal Wetlands Conservation Grant Program	Provides matching grants to states for acquisition, restoration, management, or enhancement of coastal wetlands. http://www.fws.gov/coastal/CoastalGrants/index.html	States which border the Atlantic, the Gulf of Mexico, the Pacific, and the Great Lakes are eligible. The exception is the State of Louisiana. Also eligible are the Trust Territories and Commonwealths of the United States.	Approximately $20 Million awarded in 2016. Approximately $17 Million will be awarded in FY 2017. https://www.fws.gov/coastal/pdfs/2017NCWCGP_NOFOfinal01212016.pdf
FWS/Partners for Fish and Wildlife Program	Provides technical and financial assistance to private landowners and Tribes for restoring degraded wildlife habitat. http://www.fws.gov/partners/aboutus.html	Funding for volunteer-based programs Additional information: https://www.fws.gov/partners/faq.html	

2.2.5. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

Community Development Block Grants (CDBG) and other programs administered by HUD can be used to fund hazard mitigation projects (see Annex Table 2.F).

Annex Table 2.F: HUD Mitigation Funding Sources

Program	Details	Eligible Applicants/Notes	Funding Availability
Community Development Block Grants (CDBG)	Grants to develop viable communities, principally for low and moderate-income persons. https://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs	Funding to states, local governments, tribal governments	Total Disbursements up to FY 2017: $3,205,801,203,45
CDBG-Disaster Recovery Program	CDBG funds available through the Disaster Recovery Initiative made in areas designated by the President of the United States as disaster areas. Communities must have significant unmet recovery needs and the capacity to carry out a disaster recovery program (usually these are governments that already receive HOME or CDBG allocations).	Funding to states, local governments, tribal governments, and Insular areas designated by the President of the United States as disaster areas	Nationally, $70.7 billion in Active Grants, as of July 2017

Program	Details	Eligible Applicants/Notes	Funding Availability
	https://www.hudexchange.info/programs/cdbg-dr/ http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/drsi		
Neighborhood Stabilization Program (NSP)	Provides grants to address the problems associated with homes that have been foreclosed upon and are creating economic problems for their communities. https://www.hudexchange.info/programs/nsp/ Potential homebuyers, contractors, and program partners aren't able to receive direct assistance from HUD. Potential applicants need to contact state, local government, or an NSP non-profit grantee to find out how the program operates in specific area.	Funding to states, local governments, and non-profits For more information on eligibility, see: https://www.hudexchange.info/grantees	$1.93 billion in funds available, as of July 2017
National Disaster Resilience Competition	HUD award program that allowed 40 states and communities to request up to $500 million for projects that address unmet needs from past disasters while addressing the vulnerabilities that could put Americans in harm's way during future disasters https://www.hudexchange.info/programs/cdbg-dr/resilient-recovery/ For more information on eligibility, see: http://hcd.ca.gov/nationaldisaster/docs/ndrc-release-final-1-22-16-3.pdf	$70 million dollars was granted in Tuolumne county for recovery from the 2013 Rim Fire. The $70 million will create a partnership between federal, state, and local agencies to create the Community Watershed and Resilience Program.	One time Competitive grant awards totaling $1 billion in 2016.

2.2.6. BUREAU OF LAND MANAGEMENT (BLM)

The Bureau of Land Management (BLM) supports a technical assistance program focused on fire mitigation strategies at the community level (see Annex Table 2.G).

Annex Table 2.G: Bureau of Land Management Mitigation Funding Sources

Program	Details
Wildland Urban Interface Community Fire Assistance	The grants provide support to planning and implementation of hazardous fuels reduction projects in Wildland Urban Interface areas, education and outreach programs that help create fire adapted communities and resilient landscapes. The grant is open to any type of entity. Program mitigation/prevention experts address reduction of wildland fire threats and losses to communities and natural resources by taking actions before a fire starts. These teams work with local residents to help reduce the number of human-caused fires and implement wildland fire prevention programs. Additionally, the Community Assistance and Protection Program facilitates additionally programs such as FIREWISE and Wildland Fire Education Public Service Announcements.

2.2.7. U.S. DEPARTMENT OF AGRICULTURE (USDA)

There are multiple mitigation funding and technical assistance opportunities available from the USDA and its various sub-agencies: the Farm Service Agency, Forest Service, and Natural Resources Conservation Service (see Annex Table 2.H).

Annex Table 2.H: USDA Mitigation Funding Sources

Program	Details	Eligible Applicants/Notes	Funding Availability
USDA/Smith-Lever Special Needs Funding	Helps enable families, communities, and businesses to successfully prepare for, respond to and cope with disaster losses and critical incidents. This National Institute of Food and Agriculture Program (NIFA) fund Special Needs projects to implement applied scientific programs that serve public needs in preparation for, during, and after local or regional emergency situations. https://nifa.usda.gov/funding-opportunity/smith-lever-special-needs-competitive-grants-program	States, American Samoa, Guam, Micronesia, Northern Marianas, Puerto Rico, and the U.S. Virgin Islands	Range of awards are between $15,000-$150,000. 2016 Program Funding: Estimated $462,000
USDA/ Community Facilities Direct and Guaranteed Loans Program	This program funds the development of essential community facilities in rural areas. An essential community facility is defined as a facility that provides an essential service to the local community for the orderly development of the community in a primarily rural area, and does not include private, commercial, or business undertakings. https://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program	Localities (less than 20,000), special purpose districts, tribal governments, and community-based non-profit corporations Public bodies, Community-based non-profit corporations, Federally recognized Tribes carrying out activities in rural areas including cities, villages, townships and towns including Federally Recognized Tribal Lands with no more than 20,000 residents.	Combination of grant and loan programs are available. See website for grant and loan conditions

Program	Details	Eligible Applicants/Notes	Funding Availability
USDA/Farm Service Agency Disaster Assistance Programs	Assistance for natural disaster losses, resulting from drought, flood, fire, freeze, tornadoes, pest infestation, and other calamities. Various programs including an Emergency Loan Program, Disaster Set-Aside Program, and Live Stock Forage Program. To be eligible for disaster assistance programs under the 2014 Farm Bill, producers are no longer required to purchase crop insurance or NAP coverage http://www.fsa.usda.gov/FSA/webapp?area=home&subject=diap&topic=landing	Farmers, ranchers, and agricultural producers.	Each year, the U.S Congress appropriates funds for FSA farm loans as part of the USDA budget. The funds generally are appropriate for the government's fiscal year. More information available: https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/FactSheets/2016/farm_loan_program_funding_nov2016.pdf
USDA Forest Service/ Community Wildfire Protection Plan (CWPP)	Provides communities with an opportunity to influence where and how federal agencies implement fuel reduction projects on federal lands and how additional federal funds may be distributed for projects on nonfederal lands. A CWPP must be collaboratively developed by local and state government representatives, in consultation with federal agencies and other interested parties. Creation of a CWPP can specifically address a community's unique conditions, values, and priorities related to wildfire risk reduction and resilience. Communities with CWPPs in place are given priority for funding of hazardous fuels reduction projects carried out under the Healthy Forests Restoration Act (HFRA). http://www.forestsandrangelands.gov/communities/cwpp.shtml	Communities who want to prepare a Wildfire Protection Plan (CWPP) A Handbook with guidance on assembling a CWPP can be found here: https://www.forestsandrangelands.gov/communities/documents/cwpphandbook.pdf	
Firewise Communities Program	The National Fire Protection Association (NFPA) Firewise Communities Program encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. This program is facilitated by the USDA Forest Service, the US Department of the Interior and the National Association of State Foresters. https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA	Check website for procedures and funding availability	

Program	Details	Eligible Applicants/Notes	Funding Availability
USDA Forest Service/ Wildland Fire Management (WFM)	The WFM program works to integrate fire as a critical natural process in land and resource management plans and activities, managing wildfire across landownership boundaries, and applying the best available science. Updated in 2010 under the American Recovery and Investment Act of 2009, WFM supports job creation and programs that lead to the protection of communities for large-scale unnaturally severe fires and contribute to the restoration of fire adapted ecosystems. Assistance is intended to reduce forest susceptibility to wildfire, remove excess vegetative debris, and mitigate falling-tree hazards; improve vigor of live forest trees, and reforest areas damaged by wildfire and recent forest insect tree mortality. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5176385.pdf	Federal lands and in cooperation with states, local governments, tribes, and owners of private lands. Non- profit organizations, independent school districts, individuals, tribal governments, tribal organizations, private institutions of higher education, public and state-controlled institutions of higher education, public housing authorities, small businesses, special district governments, state governments.	Nationally, $3,000,000, as of July 2018
USDA Natural Resources Conservation Service/ Emergency Watershed Protection Support Services	Funds for implementing emergency measures to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or any other natural occurrence is causing or has caused a sudden impairment of the watershed. The program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. EWP is an emergency recovery program. All projects undertaken, with the exception of the purchase of floodplain easements, must have a project sponsor. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/	Public and private landowners are eligible for assistance but must be represented by a project sponsor. Sponsors can include legal subdivisions of the State, such as a city, county, general improvement district, conservation district, or any tribe or tribal organization.	March 2016, NRCS invested $103 million in EWP Program funds.
USDA Natural Resources Conservation Service/ Watershed and Flood Prevention Operations (WFPO) Program	Provides funds to prevent erosion, floodwater and sediment damage, to further the conservation development, use and disposal of water, and to further the conservation and proper use of land in authorized watersheds. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/wfpo/?cid=nrcs143_008271	States, local governments and Tribes (project sponsors)	

2.2.8. HEALTH AND ECONOMIC AGENCIES

Alternative mitigation programs can be found through health and economic agencies that provide loans and grants aimed primarily at disaster relief (see Annex Table 2.I).

Annex Table 2.I: Federal Loans and Grants for Disaster Relief

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
Department of Health and Human Services (Administration for Community Living)/ Disaster Assistance for State Units on Aging (SUAs)	Grants to provide disaster reimbursement and assistance funds to those who are receiving a grant under Title VI of the Older American Act. The fund is only available when the President declares National Disaster and may only be used in those areas designated in the Disaster Declaration issued by the President of the United States. https://www.acl.gov/grants/disaster-assistance-state-units-aging-suas-and-tribal-organizations-national-disasters-1	State governments, tribal organizations (other than Federally recognized tribal governments)	See website
U.S. Small Business Administration (SBA)/Disaster Loans	The Small Business Administration provides low-interest disaster loans that can be used to repair or replace real estate, personal property, machinery and equipment, inventory and business assets damaged or destroyed in a declared disaster. https://www.sba.gov/sites/default/files/articles/sba-disaster-loans-faq.pdf	Individuals, businesses, and organizations in a declared disaster area.	Loans with a limit of $2,000,000 for business physical disaster and economic injury disaster, and $40,000-$200,000 for home disaster.

2.2.9. RESEARCH AGENCIES

The United States Geological Survey (USGS) and the National Science Foundation (NSF) provide grant money for hazard mitigation-related research efforts (see Annex Table 2.J).

Annex Table 2.J: Hazard Mitigation Research Grants

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
National Science Foundation (NSF)/Decision, Risk, and Management Sciences Program (DRMS)	Grant program that provides funding to support scientific research directed at increasing the understanding and effectiveness of decision-making by individuals, groups, organizations, and society. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423&org=SES *Note that NSF grant funding is not used for hazard mitigation but can be useful for related research topics.*	See website	$8,000,000 annually for DRMS
National Science Foundation (NSF) / Prediction of and Resilience against Extreme Events (PREEVENTS)	PREEVENTS seeks projects that will (1) enhance understanding of the fundamental processes underlying natural hazards and extreme events on various spatial and temporal scales, as well as the variability inherent in such hazards and events, and (2)	Proposals may be submitted by institutions of higher education, non-profit, non-academic organizations, for-profit organizations, and NSF-funded FFRDCs.	

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
	improve our capability to model and forecast such hazards and events. https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504804	More information available: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504804	
National Science Foundation (NSF)/ Natural Hazards Engineering Research Infrastructure 2015-2019 (NHERI)	NHERI will be a distributed, multi-user, national facility that will provide the natural hazards engineering community with access to research infrastructure, coupled with education and community outreach activities. https://www.nsf.gov/pubs/2014/nsf14605/nsf14605.htm	Proposals may only be submitted by Universities and Colleges See website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503259	$62,000,000 is the estimated total for up to five years for up to ten awards.
National Science Foundation (NSF)/ Decision Frameworks for Multi-Hazard Resilient and Sustainable Buildings (RSB)	The goal of the Decision Frameworks for Multi-Hazard Resilient and Sustainable Buildings (RSB) solicitation is to advance knowledge for new concepts for multi-hazard resilient and sustainable SFSE building systems using decision frameworks for selection among alternative building system designs.	Proposals may only be submitted by Universities and Colleges See website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=6192	Awards for single institution proposals and collaborative proposals in total may range from $800,000 to $1,200,000 total, for up to four years.
National Science Foundation (NSF)/ Infrastructure Management and Extreme Events (IMEE)	The IMEE program supports fundamental, multidisciplinary research on the impact of hazards and disasters upon civil infrastructure and society. The program is focused upon research on the mitigation of, preparedness for, response to, and recovery from multi-hazard disasters.	https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13353&org=NSF	
National Science Foundation (NSF)/ Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP)	The goals of the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) solicitation are to: (1) foster an interdisciplinary research community of engineers, computer and computational scientists and social and behavioral scientists, that creates new approaches and engineering solutions for the design and operation of infrastructures as processes and services; (2) enhance the understanding and design of interdependent critical infrastructure systems (ICIs) and processes that provide essential goods and services despite disruptions and failures from any cause, natural, technological, or malicious; (3) create the knowledge for innovation in ICIs so that they safely, securely, and effectively expand the range of goods and services they enable; and (4) improve the effectiveness and efficiency with which they deliver existing goods and services.	Proposals may only be submitted by Universities and Colleges.	Anticipated funding amount: $13,400,000

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
	https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505277 https://www.nsf.gov/pubs/2018/nsf18523/nsf18523.htm		
United States Geological Survey (USGS)/Earthquake Hazards Program	The goal of the Earthquake Hazards Program is to mitigate earthquake losses that can occur in many parts of the nation by providing earth science data and assessments that are critical for land-use planning, engineering design, and emergency preparedness decisions. http://earthquake.usgs.gov/research/external/	See website:	$2,482,577 were distributed among 60 proposals during 2018

2.2.10. U.S. DEPARTMENT OF HOMELAND SECURITY

The United States Department of Homeland Security provides grant money for disaster preparedness (see Annex Table 2.K).

Annex Table 2.K: Department of Homeland Security Mitigation Funding Sources

Program	Details	Eligible Applicants/Notes	Funding Availability
Department of Homeland Security/ Preparedness (Non-Disaster) Grants (HSGP) (FEMA)	This DHS/FEMA program provides state and local governments with preparedness program funding in the form of various Non-Disaster Grants to enhance the capacity of state and local emergency responders to prevent, respond to, and recover from a weapons of mass destruction terrorism incident involving chemical, biological, radiological, nuclear, and explosive devices and cyber-attacks. http://www.fema.gov/preparedness-non-disaster-grants	The State Administrative Agency is the only entity eligible to submit HSGP applications to DHS/FEMA. Tribal governments may not apply directly for HSGP funding; however, funding may be available to tribes under the SHSP and OPSG through the SAA. Varies depending on grant program. See website	Nationally, total funding available in fiscal year 2018: $1,067,000,000.
Department of Homeland Security/ Emergency Management Performance Grants (EMPG) Program (FEMA)	Provide necessary direction, coordination, guidance, and assistance for a comprehensive emergency preparedness system for all hazards. This program primarily helps implementation of the National Preparedness System by supporting the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal. https://www.fema.gov/emergency-management-performance-grant-program	States, localities, tribal governments, and territories All 56 States and territories, as well as the Republic of the Marshall Islands and the Federated States of Micronesia, are eligible for FY 2016 EMPG Program funds. Either the State Administrative Agency (SAA) or the state's Emergency Management Agency (EMA) applies directly to FEMA for EMPG Program funds on behalf	Total amount of funds to be distributed for FY 2018: $350,100,000

Program	Details	Eligible Applicants/Notes	Funding Availability
		of each state or territory, however, only one application is accepted from each state or territory.	

2.3. STATE FUNDING SOURCES

California is fortunate that its legislature and citizens recognize the need for safer and more disaster-resilient communities. Projects that support the SHMP goals and objectives are embedded in the budgets and programs of significant amount of State departments. A sizeable portion of funds are mitigation-directed or mitigation-related. The following is a brief summary of each of these programs sorted by primary hazard type.

2.3.1. EARTHQUAKE HAZARD MITIGATION FUNDING

Seismic mitigation is addressed by many state agencies and commissions. Some agencies focus on structural measures (such as Caltrans) while others focus on nonstructural measures (such as the Seismic Safety Commission).

California Department of Transportation

Bridge Retrofit Funding and Toll Bridge Program

The California Department of Transportation (Caltrans) operates and maintains more than 12,000 bridges statewide. When the 1971 Sylmar earthquake struck the Los Angeles area and damaged several bridges, Caltrans began operating a bridge seismic safety retrofit program focused on bridge expansion joints, which was completed in 1989 at a cost of $55 million. After the 1989 Loma Prieta and 1994 Northridge earthquakes caused significant loss of life and closure of major routes, Caltrans established the Seismic Retrofit Programs Phase I and II. The current Seismic Retrofit Programs have focused on retrofitting existing bridges statewide and bringing these structures up to the latest seismic retrofit safety programs established to prevent future collapse during future earthquakes. A total of 2,194 state bridges have been identified for seismic retrofit, and 2,191 have been retrofitted. In less than 20 years over 99% of the state's bridges are safer. The three remaining bridges are under construction and expected to be completed by 2017.

Caltrans spent a total of $10,781 billion on the Seismic Retrofit Program (See Table 2.L) for identified structures and toll bridges. Caltrans expended a total of $1.08 billion for their Phase I Seismic Retrofit Program and a total of $1.501 billion has been expended for Phase II, utilizing SHA/HBRR funds (State Highway Accounts), Federal Trust Fund, and the Proposition 192 Retrofit Bond Fund of 1996. The toll bridge program funding came from Bay Area Authority toll revenues, Motor Vehicle Account, Redirect Spillover, Public Transit Account Funds, Vincent Thomas and Coronado funds. Annex Table 2.L summarizes the Seismic Retrofit Programs Phase I and II. Privately owned toll bridges as well as city-and county-owned bridges are at earthquake damage risk. Although Caltrans is the lead agency, Senate Bills 60 and 226 established the Toll Bridge Program and provided initial funding. Assembly Bills 1171, 144 and 1175 established the funding levels. As seen in Table 2.L, the nine bridges identified in the toll bridge program have been completed.

Annex Table 2.L: Seismic Retrofit Programs Funds

Retrofit Programs	BRIDGES	COMPLETED	PERCENT	COST(millions)	Expended(Millions)	Percent
Phase 1	1,039	1,039	100.0%	$1,082	$1,082	100.0%
Phase 2	1,155	1,154	99.9%	$,1745	$1,501	86.0%
Toll Bridge Program (as of 2014)	9	9	100.0%	$9,435	$8,198	86.9%
TOTAL	**2,203**	**2,202**	**99.9%**	**$12,262**	**$10,781**	**87.9%**

Source: Caltrans Seismic Retrofit Program http://www.dot.ca.gov/hq/paffairs/about/retrofit.htm

Annex Table 2.M: Toll Bridge Seismic

Program Funds	Phase 1 (millions)	Phase II (millions)	Toll Bridge (millions)	Total (millions)
Prop 192	$0	$1,210	$ 790	$2,000
SHA/HBRR	$1,082	$535	$ 2,265	$3,882
Tolls	$0	$0	$ 6,002	$6,002
Miscellaneous Funds	$0	$0	$ 378	$378
TOTAL	**$1,082**	**$1,745**	**$ 378**	**$12,262**

Source: Caltrans Seismic Retrofit Program http://www.dot.ca.gov/hq/paffairs/about/retrofit.htm

California Seismic Safety Commission

The Alfred E. Alquist Seismic Safety Commission is funded by fees paid by insurance companies that sell policies in California. It has 20 volunteer commissioners and six staff members that manage programs for public education, preparedness, mitigation, and research to improve earthquake safety. The Commission's efforts are funded, in part, by an insurance claim settlement resulting from the Northridge Earthquake.

California Earthquake Authority

The California Earthquake Authority (CEA), created in 1996 in response to the Northridge Earthquake, is a privately financed, publicly managed provider of earthquake insurance. Policyholders purchase coverage through the CEA as an add-on to their homeowner's insurance. Insurance companies can join the CEA and issue seismic policies under its structure. The CEA reduces the risk of earthquake damage to homeowners through education, mitigation, and insurance policies that help repair and rebuild damaged homes, and replace valuables and personal belongings.

In 2016, the CEA introduced policy enhancements that included more coverage choices, deductible options, and more affordable rates. In 2017, a policy count of 1,006,927, surpassing the one million mark for the first time in its history was announced.

California Earthquake Authority (CEA) provides residential earthquake insurance. The CEA reduces the risk of earthquake damage to homeowners through education, mitigation, and insurance policies that help repair and rebuild damaged homes, and replace valuables and personal belongings. The CEA is privately funded and publicly managed, with state legislators serving on the Governing Board. In terms of mitigation, the CEA provides discounts (Hazard Reduction Discount) for homeowners who carry out seismic retrofitting. For more information on the Hazard Reduction Discount program, visit: https://www.earthquakeauthority.com/.

The California Residential Mitigation Program (CRMP) was created through a Joint Exercise of Powers Agreement between the California Emergency Management Agency (Cal EMA, now Cal OES) and the CEA. The CRMP is a public entity and is separate from Cal OES and the CEA. The CRMP's goal is to provide incentives to California homeowners to seismically retrofit wood frame residential structures. For more information, visit: https://www.earthquakeauthority.com/About-CEA/CEA-History.

2.3.2. FLOOD HAZARD MITIGATION FUNDING

California makes significant and continued investments in mitigating flood risks. Funding for this comes from the state general fund and from large bond issues voted on by the citizens of the state.

General Fund

In general, state flood management programs are funded from the general fund and voter-approved bonds. In addition, local governments, including flood control districts and other public water agencies, operate their own flood management programs and projects. Funding for these local programs comes from various sources, including property assessments, sales tax revenue, and state financial assistance.

Proposition 1E: Disaster Preparedness and Flood Prevention Bond Act of 2006

In addition to the general fund, bonds are an important source of state funding for flood hazard mitigation projects. Among the largest is the voter-approved $4.09 billion Proposition 1E (the Disaster Preparedness and Flood Prevention Bond Act of 2006) to fund flood management projects, including repairs and improvements to levees, weirs, bypasses, and other flood control facilities throughout the state. Proposition 1E allocates $3 billion to repair and improve state-federal facilities that are part of the State Plan of Flood Control for the Central Valley and to reduce the risks of levee failure in the Sacramento-San Joaquin Delta.

Of these funds, a minimum of $1 billion will be allocated to high-level flood protection for urban areas protected by state-federal project levees, $300 million to design flood level protection for non-urban areas protected by state-federal project levees, and a minimum of $500 million to reduce the risks of levee failure in the Sacramento-San Joaquin Delta. Also allocated are $500 million for State Flood Control Subventions and $300 million in storm water Flood Management Grants. Annex Table 2.N summarizes the purpose of allocated Proposition 1E dollars and funding levels.

Annex Table 2.N: Proposition 1E Uses of Bond Funds (as of July 2016)

Bond Project Allocation	Amount Allocated	PROP 1 REDUCTION	Program Amt Committed	Statewide Costs	True Balance	Balance (State-wide separated)
DWR - State Plan for Flood Control	$3,000,000,000	$73,349,633	$2,870,373,653	$31,650,367	$24,626,347	$56,276,714
DWR - Flood Control and Flood Prevention	$500,000,000	$12,224,939	478,627,900	$5,275,061	$3,872,100	$9,147,161
DWR - Flood Protection Corridors and Bypasses	$290,000,000	$7,090,465	$274,395,175	$3,059,535	$5,454,825	$8,514,360
DWR - Storm Water Flood Management	$300,000,000	$7,334,963	$289,474,811	$3,165,037	$25,189	$3,190,226
Statewide Bond Cost	0		$43,150,000	-$43,150,000	0	-$43,150,000
Total	**$4,090,000,000**	**$100,000,000**	**$3,956,021,539**	**$0**	**$33,978,461**	**$33,978,461**

Source: California Natural Resources Agency, http://bondaccountability.resources.ca.gov/p1e.aspx

Proposition 1: The Water Quality, Supply, and Infrastructure Improvement Act of 2014

In 2014, California voters approved the Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1) authorizes $7.545 billion in general obligation bonds to fund ecosystems and watershed protection and restoration, water supply infrastructure projects, including surface and groundwater storage, and drinking water protection. Table 2.O illustrates funding status of Proposition 1 programs.

Many of the projects funded through Prop 1 further implement the California Water Action Plan, which, outlines the State's roadmap toward sustainable water management since 2014. This funding has gone to projects for watershed restoration throughout the State. Specific examples include the American River Headwaters Restoration Project ($1.8 million), Napa River Restoration Oakville to Oak Knoll Project ($800,000) and appropriations to regional water agencies and conservancies, such as the Department of Water Resources and the San Diego River Conservancy. More information on Prop 1. Programs can be found at:
http://bondaccountability.resources.ca.gov/P1ProgramList.aspx .

Annex Table 2.O: Proposition 1 (The Water Quality, Supply, and Infrastructure Improvement Act of 2014) Programs and Balance

Chapter	Allocation	Committed	Balance
5: Safe and Reliable Drinking Water	$520,000,000	$480,451,000	$39,549,000
6: Protecting River, Lakes Streams, Coastal Waters and Watersheds	$1,495,000,000	$1.161,661,000	$333,339,000
7: Regional Water Security, Climate and Drought Preparedness	$810,000,000	$512,726,000	$297,274,000
8: Statewide Water System Operation Improvement and Drought Preparedness	$2,700,000,000	$2,646,000,000	$54,000,000
9: Water Recycling	$725,000,000	$694,834,000	$30,166,000
10: Groundwater Sustainability	$900,000,000	$859,066,000	$40,934,000
11: Flood Management	$395,000,000	$111,000,000	$284,000,000
4/12: Statewide Bond Costs	0	$150,900,000	($150,900,000)
TOTAL	**$7,545,000,000**	**$6,616,638,000**	**$928,362,000**

Source: http://bondaccountability.resources.ca.gov/p1.aspx

Proposition 84

The voter-approved $5.4 billion Proposition 84 (the Safe Water Quality, Supply, Flood Control, River and Coastal Protection Act of 2006) will allocate about $1.2 billion in additional funding beyond Proposition 1E for flood control projects including the Delta Levee Program, State Flood Control Subventions Program, and floodplain evaluation and delineations (see Annex Table 2.P). Local agencies have already proposed mitigation and levee strengthening projects in the amount of $204 million related to funds from Propositions 1E and 84.

Annex Table 2.P: Proposition 84 Uses of Bond Funds

Bond Project Allocation	Original Allocation	Adjusted Allocation	Committed	Balance
Safe Drinking Water and Water Quality Projects	$1,525,000,000	$1,495,281,000	$1,466,833,000	$28,448
Flood Control	$800,000,000	$784,410,000	$752,247,000	$31,163
Statewide Water Planning and Design	$65,000,000	$63,733,000	$62,299,000	$1,435
Protection of Rivers, Lakes and Streams	$928,000,000	$909,915,000	$847,219,000	$62,696
Forest and Wildlife Conservation	$450,000,000	$441,231,000	$446,667,000	($5,436)
Protection of Beaches, Bays and Coastal Waters	$540,000,000	$529,477,000	$488,841,000	$40,635
Parks and Nature Education Facilities	$500,000,000	$490,256,000	$453,901,000	$36,355
Sustainable Communities and Climate Change Reduction	$580,000,000	$568,697,000	$552,859,000	$15,838
Statewide Bond Cost	$0	$0	$83,580	($83,580)
Reallocated to Proposition 1	$0	$105,000	$105,000	$0
TOTAL	**$5,388,000,000**	**$5,388,000,000**	**$5,259,446,000**	**$128,554**

Source: http://bondaccountability.resources.ca.gov/p84.aspx

Proposition 40

For information on Proposition 40 (California Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act of 2002) see the 2013 State Hazard Mitigation Plan.

Proposition 50

For information on Proposition 50 (Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, see the 2013 State Hazard Mitigation Plan.

California Water Resources Control Board

The Water Resources Control Board has three programs for funding hazard mitigation projects:

1. *Watershed Protection Program*. This program provides grants to municipalities, local agencies, or non-profit organizations to develop local watershed management plans and/or implement projects consistent with watershed plans. Sixty percent of the funds are allocated to projects in Los Angeles, Orange, Riverside, Ventura, San Bernardino, and San Diego counties. Forty percent of the funds are allocated to projects in the remaining counties. A total of $90 million is allocated for the program, $35 million of which is set aside for grants to small communities.

2. *Southern California Integrated Watershed Program*. This program provides local assistance to the Santa Ana Watershed Project Authority for projects in the Santa Ana watershed such as basin water banking; contaminant and salt removal; removal of non-native plants; the creation of wetlands; water conservation efficiency; storm water management; and planning and implementation of a flood control program to protect agricultural operations and adjacent property and to assist in abating the effects of waste discharges into the water supply. The program have allocated $235 million in funding to localities through the Santa Ana Watershed Project Authority.

3. *Lake Elsinore and San Jacinto Watershed Program*. This program provides $15 million in local funding for watershed management and flood control projects consistent with the Lake Elsinore Management Plan that preserve agricultural land, protect wildlife habitat, protect and enhance recreation resources, and improve lake water quality. As of July 2017, funds available are $747,715.31. Visit: http://www.sawpa.org/wp-content/uploads/2017/07/Pkt-2017-10-19.pdf.

Department of Water Resources (DWR)

DWR programs that provide funding for hazard mitigation projects include the following:

1. *Urban Streams Restoration Program*. This competitive grant program promotes effective low-cost flood control projects, including stream clearance and flood mitigation and cleanup activities. Funds are available to public agencies, nonprofit organizations, and local community groups. All public agencies must have a partnership with a nonprofit citizens group to receive funding. Individual projects are range from $1,000 to a $1 million maximum. Projects include the restoration of Berkershire creek in Los Angeles County and the Janes Creek Instream restoration in the City of Arcata.

2. *Urban Flood Risk Reduction*. The program works to improve flood protection for urban areas associates with State Plan of Flood Control and seeks to increase flood protection, provide ecosystem restoration and improvement, protect farmland, and improve operation and maintenance of State Plan od Food Control facilities. Applicants must be a Local Agency and may submit proposals for one or more repair or improvement projects that are consistent with an Area Plan and Area Project cost limits. $1.2 billion allocated to provide improvements that address urban flood improvements identifies in the Central Valley Flood Protection Plan. Visit: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Urban-Flood-Risk-Reduction.

3. *Flood Protection Corridor Program*. This is a competitive grant program for flood protection projects, including the acquisition of real property and the acquisition of easements from willing sellers. Funds are available to public agencies, nonprofit organizations, and DWR. This program, established in 2000, is a competitive grant program for flood protection projects, including the acquisition of real property and the acquisition of easements from willing sellers. Funds are available to public agencies, nonprofit organizations, and DWR. Prop 84 and Prop 1E provided additional funds for this Program's regular activities.

4. *Flood Control Subventions Program*. The DWR Division of Flood Management provides financial assistance to non-federal partners cooperation in the construction of federally authorized flood control projects located outside of the Central Valley. More information available: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Flood-Control-Subventions-Program.

5. *Delta Levees Maintenance Subventions*. This program provides funding on a cost-share basis to local levee maintaining agencies for rehabilitation and maintenance of levees in the Delta. Levee maintaining agencies, reclamation districts, and other government agencies responsible for maintaining levees in the Delta are eligible. $400 million investment in both subvention and Special Projects. Visit: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Delta-Levees-Maintenance-Subventions.

6. *Local Levee Assistance Program*. This program provides financial assistance to local public agencies responsible for flood management outside the Sacramento-San Joaquin Delta. This assistance helps local agencies obtain the geotechnical information needed to repair damaged levees and to restore or maintain levee accreditation by the Federal Emergency Management Agency. More information available: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Local-Levee-Assistance-Program.

7. *Delta Levees Special Flood Control Projects*. This program provides critical financial assistance for flood protection in the Delta by providing funding to safeguard public benefit from flood hazards. Levee Maintaining Agencies, Reclamation Districts, Other government agencies responsible for levees in the Delta are eligible. Visit: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Delta-Levees-Special-Flood-Control-Projects.

8. *Central Valley Tributaries Program*. This program funds multi-benefit flood risk reduction projects that address flood risk for urban communities, small communities and rural areas; and enhance ecosystems by improving fish and wildfire habitat and water quality downstream. Any California public agency, nonprofit organization, public utility agency, federally recognized Indian tribe, State Indian tribe listed on the Native American Heritage Commission's California Tribal Consultation List, or mutual water company is eligible. Grants up to $36 million. Visit: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Central-Valley-Tributaries-Program.

9. *Small Communities Flood Risk Reduction Program*. A local assistance program that works to reduce flood risk for small communities protected by State plan of Flood Control facilities. Communities must be protected by SPFC facilities, be within the Levee Flood Protection Zone and have land use authority. Projects must both rehabilitate, reconstruct or replace SPFC facilities and be consistent with CVFPP goals and objectives. Delivered in multiple phases. In the first phase, funds are awarded to complete feasibility studies of structural and nonstructural flood risk reduction projects. Funds to design and implement projects are awarded in subsequent phases. Visit: https://water.ca.gov/Work-With-Us/Grants-And-Loans/Small-Communities-Flood-Risk-Reduction.

10. Integrated Regional Water management Grant Programs. A collaborative effort to manage all aspects of water resources in a region. The grant programs fund planning, implementation, and disadvantaged community involvement. Public Agencies, Non-profit Organizations, Public Utilities, Federally recognized Indian Tribes, State Indian Tribes listed on the Native American Heritage Commission's Tribal Consultation list, and Mutual water companies are eligible. $510 million were authorized to support the program. Visit: http://abcrs.resources.ca.gov/guidelines/guideline_624.pdf.

2.3.3. WILDFIRE HAZARD MITIGATION FUNDING

CAL FIRE

The goal of the Fuels Reduction Program within CAL FIRE is to reduce wildland fuel loadings that pose a threat to watershed resources and water quality. CAL FIRE is implementing the Fuels Reduction Program through the following existing mitigation programs:

1. *Vegetation Management Program*. The Vegetation Management Program (VMP) is a cost-sharing program that focuses on the use of prescribed fire, and mechanical means, for addressing wildland fire fuel hazards and other resource management issues on State Responsibility Area (SRA) lands. The use of prescribed fire mimics natural processes, restores fire to its historic role in wildland ecosystems, and provides significant fire hazard reduction benefits that enhance public and firefighter safety. VMP allows private landowners to enter into a contract with CAL FIRE to use prescribed fire to accomplish a combination of fire protection and resource management goals. The Vegetation Management Program has been in existence since 1982 and has benefitted an average of approximately 35,000 acres per year since its inception. Visit: http://www.fire.ca.gov/resource_mgt/downloads/VMP2004.pdf

2. *Forest Stewardship Program*. This program combines funds from state and federal sources to assist communities with multiple-ownership watershed and community issues related to pre-fire fuels treatment, forest health, erosion control, and fisheries issues. Visit: https://www.fs.fed.us/spf/coop/library/fsp_standards_guidelines.pdf

California Fire Safe Councils

An additional fire mitigation program is operated through the California Fire Safe Council, a state-level non-profit comprised of 150 local Fire Safe Councils. These local councils are made up of cross-sections of the community and

members can apply for grant funding from federal and private entities (such as PG&E) for fuel hazard reduction and education programs. A comprehensive listing of available funding is available on the California Fire Safe Council Grants Clearinghouse web page: http://www.cafiresafecouncil.org/grants-clearinghouse/

2.3.4. OTHER STATE HAZARD MITIGATION FUNDING

California Climate Investments program

The California State Legislature and Governor's office have created the California Climate Investments program as a result of the Greenhouse Gas Reduction Fund (GRRF) auction program. Managed by the California Air Resources Board, the auction directs funding from the California's cap and trade program to agencies and programs through the state budget process. These California Climate Investment programs are divided into three general categories: Transportation and Sustainable Communities Funding, Clean Energy and Energy Efficiency Funding, and Natural Resources and Waste Diversion Funding.

These various programs also fund work to address the needs of disadvantaged communities to create healthier and more resilient communities. For example, wetland restoration programs can provide flood resiliency to communities and urban greening can mitigate effects of heat and heat-related illnesses. Additionally, sustainably managed natural resource can provide numerous co-benefits in by buffering communities from unexpected impacts of climate change and natural disasters. This includes by water quality improvement, flood control, groundwater recharge, creation of shade and shelter, reduction of incidence of disease and wildlife and protection against soil erosion. Below are California Climate Investment programs that contain funding related to resiliency, community planning and hazard mitigation. Annex Table 2.Q summarizes California Climate Investment program funding.

Annex Table 2.Q: California Climate Investments Program Summary

Agency	Program	Expenditure Plan FY 2018-2019
California Department of Forestry and Fire Protection (CAL FIRE)	Forest Health Program: Through the Forest Health GGRF Grant Program, CAL FIRE funds and implements projects to proactively restore forest health in order to reduce greenhouse gases, to protect upper watersheds where the state's water supply originates, to promote the long-term storage of carbon in forest trees and soils, minimize the loss of forest carbon from large-scale wildfires. http://www.fire.ca.gov/grants/grants	$160,000,000
California Department of Forestry and Fire Protection (CAL FIRE)	Urban and Community Forestry (UCF): This program works to provide expansion and better management of urban forestry. http://calfire.ca.gov/resource_mgt/resource_mgt_urbanforestry_grants	$5,000,000
California Department of Forestry and Fire Protection (CAL FIRE)	Fuels Reduction: This program provides grants and cost share agreements for selective removal and utilization of vegetation to reduce wildfire hazards and increase forest resilience. http://calfire.ca.gov/resource_mgt/resource_mgt_fuelreduction	30,000,000
California Department of Fish and Wildlife	Wetlands and Watershed Program: This program works to Increase the quality and quantity of key wetlands in California will provide measurable benefits consistent with the most recent climate change adaptation and mitigation strategies and wildlife and fisheries management and recovery plans. https://www.wildlife.ca.gov/Conservation/Watersheds/Greenhouse-Gas-Reduction	$5,000,000
California Strategic Growth Council	Transformative Climate Communities: This program (scoping guidelines still being drafted) proposed to invest $140 million of cap and trade funding in three California communities: $70	$140,000,000

Agency	Program	Expenditure Plan FY 2018-2019
	million in Fresno, $35 million in Los Angeles and $35 million in a third location yet to be determined. This program will advance local climate action in disadvantaged communities through programs that enhance economic opportunity and increase resiliency. Additionally, the program will work to realize the State's vision of Vibrant Communities and Landscapes. http://sgc.ca.gov/programs/tcc/	
California Natural Resources Agency (CRNRA)	Urban Greening Program: This program will fund projects that transform the build environment into sustainable environments and greening of public lands and infrastructure. http://resources.ca.gov/grants/urban-greening/	$20,000,000

Source: https://lao.ca.gov/Publications/Report/3870/9

California Department of Boating and Waterways

California Beach Restoration and Erosion Control Programs. The purpose of this program is to preserve and protect the California Shoreline, minimize the economic losses caused by beach erosion and maintain urgently needed recreational beach areas. All California Beaches are eligible to apply. A minimum of $40,000 maximum of $5 million. Visit: https://dbw.parks.ca.gov/?page_id=28766.

California Natural Resources Agency

1. *River Parkways Grant Program.* The California Natural Resource Agency awards approximately $7.6 million dollars for the acquisition, restoration, protection, and development of river parkways in accordance with the California River Parkways Act of 2014. For more information visit: http://resources.ca.gov/docs/bonds_and_grants/Prop_13_River_Parkways_2015.pdf.

2. *Environmental Enhancement and Mitigation Program.* The Environmental Enhancement and Mitigation Program (EEMP), established in 1989, offers grants limited to $500,000 each and up to $1,000,000 may be awarded for acquisition projects during 2018. Grants are local, state, and federal governmental agencies and to nonprofit organizations. Eligible projects must be directly or indirectly related to the environmental impact of the modification of an existing transportation facility or construction of a new transportation facility. Funding categories are: highway landscaping and urban forestry, resource lands projects, roadside recreation projects, and mitigation projects beyond the scope of the lead agency. Grants for individual projects are generally limited to $500,000 each. For more information visit: http://resources.ca.gov/grants/wp-content/uploads/2018/04/Final-Guidelines-1.pdf.

Commerce and Economic Development Department Programs

The Commerce and Economic Development Department administers two programs that may provide funding for hazard mitigation projects:

1. *The Infrastructure State Revolving Fund (ISRF).* This program provides low-cost financing to public agencies for a wide variety of infrastructure projects. Loans are available in amounts ranging from $250,000 to $10,000,000 with loan terms of up to 30 years. Eligible applicants include any subdivision of a local government, including cities, counties, redevelopment agencies, special districts, assessment districts, joint powers authorities, and non-profit corporations formed on behalf of a local government. Flood control is an eligible project type.

2. *The Rural Economic Development Infrastructure Program (REDIP).* This program provides loans to eligible public entities for water treatment and supply facilities and flood control projects. There is a limit of $1 million per project.

Department of General Services

Seismic Mitigation Program. This program is a subset of the Facility Hardship program that provides for the seismic repair, reconstruction, or replacement of the 'most vulnerable' school facilities. School districts must have a qualifying Category 2 Building type as defined in the definitions of the School Facility Program:

- The construction contract was executed on or after May 20, 2006.
- The project funding provided shall be the minimum work necessary to obtain DSA approval.
- The building is designed for occupancy by students and staff.
- The DSA concurs with a structural engineer's report that identifies structural deficiencies in accordance with the requirements of DSA Procedure 08-03

There is approximately $86.2 million in remaining bond authority as of July 2018.
Visit: http://www.dgs.ca.gov/opsc/Programs/seismicmitigationprogram.aspx.

Department of Housing and Community Development

1. *Codes and Standards Program.* The purpose of HCD's Codes and Standards Program is to protect the public's health, safety, and general welfare in buildings and structures designed for human occupancy by the enforcement of the relevant provisions of the California Health and Safety Code, including the State Housing Law, Employee Housing Act, Mobile Home Parks Act, California Factory-Built Housing Law, and the Mobile Home-Manufactured Housing Act of 1980 as well as by enforcement of federal and state standards for the construction and safety of manufactured homes.

2. *Community Development Block Grant Program.* The Community Development Block Grant (CDBG) program, administered by the Department of Housing and Community Development (HCD) funds housing, economic development, public works, community facilities, and public service activities for lower-income people in small, typically rural communities. State regulations dictate the method of fund distribution to eligible jurisdictions, including ratings and rankings for most of the funds. State regulations allow the amendment of an existing grant to fund an otherwise CDBG-eligible replacement project or activity in an area proclaimed by the Governor as either a "state of emergency" or a "local emergency" as defined in Government Code Section 8558.

3. *Drought Housing Relocation Assistance Program.* This program provides needed assistance to those affected by the California drought. Eligible entities include 1) households with an income less than one hundred twenty percent of Area Media Income adjusted for household size and 2) any qualified local government agency or nonprofit corporation that has submitted a response to the Notice of Funding Availability. $1 million available as of July 2018. For more information visit: http://www.hcd.ca.gov/grants-funding/active-no-funding/dhra.shtml.

State Water Resources Control Board

Storm Water Grant Program

The Storm Water Grant Program identifies funds available for multi-benefit storm water management projects which may include, but are not limited to: green infrastructure, rainwater and storm water capture projects, and storm water treatment facilities.

Public agencies, nonprofit organizations, public utilities, federally recognized Indian tribes, state Indian tribes listed on Native American Heritage Commission's California Tribal Consultation List, and mutual water companies are eligible.

As of July 2018, approximately $10 million in planning grants were awarded. For "Round 1 Implementation Grants" approximately $80 million was awarded. For "Round 2 Implementation Grants" approximately $90 million is available. For more information, visit:
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/swgp/prop1/.

Drought Response Outreach Program for Schools

Drought Response Outreach Program for Schools (DROPS) is focused on funding projects that reduce stormwater pollution and provide multiple benefits including water conservation, water supply augmentation, energy savings, increased awareness of water resource sustainability, and reduced dry weather runoff. Projects must include an education/outreach component that is designed to increase student and public understanding of the project's environmental benefits and the sustainability of California's water resources directly related to the project.

Local educational Agencies limited to K-12 school districts, county offices of education, Federally Recognized Tribes in California with Tribal K-12 schools, and K-12 charter schools on publicly owned property are eligible. As of July 2018, approximately $25 million is available. For more information, visit: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/drops/docs/updated_drought_response_flyer.pdf.

For more information on other California Water Boards financial assistance opportunities, visit: https://www.waterboards.ca.gov/water_issues/programs/grants_loans/319h/index.html.

Strategic Growth Council Sustainable Planning Grant Funds

California is a national leader in its efforts to protect natural resources, reduce greenhouse gas emissions, and move toward sustainable communities. In 2010, the Strategic Growth Council (SGC), created through adoption of SB 732, The Council's mission is to help make California's communities more sustainable. The Council defines sustainability holistically through: reducing greenhouse gas emissions; improving air and water quality; improving protection of natural resources and agricultural lands; increasing the availability of affordable housing; improving public health, improve transportation; encouraging sustainable land use plans and greater infill development; and revitalizing urban and community centers in a sustainable manner.

For more information regarding the SGCs grant program, see: http://sgc.ca.gov/programs/ahsc/vision/.

Sustainable Agricultural Land Conservation Program

The Sustainable Agricultural Lands Conservation Program (SALC Program), a component of the Strategic Growth Council's (Council's) Affordable Housing and Sustainable Communities (AHSC) Program, supports the State's greenhouse gas (GHG) emission reduction goals by making strategic investments to protect agricultural lands from conversion to more GHG-intensive uses. The Department of Conservation works in cooperation with the Natural Resources Agency and the Strategic Growth Council (SGC) to implement the SALC Program. The SALC Program is part of California Climate Investments, a statewide program that puts billions of cap-and-trade dollars to work reducing greenhouse gas emissions, strengthening the economy and improving public health and the environment—particularly in disadvantaged communities.

Protecting critical agricultural lands from conversion to urban or rural residential development promotes smart growth within existing jurisdictions, ensures open space remains available, and supports a healthy agricultural economy and resulting food security. A healthy and resilient agricultural sector is becoming increasingly important in meeting the challenges occurring and anticipated as a result of climate change. Auction revenues from the Cap-and-Trade Program are deposited into the Greenhouse Gas Reduction Fund (GGRF), which the Legislature and Governor appropriate to a variety of programs such as the SALC Program and which operate under the umbrella of California Climate Investments. All projects funded by GGRF monies must reduce or avoid greenhouse gas emissions. The 2017-2018 grant application period was open from May-August 2018.

2.4. EXAMPLES OF LOCAL FUNDING SOURCES

Local funding occurs in various forms. California's local governments and special districts have made considerable commitments to funding mitigation measures. Local governments must provide a local match of 25 percent if they participate in the federal funds HMGP, PDM, and FMA grant programs.

Many of California's local governments (cities, counties, and special districts spend their own funds for hazard mitigation efforts. The following discussion provides examples of mitigation funding at the local level.

2.4.1. NAPA COUNTY FLOOD PROTECTION AND WATERSHED IMPROVEMENT EXPENDITURE PLAN

The Napa County Flood Protection and Watershed Improvement Expenditure Plan ends in 2018. Voted on and passed in 1998 by the citizens of Napa County, Measure A was enacted as the Napa County Flood Protection Sales Tax Ordinance (97-1) which established a 0.5-cent increase in the local sales tax for a 20-year period (1998-2018) to fund flood protection water supply reliability, and wastewater projects. The sales tax revenue is distributed among incorporated cities, Napa County, and town located in Napa County. Each entity receives a share of generated funds to carry out specific approved projects in addition to other projects to improve flood protection, water supply and the health of the watershed. This measure has enabled Napa County to collect over $70 million in local funds that are paired with financial help from the Napa County Flood Control and Water Conservation District (NCFCWCD) and the U.S. Army Corps of Engineers.

Annex Table 2.R shows the amount of funding that each city received as of 2017.

Annex Table 2.R: Percentage of Funding Received from Measure A

Expenditures as of 2017	
City	**Funding**
City of American Canyon	11.1% $13,179,317
City of Calistoga	1.1%$7,404,936
City of Napa	$181,400,37140.2%
City of St. Helena	4.9%$35,962,700
Town of Yountville	3.0%$8,015,923
Napa County Unincorporated Areas	14.8%$34,204,241

Source: Napa County, https://www.countyofnapa.org/aboutmeasurea

In addition to funding flood mitigation measures, the plan has taken a restorative approach to flood protection by connecting the Napa River to its historic floodplain.
Visit: https://www.countyofnapa.org/ArchiveCenter/ViewFile/Item/515.

2.4.2. CITY OF ROSEVILLE FLOODPLAIN MANAGEMENT

Roseville is another city that continues to pursue floodplain management on the local level by using a combination of local and federal funding. In addition to setting up an advanced flood warning system that alerts residents to current flood levels, the city prohibits building in the floodplain and has brought hundreds of homes out of the 100-year floodplain through the clearing and maintenance of streams. Roseville has become the first community in the nation to receive FEMA's Community Rating System highest rating of Class 1, entitling Roseville property owners to discounts of up to 45 percent on their flood insurance premiums.

2.4.3. SAN FRANCISCO PUBLIC UTILITIES COMMISSION WATER SYSTEM IMPROVEMENT PROGRAM (WSIP)

Overview

The Water System Improvement Project (WSIP) is a massive retrofitting project being undertaken by the San Francisco Public Utilities Commission (PUC). The purpose of the $4.6-billion initiative is to retrofit the city's water supply system in order for it to withstand a major earthquake. In 2002, San Francisco voters passed legislation that nearly doubled their residential water rates (from $23 to $40 per month) in order to fund this initiative.

The Water System Improvement Program (WSIP) reached the peak of construction in 2012 with 18 projects valued at $2.6B in construction and all major projects launched. As of 2017, more than two-thirds of the 81 WSIP projects

have completed construction between California's Central Valley and San Francisco. Redundant seismically engineered conduits were installed where the Hetch Hetchy Regional Water System crosses three of the nation's most active earthquake faults to help establish a resilient supply system around the San Francisco Bay.

Irvington Bay Tunnel

One of the main projects that were undertaken was the Irvington Bay Tunnel. The bay tunnel extends 3.5 miles under San Francisco Bay. The tunnel was deemed the best option from a technical and environmental standpoint. It was completed in 2016. For more information visit: https://sfwater.org/index.aspx?page=115.

Calaveras Dam Replacement

The project consists of building a new-zoned earth and rock fill dam immediately downstream of the existing dam that will have a structural height of 220-feet high and is designed to accommodate a maximum credible earthquake on the Calaveras Fault. The total volume of the dam will be approximately 3.5 million cubic yards. The $823 million replacement dam project will restore the original reservoir capacity of 96,850 acre-feet, or 31 billion gallons of water. The project has experienced some slowdown in activities due to storms, but as of March 2018 the project is 90% complete. The expected completion date is April 2019.

2.4.4. CITY OF SANTA BARBARA LAND PURCHASE

In an attempt to reduce vulnerability to landslides, the City of Santa Barbara purchased four high risk for landslide properties. The four properties cost a combined total of approximately $1 million and were purchased in 1998 using both federal and local funds. For more information see the 2013 State Hazard Mitigation Plan.

2.5. EXAMPLES OF ALTERNATIVE FUNDING SOURCES

2.5.1. COMBINED FUNDING APPROACHES

Combining funding from one or more state agencies, state, and local agencies, federal and state agencies, commonly occurs on projects in California. Partnerships have also been formed with non-profit groups and utility companies. These approaches have been both informal and formal.

2.5.2. CALIFORNIA FINANCING COORDINATING COMMITTEE (CFCC)

The California Financing Coordinating Committee (CFCC), created in 1998, consists of state and federal agencies and departments that work together to offer coordinated and streamlined access to subsidized infrastructure financing for California's local communities. The CFCC members provide potential borrowers and grant recipients with an efficient and effective infrastructure funding mechanism. Funds for flood control projects are made available through the California Infrastructure and Economic Development Bank (I-Bank). Visit: http://www.cfcc.ca.gov.

2.5.3. NON-PROFIT GOVERNMENT PARTNERSHIPS

Land purchases in California have been carried out in cooperation with non-profit agencies. The Trust for Public Land, The Nature Conservancy, and Conservation Fund are all helping communities throughout the country to develop local and regional plans for systems of open space. The California Council of Land Trusts (CCLT) is the statewide voice for more than 150 land trusts that conserve land and waters in local communities throughout California. Visit: https://www.calandtrusts.org/.

2.5.4. UTILITY COMPANIES

California's public and private utilities play an essential role in keeping critical facilities up and running. Mitigation is an essential part of core infrastructure planning for them. The California Utilities Emergency Association (CUEA) is integrated into state's overall mitigation effort (http://www.cueainc.com). CUEA has grown to include nearly 100 members, and provides training programs for both, members and associate members in mitigation and response

protocols. Its annual base budget of $340,000 is member-paid, and members also contribute equipment and staffing for response events in an average annual amount of $10 million per year.

Major private utility companies, such as Pacific Gas and Electric (PG&E) and Southern California Edison, as well as small local water companies, continuously program capital investments that provide strengthening of their companies' overall capacities to withstand various natural and human-caused disasters. Many of these investments represent incremental improvements in the resilience against natural and human-caused hazards within their plants and facilities. Visit: https://www.cueainc.com/about-us/history/

2.6. OTHER FUNDING SOURCES AND FUNDED PROJECT EXAMPLES

Additional examples of funding arrangements and funded project examples include the following:

2.6.1. GEOLOGICAL HAZARD ASSESSMENT DISTRICTS

Another source of potential local funding in California for hazard (geological hazard) mitigation is Geological Hazard Assessment Districts, or GHADs. The passage of the Beverly Act in 1979 (SB 1195) enabled local jurisdictions and community members to form GHADs in order to create a mechanism to create local assessment districts that can prevent, mitigate, abate, or control geologic hazards. The Act broadly defines a geological hazard as an actual or threatened landslide, land subsidence, soil erosion, earthquake, or any other natural or unnatural disaster movement of land or earth. Additionally, GHADS are formed in advance of construction and platting projects and used to prevent geological hazards by utilizing assessed funds to pay for regular maintenance of drainage systems, routine reconnaissance, and repairs related to slope failure.

GHAD are created by 1) a petition signed by owners of at least 10 percent of the real property in the district, or 2) by resolution of a local legislative body. While formation of a GHAD is exempt from the California Quality Act, public hearings are required. Proposal to develop a GHAD must be accompanied by a "plan of control", which is required to be prepared by a certified engineering geologist. According to the Act, this plan of control "describes in detail a geologic hazard, its location and the area affected thereby, and plan for the prevention, mitigation, abatement, or control thereof."

The act itself and the first GHAD was a result of the formation of the Abalone Cove Landslide Abatement District in Rancho Palos Verdes, Los Angeles County. In 1978, over 100 homes were threatened by 600-acre Abalone Cove landslide. The Act and subsequent Abatement District formed allow homeowners to finance abatement measures and treat the landslide as a single physical entity circumventing property boundaries. According to the California Association of GHADs, there are over 35 GHADs in the state that have are actively working to prevent, mitigate and abate geological hazards, the majority located in Alameda and Contra Costa Counties. More information on GHADS can be found at: http://www.conservation.ca.gov/cgs/rghm/Pages/haz_abatement.aspx or http://ghad.org/.

2.6.2. BART EARTHQUAKE SAFETY BOND

The Bay Area Rapid Transit District (BART) Earthquake Safety Bond funds provides $980 million of the $1.3 billion project cost to retrofit BART facilities in Contra Costa, Alameda, and San Francisco counties. Bonds are repaid from proceeds of property tax estimated to average $7.04 annually per $100,000 of assessed value. The remainder of the project will be funded through additional BART passenger revenues ($50 million), funding from the Caltrans Local Seismic Retrofit Program ($134 million), and Regional Measure 2 ($143 million). The anticipated date of competition of all earthquake upgrades is by 2022. Visit: http://www.bart.gov/about/financials.

2.6.3. PORT OF LONG BEACH MITIGATION GRANT PROGRAM

The Port of Long Beach funds a mitigation grant program is designed to improve community health by lowering port related impacts on air pollution and greenhouse gas emissions. Grant support is given in three broad categories 1) Air quality improvements and noise-reduction measures at schools and related sites; 2) Air quality improvements at hospitals, clinics, medical centers and senior facilities, as well as health education, outreach and screening; and 3) Greenhouse gas reductions through projects such as renewable power, energy efficiency, tree-planting, etc. Visit: http://www.polb.com/environment/grants/default.asp.

2.6.4. CONTRA COSTA COUNTY KELLER MITIGATION FUND

The Keller Canyon Landfill Fund supports mitigation projects that benefit residents living in the Bay Point, Pittsburgh, and other parts of Antioch and Concord, in Contra Costa County. Projects related to public safety, community beautification, and community services are considered.

2.6.5. MEASURE AA, SAN FRANCISCO CLEAN WATER, POLLUTION PREVENTION, AND HABITAT RESTORATION

This measure will provide $500 million dollars over 20 years to address bay restoration projects in all nine counties touching the bay. The funding source is a $12 parcel tax for 20 years on all the residents of the 9 county San Francisco Bay Area. This will raise approximately $25 million annually. It is controlled by the San Francisco Bay Restoration Authority.

2.6.6. SAN FRANCISCO CITY/COUNTY SEISMIC IMPROVEMENTS

In 2016 San Francisco voters approved $58 million dollars for bonds that will seismically improve fire stations and the county's general hospitals in partnership with philanthropic funders.

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