ANNEX 1 – GUIDE TO CALIFORNIA HAZARD MITIGATION LAWS, POLICIES AND INSTITUTIONS

ANNEX CONTENT

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

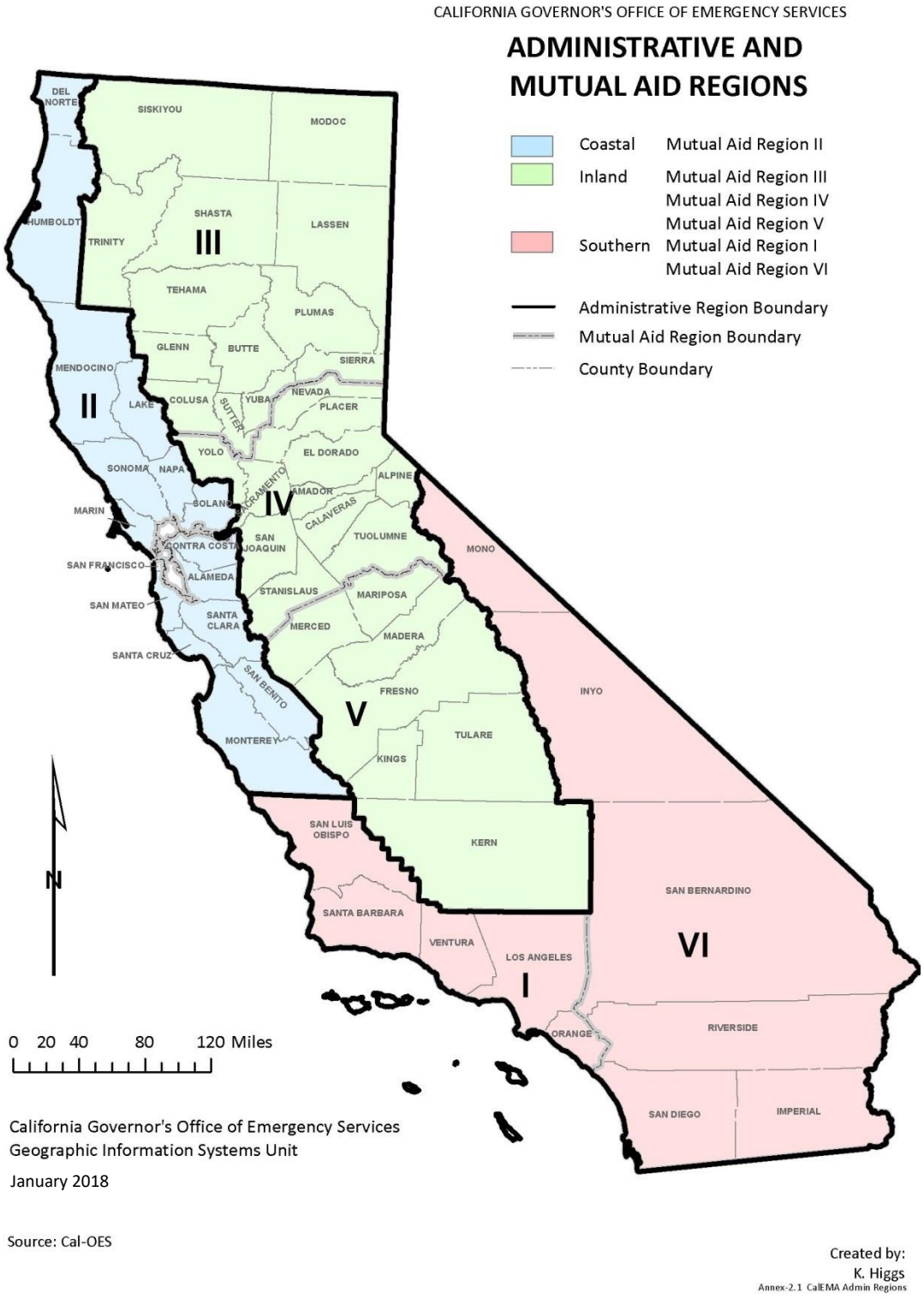
Cal OES is an Office of the Governor. Cal OES' mission is to protect lives and property by effectively mitigating, preparing for, preventing, responding to, and recovering from all threats, crimes, hazards, and emergencies. Cal OES responds to and coordinates emergency activities to save lives and reduce 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

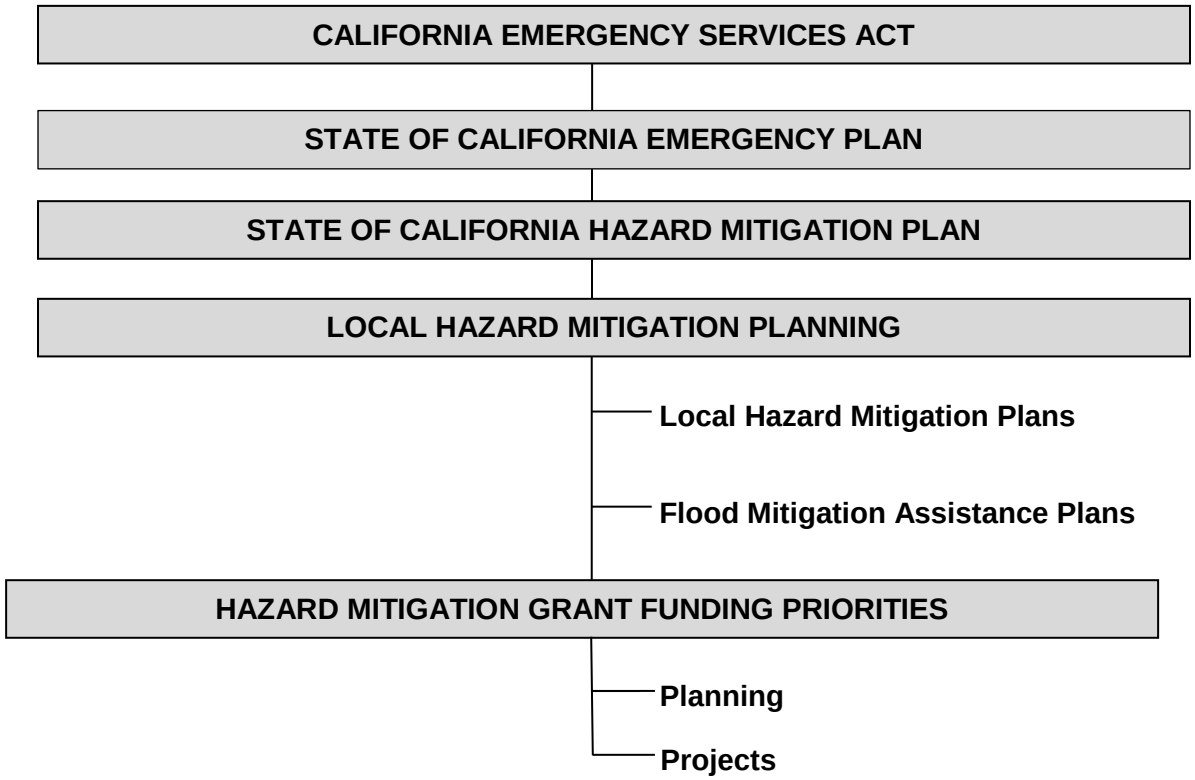
As pointed out in other chapters, the SHMP plays a fundamental role in comprehensive, integrated emergency management in California. Among other things, it identifies and analyzes the consequences of the risks associated with human-caused and natural hazards, together with vulnerabilities of people and 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

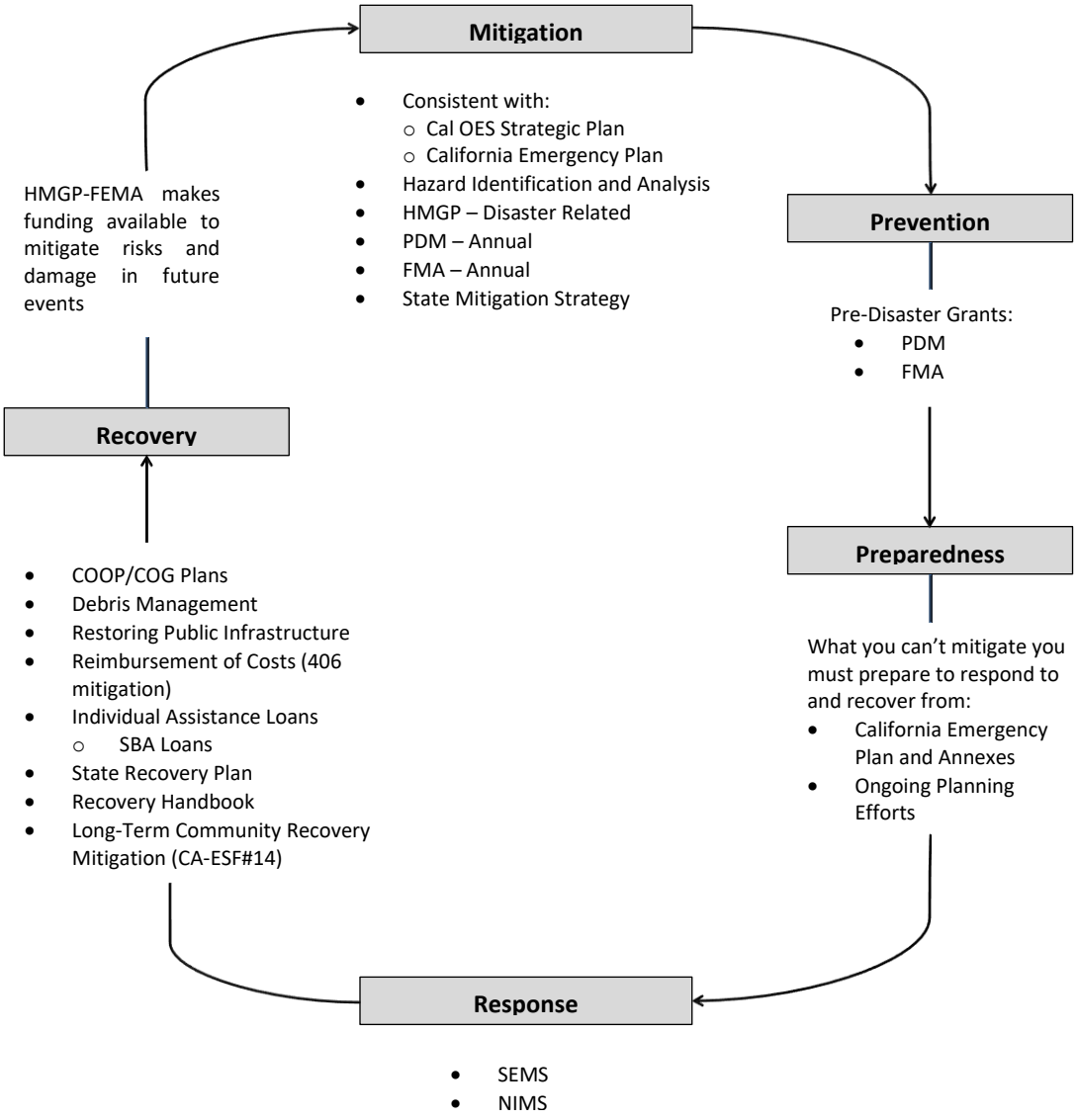
and other hazards and their mitigation in *Chapters 6 through 9*, and the description of the California's comprehensive mitigation program management in *Chapter 10*.

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 2 – PUBLIC SECTOR FUNDING SOURCES

ANNEX CONTENT

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.
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.

Agency/Program	Details	Eligible Applicants/Notes	Funding Availability
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). https://www.hudexchange.info/programs/cdbg-dr/ http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/drsi	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
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.	Funding to states, local governments, and non-profits	$1.93 billion in funds available, as of July 2017

Program	Details	Eligible Applicants/Notes	Funding Availability
	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.	For more information on eligibility, see: https://www.hudexchange.info/grantees	
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
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

Program	Details	Eligible Applicants/Notes	Funding Availability
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.

ANNEX 3 – LIFELINES INFRASTRUCTURE AND HAZARD MITIGATION PLANNING

ANNEX CONTENT

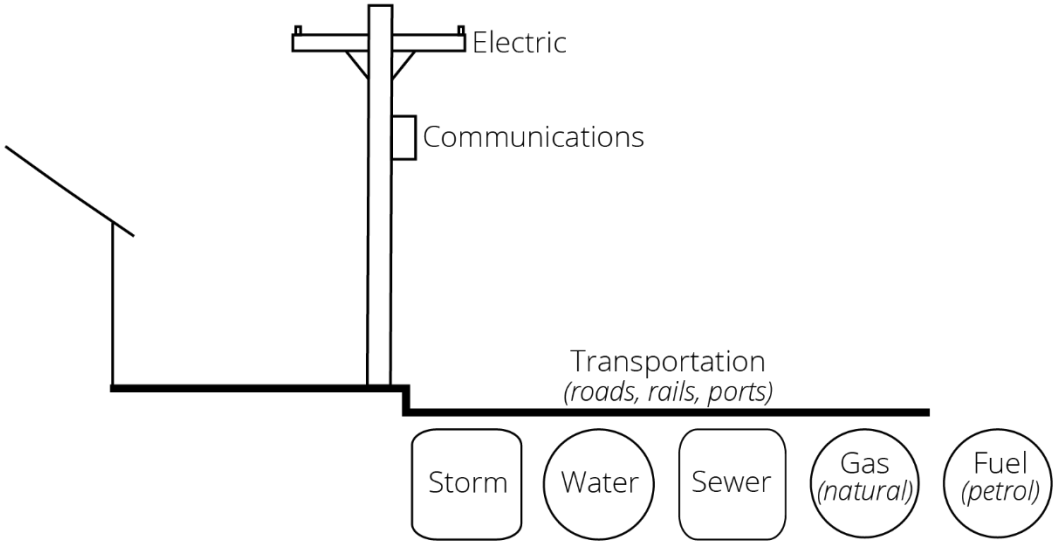
3.1. INTRODUCTION

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

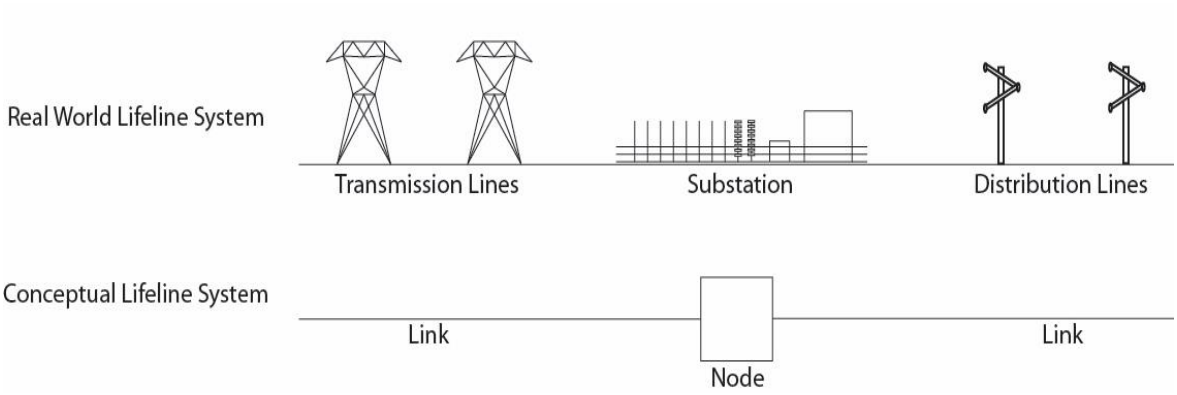


Source: Cal Poly SHMP Support Team

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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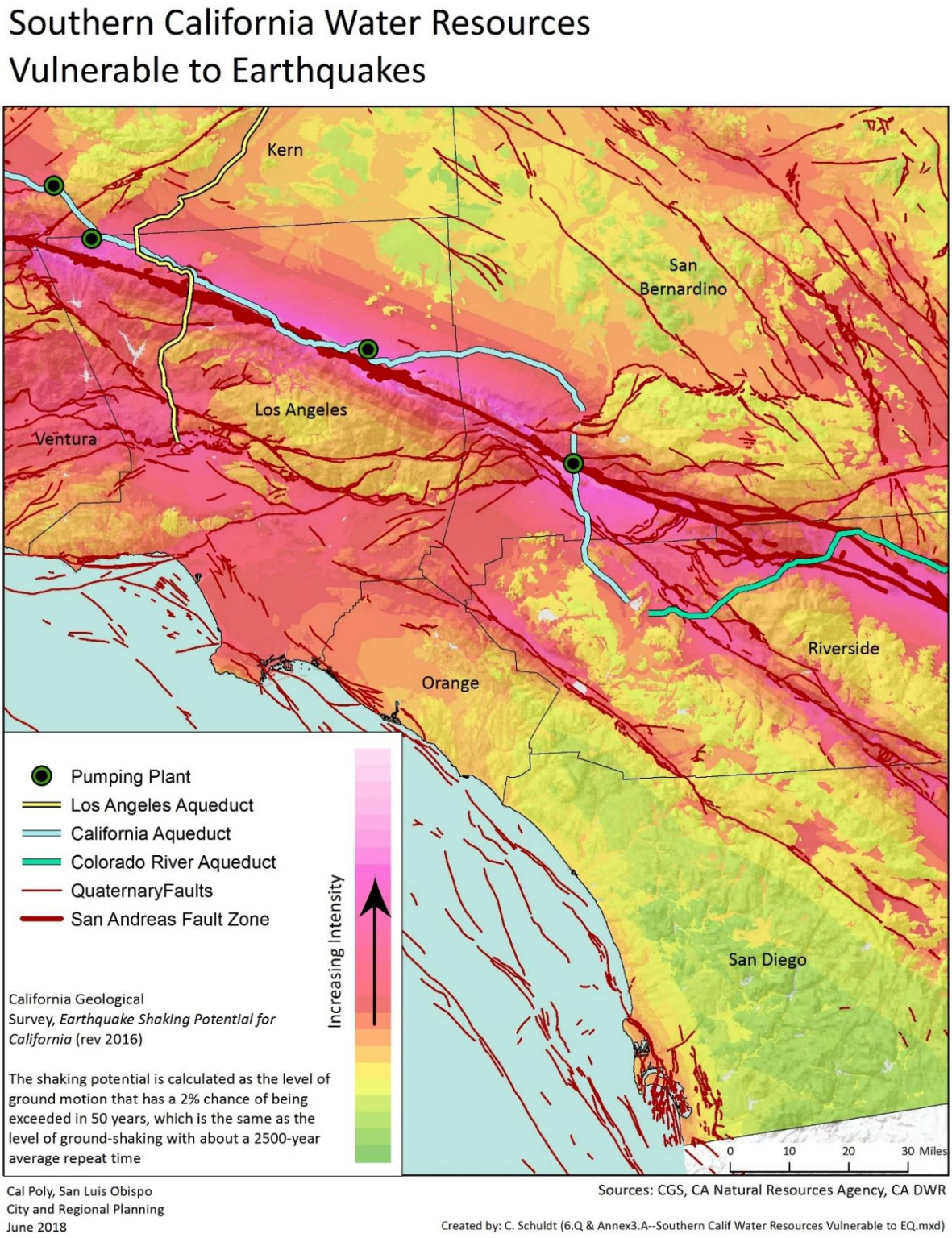
Annex Map 3.A: Southern California Water Resources Vulnerability to Earthquakes



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.

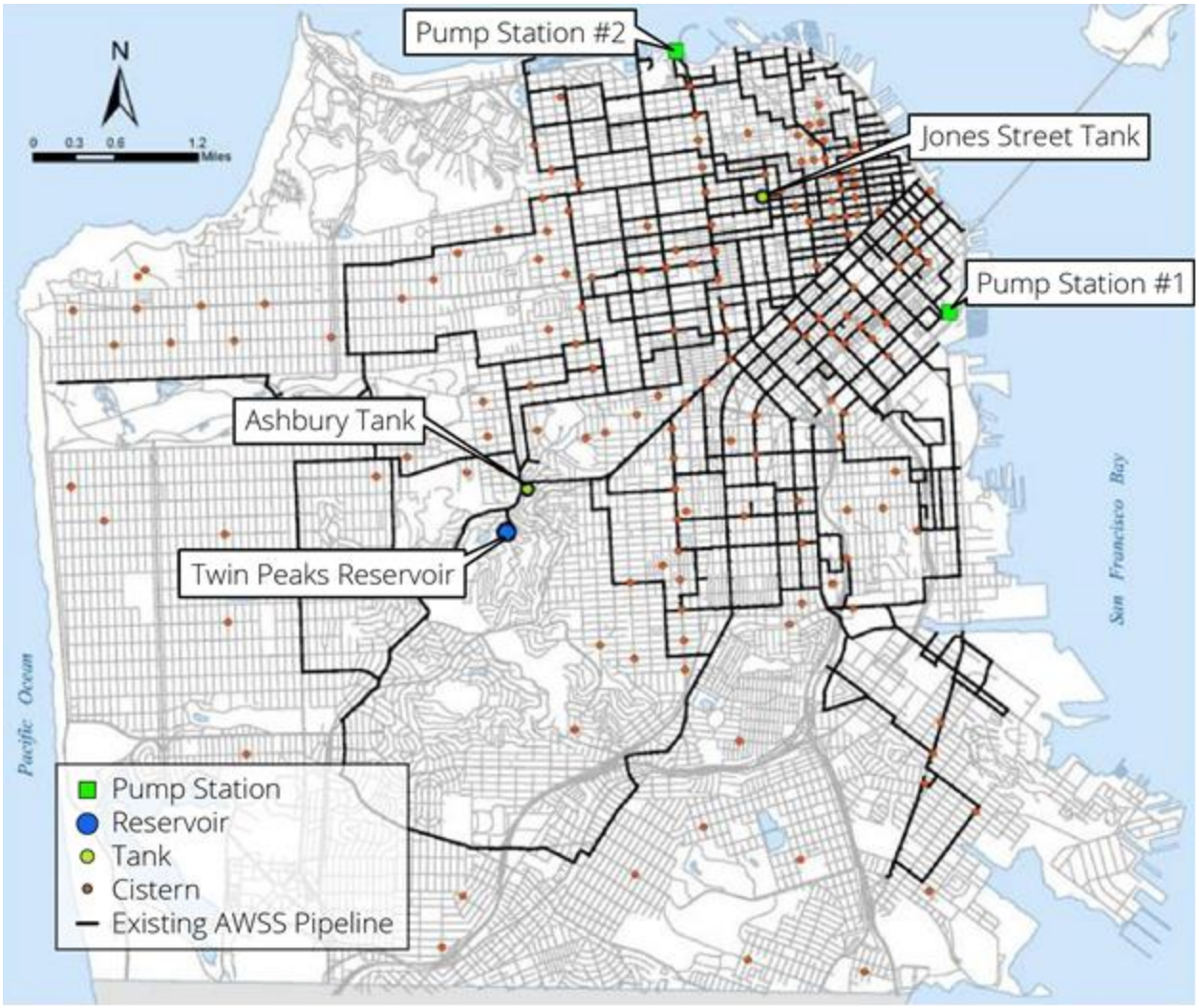
The transportation systems in the greater Bay Area sustained over $1 billion in damage due to the earthquake. The most prominent failures were the collapse of the Bay Bridge deck and the collapse of the Cypress Viaduct freeway structure in Oakland. The Bay Bridge was closed for a full month, while the 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)

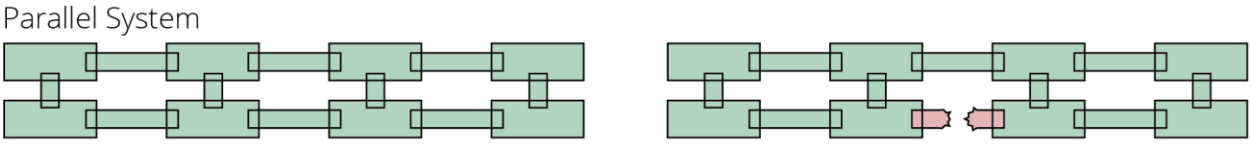
Source: Cal Poly SHMP Support Team

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)

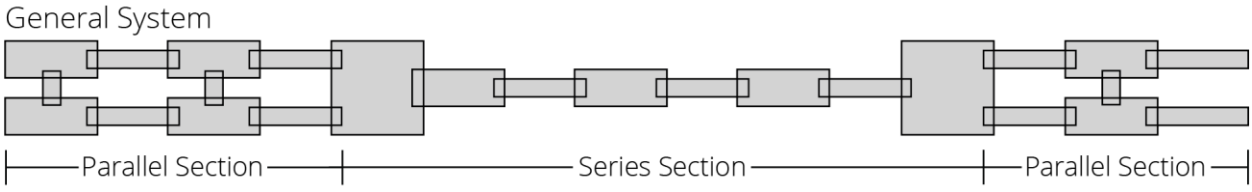


Source: Cal Poly SHMP Support Team

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.

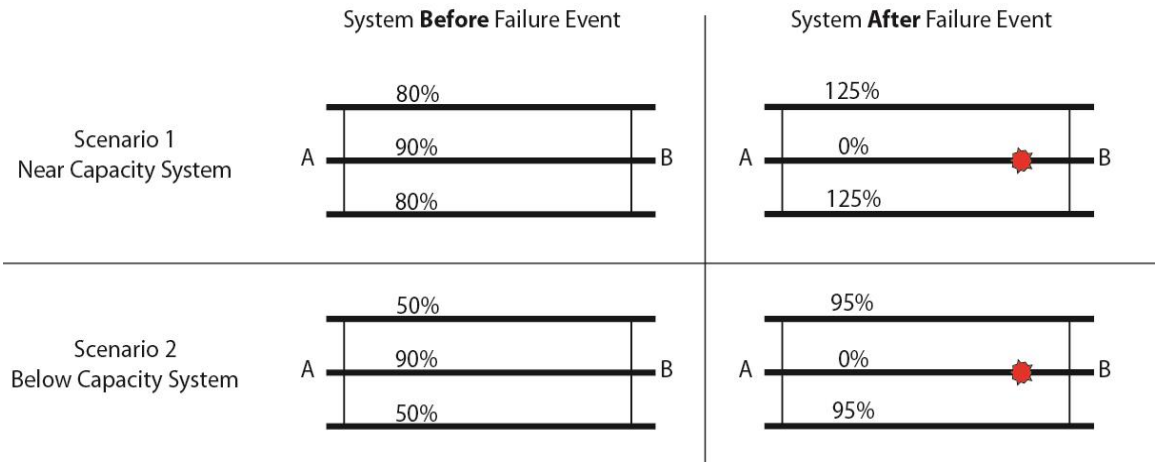
This discussion can be expanded to include interdependent/interrelated systems such as those highlighted in some of the case examples:

- 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

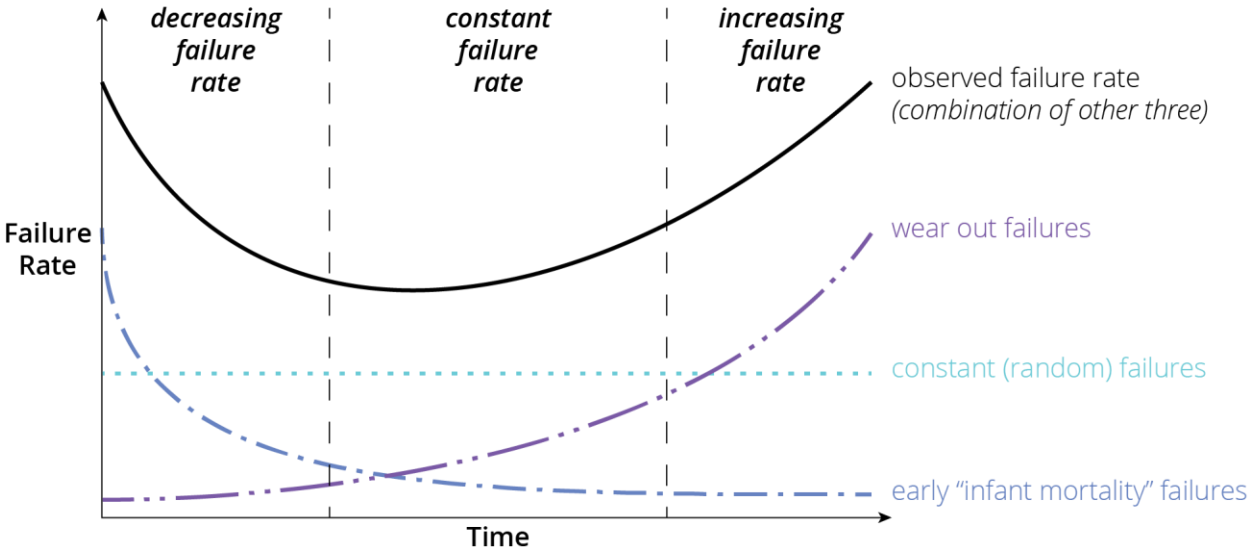


Source: Cal Poly SHMP Support Team

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

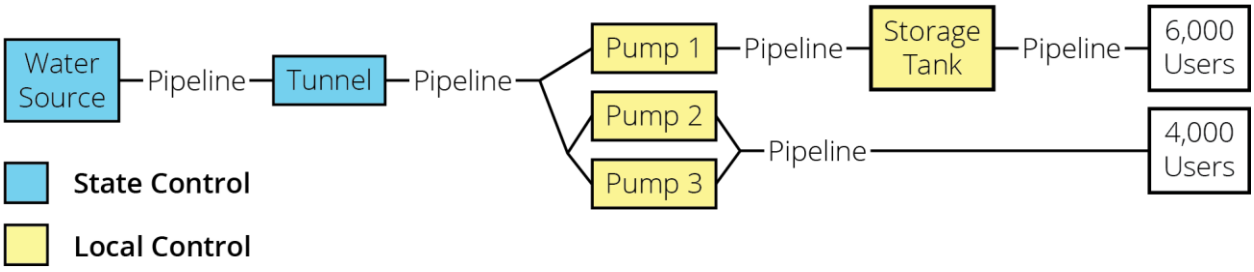
3.3.3. USING "DECISION TREES": A FICTIONAL EXAMPLE

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.

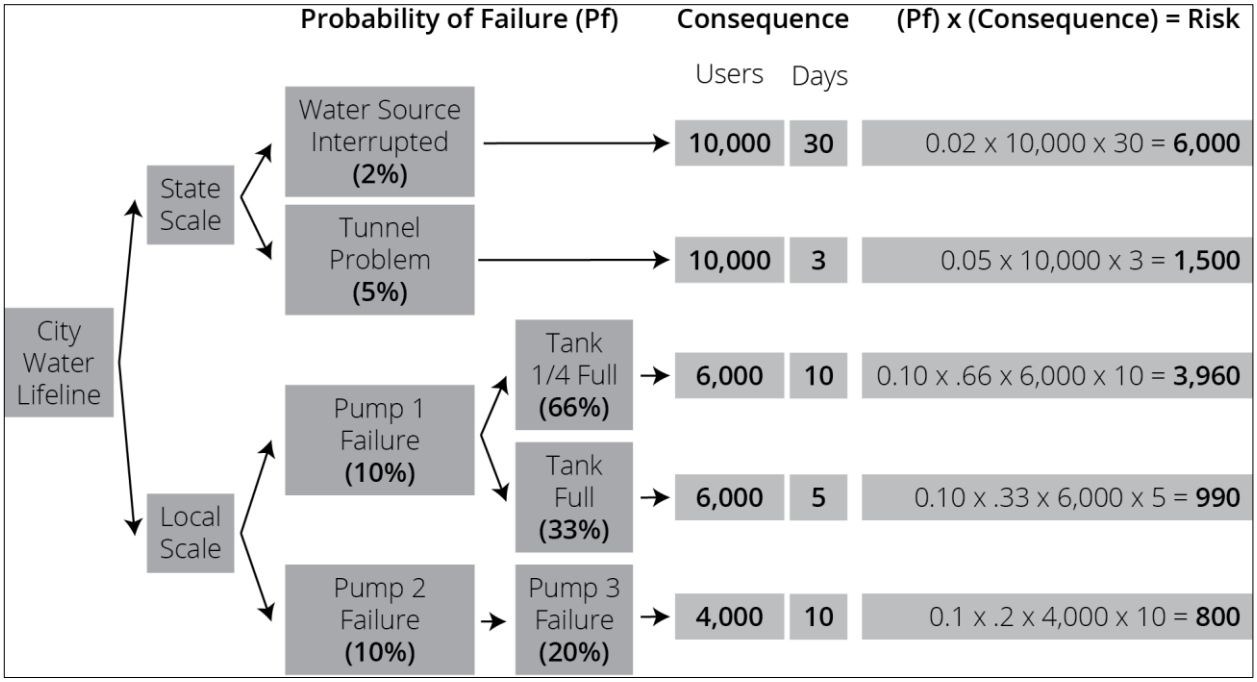
Annex Diagram 3.H: Conceptual Diagram of Fictional Water System



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

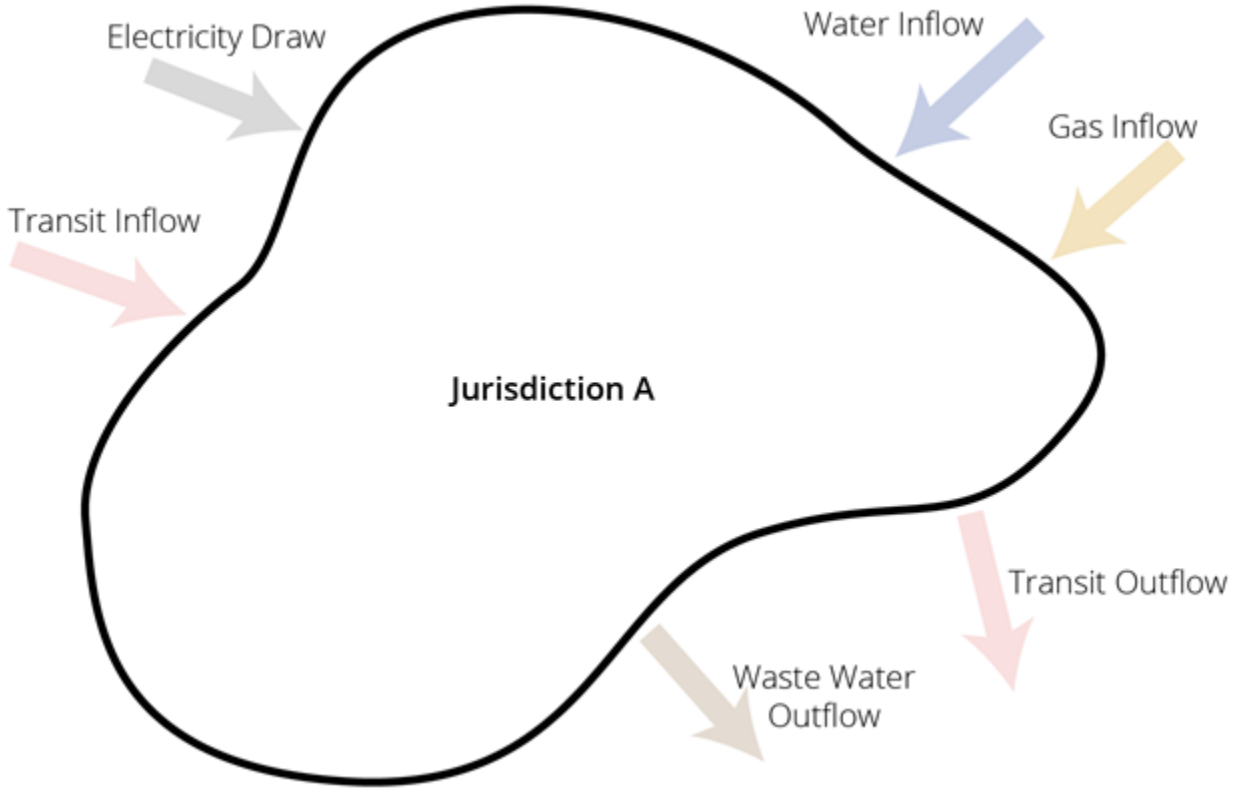


Source: Cal Poly SHMP Support Team

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

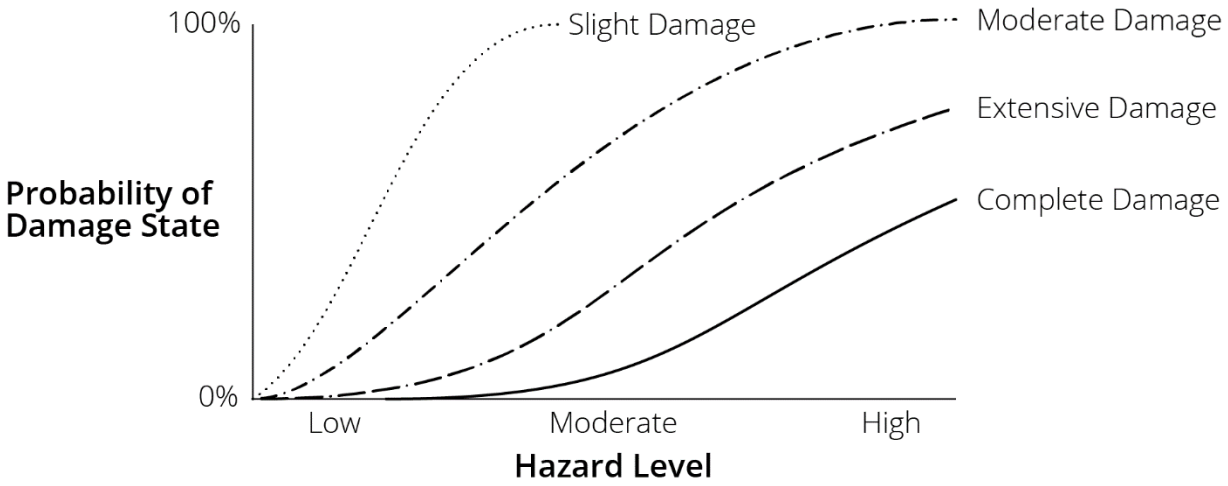
Lifeline assessments rely on quality data on the system, quality data on the hazards, and knowledge about the fragility of system components to different hazard conditions. After collecting these elements, a variety of tools, models, and analytical methods can be applied to characterize and assess the 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



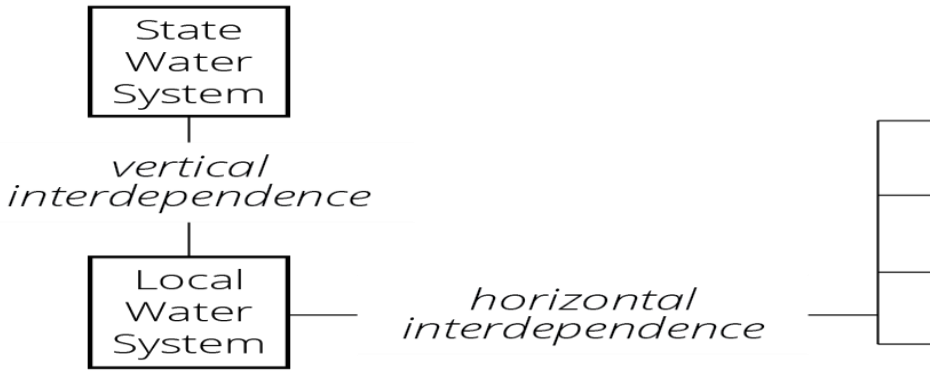
Source: Cal Poly SHMP Support Team

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.

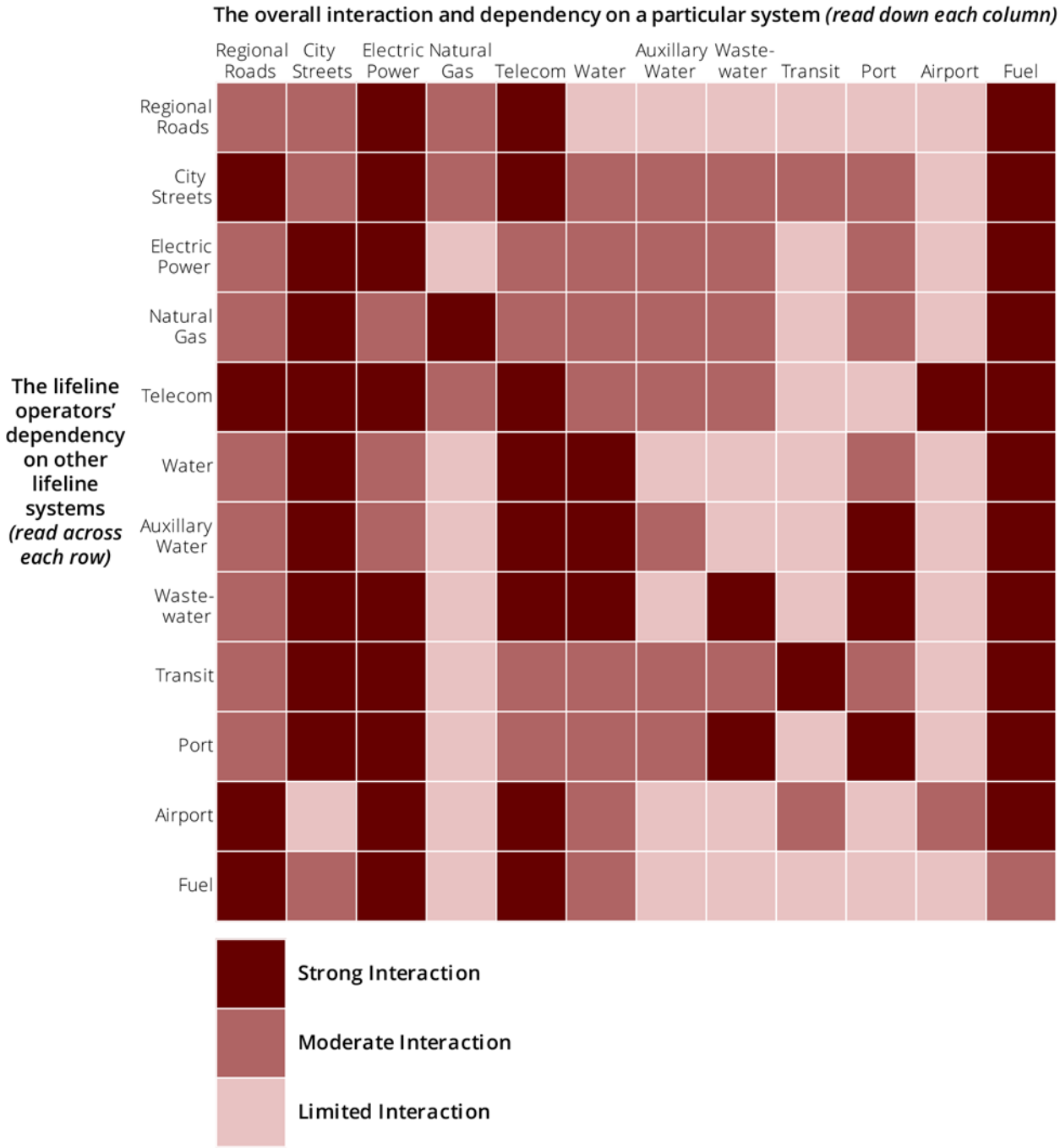
To develop a complete risk profile, it is important to understand the vertical interaction. As shown *in Annex Section 3.3.2*, an upstream system failure often has direct and sometimes immediate downstream impacts. Vertical dependencies are not unique to water. Electrical systems can have different entities 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)

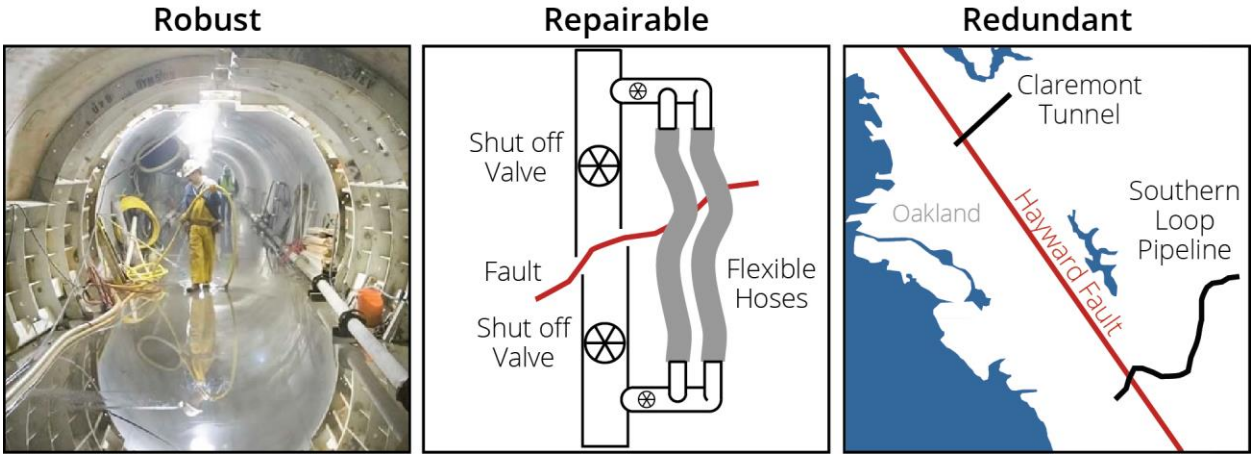
2. Improving the user's ability to function without lifeline services, by offering interim services:
- Of a sufficient quantity
- Of a sufficient quality
- Within a sufficient distance

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/)

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