# California's Flood Future

## Recommendations for Managing the State's Flood Risk

## Attachment G:
## Risk Information Inventory

**FINAL November 2013**

***California's Flood Future*** is provided to help inform local, State, and Federal decisions about policies and financial investments to improve public safety, foster environmental stewardship, and support economic stability

FloodSAFE CALIFORNIA

PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY

US Army Corps of Engineers ®

STATEWIDE FLOOD MANAGEMENT PLANNING PROGRAM

FloodSAFE CALIFORNIA

FINAL

# Attachment G: Risk Information Inventory

## November 2013

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

UNITED STATES ARMY CORPS OF ENGINEERS
FLOOD PLAIN MANAGEMENT SERVICES PROGRAM

*Photographs in this text are courtesy of the following agencies:*

*California Department of Conservation, David Ford Consulting Engineers, Inc., Los Angeles County Department of Public Works, Orange County Public Works, San Francisquito Joint Power Authority, Santa Clara Valley Water District, and Ventura County Watershed Protection District*

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# Acronyms and Abbreviations

| | |
|---|---|
| ACE | Annual Chance Exceedance |
| B/C | benefit-to-cost |
| CalEMA | California Emergency Management Agency |
| CDFW | California Department of Fish and Wildlife (formerly California Department of Fish and Game) |
| CEAC | County Engineers Association of California |
| CIP | Capital Improvement Plan |
| CVFPP | Central Valley Flood Protection Plan |
| DWR | California Department of Water Resources |
| EAD | Expected Annual Damage |
| EM | Engineer Manual |
| ER | Engineer Regulation |
| ETL | Engineer Technical Letter |
| FCWCD | Flood Control and Water Conservation District |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| FIS | Flood Insurance Study |
| Flood Future Report | *California's Flood Future: Recommendations for Managing the State's Flood Risk Report* |
| FPMS | Flood Plain Management Services |
| GIS | Geographic Information System |
| HAZUS | Hazards United States |
| HEC-2 | Hydrologic Engineering Center River Hydraulics |
| HEC-FDA | Hydrologic Engineering Center-Flood Damage Analysis |
| HEC-RAS | Hydrologic Engineering Center-River Analysis System |
| HMP | Hazard Mitigation Plan |
| IFM | Integrated Flood Management |
| IRWM | Integrated Regional Water Management |
| IWM | Integrated Water Management |
| LACDPW | Los Angeles County Department of Public Works |
| LAR | Lower American River |
| MCWRA | Monterey County Water Resource Agency |
| NFIP | National Flood Insurance Program |
| O&M | operation and maintenance |
| OCFCD | Orange County Flood Control District |
| OMRR&R | operation, maintenance, repair, rehabilitation, and replacement |

# Acronyms and Abbreviations

| | |
|---|---|
| SAFCA | Sacramento Area Flood Control Agency |
| SAWPA | Santa Ana Watershed Project Authority |
| SCVWD | Santa Clara Valley Water District |
| SFCJPA | San Francisquito Creek Joint Powers Authority |
| SFHA | Special Flood Hazard Areas |
| SFMP | Statewide Flood Management Planning |
| SPFC | State Plan of Flood Control |
| SRL | Severe Repetitive Loss |
| SRS/CRS | Strong Ranch Slough and Chicken Ranch Slough |
| TM | technical memorandum |
| USACE | United States Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | United States Geological Survey |
| VCWPD | Ventura County Watershed Protection District |
| WMP | Watershed Management Plan |

# 1.0 Introduction

## 1.1 Background

California is at risk for catastrophic flooding. All 58 California counties have experienced at least one flood event with significant consequences in the last 20 years, resulting in loss of life, and billions of dollars in damages. This report, *California's Flood Future: Recommendations for Managing the State's Flood Risk* (Flood Future Report), is the first product of the Statewide Flood Management Planning (SFMP) Program. The Program was developed under the FloodSAFE Initiative to expand California's flood management planning statewide. Specifically, the purpose of the SFMP Program is to make recommendations to inform flood management policies and investments in the coming decades by:

- Promoting a clear understanding of flood risks in California
- Garnering active support for partnerships at the local, tribal, State, and Federal levels[1]
- Coordinating with other California Department of Water Resources (DWR) planning efforts
- Identifying strategies and feasible next steps to better incorporate flood management into Integrated Water Management (IWM)
- Promoting an IWM approach for flood management solutions

The initial work of the SFMP Program was to collect information in support of Flood Future Report, as well as to build unique partnerships with local flood management agencies, the County Engineers Association of California (CEAC), Federal Emergency Management Agency (FEMA), and the United States Army Corps of Engineers (USACE). Throughout the Flood Future Report, determinations about specific flood terms were made that may not represent the specific terms used by partner agencies. These are described in Textbox 1-1. A description of the Flood Future Report components, organization, and layout is provided in Appendix A.

## 1.2 Purpose

The purpose of the risk information inventory effort discussed in this technical memorandum (TM), presented as Attachment G, is to develop a better understanding of flood risk statewide, based on the best available information.

Initially, the effort focused on defining flood risk and cataloging risk assessments completed in California. However, the information gathering effort identified that few full risk assessments had been completed in the state, as summarized in *Attachment E: Existing Conditions of Flood Management in California (Information Gathering Findings)*. FEMA, the California Emergency Management Agency (CalEMA), and many local agencies characterize hazards resulting from a flood with a 100-year (annual chance of exceedance) flood event and, in some cases, the flood

[1] Hereafter in this document, the mention of governmental agencies is implicit to include tribal entities.

with a 500-year (annual chance of exceedance) event. Inundated areas or impact areas are published in Flood Insurance Rate Maps (FIRMs). Counties that had partnered with the USACE to build projects in their respective jurisdictions tended to have the most information regarding flood risk. In other areas of the state, local agencies developed hydrologic and hydraulic studies for site-specific projects. In a few instances, agencies had gone a step further and developed a method for identifying the deficiencies in their entire flood management system. To characterize flood risk in California, the SFMP developed a risk exposure analysis using FEMA's Hazards United States (HAZUS) approach in conjunction with an inventory of risk-relevant information gathered from agency meetings. *Attachment F: Flood Hazard Exposure Analysis* provides additional information about the analytical procedures used to quantify flood exposure.

This TM provides a description of the risk-related documents identified in each county, as well as insights into how local agencies define and understand risk. It describes how local agencies view and approach the responsibility of reducing flood hazard in their jurisdictions. Four case studies are included that demonstrate how local agencies have approached performing risk assessments. These case studies cover different agency sizes and project locations, as well as a variety of purposes and types of flooding. The findings from this TM support information presented in the Flood Future Report.

## 1.3 Overview of TM Organization

The following sections define and characterize risk (including the four case studies), summarize statewide flood risk information (including data gaps; that is, the lack of raw information for a specific area, type of data, or use), and describe ways to improve understanding of flood risk management statewide. Attachment G includes the following sections:

- Section 1: Introduction
- Section 2: What is Flood Risk?
- Section 3: Flood Risk and Hazard Assessments
- Section 4: Approach for Reviewing Risk Information
- Section 5: Statewide Inventory of Risk Information
- Section 6: Findings
- Section 7: References
- Appendix A: Flood Future Report Components
- Appendix B: Risk-Relevant Documents from DWR Database
- Appendix C: FEMA NFIP Insurance Claims Cost by County
- Appendix D: Risk Assessment Case Studies
- Appendix E: Glossary

**Textbox 1-1: Agencies Differ in Flood Terminology**

One of the challenges in a multi-agency effort is resolving language and culture differences between agencies. Staff from both USACE and DWR who are responsible for developing this report have made a conscious choice to adopt certain terminology throughout the documents.

As an example, USACE has adopted ***flood risk management*** as the term to describe a broad flood program that encompasses planning, construction, and operation, maintenance, repair, rehabilitation, and replacement (***OMRR&R***). DWR executes a similar broad program, largely through its Flood Management Division. As a result, DWR uses the term ***flood management*** in much the same way USACE uses *flood risk management*.

Another term used throughout this document is ***100-year flood*** (or some other *x*-year flood). Although these terms are commonly used, both USACE and DWR prefer using ***1 percent chance flood*** (or a 1-in-100 chance event) to describe a flood that has a 1 percent chance of occurring in any given year. However, legislative language from 2007 directing DWR to undertake new planning using bond proceeds uses 100-year flood.

For Federally funded projects, the definition of operation and maintenance (***O&M)*** includes the local entity's financial obligation for OMRR&R of the implemented project. OMRR&R is a non-Federal responsibility when local, regional and/or State entities partner on a Federal project. DWR typically uses O&M to refer simply to operation and maintenance, although repair and rehabilitation are sometimes included depending on project specifics. References to O&M provided in this report include OMRR&R responsibilities when the project is a Federal/non-Federal partnership.

For this report, both agencies agreed that, although language and cultural differences remain, it is more important to focus on the shared responsibility of performing our flood risk management or flood management missions rather than the use of specific phrases not in each agency's respective culture. A glossary is included to help the reader understand specific terms used by flood professionals and those terms that are used to define specific agency missions.

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# 2.0 What Is Flood Risk?

Floods can be caused by bodies of water that leave their boundaries due to heavy rainfall, tsunamis, engineered structures failing (e.g., dams or levees), or extreme wet-weather patterns. Historically, the most dangerous storms in California have been extreme events resulting from weather patterns known as Atmospheric Rivers or Pineapple Express (e.g., warm and wet storms that strike in winter, producing intense rains over large areas).

**Flood risk** is the likelihood of adverse economic and life-safety consequences from flood inundation.

Engineers, scientists, and floodplain managers define **flood risk** (or inundation risk) as the likelihood of consequences (damages) from flood inundation (resulting from an entire range of hydrologic events), including both economic and life-safety consequences. Flood risk is not simply the loss of life or damage incurred due to a single catastrophic event. Rather, flood risk characterizes the likelihood of adverse consequences for the entire range of flood events for a given impact area. *Impact area* is a term used to describe a geographic area for which risk is assessed.

Flood risk can be thought of as a function of five components, as shown in Figure G-1 and described below:

- Hazard: The cause of the harm, including its probability, extent, depth, and other characteristics (i.e., flooding and how often)
- Performance: How well the flood management system responds to the hazard (i.e., flood management system inadequacy or failure)
- Exposure: Who and what might be harmed by the hazard (i.e., who and what are flooded)

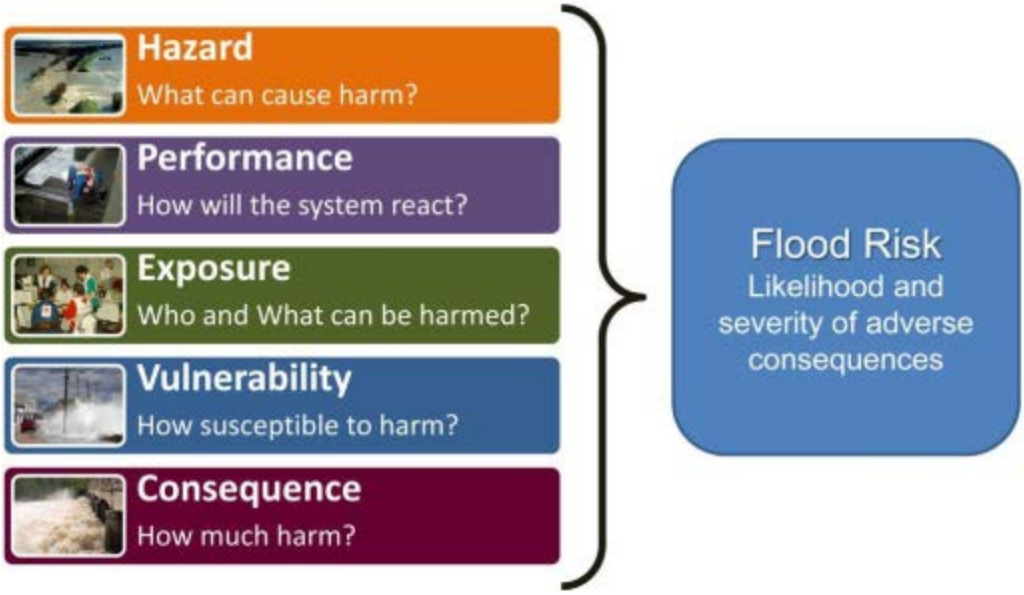


**Figure G-1. Flood (Inundation) Risk Defined**

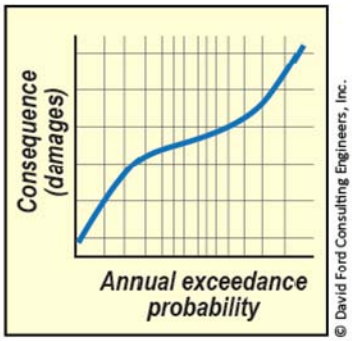


**Figure G-2. Flood Risk Shown as a Graph of Consequence-Exceedance Probability**

- Vulnerability: The susceptibility of people and property to be harmed from the hazard (i.e., how flooding adversely affects people and property)
- Consequence: The loss or damage incurred as a result of the hazard (i.e., what is the cost of the flooding in terms of lives and dollars)

A detailed flood risk analysis, which would be necessary for a major flood planning study for DWR or USACE, is intended to identify and evaluate specific flood management measures, which could include both structural and non-structural elements. Such an analysis would assess flood management, economic impacts, life-safety risks, environmental impacts, and social impacts of the proposed measures. In addition, a detailed flood risk analysis would evaluate the consequences of a full range of possible flood hazards. Such a risk analysis would consider the likelihood of the flooding, the performance of existing or proposed actions and measures, current and future exposure of people and property to flooding, and the vulnerability of both.

For convenience, flood risk can be displayed graphically as a consequence-exceedance probability function, as shown in Figure G-2. Commonly, the consequence is expressed as flood inundation damage, so risk—or at least economic risk—is the likelihood of flood damage of various magnitudes. Annual exceedance probability is the likelihood that a specified magnitude will be exceeded once in any year. Probability is ordinarily used to describe the variability of the occurrence of an event. The random variability can be described in terms of a numerical measure between 0 and 1. The higher the probability of an event, the more likely it is that a specified magnitude will be exceeded. Thus, probability in an applied sense is a measure of the likelihood that a random event or combination of events will occur (or be exceeded).

**An annual maximum flood event** has a return period of X years if its magnitude is equaled or exceeded once, on the average, every X years:

- ✓ **25-year event –** 4 percent chance of exceedance in a given year
- ✓ **50-year event –** 2 percent chance of exceedance in a given year
- ✓ **100-year event -** (also known as a base flood) 1 percent chance of exceedance in a given year
- ✓ **200-year event -** 0.5 percent chance of exceedance in a given year
- ✓ **500-year event -** 0.2 percent chance of exceedance in a given year

## 2.1 Computation of Flood Risk

Assessing flood risk requires gathering or developing data for the five building blocks described above. The computation of risk takes into account the probability of floods of various magnitudes occurring, the performance of levees and other flood management facilities, the exposure of property and people to the hazard, the vulnerability of property and people to the hazard, and the consequences of exposure. The computations explicitly consider the uncertainty associated with these variables. The components of flood risk are defined in more detail below.

### 2.1.1 Hazard

The hazard is the frequency of occurrence from excess water (large flow rates, high stages, or both) at a location. Commonly, this is represented with flow- or stage-frequency relationships (how severe and how often floods occur) at specific locations. Figure G-3 is an example of a flow-frequency function (also referred to as a discharge-probability function or a channel unregulated flow-probability function) that describes flood hazard.

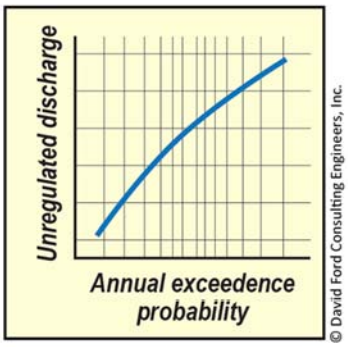


**Figure G-3. Channel Unregulated Flow-Probability Function**

Further analytical steps are often needed to describe characteristics of the hazard (sometimes called the loading) on the impact area, such as:

- Transforming the unregulated discharge value to a regulated value. Detention basins, for example, are often used to attenuate (or control and release) flow in a stream as a flood reduction management measure.
- Transforming the series of discharge for the channel at the index point to an equivalent series of water surface elevations.
- Transforming, using an interior-exterior relationship, the channel-loading function to an impact area loading function. In other terms, knowing the capacity of the channel and the understanding the level of flooding expected as a result of exceeding its capacity can be translated to the level of inundation of the floodplain.

### 2.1.2 Performance

Performance is the effectiveness of flood or floodplain management measures. This is represented by functions such as the levee fragility curve (also referred to as a stage-failure probability facility) shown in Figure G-4, which describes the likelihood of flooding due to a levee breach, given the loading on the water side of the levee. Performance could also be represented by functions that represent peak flow or volume reductions attributable to reservoirs, bypasses, diversions, or pump stations.

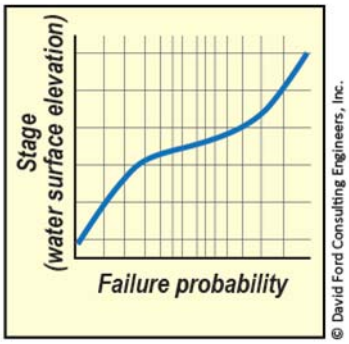


**Figure G-4. Performance Represented with Stage-Failure Probability Facility**

### 2.1.3 Exposure

Exposure is the number of people and value of property that might be harmed by inundation. Economic values can be determined from inspection, appraisal, or other methods. Population estimates are obtained from U.S. Census data and other sources (Census, 2010).

### 2.1.4 Vulnerability

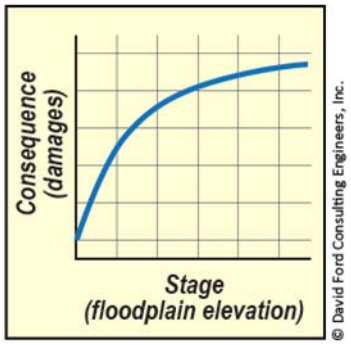


**Figure G-5. Graph of Floodplain Elevation-Consequence Relationship**

Vulnerability is the susceptibility to loss or damage of people and property exposed to the flood hazard. It is characterized by the relationship between stage (water surface elevation) in the floodplain and consequence (damage). Thus, vulnerability is represented with stage-damage functions (also referred to as a floodplain elevation-consequence relationship) that estimate damage to inundated property (e.g., structures, houses) as a function of flooding depth, and by functions that estimate loss of life as a function of type of inundation (e.g., depth, length of time) based on past events. Such a function is illustrated in Figure G-5. Vulnerability of property to flooding can be determined from review of the history of damage to similar properties when inundated, combined with estimates of actions that might be taken to protect the property (e.g., sandbagging). Estimates of the vulnerability of people in harm's way take into account human characteristics, such as age and mobility, access to safe havens, and protective actions that might be taken.

For convenience, damage functions can be aggregated, yielding a flood elevation-damage function for a portion (or all) of the impact area.

### 2.1.5 Consequence

Consequence is the quantitative measure of loss, such as direct tangible monetary loss or number of lives lost, when the capacity of a flood management facility is exceeded or fails, and water inundates the people and property exposed. Inundation depths for various probabilities at property locations within the impact area are transformed to estimates of damage (consequence) at those locations using a flood elevation-damage function.

The flood probability-consequence function is developed from loading, exposure, and vulnerability information. The function might represent physical damage to a single item, such as a residential structure, a vehicle, or a section of roadway. It might also represent the economic cost due to loss of function; thus, if a business is unable to operate following a flood, the lost revenue could be included as damage. Similarly, if economic costs associated with displacement of floodplain occupants can be related to the depth of flooding of structures, that damage can also be included. Costs included or not included vary with the economic analysis procedures used by various agencies.

## 2.2 Expected Risk

The consequence-exceedance probability function can be integrated to compute an expected or most likely value of the consequence. If the probabilities are annual values, this most likely value is called the expected annual value. If the consequence considered is economic loss, the most likely value is called the expected annual damage (EAD). EAD reduction is often used to measure the effectiveness of proposed flood management actions.

## 2.3 Residual Risk

Residual risk is the likelihood of damage or other adverse consequence remaining after flood management actions are taken.

**Figure G-6. Residual Risk – Example of Dam Overtopping**

For example, if a new dam were constructed, that reservoir would reduce the risk to people and property in the floodplain because it limits the flow of water in the channel by storing some of the water upstream, thereby limiting overflow from the channel into the floodplain. The dam limits the loading or hazard. The dam and reservoir would be designed and built with a certain storage capacity—a capacity that would be exceeded, albeit rarely. As shown in Figure G-6, once that capacity is exceeded by a flood that yields inflow volume greater than the storage capacity of the reservoir, the dam will no longer eliminate damage within the floodplain because releases will exceed downstream channel capacity. Water will overflow the channel, inundating property and causing damage in the floodplain. The dam did not fail—the reservoir storage capacity was exceeded. The remaining potential for damage from the dam is referred to as the residual damage, and the likelihood of various magnitudes of residual damage is the residual economic risk. Similarly, exceedance of reservoir capacity in this example may cause loss of life, and the likelihood of loss of life (based on past events) is the residual life-safety risk.

In addition to capacity exceedance as described above, residual risk is a consequence of imperfect performance or failure of flood management measures.

**Figure G-7. Residual Risk – Example of Levee System Failure**

For example, a number of levees were built prior to modern standards being in place and might have been constructed using what is now considered substandard building materials. Another example is the effect of rodents burrowing through the levee, which compromises the efficacy of the levee and leads to seepage through the levee core. This seepage can result in levee breaching and/or failure, as shown in Figure G-7. For reasons such as these, areas protected by levees have a certain residual risk. A floodplain is never fully protected with 100 percent certainty.

## 2.4 Flood Risk Management

Managing flood risk includes managing floodwater (keeping floodwater away from people), managing floodplain resources (keeping people and assets out of the path of floodwater), and protecting and restoring natural floodplain processes. The goal of flood management is to reduce the risk in a cost-effective, environmentally sensitive, and sustainable manner, recognizing that completely eliminating risk is virtually impossible; the possibility remains that some floods will exceed the expected performance of any flood management measure designed for a certain capacity, and it is impossible to design and build a "perfect" risk management measure. Knowing these facts and acknowledging the need to plan and prepare for the impacts of exceedance or failure to perform are critical to successful statewide flood management. Flood awareness and risk notification programs will alert floodplain occupants to the likelihood of damage, even as the occupants may falsely believe that they are protected with 100 percent certainty by levees, bypasses, or reservoirs. Flood forecasting and flood emergency response activities enable occupants and property owners to further protect themselves from damage or loss of life that is impossible to eliminate with structural measures alone.

## 2.5 Summary

Floods can be caused by bodies of water that leave their boundaries due to heavy rainfall, tsunamis, failure of dams and levees (or other engineered structures), or extreme wet-weather patterns. Flood risk is not simply the loss of life or damage incurred due to a single catastrophic event. Rather, flood risk characterizes the likelihood of adverse consequences for the entire range of flood events for a given impact area. Flood risk is assessed as a function of five components—hazard (what causes the harm), performance (how the flood management system reacts to the harm), exposure (who and what can be harmed), vulnerability (how susceptible are people and property to the harm), and consequence (what are the costs in lives lost and dollars). EAD is a commonly used measuring unit for characterizing and comparing flood risk. Using the factors described is important because they help calculate the impact and cost of potential floods. Once computed, "flood risk" can be used to plan budgets for operation and maintenance (O&M), to ensure the sustainability of infrastructure investments, and to set project priorities. Flood risk can never be 100 percent eliminated. However, with effective flood risk management it can be mitigated.

# 3.0 Flood Risk and Hazard Assessments

Flood risk assessments are a systematic process for quantifying and describing the nature, likelihood, and magnitude of risk associated with a flood event. Below is a description and comparison of the most widely used agency standards for defining flood risk.

## 3.1 FEMA Flood Hazard Approach

FEMA describes flood hazard with a Flood Insurance Study (FIS). The FIS uses statistical data for river flow, storm tides, hydrologic/hydraulic analyses, and surveys of rainfall and topography to create flood hazard maps that outline a community's different areas of flood exposure. These areas are identified on FIRMs. FIRMs do not describe actual consequences; FIRMs focus on hazard and performance (to a limited degree).

FIRMs show Special Flood Hazard Areas (SFHAs), which are areas subject to inundation from a flood that has a 1 percent chance of being equaled or exceeded in a given year. This is known as the 1 percent annual chance flood event, the 100-year flood event, or base flood, and is used as the basis of the National Flood Insurance Program (NFIP). The NFIP is a Federal program created by the U.S. Congress to mitigate future flood losses nationwide. The NFIP requires local communities to enforce building and zoning ordinances in exchange for access to affordable, Federally funded, flood insurance protection for property owners.

The NFIP is a Federal program created by the U.S. Congress to mitigate future flood losses nationwide.

The flood hazard information presented on the FIRMs results from engineering studies performed by engineering companies, other Federal agencies, or communities. These studies are reviewed for compliance with FEMA guidelines and approved by FEMA.

## 3.2 DWR and USACE Approaches

A major flood planning study for DWR or USACE that is intended to identify and evaluate specific flood management measures (including type, location, and dimensions) requires a detailed risk analysis. Such an analysis would assess flood management, economic impacts, life-safety risks, environmental impacts, and social impacts of proposed measures. In addition, a detailed flood risk analysis would evaluate the consequences of a full range of possible flood hazards, considering the likelihood of the flooding, the performance of existing or proposed actions and measures, current and future exposure of people and property to flooding, and the vulnerability of both.

The DWR method for developing risk assessments is described in two documents:

- DWR, *Economic Analysis Guidebook*, January 2008
- DWR, *Draft Economic Analysis Guidelines Flood Risk Management*, May 2010

These DWR documents are available for downloading from the Internet at http://www.water.ca.gov/economics/guidance.cfm.

These methods are primarily used for Early Implementation Projects funded under Propositions 1E and 84 of 2006. The DWR approach is based upon the USACE method for risk assessments.

The USACE method for developing risk assessments is described in the following reference documents:

- Engineer Regulation (ER) 1105-2-100, *Planning Guidance Notebook*, April 22, 2000
- Engineer Manual (EM) 1110-2-1619, *Risk-Based Analysis for Flood Damage Reduction Studies*, August 1, 1996
- ER 1105-2-101, *Risk Analysis for Flood Damage Reduction Studies*, January 3, 2006

These USACE documents are available on the Internet at http://usace.army.mil/publications/.

The analysis for risk, as described in Section 2.1 and used in the DWR and USACE methods, has potential uncertainties built into the calculation, including the following:

- **Uncertainties about hazard** are a result of errors in estimating discharge from measurements of stage, lack of perfect knowledge about the mathematical form of the probability model, limitations in fitting a probability model of rare events with few observations, and limitations in the knowledge of and ability to build and calibrate models of flow in channels and over floodplains.
- **Uncertainties about performance** are a result of how features or infrastructure constructed to limit exposure in an impact area will perform when loaded (e.g., levee failure).
- **Uncertainties about consequences** are a result of errors in estimating damage at each impact area elevation.

Risk can be computed, and these uncertainties can be addressed using the Hydrologic Engineering Center-Flood Damage Analysis (HEC-FDA) software application. HEC-FDA combines information about hazard, performance, exposure, vulnerability, and consequence to develop a damage-probability function. It also computes and reports various statistics of this function, including EAD. HEC-FDA explicitly evaluates the impact of errors in describing hazard, performance, exposure, and vulnerability with a set of probability distributions that describe the potential errors in each of the inputs. This error distribution is sampled during the computation of risk.

Other software applications are available for all or portions of the risk computations. For example, FEMA's HAZUS Multi-Hazard version 2.0 (HAZUS-MH 2.0) software analyzes potential losses from floods, hurricanes, and earthquakes. HAZUS software is a risk assessment methodology for analyzing potential losses due to damages. Information about FEMA's HAZUS-MH can be found on the Internet at

http://www.fema.gov/hazus. For risks related to floods, HAZUS-MH 2.0 computes the consequence of single floods, given hazard, performance, exposure, and vulnerability information.

## 3.3 Comparison of FEMA and USACE Approaches to Assessing Risk

FEMA and the USACE have established methodologies for assessing risk. FEMA uses an approach that has traditionally focused only on the hazards associated with the 100-year (1 percent) and 500-year (0.2 percent) flood events. In contrast, the USACE approach to assessing risk uses the parameters as described in Section 2.1. Table G-1 provides a comparison of the FEMA and USACE approaches to assessing risk.

**Table G-1. Comparison of FEMA and USACE Risk Assessment Approaches**

| Component | FEMA Approach | USACE Approach |
|---|---|---|
| Purpose of Analysis | To develop a Flood Insurance Study that creates flood hazard maps to outline a community's different flood hazard areas. | The USACE and other water resources agencies utilize the system of accounts to do a comprehensive evaluation of flood risk management plans. The system of accounts includes National Economic Development; Regional Economic Development; Environmental Quality; and Other Social Effects to better evaluate plans beyond purely economic measures. The accounts are part of Principles and Guidelines. |
| Subject of Analysis | The area impacted by the 100-year (1 percent annual chance exceedance) and 500-year (0.2 percent annual chance exceedance) flood events, both of which are identified on FIRMs. | A detailed risk analysis assesses economic, life-safety, environmental, and social benefits of proposed flood risk management measures. In addition, it evaluates the consequences of a full range of possible flood hazards, considering the likelihood of the flooding, the performance of existing or proposed actions and measures, current and future exposure of people and property to flooding, and the vulnerability of both. |
| Methodology | Uses statistical analysis of river flow, storm tides, hydrologic/hydraulic analyses, and surveys of rainfall and topography to estimate likelihood of flooding. FEMA creates flood hazard maps that outline areas subject to this flooding. FIRMs do not describe consequences or consider uncertainty; FIRMs focus on hazard and performance (to a limited degree). | Computes consequence (economic and life-safety) considering the probability of floods of various magnitudes occurring, performance of levees and other flood management facilities, exposure and vulnerability of property and people to the hazard. The computations consider explicitly the uncertainty about information on frequency, exposure, performance, vulnerability, and consequences. |
| References | FEMA, *Guidelines and Specifications for Flood Hazard Mapping Partners*, April 2003<br>FEMA, *Document Controls Manual*, September 2006<br>*Floodplain Modeling Manual: HEC-RAS Procedures for HEC-2 Modelers*, April 2002<br>FEMA, *Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States*, January 2005 | USACE, ER 1105-2-100, *Planning Guidance Notebook*, April 22, 2000<br>USACE, EM 1110-2-1619, *Risk-Based Analysis for Flood Damage Reduction Studies*, August 1, 1996<br>USACE, ER 1105-2-101, *Risk Analysis for Flood Damage Reduction Studies*, January 3, 2006 |

## 3.4 HAZUS Exposure Analysis Approach

Flood hazard exposure describes who and what may be harmed by the flood hazard. Thus, flood hazard exposure requires a description of where the flooding occurs and what exists in that area. For the purposes of the SFMP Flood Future Report, this study uses FEMA 100-year and 500-year annual maximum flood event floodplains and other flood maps. These delineations of flood areas are based on flood frequency and thus provide information about the hazard. The primary tool used for this flood hazard exposure analysis is Geographic Information System (GIS) software that includes mapping and geodatabases.

*Attachment F: Flood Hazard Exposure Analysis* documents the analytical procedures that the SFMP used to compute flood exposure.

# 4.0 Approach for Reviewing Risk Information

To understand how agencies prioritize flood management projects, assess flood risk, and monitor residual risk, agencies were asked who was susceptible to flooding (i.e., who was in harm's way of the hazard) and how it was documented. Agencies typically referred to local hydrologic and hydraulic studies prepared in support of a specific project and/or FEMA FIRM maps. Once the available information was gathered from local agencies, the SFMP developed an inventory of risk-relevant information, in conjunction with a risk exposure analysis using the HAZUS approach, to best characterize flood risk in California.

## 4.1 SFMP Flood Risk Inventory and Exposure Analysis

Early in the information gathering phase of SFMP, it became apparent that the data and information required for a detailed statewide risk analysis were not consistently available throughout the state. A detailed flood risk analysis is intended to identify and evaluate specific flood hazards and flood management impacts in universally comparable units of measure, such as economic cost and lives lost. Such a risk analysis would consider the likelihood of the flooding, the performance of existing or proposed actions and measures, current and future exposure of people and property to flooding, and the vulnerability of both. The analytical method used for the SFMP to assess flood risk is consistent with—but narrower in scope than—the method used for detailed flood risk analysis as defined by the USACE.

Because of the effort required, a detailed risk analysis has been completed for a limited number of locations in the state, specifically for projects that need to evaluate the economic efficiency of flood risk reduction plans to comply with Federal funding requirements. Because of the costs (time and resources), very few detailed flood risk analyses have been completed in California; however, some agencies perform parts of a risk assessment study as needed. Examples of partial risk assessments are highlighted in Section 5.6 of this TM.

To address this deficiency of information, the SFMP sought to provide the first steps in an efficient allocation of resources aimed at identifying and prioritizing flood management efforts. The challenge of analyzing the available flood risk information in consistent and accurate terms was addressed by splitting the SFMP flood risk efforts into two parts—a flood risk information inventory and a flood exposure analysis, presented in *Attachment F: Flood Hazard Exposure Analysis*.

The SFMP flood risk information inventory categorizes and catalogs the available risk-related information from flood agencies statewide. Each document collected was reviewed and identified to contain any of the following risk analysis components (as described earlier in this document)—hazard, performance, exposure, vulnerability, and consequence. Digesting this often complex information into the five categories also provides a consistent basis to compare risk

planning and preparedness among various areas of the state. It also provides information to identify and prioritize flood risk information needs, as well as areas of strength.

The SFMP flood exposure analysis is spatially-driven, using mapped demographic information as the basis for flood risk analysis. This analysis of exposure to flood hazard provides information on potential consequences of flooding throughout the state in a consistent, systematic, repeatable manner for comparison among various areas of the state. It provides information adequate to identify and categorize the flood information needs in the state, as well as areas where significant flood risk information is available.

Both the SFMP flood risk information inventory and flood exposure analysis use flood hazard and exposure information from a variety of reliable, reviewed sources, including DWR, USACE, FEMA, and local flood management agencies. These methods are aligned with, although not identical to, the risk analysis completed for the Central Valley Flood Protection Plan (CVFPP) project. Using either of these methods was also determined to be cost effective for gathering the information needed for inclusion in the SFMP Flood Future Report. Combined, the SFMP flood risk information inventory and flood exposure analysis provide an overview of statewide flood risk as it can be determined from the available information. This overview lays a firm foundation for future, more detailed, risk analyses.

*Attachment F: Flood Hazard Exposure Analysis* provides additional information about the analytical procedures used to compute flood exposure. In this TM, the process and results of the SFMP Flood Risk Information Inventory are discussed.

A primary goal of the information gathering process was to collect and review local agency documents related to flood risk.

## 4.2 Risk Information Gathering

A primary goal of the information gathering process was to collect and review local agency documents related to flood risk. The information gathering teams reviewed all documents collected and posted reports to the DWR's SFMP Flood Risk Document System, as described in *Attachment E: Existing Conditions of Flood Management in California (Information Gathering Findings)*. Documents posted had information related to risk as defined by the USACE. The steps below describe the approach used to filter the information:

1. Identify and collect USACE risk studies for the counties. Review to make sure that the latest version released was obtained.
2. Review all documents and reports that the agencies identified as having risk-relevant information.
3. Catalog the documents and reports by the level of information they contain (i.e., full risk analysis; partial risk analysis; and information related to loading, performance, exposure, and vulnerability).
4. Review documents with potential for full or partial risk information.

# 4.3 Risk Information Review Process

## 4.3.1 Risk Component Categories

Five categories were used to filter what type of risk information was available in these documents. This information was used to develop a statewide risk information inventory. The categories used to filter and categorize the available risk information in the database are loading, performance, exposure, vulnerability, and consequence.

These categories are based on USACE best practices for determining risk, as described in Section 2.0 in this TM.

## 4.3.2 Risk Information Assessment

A complete risk assessment would contain all five elements as discussed above. However, many studies contained only components of flood risk information.

Information collected was reviewed to ensure that it met minimum standards prior to synthesis. To be considered risk-relevant, the information had to include at least one of the following components:

- Studies defined components of risk, consistent with components identified herein. The study identified the hazard (hydrology and hydraulics), performance (likelihood of flooding due to breach of levees, for example), exposure (people or property harmed), vulnerability (susceptibility to loss or damage), and consequence (damage and loss of life).
- Studies must have followed standard practice for computing economic risk, such as using EAD. Risk ideally would be computed considering a range of events, not simply a single event, such as might be done for a dam-breach study or certain specific design studies.
- Studies must have provided dates of and sources for information (e.g., the dates of structure inventories and hydrology studies upon which the risk analysis is based).

After the technical review, documents were organized by the level of risk assessment completed and/or the available components of risk assessment.

Table G-2 outlines the categories of different levels of risk assessment, depending on the type of information/data available.

**Table G-2. Summary of Risk Information Assessment Categories**

| Category | Subcategory | Example |
|---|---|---|
| Adequate risk assessment (following our definition of risk equaling the function of loading, exposure, consequence) | Recent loading (hazard), exposure, consequence information | Recent USACE feasibility study available |
| | Dated (old) consequence information | Older USACE feasibility study available |
| Study with components of risk assessment (as defined), but some components missing | Missing or inadequate consequence information | Local or regional stormwater management study available |
| | Missing or inadequate hazard or exposure information | Incomplete planning study available (prepared for a different purpose, such as design with specified level of protection without regard to benefit-to-cost ratio) |
| Components of risk assessment available, but incomplete in context of definition | Incomplete hazard or exposure information | Dam break study with only probable maximum flood considered; FEMA floodplain mapping study |
| | Incomplete consequence information | Report of damage from single historical flood |
| No assessment available or assessment components seriously out of date or do not apply minimum standards | N/A | N/A |

Notes:
N/A = Not applicable

# 5.0 Statewide Inventory of Risk Information

Approximately 700 documents of the 1,850 documents posted to the DWR database were identified as potentially containing risk information and were reviewed for risk-relevant information as described in Section 4.3. Of the 700 documents originally identified, a subset of these was included in the SFMP Risk Information Inventory. Those that were mapping-related were used in the SFMP Exposure Analysis (see *Attachment F: Flood Hazard Exposure Analysis* for further details). A list of the documents included in the SFMP Risk Information Inventory can be found in Appendix B.

Further review of the documents revealed that, of the more than 140 agencies participating in the SFMP Program, only a few agencies had specific risk information on consequences and likelihood. Typically, these agencies were partnering with the USACE or were seeking funding and, therefore, were following the USACE process for assessing risk. This exercise also revealed that the majority of the agencies referred to FIRMs and Hazard Mitigation Plans (HMPs) as containing the only risk information available. HMPs identify potential hazards within a jurisdiction primarily using FIRM and NFIP damage claims, which do not constitute a full risk assessment as defined by USACE.

Further review of the documents revealed that, of the more than 140 agencies participating in the SFMP Program, only a few agencies had specific risk information on consequences and likelihood.

To understand how agencies prioritize flood management projects, assess flood risk, and monitor residual risk, agencies were asked who was flooded (i.e., who was in harm's way of the hazard) and how that information was documented. Agencies typically referred to local hydrologic and hydraulic studies prepared in support of a specific project and/or FEMA FIRM maps. Local agencies did not report flood risk in terms of potential loss of lives. Due to funding limitations, most local agencies typically do not undertake USACE risk assessments.

## 5.1 Local Information

Risk assessment information was tabulated using the methodology described in Section 4.3. As shown in Table G-3, the SFMP team determined that few documents had information that could be used to perform a complete risk analysis. Counties such as Santa Clara, Marin, Monterey, Ventura, Orange, Los Angeles, and San Luis Obispo have developed guidelines or approaches to project planning that consider several of the components needed for a full risk assessment as defined by USACE. These components include information related to hazard, performance, exposure, vulnerability, and consequences.

There are a few areas of the state where either a partial or full risk assessment has been performed. A full risk assessment was performed in the Central Valley for the area covering the State Plan of Flood Control (SPFC). A risk assessment for the SPFC was developed to assist in administering Federal and State flood management responsibilities. The Santa Clara Valley Water District used a HAZUS analysis to assist in identifying EAD for a majority of river/stream reaches within the jurisdiction of the agency. This analysis was developed to understand potential damages and assist

with identifying Federal interest in potential projects. Orange County Public Works performed a study to identify system deficiencies to protect against the 100-year (1 percent) flood event. In Ventura County, due to the availability of recent high-quality topographic mapping, generally site-specific studies that include hazard, exposure, and consequence information for the 100-year (1 percent) flood event were evaluated. From this information, damage estimates were calculated by combining information about depths of flooding (hazard) with information about exposure and vulnerability.

Because there is no statewide standard for reporting information related to flood risk, a wide variety of reports have been produced, and some contain useful information necessary to assess risk. Below is a sample of the types of reports found that contain information related to flood risk:

- Floodplain studies
- Flood mitigation plans
- Hazard mitigation plans
- Deficiency studies
- Hydrologic and hydraulic studies
- Flood management plans
- Flood insurance studies
- Repetitive loss studies
- Watershed hydrologic assessment reports/studies
- Watershed management plans
- Hydraulic and sediment transport studies
- River and stream deficiency studies
- Stormwater management plans
- Feasibility and environmental impact statements
- Regional flood mitigation plans
- River enhancement and management plans
- Location hydraulic studies
- Benefit-to-Cost (B/C) analysis studies
- Integrated Regional Management Plans

Table G-3 summarizes the types of risk-relevant information available by county, along with documents that have general or policy references to floodplain regulations and agency standards for identifying flood hazard areas and flood management measures. The source of the loading information summarized in Table G-3 was most commonly site-specific hydraulic studies. A complete list of the tabulated documents is included in Appendix B.

**Table G-3. Summary of Risk-Relevant and General Flood Management Documents**

| County | Hydrologic Regions | USACE Study | Risk-Relevant Documents by Category | | | | General/ Policy | Rivers/Streams Studied |
|---|---|---|---|---|---|---|---|---|
| | | | Loading | Exposure/ Vulnerability | Performance | Consequence/ Repetitive Loss | | |
| Alameda | San Francisco Bay, San Joaquin River | | | 1 | 1 | | 2 | Countywide studies[a] |
| | San Francisco Bay | | 1 | 1 | 1 | | 2 | Arroyo Las Positas, Arroyo Mocho, South Bay Salt Ponds, Arroyo de la Laguna, El Charro |
| Alpine | North Lahontan, San Joaquin River | | | | | | 1 | Countywide study |
| Amador | San Joaquin River | | 1 | 1 | | 1 | | Countywide study |
| Butte | Sacramento River | | 1 | 1 | | | 2 | Thermalito Forebay, Feather River, countywide study |
| | Sacramento River | ✓ | 1 | 1 | 1 | 1 | 3 | Murphy Slough, Rock Creek, Keefer Slough, Cherokee Canal, Feather River |
| Calaveras | San Joaquin River | | 2 | 1 | | 1 | | Countywide studies[a] |
| | San Joaquin River | ✓ | | 1 | 1 | | | Mokelumne River |
| Colusa | Sacramento River | | 1 | | | | | Colusa Basin |
| Contra Costa | Sacramento River, San Francisco Bay, San Joaquin River | | 1 | 1 | | 1 | 2 | Countywide study |
| | San Joaquin River | | | 1 | | | | Contra Costa Canal |
| | San Francisco Bay | ✓ | | | | | 1 | Grayson's Creek, Murderer's Creek |
| Del Norte | North Coast | | 2 | 1 | | 1 | | Klamath River, countywide study |
| | North Coast | ✓ | 1 | 2 | | 3 | | Smith River, Coastal Crescent City |
| El Dorado | Sacramento River | ✓ | 1 | 1 | 1 | 1 | | American River |
| Fresno | San Joaquin River, Tulare Lake | | 1 | 1 | | | 1 | Countywide study |
| | San Joaquin River | ✓ | | 1 | | | | San Joaquin River |

**Table G-3. Summary of Risk-Relevant and General Flood Management Documents**

| County | Hydrologic Regions | USACE Study | Risk-Relevant Documents by Category | | | | General/ Policy | Rivers/Streams Studied |
|---|---|---|---|---|---|---|---|---|
| | | | Loading | Exposure/ Vulnerability | Performance | Consequence/ Repetitive Loss | | |
| Glenn | Sacramento River | | 4 | 2 | 1 | 1 | 1 | Colusa Basin, Wilson Creek |
| | Sacramento River | ✓ | 3 | 2 | 2 | 1 | | Black Butte Lake, Streams in the Hamilton City Area |
| Humboldt | North Coast | | 1 | | | | | Countywide study |
| | North Coast | ✓ | 5 | 5 | | | | Eel River, Freshwater Creek, South Fork Eel River, Van Duzen River |
| Imperial | Colorado River | | 1 | 1 | | | | Countywide study |
| Inyo | South Lahontan | | | | 3 | | | Oak Creek, Los Angeles Aqueduct |
| Kern | Tulare Lake | | 2 | | | | 1 | Poso Creek, Bodfish Creek, Lake Isabella |
| Kings | Tulare Lake | ✓ | 3 | 3 | 2 | 2 | | Tule River, countywide study |
| Lake | Sacramento River | ✓ | 1 | 3 | 1 | 1 | | Middle Creek, Clear Lake |
| Lassen | North Lahontan, Sacramento River | | | 1 | | 1 | | Susan River, Honey Lake |
| | North Lahontan | ✓ | 1 | | | | | Susan River |
| Los Angeles | South Lahontan | | | | | | 1 | Palmdale Citywide study |
| | South Coast, South Lahontan | | 2 | 1 | 1 | 1 | 1 | Countywide studies[a] |
| | South Coast | ✓ | 1 | | | | | Coastal study |
| | South Coast, South Lahontan | ✓ | 4 | 3 | | | | Los Angeles River, Rio Hondo Channel, countywide studies[a] |
| Madera | San Joaquin River | | | 1 | | | | Countywide study |
| Marin | San Francisco Bay | | | 1 | | 1 | 1 | Countywide study |
| | San Francisco Bay | ✓ | 7 | | 2 | 1 | | Corte Madera Creek, Las Gallinas Creek, Novato Creek, San Clemente Creek |
| Mariposa | San Joaquin River | | 1 | | | | | Countywide study |
| | San Joaquin River | ✓ | 2 | | | | | Merced River |
| Mendocino[b] | | | | | | | | |

**Table G-3. Summary of Risk-Relevant and General Flood Management Documents**

| County | Hydrologic Regions | USACE Study | Risk-Relevant Documents by Category | | | | General/ Policy | Rivers/Streams Studied |
|---|---|---|---|---|---|---|---|---|
| | | | Loading | Exposure/ Vulnerability | Performance | Consequence/ Repetitive Loss | | |
| Merced | San Joaquin River | | 1 | | | | | Black Rascal Creek |
| | San Joaquin River | ✓ | 1 | | | 1 | | Countywide study |
| Modoc | North Coast, North Lahontan, Sacramento River | | 1 | | | | | Countywide study |
| Mono | North Lahontan | ✓ | 1 | | | | | Walker River |
| Monterey | Central Coast | | | 2 | 1 | | 6 | Carmel River and State Beach, Monterey Bay, Pajaro River, countywide studies[a] |
| | Central Coast | ✓ | 1 | | | | | Monterey Bay |
| Napa | San Francisco Bay | | 2 | 1 | | | 2 | Napa Creek, Napa River |
| | Sacramento River, San Francisco Bay | | | | | | 1 | Countywide study |
| | Sacramento River, San Francisco Bay | ✓ | 1 | 1 | 1 | | | San Francisco Bay Shoreline |
| Nevada[b] | | | | | | | | |
| Orange | South Coast | | | | | 1 | | Countywide study |
| | South Coast | ✓ | 1 | 1 | | | 1 | San Juan Creek, Laguna Canyon Channel, Coast |
| Placer | Sacramento River | | 3 | | | | | Dry Creek, countywide study |
| | Sacramento River | ✓ | 2 | | | 1 | | Dry Creek |
| Plumas[b] | | | | | | | | |
| Riverside | South Coast | | 1 | | | | | Lakeview Wash, San Jacinto River |
| | South Coast | ✓ | 1 | 1 | 1 | | | Warm Springs Creek |
| | Colorado River | | 2 | | | | | San Gorgonio River, Jenson Creek, Millard Canyon Creek |
| Sacramento | Sacramento River | | 3 | 4 | 2 | 3 | 1 | American River, Colusa Basin, Sacramento River |
| | Sacramento River | ✓ | 6 | 4 | 2 | 3 | 1 | American River, Feather River, Magpie Creek, Sacramento River, Yolo Bypass, Yuba River |

**Table G-3. Summary of Risk-Relevant and General Flood Management Documents**

| County | Hydrologic Regions | USACE Study | Risk-Relevant Documents by Category | | | | General/ Policy | Rivers/Streams Studied |
|---|---|---|---|---|---|---|---|---|
| | | | Loading | Exposure/ Vulnerability | Performance | Consequence/ Repetitive Loss | | |
| Sacramento (continued) | Sacramento River, San Joaquin River | | | 1 | | | | Sacramento River, San Joaquin River, countywide study |
| | Sacramento River, San Joaquin River | ✓ | 2 | 2 | 2 | | | Sacramento-San Joaquin River Delta |
| | Sacramento River, San Joaquin River, San Francisco Bay | ✓ | 4 | 1 | | | | Sacramento-San Joaquin River Delta |
| | Sacramento River, San Joaquin River, Tulare Lake | ✓ | 1 | 1 | | | | Sacramento River, San Joaquin River |
| San Benito | Central Coast | | | | | | 1 | Pajaro River |
| | Central Coast | ✓ | 1 | | | 1 | | Pajaro River |
| San Bernardino | Colorado River | | 1 | | | | | Lucerne Lake |
| | South Coast | | 1 | | 1 | | | Sand Creek, Declez Channel |
| | Colorado River, South Coast, South Lahontan | | | | 4 | | | Countywide studies[a] |
| | South Lahontan | | 1 | | | | | Apple Valley Dry Lake |
| San Diego | South Coast | | 1 | 1 | | 1 | | Citywide study |
| | Colorado River, South Coast | | 1 | 1 | | 1 | 1 | Countywide study |
| | South Coast | ✓ | 1 | | | | | Otay River |
| San Francisco | San Francisco Bay | | | 1 | 1 | | 1 | Citywide study |
| | San Francisco Bay | ✓ | 1 | 1 | | | | San Francisco Bay |
| San Joaquin[b] | | | | | | | | |
| San Luis Obispo | Central Coast | | 1 | 2 | | | 2 | Cayucos Creek, San Luis Obispo Creek, Tally Ho Creek |
| San Mateo | San Francisco Bay | | | 2 | | | 3 | Colma Creek, San Bruno Creek, San Francisquito Creek |

**Table G-3. Summary of Risk-Relevant and General Flood Management Documents**

| County | Hydrologic Regions | USACE Study | Risk-Relevant Documents by Category | | | | General/ Policy | Rivers/Streams Studied |
|---|---|---|---|---|---|---|---|---|
| | | | Loading | Exposure/ Vulnerability | Performance | Consequence/ Repetitive Loss | | |
| San Mateo (continued) | San Francisco Bay | ✓ | 10 | 3 | 4 | 1 | 1 | Colma Creek, San Pedro Creek, San Francisquito Creek, Matadero Creek, Barron Creek, Adobe Creek, Permanente Creek, Stevens Creek, Sunnyvale West Creek, Sunnyvale East Creek, Calabazas Creek, San Tomas Aquinas Creek, Guadalupe River, Coyote Creek, Fremont Flood Control Channel, Agua Caliente Creek, Laguna Creek, Scott Creek |
| Santa Barbara | Central Coast | | | 3 | 3 | | 3 | Coast Village, Santa Barbara Airport-Area |
| | Central Coast | ✓ | 3 | 3 | | | | Lower Mission Creek, Mission Creek, Rattlesnake Creek |
| Santa Clara | Central Coast, San Francisco Bay | ✓ | 2 | 2 | 1 | 1 | | Berryessa Creek, Coyote Creek, Guadalupe River |
| Santa Cruz | Central Coast | | | | | | 2 | Pajaro River |
| | Central Coast | ✓ | 5 | | | 1 | | Pajaro River, San Lorenzo River |
| Shasta | Sacramento River | ✓ | 3 | 2 | 1 | 1 | | Burney Creek, Churn Creek, Sacramento River |
| Sierra[b] | | | | | | | | |
| Siskiyou | North Coast | | | 3 | 3 | | | Domino Dam, Iron Gate Dam, JC Boyle Dam |
| | Sacramento River | | | 1 | 1 | | | Box Canyon Dam |
| | North Coast, Sacramento River | | 2 | 2 | 1 | | | Countywide studies[a] |
| Solano | Sacramento River | | | 1 | 1 | | 1 | Sacramento River, Yolo Bypass and local creeks |
| | San Francisco Bay | | | 3 | 3 | 1 | 3 | Green Valley Creek, Hennessey Creek, Suisun Valley Creek |
| | Sacramento River, San Francisco Bay | | | 1 | 1 | 1 | 3 | Sweeny Creek, Middle Green Valley Area |
| | Sacramento River | ✓ | 1 | | | | | Yolo Bypass |
| | San Francisco Bay | ✓ | 3 | | | | | White Slough, Austin Creek |

**Table G-3. Summary of Risk-Relevant and General Flood Management Documents**

| County | Hydrologic Regions | USACE Study | Risk-Relevant Documents by Category | | | | General/ Policy | Rivers/Streams Studied |
|---|---|---|---|---|---|---|---|---|
| | | | Loading | Exposure/ Vulnerability | Performance | Consequence/ Repetitive Loss | | |
| Sonoma | North Coast | | 1 | 1 | 1 | | 4 | Russian River, Sonoma Creek |
| | North Coast | ✓ | 3 | | | 1 | | Russian River, Petaluma River |
| Stanislaus | San Joaquin River | | 1 | 1 | | 1 | | Countywide study |
| Sutter | Sacramento River | | 1 | 3 | 4 | | 1 | Feather River, Butte Sink, Meridian Basin, Nicolaus Basin, Robbins Basin |
| Tehama | Sacramento River | | 1 | | | | 2 | Los Molinos |
| | Sacramento River | ✓ | 2 | 1 | 1 | | | Sacramento River, McClure Creek, Rodeo Creek, Tehama Slough |
| Trinity[b] | | | | | | | | |
| Tulare | Tulare Lake | | | | | | 1 | Tule River |
| | Tulare Lake | ✓ | 4 | 4 | 4 | 2 | 1 | Kaweah River, Tule River |
| Tuolumne | San Joaquin River | | | 1 | | | | Countywide study |
| Ventura | South Coast | | 10 | 5 | 1 | 2 | 3 | Matilija Dam, Ventura River, Arundell Barranca, Calleguas Creek, J-Street Drain, Ormond Beach Lagoon, Santa Clara River, Ventura River, Dry Canyon |
| | South Coast | ✓ | | | | | | Coastal Study |
| Yolo | Sacramento River | | 1 | 4 | | 1 | 2 | Covell Drain, Willow Slough, Dry Slough, Willow Slough Bypass and Yolo Bypass, American River, Yolo Bypass, Sacramento River and Sacramento Deep Water Ship Canal |
| | Sacramento River | ✓ | 9 | 7 | 4 | 4 | 4 | Yolo Bypass, Lower Cache Creek, Cache Creek, Sacramento River, Solano Dam, South Fork Putah Creek, Chapman Reservoir, Monticello Dam, Putah South Canal, Willow Slough, Putah Creek, American River |
| Yuba | Sacramento River | ✓ | 4 | 6 | 2 | 1 | | Yuba River, Feather River |
| | Category Total | | 160 | 122 | 68 | 48 | 70 | |

Notes:
[a] Risk-related studies that did not focus on a specific body of water or city were designated as "countywide."
[b] No risk documents available from this county.

Exposure/vulnerability information was defined as the number of people or structures affected by different severities of storm events. In most cases, the existing studies analyzed impacts from a flood with the 100-year floodplain (1 percent annual chance of exceedance) exclusively, identifying structures and properties within the floodplain of this event. Consequence and repetitive loss information were estimated in those studies, including historical and expected future flood damage. The consequence information measured or calculated monetary loss or number of lives lost when water inundates people and property exposed. Reports that contained repetitive loss information, such as HMPs, typically included information on inundation of properties and level of inundation, as defined by the Severe Repetitive Loss (SRL) program of the NFIP.

## 5.2 Recent USACE Risk Assessment Studies

The USACE recently has worked with local agencies in 23 California counties to develop documents that include a risk assessment, as shown in Table G-4. These studies were performed primarily in areas where significant deficiencies were identified by local agencies. Examples of such areas are major streams (e.g., Sacramento and Santa Ana rivers), high-risk population areas (e.g., Los Angeles area), and areas with recurring flood events (e.g., Napa and Santa Clara counties). Figure G-8 shows the locations of USACE risk studies throughout California.

**Table G-4. Recent USACE Risk Assessment Studies**

| County | USACE District | Study Name | Status |
|---|---|---|---|
| Los Angeles | Los Angeles | Ballona Creek | Ongoing |
| Los Angeles and Ventura | Los Angeles | Malibu Creek | Ongoing |
| Orange | Los Angeles | San Juan Creek | Ongoing |
| Orange | Los Angeles | Westminster | Ongoing |
| Riverside | Los Angeles | Murrieta Creek | Completed |
| Riverside | Los Angeles | Cactus and Heacock Channels | Ongoing |
| Riverside, San Bernardino, and Orange | Los Angeles | Santa Ana River Mainstem Ecosystem Restoration Report | Ongoing |
| San Bernardino | Los Angeles | Long Canyon Wash | Ongoing |
| San Diego | Los Angeles | San Luis Rey Ecosystem Restoration Report | Ongoing |
| Santa Barbara | Los Angeles | Lower Mission Creek | Completed |
| Glenn County | Sacramento | Hamilton City | Completed |
| Napa and Solano Counties | Sacramento | Napa River | Completed |
| Sacramento and San Joaquin | Sacramento | South Sacramento County Streams | Ongoing |
| Sacramento County | Sacramento | 408 Permits | Completed |
| Sacramento County | Sacramento | Common Features General Reevaluation Report | Completed |
| San Joaquin and Stanislaus | Sacramento | Lower San Joaquin | Ongoing |
| Santa Clara County | Sacramento | Berryessa Creek | Completed |
| Stanislaus County | Sacramento | Orestimba | Completed |

**Table G-4. Recent USACE Risk Assessment Studies**

| County | USACE District | Study Name | Status |
|---|---|---|---|
| Sutter County | Sacramento | Sutter County Feasibility | Ongoing |
| Sutter, Yuba, Sacramento, Butte, and Yolo Counties | Sacramento | Mid Valley | Completed |
| Yolo | Sacramento | West Sacramento Feasibility Study | Completed |
| Yuba | Sacramento | Yuba River General Reevaluation Report | Completed |
| Alameda County | San Francisco | Estudillo Canal | Ongoing |
| Alameda, San Mateo, and Santa Clara counties | San Francisco | South San Francisco Bay Shoreline Study | Ongoing |
| Contra Costa County | San Francisco | Pinole Creek, Sec 1135 | Planned |
| Contra Costa County | San Francisco | Wildcat Creek Restoration | Ongoing |
| Marin County | San Francisco | Las Gallinas Creek | Ongoing |
| Marin County | San Francisco | Corte Madera Creek | Ongoing |
| Sonoma County | San Francisco | Petaluma River | Completed, but may need to be revised |
| Monterey and Santa Cruz Counties | San Francisco | Pajaro River | Completed, but may need to be revised |
| San Mateo and Santa Clara Counties | San Francisco | San Francisquito Creek | Ongoing |
| San Mateo County | San Francisco | San Pedro Creek, Pacifica | Completed |
| Santa Clara County | San Francisco | Guadalupe River | Ongoing |
| Santa Clara County | San Francisco | Upper Penitencia Creek | Completed, but may need to be revised |
| Santa Clara County | San Francisco | Llagas Creek | Ongoing |
| Santa Cruz County | San Francisco | San Lorenzo River | Ongoing |
| Solano County | San Francisco | White Slough | Completed |


**Figure G-8. USACE Risk Studies in California**

## 5.3 NFIP Claims Information

The database of NFIP claims was reviewed as part of the information gathering effort. The NFIP provides flood insurance to exposed communities. Participation in the NFIP requires a community to adopt and enforce a floodplain management ordinance to reduce future flood risks due to new construction in SFHAs. The SFHAs and other risk premium zones applicable to each participating community are depicted in FIRMs. All counties in California participate in the NFIP except Mariposa County, where the steep terrain makes flooding hazards low.

Although flooding events occur across the state, Figure G-9 indicates where the largest NFIP claims have been incurred by hydrologic region. The leading counties with the largest financial impacts documented are in Sonoma, Los Angeles, Marin, Sacramento, Napa, and Monterey. The NFIP has paid more than $495 million in claims in California since 1978, as summarized in Table G-C-1 in Appendix C. These claims do not represent all residential, private, or public costs to recover from flooding because private insurance reimbursements as well as recovery costs are not included. However, these trends in flood damage match the high levels of exposure to flood hazards found in these counties, which are described in *Attachment F: Flood Hazard Exposure Analysis*.

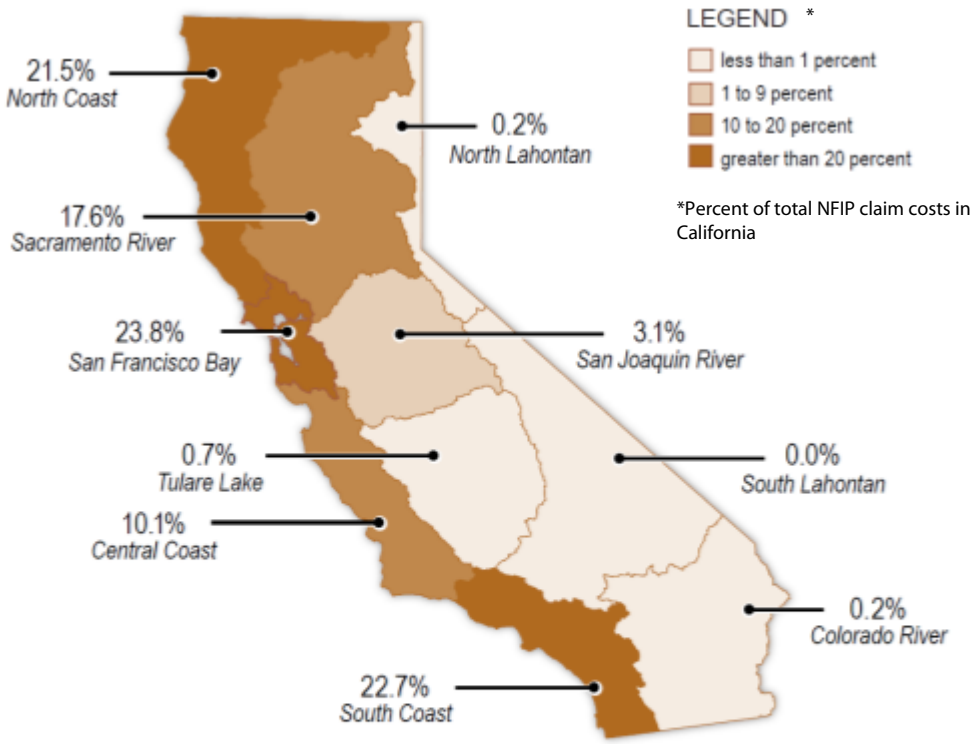


**Figure G-9. Percentage of Total NFIP Claim Costs by Hydrologic Region**

Notes:
1. NFIP claims cover residential structures only. Commercial structures are not covered in this program.
2. Mariposa County is not a participant in the NFIP. Due to the steep terrain, hazards from flooding are relatively low in the county. However, there has been localized flooding in areas of low elevation and in areas where stream channels are not well defined.

## 5.4 Information Gaps and Future Approach to Risk Assessment

The Central Valley has been the most thoroughly studied region, and flood risks are well understood in that area. A system-wide investment approach has been proposed, as reflected in the CVFPP. Outside this area, the economic and loss of life consequences are less understood, as shown in Table G-3. The information gathered indicates that, although agencies chartered with flood management responsibilities might not complete risk assessments as prescribed by the USACE, they do complete studies and analyses that would qualify as components of a flood risk analysis.

Agencies typically do not perform a damage assessment or benefit-to-cost (B/C) analysis unless the project is seeking involvement and funding from the USACE or DWR.

Local agencies perform risk-related assessments to either demonstrate that NFIP-compliant protection against a flood within the 100-year floodplain (annual chance of exceedance) is provided for a parcel, or as part of a hydraulic analysis for a planning study or design of a flood protection project in support of a specific project. Agencies typically do not perform a damage assessment or B/C analysis unless the project is seeking involvement and funding from the USACE or DWR. Generally, agencies focus efforts on studying and constructing site-specific projects where flooding problems are known to exist. In addition, some local land use agencies experience pressure to foster economic growth by approving development in areas with high exposure to floods.

Existing risk and flood exposure information can be used to identify and prioritized potential locations for future risk assessments statewide. The SFMP Risk Exposure concept could be developed into a methodology for local, State, and Federal agencies to establish investment priorities for identifying study areas for future risk assessments and for making better informed flood management planning decisions. See *Attachment F: Flood Hazard Exposure Analysis* for the full extent of this approach. The flow chart in Figure G-10 illustrates the proposed process that would guide and streamline future risk assessment decisions.


**Figure G-10. Approach to Prioritize Future Risk Assessment Areas**

A visualization of this approach is provided in Figure G-11. In this example, there are three ongoing USACE risk studies in the counties of Santa Clara and San Mateo—San Francisquito Creek Study, Shoreline Study, and Guadalupe River Study. For example, in Figure G-11, the pink, purple, and navy highlighted areas show existing USACE project study boundaries, and the yellow and green shading shows population density within the 500-year floodplain. Areas in green and yellow outside existing study areas show that significant portions of population exposed to flood hazard are not included within these study area boundaries. Figure G-11 illustrates how a regionwide approach could be used to combine information provided by the local agencies, along with exposure information and completed risk assessments, to identify areas where significant exposure to flood hazard exists and then prioritize areas where future risk assessments are needed.

An approach for developing risk assessments for coastal regions is another area where additional data and study guidelines are needed. Coastal areas have specific issues distinct from riverine systems, such as sea level rise, which are issues that make the extent of exposure difficult to predict. Local agencies need assistance with mapping and developing models/data that address the impacts of sea level rise and climate change.

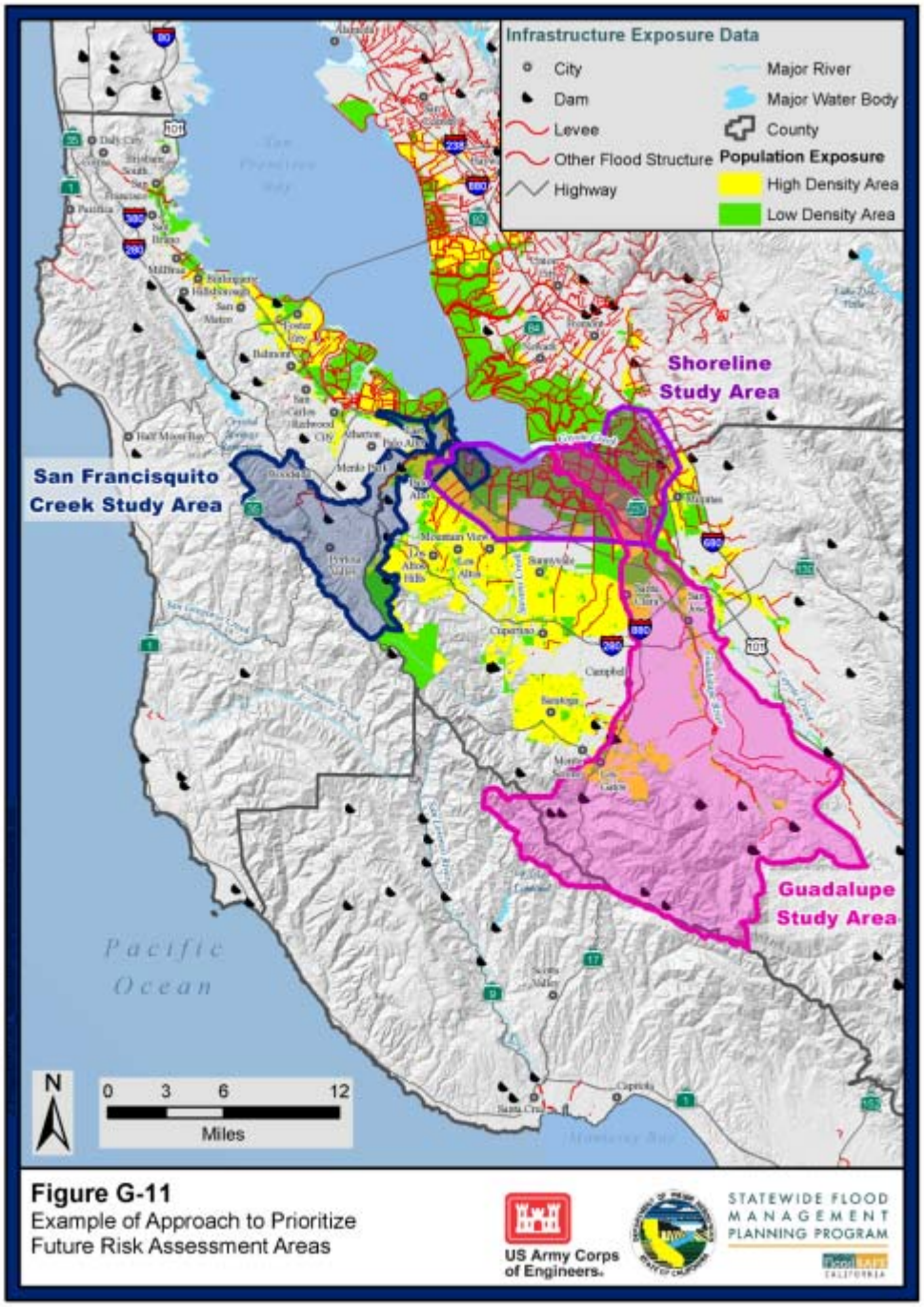


**Figure G-11. Example of Approach to Prioritize Future Risk Assessments**

## 5.5 Sample Risk Assessments

Most complete risk assessments are developed either in cooperation with USACE or by local agencies that are seeking Federal funding partners for projects. As shown in Figure G-12, four case studies are provided that demonstrate using the USACE approach for assessing risk:

- San Francisquito Creek Risk Assessment (San Francisco Bay Hydrologic Region)
- Chicken Ranch and Strong Ranch Slough Risk Assessments (Sacramento Hydrologic Region)
- Natomas Levee Improvement Project Risk Assessment (Sacramento Hydrologic Region)
- Aliso Creek Watershed Management Feasibility Study (South Coast Hydrologic Region)

These case studies provide a snapshot of the different types of risk assessments completed throughout the state in areas at high risk of flooding. The two case studies in the Sacramento area provide examples of slow rise flooding in an area protected by a levee system. The Chicken Ranch and Strong Ranch Slough risk analysis is an example of a small interior watershed protected from flooding by levees that are part of the Federal-State flood management system. The analysis was completed by the local agency using methods consistent with USACE. The Natomas Levee Improvement Project case study is an example of a large basin protected by levees on all sides against flooding from multiple sources, including the Sacramento River, American River, and local streams. Local agencies completed the risk analyses for both studies using methods consistent with USACE, which laid the foundation for deciding if there was a Federal interest in the project.

The San Francisquito Creek case study provides an example of a risk assessment in a densely populated urban coastal area. The local agency initiated this work, but the feasibility study currently underway is being completed by USACE. The Aliso Creek Watershed Management Feasibility Study, regarding an area located in the South Coast Hydrologic Region, demonstrates flash flooding in urban coastal southern California. The results of this risk assessment did not support continued Federal participation in the project. See Appendix D for details on each of these risk assessment case studies.

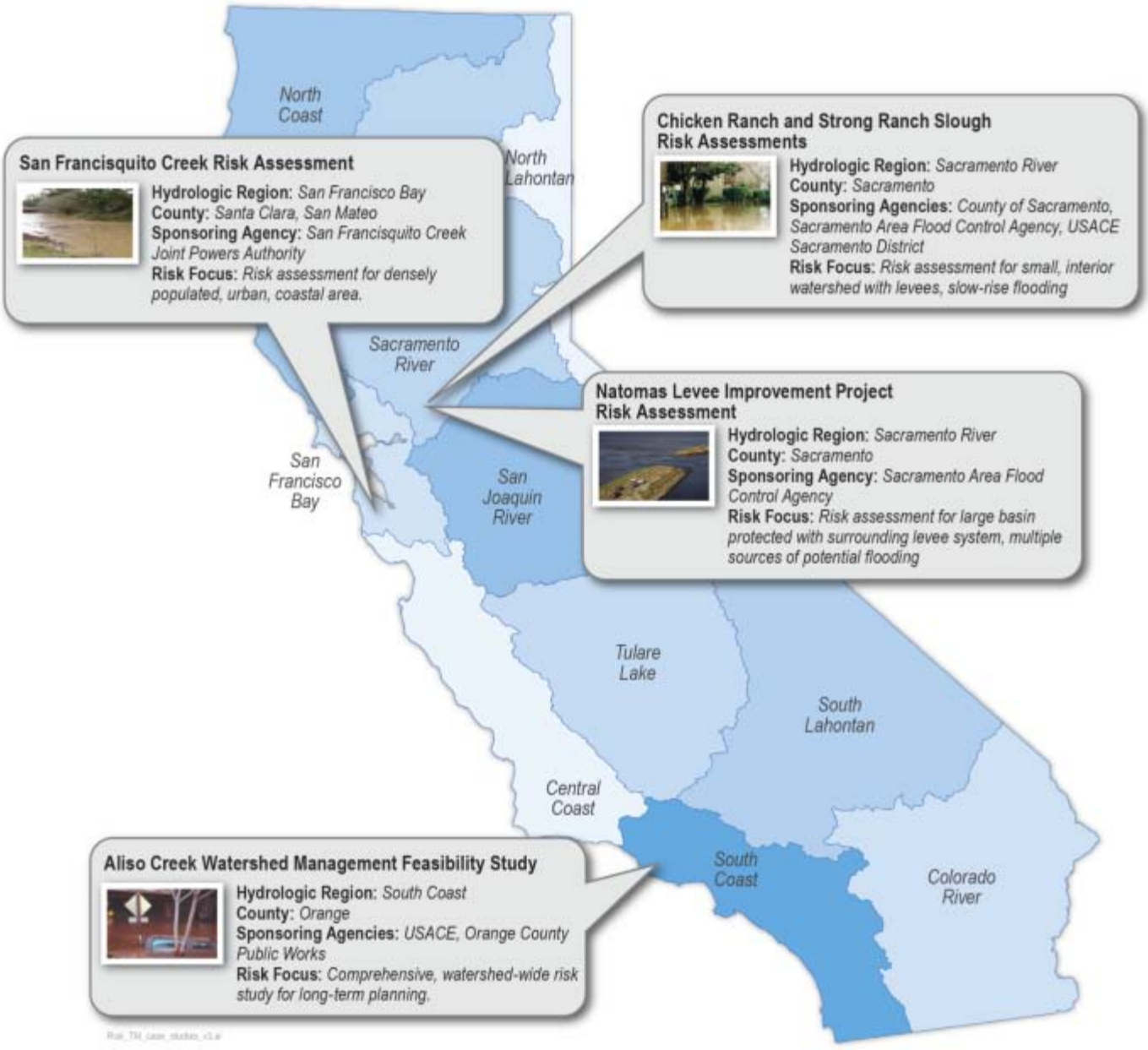


**Figure G-12. Risk TM Case Studies**

## 5.6 Examples of Alternate Approaches to Identify Flood Management Actions

Risk assessments are commonly developed by agencies either in cooperation with the USACE or by local agencies that are seeking Federal funding for projects. Most local agencies, however, are not focused on calculating risk using the USACE approach. Instead, they rely on mapping flood hazards resulting from the 100-year (1 percent) flood event for NFIP compliance.

Local agencies typically undertake individual site-specific hydrologic and hydraulic studies to identify system deficiencies and flood management actions. In some cases, even if an agency has studied a watershed and identified the locations of the greatest deficiencies, the agency might not have the topographic mapping needed to delineate the floodplains. In such cases, the agency could be building projects in phases without knowing how improvements are benefitting the flood management system. If local agencies had the resources to perform risk assessments, this information could be used to better prioritize projects at a system, regional, or watershed level.

This section provides three examples of local agencies that worked to identify and prioritize flood management projects in a watershed or countywide approach (see Figure G-13). These agencies have taken a comprehensive approach to identify deficiencies in their systems and, in some cases, have completed risk assessments for projects for which the USACE or other Federal agency is a partner. These examples illustrate a concerted effort to prioritize projects by flood management benefits as well as economic benefits, and in some cases societal benefits and sustainability.

Orange County (Orange County Flood Control District [OCFCD]) and Santa Clara Valley Water District (SCVWD) have used a comprehensive approach to identify flood system deficiencies. Both OCFCD and SCVWD have identified the deficiencies in their systems for the 100-year (1 percent annual chance exceedance) flood event using similar approaches. The analyses enable these local agencies to identify projects and flood facility improvements that are needed and to prioritize the work.

The following subsections describe the approach that each of these agencies uses to evaluate system deficiencies.

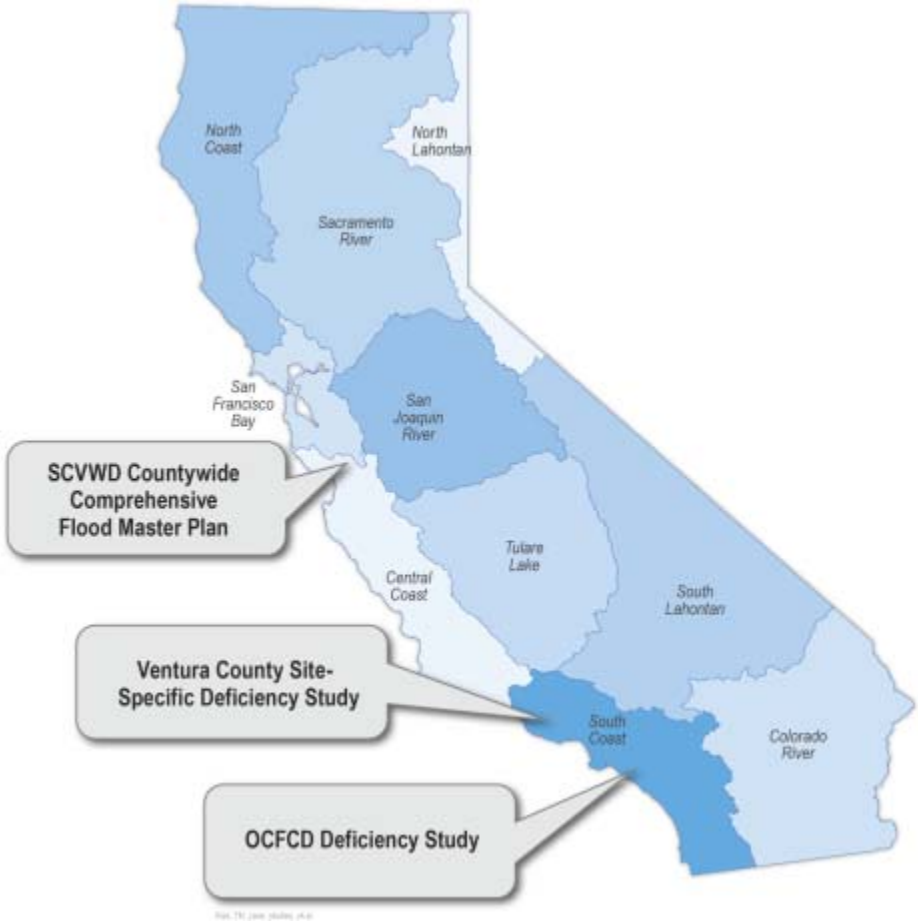


**Figure G-13. Management Projects in a Watershed or Countywide Approach**

## 5.6.1 OCFCD Deficiency Study

OCFCD is responsible for 13 major watersheds in Orange County, as well as 78 channels, 26 retarding basins, and 8 pump stations. OCFCD performed a deficiency study to identify where the system could not protect against the 100-year (1 percent) flood event, as well as to estimate the cost of upgrading facilities to fully achieve this level of protection. The OCFCD study identifies deficiencies, as well as provides information on budget allocations for past and future flood management projects to achieve protection from the 100-year (1 percent) flood event. The study also develops cost estimates and prioritizes projects within each watershed in the county. The cost estimates developed assist in forecasting budget allocations for the OCFCD 7-Year Capital Improvement Plan (CIP) and provide the estimated total compliance costs to upgrade OCFCD facilities. Capital improvement projects are prioritized by the City Engineer's Flood Control Advisory Committee from the CIP list of projects.

### 5.6.2 SCVWD Countywide Comprehensive Flood Master Plan

The SCVWD is currently developing a countywide comprehensive master plan under the Watershed Stream Stewardship program.

The first of two primary objectives in the master plan is to balance environmental quality and protection from flooding in a cost-effective manner. A key performance indicator for capital improvements for flood protection is the number of parcels protected from the 100-year (1 percent annual chance exceedance) flood event.

The second of the two primary objectives is to preserve flood conveyance capacity. The SCVWD administers a total asset management program and performs stream maintenance activities to achieve this objective. Key performance indicators for preserving flood conveyance capacity include average annual sediment removal quantities, number of facility condition assessments performed annually, miles of levees inspected and maintained, and acres of vegetation control for restoring stream capacity.

As an initial step, the SCVWD is identifying those areas that might not achieve the master plan goals and objectives within the 25-year planning horizon. To better understand the system deficiencies, the SCVWD used a HAZUS analysis approach to assist in identifying EAD for a majority of river/stream reaches within the jurisdiction of the agency. The results will provide the SCVWD with a list of priorities that will allow them to communicate project needs and identify Federal interest in potential projects.

### 5.6.3 Ventura County – Site-Specific Deficiency Study

An example of a site-specific case study is Arundell Barranca in Ventura County. This case study demonstrates how a local agency has expanded a site-specific hydrologic and hydraulic study to include an analysis of hazard, exposure, and consequence. This example does not follow the complete USACE approach for fully assessing risk. The existing (without-project) and future (with-project) hydraulic analyses were completed for multiple alternatives for the 2-year (50 percent) to the 100-year (1 percent annual chance exceedance) flood events. Damage estimates were calculated only for the 100-year (1 percent) flood event by combining information about depths of flooding (hazard) with information about exposure and vulnerability. Damages were calculated for agricultural areas, residential areas, and commercial areas. Although the Arundell Barranca deficiency study produced damage estimates only for the 100-year (1 percent) flood event, the hydraulic analysis could be expanded, and damages for a broader range of conditions could be estimated to comply with the USACE approach to assessing risk.

# 6.0 Findings

Identifying flood risks is an important first step toward reducing risk and prioritizing flood management infrastructure needs in California; however, few detailed risk assessments have been completed. The cost of performing complete USACE assessments often causes agencies to default to overly simplistic methods or leave their flood risk undetermined. Local agencies initiate the development of the more complex and involved USACE standard risk assessment with the intent of asking the USACE to be a project partner or to seek Federal funding. Findings from review of the risk-relevant documents as well as information gathered from local agencies include:

- In California, most local projects are developed to achieve protection from the 100-year (1 percent annual chance exceedance) flood event and to comply with FEMA NFIP requirements. These projects are developed without consideration of the economic and life-safety risk reduction that are part of the USACE risk assessment.
- Many counties in California have considered flood hazards for the 100-year (1 percent annual chance exceedance) flood event as part of their participation in the NFIP. As a result, impacts are generally quantified in terms of insurance claims.
- Most agencies participate in the NFIP and rely on FEMA for floodplain benefit analysis maps. However, mapping is often unavailable or out of date as a result of development within the floodplain. Mapping deficiencies were noted statewide, by both large and small agencies. *Attachment F: Flood Hazard Exposure Analysis* provides additional information about the analytical procedures used to compute flood exposure using mapping.
- Most agencies identified Flood Management Plans, FIRMs (or FEMA floodplain maps), and HMPs as the source for flood risk information.
- DWR and the USACE, as well as agencies seeking Federal funding, assess and describe flood risk in terms of EAD.
- Consequence, i.e., economic damage to property or loss-of-life information, is rare, except where USACE risk assessments have been performed. Larger agencies with greater exposed populations and more reliable financial resources, such as Orange County, Ventura County, Los Angeles County, and Santa Clara County, generally had the most risk-relevant information. Most of this information was related to loading.
- Local agencies often do not have the resources to identify the potential for or consequences of major flooding in their area.
- Local agencies have expressed that one role the Federal and State agencies could take on would be to assist with developing ways to analyze and report information that could be used for both USACE risk assessments and FEMA flood hazard mapping efforts. Agencies are continuously performing hydrology and hydraulic studies, preparing planning studies to assess the impacts of alternatives for specific projects, and producing HMPs. A few

agencies like OCFCD, SCVWD, Los Angeles County Department of Public Works, and Ventura County Watershed Protection District (VCWPD) went a step further to develop countywide flood projection master plans and deficiency studies from which to prioritize and build projects.

- Coastal areas have specific issues distinct from purely riverine systems. Sea level rise and sedimentation/erosion are issues that make the extent of exposure difficult to predict. Local agencies along the coast need assistance with mapping and developing models/data and addressing the impact of climate change and sea level rise.
- Agencies are challenged by the lack of public understanding of the hazards of flooding. Property owners do not understand that there is a different risk associated with different levels or magnitudes of flooding. Public officials concluded that, although a flood protection project is built, communicating residual risk to the general public is difficult.
- Property owners and residents are generally unaware of the potential damages from a major flood because these events are less frequent. For example, there is a misconception by the general public that a 100-year flood occurs only once in 100 years, when in fact it is a flood that has a 1 percent chance of exceedance in any given year.
- Responsibilities for planning, administering, financing, and maintaining facilities are fragmented among agencies. The inability to permit a flood management project or maintenance activity interferes with the function of a flood reduction project. Agencies urged DWR for help with achieving environmental permitting requirements.

Findings

# 7.0 References


California Department of Water Resources (DWR). 2008. *Economic Analysis Guidebook*. January. Web site http://www.water.ca.gov/economics/guidance.cfm.

California Department of Water Resources (DWR). 2010. *Draft Economic Analysis Guidelines Flood Risk Management.* May. Web site http://www.water.ca.gov/economics/guidance.cfm.

Federal Emergency Management Agency (FEMA). 2002. *Floodplain Modeling Manual: HEC-RAS Procedures for HEC-2 Modelers*. April.

Federal Emergency Management Agency (FEMA). 2003. *Guidelines and Specifications for Flood Hazard Mapping Partners.* April.

Federal Emergency Management Agency (FEMA). 2005. *Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States*. January.

Federal Emergency Management Agency (FEMA). 2006. *Document Controls Manual.* September.

U.S. Army Corps of Engineers (USACE). 1982. *Engineering Regulation 1165-2-119, Modifications to Completed Projects.* September 20.

U.S. Army Corps of Engineers (USACE). 1991. *American River Watershed Investigation*.

U.S. Army Corps of Engineers (USACE). 1994. *Engineering Regulation 1110-2-401, Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors.*

U.S. Army Corps of Engineers (USACE). 1996. *Engineer Manual 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies*. August 1. Web site http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1619.pdf.

U.S. Army Corps of Engineers (USACE). 2000. *Engineer Regulation 1105-2-100, Planning Guidance Notebook.* April 22. Web site http://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1105-2-100.pdf.

U.S. Army Corps of Engineers (USACE). 2002. *Sacramento and San Joaquin River Basins Comprehensive Study.* Sacramento District.

U.S. Army Corps of Engineers (USACE). 2003. *Economic Guidance Memorandum (EGM) 04-01, Generic Depth-Damage Relationships for Residential Structures with Basements.* October 10. Web site http://planning.usace.army.mil/toolbox/library/EGMs/egm04-01.pdf.

U.S. Army Corps of Engineers (USACE). 2005. *Reconstruction of U.S. Army Corps of Engineers Structural Flood Damage Reduction Projects for which Non-Federal Interests are Responsible for Operation, Maintenance, Repair, Rehabilitation and Replacement.* Memorandum for Commanders, Major Subordinate Commands. August 16. Web site http://planning.usace.army.mil/toolbox/library/MemosandLetters/reconstruction.pdf.

U.S. Army Corps of Engineers (USACE). 2006. *Engineer Regulation 1105-2-101, Risk Analysis for Flood Damage Reduction Studies.* January 3. Web site http://www.publications.usace.army.mil/.

U.S. Census Bureau (Census). 2010. "California Quick Facts from the U.S. Census Bureau, State and County Quick Facts." Web site http://quickfacts.census.gov/qfd/states/06000.html. Accessed January 9, 2013.

# Appendix A: Flood Future Report Components

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# Appendix A: Flood Future Report Components

California's Flood Future Report is composed of three layers of documents, which were developed with different audiences and purposes, as shown in Figure G-A-1. The three main layers are the Policy Brief, Highlights, and main report including the technical attachments (or technical memoranda).

The Policy Brief document provides a high-level summary of the key information contained in the Flood Future Report and its technical attachments. This document is meant to inform legislators, legislative staff, and agency executives about the report.

The Highlights document, which is an Executive Summary of the Flood Future Report, is more detailed than the Policy Brief slightly expanding the level of detail of the information provided in the Policy Brief. The Highlights document is intended for use by legislators, legislative staff, agency executives, and the public.

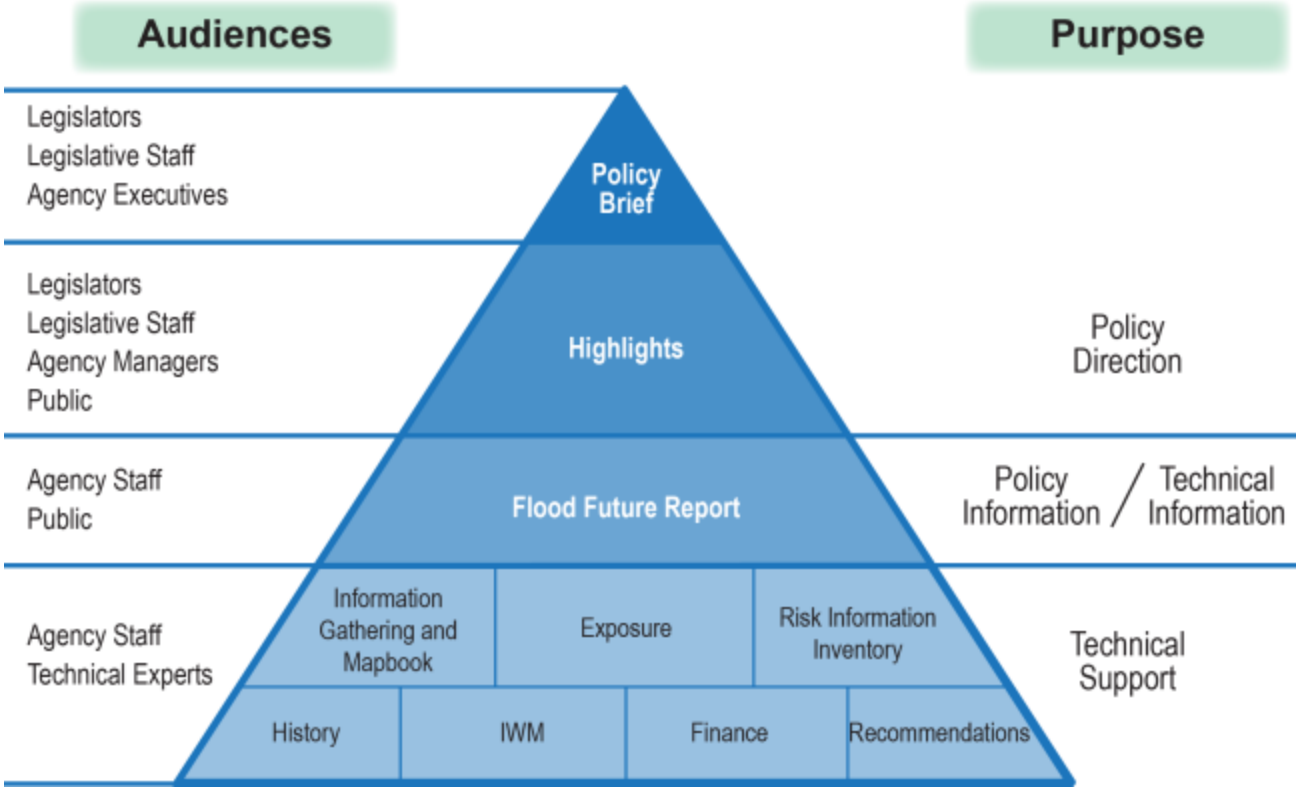


**Figure G-A-1. Flood Future Report Components Diagram**

The Flood Future Report provides a compilation of the information developed in the technical attachments. This document contains a comprehensive look at flooding throughout the state, and it describes the challenges and opportunities facing flood management. The Flood Future Report also provides information to make decisions about policies and financial investments to improve public safety, environmental stewardship, and economic stability.

This report is supported by eight technical attachments:

- ***Attachment A: References***
- ***Attachment B: Glossary***
- ***Attachment C: History of Flood Management in California.*** This attachment provides a detailed history of flooding in the 10 major California Water Plan hydrologic regions.
- ***Attachment D: Summary of Exposure and Infrastructure Inventory by County (Mapbook).*** This attachment is a mapbook organized by county providing information on exposure to flooding, flood infrastructure, flood types present, list of major floods, and information on the planned/proposed projects.
- ***Attachment E: Existing Conditions of Flood Management in California (Information Gathering Findings).*** This attachment provides an overview of the information gathering effort to collect flood management information from local, State, Tribal, and Federal agencies, as well as a detailed summary of the results of the information gathering effort. The purpose of this effort was to develop a better understanding of flood risk management in the State of California.
- ***Attachment F: Flood Hazard Exposure Analysis.*** This attachment describes the methodology used to identify flood hazard exposure statewide as well as the results of the flood hazard exposure analysis. This analysis was performed to provide insight into potential flood risks throughout the state.
- ***Attachment G: Risk Information Inventory.*** This attachment provides a better understanding of flood risk statewide, based on the best available information. To characterize flood risk in the California, the SFMP developed a risk exposure analysis used in conjunction with an inventory of risk-relevant information gathered from agency meetings.
- ***Attachment H: Practicing Flood Management Using an Integrated Water Management Approach***. This attachment provides a description of the evolution of flood management practices toward and using an IWM approach, an overview of IWM, the benefits of using an IWM approach, and sample case studies of projects that have used an IWM approach.
- ***Attachment I: Finance Strategies.*** This attachment provides an understanding of the current status of flood management financing and the challenges that lie ahead as California develops recommendations to address flood management issues.
- ***Attachment J: Recommendations to Improve Flood Management in California.*** This attachment provides a detailed description of how the Flood Future Report recommendations were developed and outlines the recommendations along with other high-level challenges.

Each of the documents follows a color scheme that was developed for the Highlights document. The documents are formatted using different-colored headers to indicate the purpose of a given section. The color scheme follows the following coding format:

- Introduction (light blue)
- Understanding the Situation (brown)
- The Problem (goldenrod)
- The Solution (royal blue)
- Recommendations (green)
- The Path Forward (yellow)

Any and all appendices to an attachment were coded using a light blue to represent that this is background or supporting information.

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# Appendix B: Risk-Relevant Documents from DWR Database

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**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alameda | Alameda County Flood Control and Water Conservation District (FCWCD) | | | 2004 District Annual Report | 1/1/2004 | General Study | San Francisco Bay, San Joaquin River | Has overview of how the district functions, what issues they prioritize for projects and monetary benefits assessments. | | | | | ✓ | ✓ | |
| Alameda | Alameda County Public Works Agency | | | Annual Engineer's Report, FY 08-09: Benefit Assessment Program | 5/13/2008 | General Study | San Francisco Bay, San Joaquin River | Has estimated benefits of flood protection provided by the district. Provides estimated cost/area of parcels and equation calculating "benefit" | | | | | ✓ | ✓ | |
| Alameda | Zone 7 Water Agency | | | Conceptual Alternatives Analysis Arroyo de la Laguna Flood Control Project | 10/5/1998 | Arroyo de la Laguna | San Francisco Bay | In considering alternatives, screening matrix takes into account both flood control objectives and cost magnitude (ranked factors) | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| Alameda | City of Livermore | | | Hydrology and Hydraulics El Charro Specific Plan Area | 1/1/2007 | Arroyo Las Positas & Arroyo Mocho | San Francisco Bay | 100-year existing conditions with no levee and with levee failure analysis; floodplain mapping | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| Alameda | USACE | | | Review Plan for Estudillo Canal Flood Risk Management Feasibility Study | 2/1/2009 | Estudillo Canal | San Francisco Bay | Exposure and hazard information | ✓ | | ✓ | | | ✓ | ✓ |
| Alameda | USACE | | | San Lorenzo Creek Flood Control Project General Design Memorandum | 8/1/1958 | San Lorenzo Creek | San Francisco Bay | General hazard information | ✓ | | | | ✓ | ✓ | |
| Alameda | Bay Area Stormwater Management Agencies Association or Regional Water Management Group | | Alameda County Public Works Agency, Contra Costa County FCWCD, Santa Clara Valley Water District, Sonoma County Water Agency, Zone 7 Water Agency, County of San Mateo Public Works, Marin County Flood Control District | SF Bay Area IRWM Plan: Flood Protection and Stormwater Management Component | 3/19/2006 | General Study | San Francisco Bay, San Joaquin River | Several area flood plain maps; discusses flooding history, major flood events and lists some damage costs - by creek | ✓ | | ✓ | ✓ | ✓ | ✓ | |
| Alameda | California State Coastal Conservancy, U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW) | | | South Bay Salt Pond Restoration Project: Flood Analyses Report | 7/1/2006 | South San Francisco Bay: Eden Landing, Alviso, Ravenswood (West Bay) | San Francisco Bay | Different alternatives for management of coastal and fluvial floods and analyzed potential failure, flooding; flood water levels | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| Alameda | Alameda County-Zone 7 | | | Zone 7 Stream Management Master Plan | 8/1/2006 | Arroyo las Positas, Arroyo Mocho, Arroyo del Valle, Niles Canyon and Alameda Creek | San Francisco Bay | | ✓ | ✓ | | | | ✓ | |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpine | Alpine County | | | Alpine County General Plan | 2009 | General Study | North Lahontan and San Joaquin River | Refer To DWR "Flood Awareness Maps" | | | | | ✓ | ✓ | ✓ |
| Alpine | Alpine County | | | Alpine County Natural Hazard Mitigation Plan | N/A | General Study | North Lahontan | Hazard Mitigation Plan | ✓ | | | | | ✓ | |
| Amador | FEMA/Amador County | | Federal Emergency Management Agency | Multi-Hazard Mitigation Plan | August, 2006 | General Study | San Joaquin River | Repetitive Loss Properties, Loading, Vulnerability, Value At Risk | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Butte | Butte County Office of Emergency Services | | Butte County | Butte County Flood Mitigation Plan | 1/1/2006 | General Study | Sacramento River | Lists Critical Facilities in several creeks in the county, estimates repetitive loss claims in several watersheds, estimate costs and total paid; vulnerability and exposure | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| Butte | Federal Emergency Management Agency | | | Flood Insurance Study Butte County, California and Incorporated Areas. | 1/6/2011 | General Study | Sacramento River | Peak Discharge -Frequency for Flood Sources; Hydraulic Study for Flood Sources; Structures Requiring Flood Hazard Revisions; Loading; Flood Profiles | ✓ | | ✓ | | ✓ | | ✓ |
| Butte | USACE | Yes | DWR | Integrated Project Modification Report and Environmental Assessment/Initial Study Murphy Slough, California Habitat Restoration | 12/1/1996 | Murphy Slough | Sacramento River | Hydraulic analysis for Murphy Slough near Chico Landing in Butte County; Flow duration curves for Hamilton and Ord Ferry locations on Sacramento River; Estimates for flow rate and water surface elevation | | | | | ✓ | | |
| Butte | USACE | Yes | USACE | Probable Maximum Flood For Lake Oroville Feather River Basin, California | 10/1/1980 | Feather River | Sacramento River | The report presents a study to estimate hydrograph, loss rate, and base flow based on 1964 storm and flood | ✓ | | ✓ | | ✓ | | ✓ |
| Butte | USACE | Yes | California Reclamation Board, Butte County, and California Department of Transportation | Rock Creek - Keefer Slough Butte County, California Project Study Plan (PSP) | 3/1/1999 | Rock Creek and Keefer Slough | Sacramento River | Lists and describes existing flood control projects and flooding problems | ✓ | | ✓ | | ✓ | | |
| Butte | USACE | Yes | California Reclamation Board | Section 1135 Hydrologic, Hydraulic, and Sediment Yield/Transport Study | 1/1/2003 | Cherokee Canal | Sacramento River | Hydraulic and sedimentation study of Cherokee Canal for 100-yr peak runoff; lists rainfall duration frequency, peak volume and discharge, and sediment loading for 2, 5, 10, 50, and 100 years. | ✓ | ✓ | ✓ | ✓ | | ✓ | |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Butte | Butte County Public Works Department and City of Oroville Department of Public Works | | Butte County Public Works Department | Update of the Thermalito Master Drainage Plans | 5/1/2007 | Thermalito Forebay, Feather River | Sacramento River | Hydrologic rainfall-runoff analysis of estimate stormwater system design runoff for the City of Oroville; estimation of velocity and discharge in the storm drainage system | ✓ | | ✓ | | ✓ | | ✓ |
| Butte, Colusa, Glenn, Tehama | Four County Group (Butte, Colusa, Glenn and Tehama) | | | Northern Sacramento Valley Four County Group Integrated Regional Water Management Plan 2009 Application | 1/1/2009 | Sacramento River, Upper Feather River | Sacramento River | General Risk Management | | | | | ✓ | ✓ | |
| Butte, Sutter | Sutter Butte Flood Control Agency | | | Final Engineer's Report Sutter Butte Flood Control Agency | 7/14/2010 | Feather River | Sacramento River | Consequence, Repetitive Loss, Performance, Hazard, Exposure | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Calaveras | Calaveras County | | Calaveras County Community Development Agency | Calaveras County Public Hearing May 28, 2008 | 5/28/2008 | San Joaquin River | San Joaquin River | General - ordinance outlining flood prevention building standards | | | | | ✓ | ✓ | |
| Calaveras | Calaveras County | | Calaveras County Water District | Calaveras County Water DistrictMulti-Hazard Mitigation Plan | October, 2006 | General Study | San Joaquin River | Repetitive loss properties, loading, vulnerability | ✓ | | ✓ | ✓ | | | |
| Calaveras | Calaveras County | | Calaveras County Planning Department | FEMA Flood Zones In Calaveras County | 2009 | General Study | San Joaquin River | Loading | ✓ | | ✓ | | | ✓ | |
| Colusa | Colusa County Public Works | | | Colusa County General Plan Update Background Report | 6/1/2010 | Sacramento River | Sacramento River | Describes and depicts dam hazards and inundation areas | ✓ | | ✓ | | ✓ | ✓ | |
| Colusa | USACE | Yes | | Office Report. Sacramento River Flood Control Project Colusa Through Drainage Canal California. | 3/1/1993 | Colusa Basin Drainage Canal | Sacramento River | Performance, consequence, cost-benefit | | ✓ | | ✓ | | ✓ | |
| Colusa | Colusa County Public Works | | | Colusa Basin Watershed Assessment | 12/15/2008 | Colusa Basin | Sacramento River | Exposure, general | | | ✓ | | ✓ | ✓ | |
| Colusa | | | | Flood Management, Colusa Basin Watershed Assessment Final | 12/15/2008 | Colusa Basin | Sacramento River | Flood history, flood maps | ✓ | | | | | ✓ | |
| Colusa | Colusa Basin Drainage District | | | Integrated Watershed Management Plan Final Environmental Impact Report and Final Feasibility Study | 1/1/2005 | Colusa Basin | Sacramento River | Historical flood damage, storm return frequency, flood damage assessment, cost benefit analysis | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| Contra Costa | USACE | Yes | | Grayson and Murderers Creeks Feasibility Study Draft Hydraulic Modeling Report for Alternative 14 | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Floodplain maps, annual exceedance probability maps, flow plots | ✓ | | ✓ | | | | |
| Contra Costa | USACE | Yes | | Grayson-Murderer's Creek Flood Damage Reduction Study: Appendix D Environmental | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Tables of environmental parameter criteria for surface water, groundwater, and species | | | | | ✓ | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contra Costa | USACE | Yes | Contra Costa County FCWCD | Lower Walnut Creek General Reevaluation Report Maps | 6/2/2008 | Lower Walnut Creek | San Francisco Bay | Maps, plots, flood frequency curves | ✓ | | | | | ✓ | |
| Contra Costa | USACE | Yes | Contra Costa County FCWCD | Lower Walnut Creek General Reevaluation Report Table 12A | N/A | Lower Walnut Creek | San Francisco Bay | 8-flood series peak flows at selected index points | ✓ | | | | | ✓ | |
| Contra Costa | Contra Costa County | | Contra Costa County Dept of Conservation and Development | Contra Costa County General Plan | 1/18/2005 | General Study | San Francisco Bay, Sacramento River and San Joaquin River | Establishes criteria for flood projects and need for risk assessment to be performed. References information from FEMA maps | | | | | ✓ | | ✓ |
| Contra Costa | Contra Costa County | | | Contra Costa County Hazard Mitigation Plan Update | 5/1/2011 | General Study | San Francisco Bay, Sacramento River and San Joaquin River | County updated their risk assessment support the measurement of "cost-effectiveness" required under FEMA mitigation grant programs. Includes pop. at risk, loading and consequence; Part 2 of report is Risk Assessment | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Contra Costa | Contra Costa County | | | Contra Costa County Hazard Mitigation Plan Update Volume 2: Planning Partner Annexes | 5/2/2011 | General Study | San Francisco Bay, Sacramento River and San Joaquin River | Hazard Mitigation Action Plan matrix, flood hazard boundaries | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Contra Costa | Contra Costa FCWCD | | FEMA | FEMA Region 9 Hydrologic Analyses Contra Costa County, California | 7/1/2011 | Brushy, Frisk, Kellogg and Mt. Diablo, Marsh Wildcat and San Pablo Creeks | San Francisco Bay | | ✓ | | | | | ✓ | |
| Contra Costa | USACE | Yes | | Grayson & Murderer's Creeks Feasibility Study – Phase 1: Hydrology Appendix | 11/1/2005 | Grayson Creek, Murderers Creek | San Francisco Bay | Presents flow frequency curves and hydrographs at study area index points for current without-project conditions for the 50-, 20-, 10-, 4-, -2, 1-, 0.5-, and 0.2-percent exceedance flood events (8-Flood Series) | ✓ | | | | | ✓ | |
| Contra Costa | USACE | Yes | | Grayson & Murderer's Creeks Feasibility Study – Phase 1: Hydraulic Appendix | 1/1/2007 | Grayson Creek, Murderers Creek | San Francisco Bay | Description of flooding along the various study reaches during a 100-year flood event | ✓ | | ✓ | | | ✓ | |
| Contra Costa | USACE | Yes | Contra Costa FCWCD and City of Pleasant Hill | Grayson and Murderer's Creeks, California Feasibility Scoping Meeting (F3) Document | 1/1/2007 | Grayson Creek, Murderers Creek | San Francisco Bay | Identifying problems and needs associated with flooding and related water resource concerns and formulating preliminary alternatives to reduce future flood damages and restore degraded ecosystems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contra Costa | USACE | Yes | | Grayson and Murderers Creeks Contra Costa County, CA: 100-Year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 22 Map: 100-Year Floodplain Depths | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | Yes | | Grayson and Murderers Creeks Contra Costa County, CA: 10-Year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 19 Map: 10-Year Floodplain Depths | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | Yes | | Grayson and Murderers Creeks Contra Costa County, CA: 200-Year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 23 Map: 200-Year Floodplain Depths | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | | | Grayson and Murderers Creeks Contra Costa County, CA: 25-year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 20 Map: 25-year Floodplain Depths | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | | | Grayson and Murderers Creeks Contra Costa County, CA: 500-Year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 24 Map: 500-Year Floodplain Depths | | | | | | | ✓ |
| Contra Costa | USACE | | | Grayson and Murderers Creeks Contra Costa County, CA: 50-Year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 21 Map: 50-Year Floodplain Depths | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | | | Grayson and Murderers Creeks Contra Costa County, CA: 5-Year Computed Floodplain | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Plate 18 Map: 5-Year Floodplain Depths | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | | | Grayson and Murderers Creeks Feasibility Study Draft Hydraulic Modeling Report for Alternative 16 | 7/1//2011 | Grayson Creek, Murderers Creek | San Francisco Bay | Stage and flow hydrographs, peak channel stages in flood damage areas, floodplain mapping | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | | | Grayson and Murderers Creeks Feasibility Study Draft Hydraulic Modeling Report for Beatrice Basin Site Detention Basin Alternative | 8/25/2010 | Grayson Creek, Murderers Creek | San Francisco Bay | Floodplain maps, annual exceedance probability maps, flow plots | ✓ | | ✓ | | | | ✓ |
| Contra Costa | USACE | | | Grayson-Murderer's Creek Flood Damage Reduction Study: Appendix C Economics | 10/1/2006 | Grayson Creek, Murderers Creek | San Francisco Bay | Economic and damage analyses | | | | ✓ | | ✓ | |
| Contra Costa | Contra Costa FCWCD | | City of Pleasant Hill | Grayson's Creek and Murderer's Creek Project | N/A | Grayson Creek, Murderers Creek | San Francisco Bay | Discusses historical flood damage (houses, costs) and proposes project cost | | | | | ✓ | | ✓ |
| Contra Costa | Contra Costa County | | FEMA | Hydrologic Analyses Contra Costa County, California | 7/1/2011 | Brushy, Frisk, Kellogg and Mt. Diablo Creeks, Wildcat and San Pablo Creeks | | Peak discharge probabilities, infiltration rates, lag times, reservoir and reach tables | ✓ | | | | | | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contra Costa | USACE | | Contra Costa County FCWCD | Lower Walnut Creek General Reevaluation Report Hydrology Appendix | 6/1/2008 | Lower Walnut Creek | San Francisco Bay | Presents flow frequency curves for the San Ramon and Walnut Creek stream flow gauges and the development of the general rainflood hydrographs at study area index points for current without-project conditions for the 50, 20, 10, 4, 2, 1, 0.5, and 0.2 percent exceedance floods (8-Flood Series) | ✓ | | | | | ✓ | |
| Del Norte | Del Norte County | | | After Action Report (AAR) Tsunami Advisory issued on February 27, 2010 | 2/27/2010 | Del Norte County, Crescent City | North Coast | Predicted and observed tsunami times and heights | ✓ | | ✓ | | ✓ | ✓ | |
| Del Norte | Crescent City Planning Department | | County of Del Norte | Crescent City / Del Norte County Hazard Mitigation Plan , Volume 1: Planning-Area-Wide Elements | 1/1/2010 | General Study | North Coast | Flood sources in the Klamath Basin and history of flood events, peak discharges for flood sources at 10-, 50-, 100-, 500-year frequencies, count of structures and fractions of land use at risk, value of exposed buildings at 100- and 500-year floodplains, and estimates of 100-year flood loss. | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| Del Norte | Crescent City Planning Department | | County of Del Norte | Crescent City/Del Norte County Hazard Mitigation Plan; Volume 2—Planning Partner Annexes | 1/1/2010 | General Study | North Coast | Natural Hazard Risk Ranking | ✓ | | ✓ | ✓ | | ✓ | |
| Del Norte | Del Norte County | | | Del Norte County General Plan | 1/28/2003 | Smith River, Klamath River, Elk Creek | North Coast | General | | | | | ✓ | ✓ | ✓ |
| Del Norte | County of Del Norte | | County of Del Norte, Community Development Department | Geotechnical Evaluation Report Klamath Glen Levee Evaluation Project Del Norte County California | 5/19/2011 | Klamath River | North Coast | Levee descriptions and past performance; evaluations: embankment and foundation stability - seepage analysis and slope stability analysis, embankment protection, settlement analysis | ✓ | | | | | ✓ | |
| Del Norte | Del Norte County | | | Hazard Areas | 1/1/1983 | Smith River, Klamath River, Elk Creek | North Coast | Consequence, Historical Flooding | | | | ✓ | ✓ | ✓ | |
| Del Norte | Del Norte County | | | Roads with Flooding Issues | 9/13/2011 | | North Coast | Exposure | | | ✓ | | | ✓ | |
| Del Norte, Siskiyou, Humboldt | U.S. Department of the Interior, CDFW | | | Klamath Facilities Removal Public Draft Environmental Impact Statement/ Environmental Impact Report | 9/1/2011 | Klamath River | North Coast | Loading | ✓ | | | | | | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Del Norte, Siskiyou, Humboldt | PacifiCorp | | | Klamath Hydroelectric Project Water Resources Final Technical Report | 2/1/2004 | Klamath River | North Coast | Loading, reservoir capacity, peak flows | ✓ | | | | | ✓ | |
| Del Norte, Siskiyou, Humboldt | PacifiCorp | | | Klamath Hydroelectric Project Water Resources Final Technical Report | 2/1/2004 | Klamath River | North Coast | General, Flood Discussion | | | | | ✓ | ✓ | |
| Del Norte, Siskiyou, Humboldt | PacifiCorp | | | Klamath Hydroelectric Project Socioeconomic Resources Final Technical Report | 2/1/2004 | | North Coast | Regional Demographics | | | ✓ | | | ✓ | |
| Del Norte, Siskiyou, Trinity, Humboldt, Mendocino, Sonoma | North Coast Regional Partnership | | | North Coast IRWM Plan Phase 1 | 7/1/2007 | Noyo River, Big River, Mattole River, Russian River, Salmon Creek | North Coast | General | | | | | ✓ | ✓ | |
| El Dorado | USACE | | | Reconnaissance Report; American River Watershed Investigation, California | 1/1/1988 | American River | Sacramento River | | ✓ | ✓ | ✓ | ✓ | | | |
| Fresno | County of Fresno | | | Fresno County Multi-Hazard Mitigation Plan | April, 2008 | General Study | Tulare Lake and San Joaquin River | Loading, vulnerability, value at risk, policies to reduce risk, 100 and 500 years flood maps, exposure to risk | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Glenn | Glenn County Public Works | | | Hamilton City Flood Damage Reduction Project, Sacramento River, California | 3/1/2008 | Sacramento River | Sacramento River | Loading | ✓ | | | | | ✓ | ✓ |
| Glenn | Resource Agency Department , DWR Northern District | | DWR | Colusa Basin Appraisal | 1990 | Colusa Basin | Sacramento River | Hydrologic Analysis, Exposure, Vulnerability | | | ✓ | | | ✓ | |
| Glenn | Colusa Basin Drainage District | | | Draft Feasibility Report Wilson Creek Dam Glenn County California. | 10/8/1996 | Wilson Creek Dam | Sacramento River | Hydrologic rainfall-runoff analysis to estimate probable maximum flood. | ✓ | | | | | | ✓ |
| Glenn | USACE | | State Reclamation Board of California, Sacramento and San Joaquin River Basins Comprehensive Study and California Bay-Delta Authority | Hamilton City Flood Damage Reduction and Ecosystem Restoration, California. Final Feasibility Report and EIS/EIR Report | 2004 | Hamilton City | Sacramento River | Loading | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| Glenn | Colusa Basin Drainage District | | | Integrated Watershed Management Plan, Final Alternatives Report, Colusa Basin Drainage District | 2003 | Colusa Basin | Sacramento River | Loading, Performance | ✓ | ✓ | | | | ✓ | |
| Glenn | Colusa Basin Drainage District | | | Integrated Watershed Management Plan, Final Environmental Impact Report and Draft Environmental Impact Report | 1/1/2005 | Colusa Basin | Sacramento River | Historical flood damage, storm return frequency, flood damage assessment, cost benefit analysis | ✓ | ✓ | ✓ | ✓ | | | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Glenn | USACE | | | Stony Creek Basin, California. Black Butte Lake Spillway Adequacy Studies | 3/1/1980 | Black Butte Lake | Sacramento River | Hydrologic Analysis, USACE | ✓ | | | | | ✓ | |
| Glenn | Colusa Basin Drainage District | | | Water Management Program, Phase Ii Watershed Priority Ranking Assessment Study | 2/1/1995 | Colusa Basin | Sacramento River | Identify flood-prone areas; estimates 10, 25, 100 years peak flows; provide Historical Flood Zone Maps | ✓ | | ✓ | | ✓ | | ✓ |
| Humboldt | Humboldt County | | | Community Infrastructure & Services Technical Report | 7/1/2008 | | North Coast | Exposure, Vulnerability, Performance, Loss Stats | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Humboldt | FEMA | | | Flood Insurance Study Humboldt County, California | 8/7/2009 | General Study | North Coast | Hydrology and Hydraulic study, Loading | ✓ | | ✓ | | | ✓ | |
| Humboldt | Humboldt County | | | Humboldt 2025 General Plan Update, Natural Resources and Hazards, Volume II: Detailed Watershed Characteristics and Regulatory Framework Analysis | 9/1/2002 | | North Coast | General, Historical Flooding | ✓ | | | | ✓ | ✓ | |
| Humboldt | Humboldt County | | | Humboldt County General Plan Update Natural Resources and Hazards, Chapter 11 Floods | 11/20/2008 | Eel River, Van Duzen River, South Fork Eel River, Mad River, Jacoby Creek, Freshwater Creek, Trinity River | North Coast | Loading, Historical Flooding | ✓ | | | | ✓ | ✓ | ✓ |
| Humboldt | Humboldt County | | | Humboldt County General Plan Update Natural Resources and Hazards, Chapter 3 Water Resources | 11/20/2008 | Eel River, Van Duzen River, South Fork Eel River, Mad River, Jacoby Creek, Freshwater Creek, Trinity River | North Coast | Historical Floods, General | ✓ | | | | ✓ | ✓ | |
| Humboldt | Humboldt County | | | Humboldt County General Plan Update Planning Commission Hearing Draft | 11/20/2008 | | North Coast | General and Historical Flooding | | | | | ✓ | ✓ | |
| Humboldt | Humboldt County | | | Local Coastal Plans Issue Identification Report | 9/1/2003 | Eel River, Mad River, Eureka Plain, Jacoby Creek, Redwood Creek | North Coast | General | | | | | ✓ | ✓ | ✓ |
| Humboldt | Humboldt County | | | Levee Operations & Maintenance Annual Report, Redwood Creek Levee System | 8/18/2010 | Redwood Creek | North Coast | General, O&M, Loading | ✓ | | | | ✓ | ✓ | |
| Imperial | Imperial County | | USACE | Flood Plain Information New River Vicinity of Brawley Imperial County, CA | 7/1/1976 | New River | Colorado River | Flood history, hazards/impacts, maps, frequency, velocities, flows, water levels, forecasts | ✓ | | ✓ | ✓ | | | ✓ |
| Imperial | Imperial County | | Imperial County | Imperial County Flood Management Plan | 4/1/2007 | Colorado River, Myer Creek, Alamo River, New River, Salton Sea | Colorado River | Complete Risk Evaluation | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Imperial | Imperial County | | Imperial Irrigation District | Imperial Irrigation District Integrated Water Resources Management Plan | 9/1/2009 | General Study | Colorado River | Description of current flood control measures | ✓ | | ✓ | | ✓ | ✓ | |
| Inyo | Inyo County | | Los Angeles County Department of Public Works (LACDPW) | Application for CA Disaster Assistance Act Program - Los Angeles Aqueduct Damage Work | 9/30/2004 | Los Angeles Aqueduct | South Lahontan | Performance, Consequence/Cost | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Inyo | Los Angeles Department of Water and Power | | Inyo County | Bishop Creek below Plant #6. | 9/28/2011 | Bishop Creek | South Lahontan | Loading - Historic, Monthly historical flow data from 1920 to 2010 | ✓ | | | | ✓ | ✓ | |
| Inyo | State of California Office of Emergency Services | | Inyo County | Exhibit "B" List of Projects. Federal Public Assistance Program/State Natural Disaster Assistance Act, Disaster 2003-02 at LA Aq. - Olancha storm drainage | 1/1/2003 | Los Angeles Aqueduct | South Lahontan | Cause of flooding and location of exposure | ✓ | | ✓ | | ✓ | ✓ | |
| Inyo | Inyo County | | DWR | Report on Oak Creek mud/debris flow | 7/28/2008 | Oak Creek | South Lahontan | Performance, Exposure, minor future planning | | ✓ | ✓ | | | ✓ | ✓ |
| Inyo | Inyo County | | LACDPW | Scope of Work – Storm Damage to the Los Angeles Aqueduct, August 2000. Application for Assistance | 8/15/2004 | Los Angeles Aqueduct | South Lahontan | Performance, Consequence/Cost | | ✓ | | ✓ | | ✓ | |
| Inyo | Inyo County | | LACDPW | Storm Damage to the Los Angeles Aqueduct. Application for Assistance CDAA-2003-02 | 7/31/2003 | Los Angeles Aqueduct | South Lahontan | Performance, Consequence/Cost | | ✓ | | ✓ | | ✓ | |
| Kern | USACE | | USACE Los Angeles District | Antelope Valley California. Hydraulic Investigation for Feasibility Studies of the Los Angeles County Department of Public Works. Master Drainage Plan | 11/1/1986 | Big Rock Creek, Little Rock Creek, Anaverde Creek, Amargosa Creek, Portal Ridge Wash, Fairmont Wash, Pearland | South Lahontan | Total discharges; exceedance intervals for 25-, 50-, 100-year floods, drainage boundary maps | ✓ | | ✓ | | | ✓ | ✓ |
| Kern | Kern County Water Agency | | | Cooperative Stream Gauging Program. A compilation of Peak Discharge Data on Selected Streams. 1958 - 1983. | 10/1/1983 | | Tulare lake | Description of historical flood events; summaries of peak discharge data | ✓ | | ✓ | | | ✓ | |
| Kern | Kern County Water Agency | | DWR | Draft Poso Creek Hydrology Report | 7/16/2001 | Poso Creek | Tulare Lake | Loading | ✓ | | | | | ✓ | ✓ |
| Kern | USACE | | | Isabella Dam and Lake, Kern River Basin, California. Spillway Adequacy Study | 6/1/2003 | Kern River | Tulare lake | Historical flood analysis; probably maximum flood; unit hydrograph, peak flows and volumes | ✓ | | ✓ | | | ✓ | |
| Kern | Kern County Water Agency | | FEMA | Kern County Flood Insurance Study Hydrology Report | 8/1/1988 | Bodfish Creek | Tulare Lake | Loading, Exposure | ✓ | | ✓ | | | | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kern | Kern County Water Agency | | Kern County Water Agency | Kern County, California Multi-Hazard Mitigation Plan | 11/1/2005 | General Study | Tulare lake | Summary of significance of flood hazard; summary table of losses due to historical flood event; description of mitigation projects | ✓ | | ✓ | ✓ | | | ✓ |
| Kern | Kern County Water Agency | | Kern County Water Agency | Kern IRWM Plan Project List | 7/21/2009 | General Study | Tulare lake | Lists flood mitigation and flood control plans | | | | | ✓ | | ✓ |
| Kern | Kern County Water Agency | | Kern County Water Agency | Kern River Basin Investigation, California. Stage 2 Report. | 3/1/1981 | Kern River | Tulare lake | Description of flood hazards and loading, flood control management measures; reservoir design data | ✓ | | | | ✓ | | ✓ |
| Kern | Kern County Water Agency | | Kern County | Lake Isabella Dam Failure Evacuation Plan | 12/1/2009 | Lake Isabella | Tulare Lake | Hazard, Performance, Exposure, Consequence | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Kern | U.S. Department of Agriculture Forest Service Burned Area Emergency Rehabilitation | | | McNally Post-Fire Discharge and the Relationship of Sierra Nevada-wide Flood Frequency Curves and Local Kern River Discharge Curves | N/A | Kern River | Tulare lake | Flood frequency curves and hydrographic physiographic discharge curves, and the relationship between the two | ✓ | | | | | | ✓ |
| Kern | Kern County Water Agency | | | Procedure for Derivation of Flood Peaks, Hydrologic Areas II and III, Kern County California. | 4/1/1978 | General Study | Tulare lake | Frequency discharge curve | ✓ | | | | | | ✓ |
| Kern | Kern County Water Agency | | | Report of Special Benefit Assessment for Improvement District No. 3. Operation and Maintenance of Kelso Creek Levees | 6/1/2011 | Kelso Creek | Tulare lake | Average annual maintenance, repair, and administration costs of the levee; flood history; | ✓ | | ✓ | ✓ | | ✓ | |
| Kern | USACE | | | Rosamond Lake Basin Hydrology Report | 8/1/1994 | Rosamond Lake | South Lahontan | Discussion of flood history, stage-frequency relationship for storm events of 10-, 50-, 100-, and 200-year frequencies; elevation capacity curves | ✓ | | ✓ | | | ✓ | |
| Kings | USACE | | Kings County | Central Valley River Basins Enhanced Flood Response and Emergency Preparedness. Preliminary Draft Feasibility Report, Preliminary Draft Environmental Assessment/Initial Study | 6/25/1905 | Kings River | Tulare Lake | Dated | | | | | | | |
| Kings | U.S. Bureau of Reclamation, DWR | | | Upper San Joaquin River Basin Storage Investigation. Initial Alternatives Information Report. Main Report. | 6/1/2005 | Kaweah River, Yohohl Creek, Kings River, Big Dry Creek, Dinkey Creek, Mill Creek | Tulare Lake | Historical flood damage; evaluation of flood management; | ✓ | ✓ | | ✓ | | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lake | USACE | | | Middle Creek Ecosystem Restoration Reconnaissance Study | 5/1/1997 | Middle Creek | Sacramento River | Exposure | | | ✓ | | | ✓ | |
| Lake | USACE | | | Reconnaissance Report Cache Creek Basin (Lake County), California | 10/1/1992 | Clear Lake, Thurston Lake | Sacramento River | Loading, performance, exposure, consequence | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Lassen | City of Susanville | | | Chapter 15.40 Floodplain Management | Not Available | | North Lahontan | Outlining responsibilities, code | | | | | ✓ | ✓ | |
| Lassen | Lassen County, City of Susanville, and Susanville Indian Rancheria | | Lassen County | Multi-Jurisdictional Hazard Mitigation Plan | 10/1/2010 | Susan River, Honey Lake | North Lahontan, Sacramento River | Vulnerability, consequence | ✓ | | ✓ | ✓ | | ✓ | |
| Lassen | USACE | | | Susanville, Lassen County California, Flood Insurance Study Hydrology | 3/1/1983 | Susan River | North Lahontan | USACE - Flow frequency curves | ✓ | | | | | ✓ | |
| Los Angeles | Los Angeles County Flood Control District | | | 1983 Los Angeles County Storm Report | 6/1/1983 | All streams within Los Angeles County | South Coast | Isohyetal map, storm-damage areas map, hydrographs, storm intensities, and frequencies, peak flows | ✓ | | ✓ | | | ✓ | |
| Los Angeles | LACDPW | | | Chronology of Important Events in Flood Control, Water Supply, and Conservation. | 1/1/1995 | All streams within Los Angeles County | South Coast | Timeline describing impact of floods | ✓ | | | ✓ | | ✓ | |
| Los Angeles | City of Palmdale | | City of Palmdale | City of Palmdale Master Plan of Drainage Update | 8/1/1996 | General Study | South Lahontan | Refers to existing floodplain and hydrology reports, proposed projects, Loading, Exposure | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Los Angeles | LACDPW | | FEMA | Federal Emergency Management Agency NFIP Insurance Report | 2/29/2011 | General Study | South Coast and South Lahontan | Insurance report of losses | | | | ✓ | | ✓ | |
| Los Angeles | USACE | | | Flood Control by the USACE in the Los Angeles River Basin California | 2/1/1946 | Los Angeles River | South Coast | Description of flood history hazards and losses; description of flood control project details (dimensions and capacities); summary of hydrology | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Los Angeles | LACDPW | | LACDPW | Flood Control District after Consolidation into Department of Public Works | 1/2/2011 | All streams within Los Angeles County | South Coast | Description of flood history and flood control projects | ✓ | | | | ✓ | ✓ | |
| Los Angeles | USACE | | | Flood Control in the Los Angeles County Drainage Area | 5/1/1938 | All streams within Los Angeles County | South Coast | Areas subject to hazard, isohyetals, flood history and peak discharges, description of loss due to historical floods; flood control measure data | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Los Angeles | U.S. Geological Survey (USGS) | | Azusa Public Works Department, Glendora Public Works Department, Los Angeles County Fire Department | Flood of January 1969 Near Azusa and Glendora, California | 1/1/1971 | San Gabriel River, Little Dalton Creek (Wash), | South Coast | Map of 1969 Azusa/Glendora flood; flood heights, discharge, frequency and depths | ✓ | | ✓ | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles | USGS | | Garden Grove Subdistrict | Flood of January 1969 Near Cucamonga, California | 1/1/1971 | Cucamonga Creek, Deer Creek, Day Creek, Etiwanda Creeks | South Coast | Map of flood 1986 Cucamonga flood; flood heights, discharge, frequency and depths | ✓ | | ✓ | | | ✓ | |
| Los Angeles | LACDPW | | | Floodplain Management Plan For Repetitive Loss Properties Progress Report for 2012 | 8/18/2011 | General Study | South Coast and South Lahontan | Repetitive Loss Properties | | | | ✓ | | ✓ | |
| Los Angeles | LACDPW | | USGS | Floods of February 1980 in Southern California and Central Arizona | 1/1/1991 | General Study | South Coast and South Lahontan | Performance, Loading | ✓ | ✓ | | | | ✓ | |
| Los Angeles | USGS | | USGS | Historic Flooding in the San Fernando Valley 1934 to 1956 | 1/1/1956 | Los Angeles River, Tujunga Wash, Dayton Creek, Caballero Creek, Bull Creek, Pacoima Wash, Verdugo Wash | South Coast | Maps of historical flooding 1894 to 1956 | ✓ | | | | | ✓ | |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Big Dalton Debris Basin | 8/1/1973 | Big Dalton Wash | South Coast | Map of inundated area | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Big Tujunga Map | 8/1/1973 | Tujunga Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Cogswell Dam | 8/1/1973 | West Fork San Gabriel River | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Devil's Gate Dam | 8/1/1973 | Arroyo Seco Channel, Flint Canyon Channel, Paradise Canyon Channel | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Eaton Wash Dam | 8/1/1973 | Eaton Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Laguna Regulation Basin | 8/1/1973 | Los Angeles River | South Coast | Map of inundated area. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Little Dalton Debris Basin | 8/1/1973 | Little Dalton Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Live Oak Dam | 8/1/1973 | Live Oak Canyon Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Morris Dam | 8/1/1973 | San Gabriel River | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Pacoima Dam | 8/1/1973 | Pacoima Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Puddingstone Dam | 8/1/1973 | Puddingstone Channel, Marshall Canyon, Emerald Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Puddingstone Diversion | 8/1/1973 | Puddingstone Channel | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for San Dimas Dam | 8/1/1973 | San Dimas Canyon Channel | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for San Gabriel Dam | 10/1/1995 | San Gabriel River | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Santa Anita Dam | 8/1/1973 | Santa Anita Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Santa Anita Debris Basin | 1/1/1974 | Santa Anita Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Sawpit Dam | 8/1/1973 | Sawpit Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Sawpit Debris Basin | 1/1/1974 | Sawpit Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Sierra Madre Dam | 8/1/1973 | Sierra Madre Villa Channel | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Inundated Area for Thompson Creek Dam | 8/1/1973 | Thompson Creek | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | Los Angeles County Flood Control District | | | Inundation Area for Big Dalton Dam | 8/1/1973 | Big Dalton Wash | South Coast | Map delineating the area of potential flooding in the event of a sudden or total failure of the dams | | | ✓ | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles | LACDPW | | | Inundation Map Risk for Big Tujunga, Santa Anita, and Puddingstone Dams | 1/2/2011 | Big Tujunga Wash, Santa Anita Wash, Puddingstone Wash | South Coast | Inundation area; vulnerability | ✓ | | ✓ | | | ✓ | |
| Los Angeles | LACDPW | | | LACDPW Flood Photos | 1/1/1969 | Santa Clara River, Tujunga Wash, Cogswell Dam | South Coast | Photos of flood damage | | | | ✓ | | ✓ | |
| Los Angeles | USACE | | | Los Angeles County Drainage Area Flood Control | 6/1/1940 | All streams within Los Angeles County | South Coast | Physical damage and danger to life, flood control history, brief description of flood control projects | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | USACE | | | Los Angeles County Drainage Area Feasibility Study Final Report | 8/1/1989 | Los Angeles River, San Gabriel Rivers | South Coast | Describes flood hazards and damages, flood levels of protection for different alternatives; benefit-to-cost ratios | ✓ | ✓ | ✓ | | | | ✓ |
| Los Angeles | USACE | | | Los Angeles County Drainage Area Feasibility Study Final Report Appendix B Hydraulics | 12/1/1991 | Los Angeles River, Tujunga Wash, San Gabriel River, Rio Honda | South Coast | Flood insurance rate maps, channel capacities, maximum-non damaging discharge, overflow depths with and without project | ✓ | | | | | ✓ | ✓ |
| Los Angeles | USACE | | | Los Angeles County Drainage Area Final Feasibility Interim Report | 12/1/1991 | All streams within Los Angeles County | South Coast | Flood history; simulation - discharge frequency results; levee failure analysis; 100-yr flood map; discharge frequency analyses | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Los Angeles | USACE | | | Northern Los Angeles County Reconnaissance Flood Control Study | 7/1/1995 | Amargosa Creek, Anaverde Creek, Little Rock Creek, Big Rock Creek, Portal Ridge Wash, Fairmont Channel | South Coast | Floodplain maps, flood history and damages, discharges and volumes, exceedance curves | ✓ | | ✓ | ✓ | | ✓ | |
| Los Angeles | LACDPW | | Los Angeles County Flood Control District | Pacoima Dam Inundated Area within San Fernando City | 8/1/1973 | Pacoima Wash | South Coast | Map of inundated area and time between dam failure and arrival of first water. | ✓ | | ✓ | | | ✓ | ✓ |
| Los Angeles | LACDPW | | #N/A | Photograph 10 – January 22, 1969 | 1/22/1969 | Glencoe Canyon | South Coast | Photo showing damage/impacts of flood | | | ✓ | | | | |
| Los Angeles | LACDPW | | #N/A | Photograph 25 – January 22, 1969 | 1/22/1969 | Hook Canyon | South Coast | Photo showing damage/impacts of flood | | | ✓ | | | | |
| Los Angeles | LACDPW | | #N/A | Photograph 48 – February 25, 1969 | 2/25/1969 | Big Tujunga Wash | South Coast | Photo showing damage/impacts of flood | | | ✓ | | | | |
| Los Angeles | LACDPW | | #N/A | Photograph 50 – February 25, 1969 | 2/25/1969 | Big Tujunga Wash | South Coast | Photo showing damage/impacts of flood | | | ✓ | | | | |
| Los Angeles | LACDPW | | #N/A | Photograph 54 – February 25, 1969 | 2/25/1969 | Bouquet Canyon Creek | South Coast | Photo showing damage/impacts of flood | | | ✓ | | | | |
| Los Angeles | LACDPW | | #N/A | Photograph 55 – February 25, 1969 | 2/27/1969 | Castaic Creek | South Coast | Photo showing damage/impacts of flood | | | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles | LACDPW | | LACDPW | Upper Santa Clara River Integrated Regional Water Management Plan | 6/1/2008 | Santa Clara River | South Coast | Description of historical flood events and damages; flood plain maps | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| Madera | Madera County | | Madera County | Final Plan Local Hazard Mitigation Plan, Madera County, California. | February, 2011 | General Study | San Joaquin River | Vulnerability, exposure | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Marin | City of Sausalito | | City of Sausalito | Gate 5 Road Area Conceptual Drainage Study | 4/1/2011 | General Study | San Francisco Bay | | ✓ | | ✓ | | | ✓ | ✓ |
| Marin | USACE | | | Las Gallinas Creek Hydrologic Analysis South Fork Drainage Basin Final Report | 5/1/2009 | Las Gallinas Creek | San Francisco Bay | | ✓ | | | | | ✓ | ✓ |
| Marin | Marin County FCWCD | | | Lower Vineyard Creek Flood Conveyance Assessment | 9/1/2006 | Novato Creek | San Francisco Bay | Hazard, exposure | ✓ | | ✓ | | | ✓ | ✓ |
| Marin | Marin County | | Marin County | Lower Vineyard Creek Flood Conveyance Assessment: Appendix A: Reach C Modified Cross-Sections; and Appendix B: KHE Letter to Marin County Department of Public Works | 9/1/2006 | Lower Vineyard Creek | San Francisco Bay | | ✓ | | ✓ | | | ✓ | |
| Marin | Marin County | | Marin County Sheriff Office of Emergency Services | Marin County Operational Area Hazard Mitigation Plan | 4/1/2006 | General Study | San Francisco Bay | Historical flooding information - losses, area, total repetitive flood loss, dam failure inundation area | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| Marin | Marin County FCWCD | | | Marin Countywide Plan: Flooding Technical Background Report | 11/1/2005 | Countywide | San Francisco Bay | Hazard, exposure | ✓ | ✓ | | | | ✓ | |
| Marin | USACE | | | Site Observations to Las Gallinas Levee System - Las Gallinas Flood Control Project | 1/1/2006 | Las Gallinas Creek | San Francisco Bay | | | | ✓ | | | | |
| Marin | Town of Corte Madera | | | Town-Wide Storm Drainage and Flood Control Study Phase 1 | 5/1/2007 | Town-wide | San Francisco Bay | | ✓ | | ✓ | | | ✓ | ✓ |
| Marin | Marin County | | Department of Public Works, FCWCD | West Creek Drainage Improvement Assessment - Tiburon, California | 7/1/2006 | West Creek | San Francisco Bay | Hydrologic/Hydraulic Analysis, Loading, Exposure | ✓ | | ✓ | | | ✓ | ✓ |
| Mariposa | USACE | | | Flood-Control Reservoir Operation, Merced River Basin, California | 12/1/1959 | Merced River | San Joaquin River | This report presents the basic flood-control operation criteria for proposed reservoirs on Merced River, a major tributary of San Joaquin River, California. | ✓ | ✓ | ✓ | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mariposa | FEMA | | | Flood Insurance Study, Mariposa County California and Incorporated Areas | 6/12/1905 | General Study | San Joaquin River | Hydrology/hydraulic analysis, loading | ✓ | | | | | | |
| Mariposa | FEMA | | USACE | Rain Flood Flow Frequency Analysis | 1999 | Merced River | San Joaquin River | Hydrologic analysis, loading, performance, frequency curves | ✓ | ✓ | | | | ✓ | ✓ |
| Merced | Merced County Public Works | | | Feasibility Study - Black Rascal Creek Flood Control Project | 6/1/2008 | | San Joaquin River | Project-specific hydrologic analysis | ✓ | | | | | ✓ | |
| Merced | USACE | | USACE | Flood Control Hydrology, Merced River Basin, California. | February, 1959 | Merced River | San Joaquin River | USACE - flow frequency curves, probable maximum floods | ✓ | | ✓ | ✓ | | ✓ | |
| Merced | Merced County Public Works | | USACE | Review Report For Flood Control on Merced County Streams California | 6/1/1969 | | San Joaquin River | Hydrologic/hydraulic analysis, some vulnerability info. | ✓ | ✓ | ✓ | | | | |
| Modoc | FEMA | | | Flood Insurance Study Modoc County, California | 6/12/2009 | General Study | North Coast, Sacramento River and North Lahontan | Hydrology and hydraulic study, loading | ✓ | | | | | ✓ | |
| Mono | Mono County Public Works | | USACE | Walker River Basin Hydrology and Baseline Resources. Hydrology Review Memorandum | 9/1/1997 | Walker River Basin | North Lahontan | USACE, flow data, frequency curves, hydrographs | ✓ | | | | | ✓ | ✓ |
| Monterey | Monterey County Water Resource Agency (MCWRA) | | Big Sur Land Trust | Big Sur Land Trust Carmel River Floodplain Restoration and Environmental Enhancement Project Initial Study - Draft | 2/1/2011 | Carmel River | Central Coast | Discusses qualitative risk factors of project (significant to no impact) largely related to construction of project, not flood benefits | ✓ | | | | ✓ | ✓ | |
| Monterey | Monterey County | | | Figure E-7. Flood Hazard Areas Map | 10/1/2005 | Monterey Bay | Central Coast | Shows flooding area and it covers majority of some city areas | | ✓ | ✓ | | | ✓ | |
| Monterey | Monterey Peninsula Water District | | | Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon | 4/17/2007 | Carmel River State Beach and Lagoon | Central Coast | Discusses plan to study risk to surrounding infrastructure due to proposed project | | | | | ✓ | ✓ | |
| Monterey | MCWRA | | | Flood Insurance Study | 4/2/2009 | Countywide | Central Coast | | ✓ | ✓ | ✓ | | | ✓ | |
| Monterey | | | | Monterey County Floodplain Management Plan | 1/1/2008 | Countywide | Central Coast | Countywide information on hazard, exposure, repetitive loss and performance of flood systems | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monterey | Monterey County Office of Emergency Services | | Monterey County | Monterey County Multi-Jurisdictional Hazard Mitigation Plan | 9/1/2007 | General Study | Central Coast | Presents historical flooding and damage info (i.e., number of residencies, businesses affected, etc.). Damage/Hazard Vulnerability of 100-yr flood hazard available in Table 6-3, 6-5 and in Flood section. Population, number of buildings affected, type and valuation, and critical facilities/transportation damage (length, cost) | ✓ | | ✓ | | ✓ | | |
| Monterey | Monterey County | | Monterey Peninsula Water Management District, Big Sur Land Trust, Monterey County Water Resources Agency, Monterey Regional Water Pollution Control Agency, California American Water, Carmel River Watershed Conservancy, Monterey County Service Area 50, MCWRA, California State University, Monterey Bay, City of Monterey, City of Pacific Grove, City of Seaside, Monterey Bay National Marine Sanctuary | Monterey Peninsula, Carmel Bay, and South Monterey Bay IRWM Plan | 11/19/2007 | General study | Central Coast | Discusses general historical damage information, no valuation | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Monterey | Watershed Institute at California State University Monterey Bay | | Monterey County | Pajaro River Watershed Flood Protection Plan | 7/22/2003 | Pajaro River | Central Coast | Brief discussion of pop. affected historically by flood in watershed | | | | | ✓ | ✓ | |
| Monterey | Pajaro River Watershed Flood Prevention Authority | | Monterey County | Phase 2 Pajaro River Watershed Study | 4/1/2003 | Pajaro River | Central Coast | Provides percentage of protection per each project alternative. No valuation, discussion of specific damage, cost-benefit | ✓ | | ✓ | | ✓ | ✓ | |
| Napa | Napa County | | City of Napa | City of Napa After-Incident Report - Flood of Dec. 2002 | 12/16/2002 | Napa Creek | San Francisco Bay | Attachment C has table of historic floods, available peak depths and damage costs, loading | ✓ | | | | | ✓ | |
| Napa | Napa County PW | | City of Napa | City of Napa Flood Insurance Study Hydrologic Engineering Report Napa River | 12/1/1985 | Napa River | San Francisco Bay | Flow frequency information | ✓ | | | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Napa | Peter A. and Venice H. Gasser Foundation | | | FEMA Letter of Map Revision Submittal, Napa Flood Protection Project - Interim Conditions, Napa River, Tulucay Creek, and Napa Creek | 4/1/2008 | Tulucay Creek and Napa Creek | San Francisco Bay | Changes from FEMA map revision and areas exposed | ✓ | | ✓ | | | ✓ | |
| Napa | Napa County Public Works | | City of Napa | Memorandum for Record Napa Creek - Hydrologic and Hydraulic Analysis of Historic Events | 9/8/2006 | Napa Creek | San Francisco Bay | Historic flood information | ✓ | | | | | ✓ | |
| Napa | Napa County Public Works | | Napa County Resource Conservation District | Napa Creek Hydrology Project | 6/1/2001 | Napa Creek | San Francisco Bay | Historic and hazard info | ✓ | | | | | ✓ | |
| Napa | Napa County Public Works | | Napa County FCWCD | Napa Record of Flood Events | 2/2/2012 | Napa River | San Francisco Bay | | ✓ | | | | | ✓ | |
| Napa | Napa County | | Napa County FCWCD | Napa River Flood Control Project General Memo. | 9/1/1975 | Napa River | San Francisco Bay | Cost-benefit, monetized on page h (pdf pg. 66) | | | | | ✓ | ✓ | |
| Napa | Napa County | | | Napa River Project Report, Chapter 10 - Existing Floodplain Analysis | 10/1/1998 | Napa River | San Francisco Bay | Discusses briefly historical flood damages, some cost estimate of damages and depth of flood waters of varying magnitude (35-year to 100-year floods) | ✓ | | | | | ✓ | |
| Napa | Napa County | | | Napa River Project Report, Chapter 17 - Interior Flood Reduction Facilities | 10/1/1998 | Napa River | San Francisco Bay | Table 17-2 includes "acres flooded" and "damage elevation" for floods of varying freq. (25-yr to 100-yr flood elevations) | ✓ | | ✓ | | | ✓ | |
| Napa | Napa County | | | Napa River/Napa Creek Flood Protection Project | 10/1/1998 | Napa River and Napa Creek | San Francisco Bay | Discusses briefly historical flood damages, some cost estimate of damages | | | | | ✓ | ✓ | |
| Napa | Napa County | | Napa County Flood Protection and Watershed Improvement Authority | Ordinance Measure A for Napa County Flood Control | 10/28/1998 | General Study | San Francisco Bay and Sacramento River | Discusses briefly historical flood damages, some cost estimate of damages | | | | | ✓ | ✓ | |
| Orange | Santa Ana Watershed Project Authority (SAWPA) | | City of Riverside, City of San Bernardino, County of Orange Resources & Development Management Department, Orange County Sanitation District, Orange County Water District, Riverside County FCWCD, San Bernardino County Flood Control District, and SAWPA; USFWS, CDFW, the Regional Board, Riverside-Corona Resource Conservation District, and the City of Corona | 2010 Integrated Regional Water Management Plan, Santa Ana Watershed Protection Agency | 1/1/2010 | All streams in Santa Ana River Watershed | South Coast | Map of 100-year flood zone; overview of flood events | ✓ | | | | ✓ | | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Orange | Orange County Public Works Flood Control Division | | | Areas of Historical Flooding Map | 9/1/2011 | Silverado Canyon, Trabuco Canyon Creek, Toro Creek, Modjeska Canyon | South Coast | Map of areas of historical flooding - shows flood locations and 100-year floodplain | ✓ | | | | | ✓ | |
| Orange | Orange County Public Works Flood Control Division | | Orange County | County of Orange Hazard Mitigation Plan | 9/1/2010 | General Study | South Coast | Hazard, vulnerability, consequence, performance - complete risk | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Orange | Orange County Public Works | | Orange County Flood Control District | Draft Environmental Impact Report for Haster Basin and Recreational Field Project (EIR 609), Volume I | 3/1/2011 | Wintersburg Channel | South Coast | Description of hazards associated with the location of the basin; FEMA floodplain map ID | ✓ | | ✓ | | ✓ | ✓ | |
| Orange | Orange County Public Works | | | DWR SFMP, Number of Deficient Under Crossings | 10/12/2011 | All streams in Orange County | South Coast | Number of Deficient Under Crossings | ✓ | | | | | ✓ | |
| Orange | FEMA | | | Federal Emergency Management Agency NFIP Insurance Report for Orange County | 9/16/2011 | All streams in Orange County | South Coast | Insurance/Loss | | | | ✓ | | ✓ | |
| Orange | Orange County Flood Control District | | USACE | Flood Plain Information Aliso Creek Orange County California | 3/1/1973 | Aliso Creek | South Coast | Description of flood events and characteristics, impacts; future flood hazards, damages, areas, and velocities and flows | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Orange | Orange County Flood Control District | | USACE | Flood Plain Information Laguna Canyon, Orange County, California | 3/1/1969 | Laguna Canyon | South Coast | Description of historical flood events and current conditions - flood discharges and areas; future flood frequencies and hazards, velocities, and flows | ✓ | | ✓ | | | | ✓ |
| Orange | Orange County Flood Control District | | USACE | Flood Plain Information Lower Santiago Creek Orange County California | 6/1/1973 | Santiago Creek | South Coast | Description of flood events and characteristics, impacts; future flood hazards, damages, areas, and velocities and flows | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Orange | Orange County Flood Control District | | USACE | Flood Plain Information San Diego Creek and Peters Canyon Wash Orange County California | 6/1/1972 | San Diego Creek, Peters Canyon Wash | South Coast | Description of flood events and characteristics, impacts; future flood hazards, damages, areas, and velocities and flows | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Orange | USACE | | USGS Division of Highways, Orange County Flood Control District, et al. | Flood Plain Information San Juan Creek Orange County California | 11/1/1970 | San Juan Creek | South Coast | Flooded area, flood profiles and cross; flood history - peak discharges and loss; future floods - hazards, area of flooding | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Orange | Orange County Flood Control District | | USACE | Flood Plain Information Santa Ana River, Imperial Highway to Prado Dam, Orange and Riverside Counties California | 6/1/1971 | Santa Ana River | South Coast | Description of flood events and characteristics, impacts; future flood hazards, damages, areas, and velocities and flows | ✓ | | ✓ | ✓ | | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Orange | Orange County Flood Control District | | USACE | Flood Plain Information Upper Peters Canyon Wash Orange County California | 6/1/1974 | Peters Canyon Wash | South Coast | Description of flood events and characteristics, impacts; future flood hazards, damages, areas, and velocities and flows | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Orange | USGS | | National Oceanic and Atmospheric Administration | Floods of February 1980 in Southern California and Central Arizona | 2/1/1980 | All streams in Orange County | South Coast | Flood history; damage; recurrence intervals of peak discharge; summary of flood stages and discharges | ✓ | | ✓ | ✓ | | ✓ | |
| Orange | Orange County Public Works Flood Control Division | | USACE | Laguna Canyon Channel Hydraulic and Sediment Transport Analysis | 7/17/2001 | Laguna Canyon Channel | South Coast | Hydraulic Analysis | | ✓ | | | ✓ | ✓ | ✓ |
| Orange | Orange County Public Works Flood Control Division | | Orange County | San Juan Creek Watershed Management Study, Feasibility Phase, F-5 Report | 8/1/2002 | San Juan Creek | South Coast | Hydrology/Hydraulic Analysis, Loading, Vulnerability, Damage Valuation | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Placer | Placer County FCWCD | | Placer County FCWCD | Auburn Ravine, Coon, and Pleasant Grove Creeks Flood Mitigation, Vol. 1 | 6/1/1993 | Auburn Ravine, Coon Pleasant Grove Creeks | Sacramento River | Hydrologic/Hydraulic Analysis, Stage and Flow curves. | ✓ | | ✓ | | | ✓ | |
| Placer | Placer County FCWCD | | Placer County FCWCD | Risk Database and Mapping for Placer Co. and City of Roseville | 10/18/2011 | Portion of County | Sacramento River | Map and spreadsheet identifying properties in the 100- and 500-yr floodplain | | | ✓ | | | ✓ | |
| Placer | Placer County FCWCD | | | American River IRWM Plan | 6/1/2006 | Portion of County | Sacramento River | Qualitative Flood benefits | | | | ✓ | ✓ | | ✓ |
| Placer | USACE | | | Documentation Report, Dry Creek (Roseville),California Interim Investigation | March, 1990 | Dry Creek, Linda Creek | Sacramento River | USACE | ✓ | | | ✓ | | ✓ | ✓ |
| Placer | USACE | | | Draft Feasibility Report, Dry Creek (Roseville), California. Interim Investigation | 1988 | Dry Creek | Sacramento River | Loading, Hydrologic/Hydraulic Analysis | ✓ | | | ✓ | | ✓ | ✓ |
| Placer | Placer County FCWCD | | | Draft Report Dry Creek Watershed Flood Control Plan | June, 1991 | Dry Creek | Sacramento River | Hydrologic Analysis, Loading | ✓ | | | | | ✓ | ✓ |
| Placer | Placer County FCWCD | | Placer County Office of Emergency Services | Flood Response Handbook | 10/4/2010 | General Study | Sacramento River | Loading | ✓ | | | | ✓ | ✓ | |
| Placer | Placer County FCWCD | | | Update to the Dry Creek Watershed Flood Control Plan | November, 2011 | Dry Creek | Sacramento River | Hydrologic/Hydraulic Analysis. Loading | ✓ | | ✓ | | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | | Cabazon Flood Study | 6/1/1980 | San Gorgonio River, Jenson Creek and Millard Canyon Creek | Colorado River | Loading | ✓ | | | | | | ✓ |
| Riverside | Riverside County FCWCD | | | Cabazon Flood Study Flood Hazard Areas Plate 1 | 6/1/1980 | Cabazon area | Colorado River | Map: 100-year floodplain and velocity, depths | | | ✓ | | | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Riverside | Riverside County FCWCD | | | Cabazon Flood Study Flood Hazard Areas Plate 2 | 6/1/1980 | Cabazon area | Colorado River | Map: 100-year floodplain and velocity, depths | | | ✓ | | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | | Cabazon Flood Study Flood Hazard Areas Plate 2A | 6/1/1980 | Cabazon area | Colorado River | Map: 100-year floodplain and velocity, depths | | | ✓ | | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | | Cactus Valley Floodplain Map | 5/14/1980 | Cactus Valley Water Course | South Coast | Map: 100-year floodplain | | | ✓ | | | ✓ | ✓ |
| Riverside | Coachella Valley Water District | | Riverside County FCWCD | Flood Insurance Study for Oasis Area of Coachella Valley | 4/1/2003 | Oasis Area of the Coachella Valley | Colorado River | Rainfall depth-duration-frequency; flood distributions; subdivisions of FEMA Zone AO | ✓ | | ✓ | | | ✓ | |
| Riverside | Riverside County FCWCD | | USACE | Flood Plain Information San Jacinto River Riverside County, CA | 5/1/1970 | San Jacinto River | South Coast | Flood history effects and damages, frequency, velocities, and future depths | ✓ | | ✓ | | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | USACE | Flood Plain Information: Salt Creek Hemet to Railroad Canyon Reservoir | 6/1/1971 | Salt Creek | South Coast | Flood hazards and damage, flood history, future hydrologic/hydraulic analysis | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | USACE | Flood Plain Information: San Gorgonio River and Tributaries, Riverside County, CA | 10/1/1974 | San Gorgonio River | Colorado River | Flood history effects and damages, frequency, velocities, and future depths | ✓ | | ✓ | | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | | Floodplain Study Upper Lakeview Wash at Juniper Flats Road | 4/11/2007 | Lakeview Wash, San Jacinto River | South Coast | Loading, Exposure | ✓ | | ✓ | | | | ✓ |
| Riverside | USACE | | Riverside County, the City of Lake Elsinore, Temescal Water Company, Elsinore Calley Municipal Water District, State of CA Dept. of Parks and Recreation, Riverside County FCWCD | Lake Elsinore Draft Feasibility Study | 1/1/1985 | Lake Elsinore, Temescal Wash | South Coast | Description of flood problem - historic lake levels and losses; description of current and future performance - capacities, water level, loss | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Riverside | Riverside County FCWCD | | | Long Valley Hydraulic Analysis | 10/21/2002 | Long Valley Wash, Paloma Wash | Colorado River | Description for 100-year floodplain | | | ✓ | | | | ✓ |
| Riverside | Riverside County FCWCD | | SAWPA | Office of Wetlands, Oceans, & Watersheds (OWOW) IRWM Plan Chapter 5.6 | 11/16/2010 | General | South Coast | 100-year flood zone map, general risk assessment guidance | | | ✓ | | ✓ | | ✓ |
| Riverside | Riverside County FCWCD | | | Profile San Gorgonio River | 4/2/1981 | San Gorgonio River | Colorado River | Shows 100-year water surface elevation | ✓ | | | | | ✓ | |
| Riverside | Riverside County FCWCD | | | RCFC FPM Database | 10/13/2011 | N/A | South Coast | Library consists of flood studies | | | | | ✓ | ✓ | |
| Riverside | Riverside County FCWCD | | DWR | Warm Springs Creek Floodplain Delineation Study | 2/1/2003 | Warm Springs Creek | South Coast | USACE, Loading, Hydrologic/Hydraulic Analysis | ✓ | ✓ | ✓ | | | | ✓ |
| Riverside | Riverside County FCWCD | | | Whitewater River Oasis Area, CA FEMA Flood Insurance Study | 4/28/2003 | White Water River Oasis area | Colorado River | Maps: 100-year and 500-year floodplain maps | | | ✓ | | | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento | National Research Council | | Committee on Flood Control Alternative, and Water Science and Technology Board, Commission on Geosciences, Environment, and Resources | American River Basin: An Evaluation | 1995 | American River | Sacramento River | Risk assessment on the American River | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Sacramento | USACE | | State of California Reclamation Board | American River Watershed Project (Common Features), California Independent Technical Review Team Draft Final Second Addendum to the Supplemental Information Report (SIR). | 2002 | American River | Sacramento River | Hydrologic/Hydraulic analysis, loading, Vulnerability, consequence, USACE | ✓ | | ✓ | ✓ | | ✓ | |
| Sacramento | USACE | | Sacramento Area Flood Control Agency | American River Watershed Project, California. Volume 1 Appendixes A- D | 6/17/1905 | American River | Sacramento River | USACE risk and uncertainty evaluation on the American River | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| Sacramento | Sacramento Area Flood Control Agency (SAFCA) | | | Development Fee Program: Comparative Risk Analysis | 2008 | Consolidated Capital Assessment District | Sacramento River | Vulnerability | | | ✓ | | | ✓ | |
| Sacramento | USACE | Yes | | Flood Recon. Report - Sacramento Metropolitan Area | 4/1/1989 | Sacramento River | Sacramento River | Level of protection for Sacramento metropolitan area | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Sacramento | USACE | Yes | | Geomorphic Analysis and Bank Protection Alternative Report for Sacramento River (RM 78-194) and Feather River (RM 0-28) | 5/1/1990 | Sacramento and Feather Rivers | Sacramento River | Analysis of levees and their performance on Sacramento and Feather Rivers | ✓ | ✓ | | | | ✓ | |
| Sacramento | USACE | Yes | State Reclamation Board of California | Milestone F-4 In-Progress Review Report Appendix D. Hydraulic Technical Documentation | 2001 | Sacramento River, San Joaquin River and Tulare Lake Basins | Sacramento River, San Joaquin River and Tulare Lake | Probability of Levee Failure | ✓ | ✓ | ✓ | | | | |
| Sacramento | SAFCA | | | Natomas Levee Evaluation Program Erosion Assessment. | 2006 | Sacramento River | Sacramento River | Vulnerability | ✓ | | ✓ | | | ✓ | |
| Sacramento | USACE | Yes | | Rain Flood Flow Frequency Analysis , Feather and Yuba Rivers California | 1/28/1999 | Feather River and Yuba River | Sacramento River | Hydrologic Analysis, Loading | ✓ | | | | | ✓ | ✓ |
| Sacramento | USACE | Yes | | Sacramento - San Joaquin Delta Special Study - Initial Report | 3/1/1993 | Sacramento River, San Joaquin River, Mokelumne River | Sacramento River | Some historical flood and damage costs information. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sacramento | Sacramento County | | | Sacramento County Local Hazard Mitigation Plan | 2011 | General Study | Sacramento River, San Joaquin River | Exposure | | | ✓ | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento | USACE | Yes | | Sacramento River Bank Protection Project - Field Recon. Report of Bank Erosion Sites | 7/1/2000 | Sacramento River | Sacramento River | List of failed/damaged eroded levee locations, unrelated to risk, but could technically be classified as vulnerability | | | ✓ | | | ✓ | |
| Sacramento | USACE | Yes | | Sacramento River Bank Protection Project - Field Recon. Report of Bank Erosion Sites | 12/1/1999 | Sacramento River | Sacramento River | List of failed/damaged eroded levee locations, unrelated to risk, but could technically be classified as vulnerability | | | ✓ | | | ✓ | |
| Sacramento | SAFCA | Yes | USACE | Sacramento River Flood Control Project, California, Phase IV, Lower Sacramento Area, Final Limited Reevaluation Report | 11/1/2002 | Sacramento River | Sacramento River | This report documents the results of an economic reevaluation of the Sacramento River Flood Control Project | ✓ | | | | ✓ | ✓ | ✓ |
| Sacramento | USACE | Yes | SAFCA | Volume I: Integrated Document American River Watershed, California. Long-Term Study. Volume III: Appendix B- Economics, C - Engineering, D - Real Estate. American River Watershed, California Long-Term Study. Final Supplemental Plan Formation Report/EIS/EIR | 2002 | American River | Sacramento River | | ✓ | ✓ | ✓ | | | ✓ | |
| Sacramento, Butte, Colusa | USACE | Yes | | Sacramento and San Joaquin River Basins, California Post-Flood Assessment | 3/29/1999 | San Joaquin River, Sacramento River | Sacramento River, San Joaquin River | Loading, Consequence, Performance, Exposure | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| San Benito | San Benito County Water District | | Pajaro Valley Water Management Agency | Pajaro River Watershed Integrated Regional Water Management Plan | 6/1/2006 | Pajaro River | Central Coast | Discusses cost-benefit of watershed projects, including monetized benefits of flood control. | ✓ | | | | ✓ | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | "Christmas Day Storm" - December 25, 2003 | 12/26/2003 | General Study | South Coast, South Lahontan and Colorado River | Performance | | ✓ | | | | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | American Society of Civil Engineers Report Card 2008, San Bernardino County Flood Control District | 1/1/2008 | San Sevaine, Wilson Creek, Lytle-Cajon Creek, Plunge Creek | South Coast | Performance evaluation criteria: condition, capacity, maintenance & operations, security and safety | | ✓ | | | ✓ | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | Declez Channel Detention Basin Dam - Dam Breach Analysis | 5/7/2003 | Declez Channel Detention Basin | South Coast | Loading, Dam Breach Analysis, Vulnerability | ✓ | | ✓ | | | | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Bernardino | San Bernardino County Flood Control District | | USGS | Flood Hazard Study – 100-yr Flood Stage for Apple Valley Dry Lake, San Bernardino County, CA | 6/1/1975 | Apple Valley Dry Lake | South Lahontan | Loading, Stage/Frequency Curve information | ✓ | | | | | | ✓ |
| San Bernardino | San Bernardino County Flood Control District | | USGS | Flood Hazard Study – 100-yr Flood Stage for Lucerne Lake | 7/1/1977 | Lucerne Lake | Colorado River | Loading | ✓ | | | | | | ✓ |
| San Bernardino | San Bernardino County Flood Control District | | | October 2004 Storm Report | 7/1/2009 | General Study | South Coast, South Lahontan and Colorado River | Performance | | ✓ | | | | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | One Water One Watershed, Chapter 6.6 Flood Risk Management | N/A | Santa Ana River | South Coast | 100-year flood zone map; discusses flood risk, and how risk is evaluated | | | | | ✓ | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | Storm Report, February 1998 - San Bernardino County Area | 2/1/1998 | General Study | South Coast, South Lahontan and Colorado River | Performance | | ✓ | | | | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | Storm Report, October 7, 1997 - San Bernardino/ Highland Area | 10/1/1997 | Sand Creek | South Coast | Performance | | ✓ | | | | ✓ | |
| San Bernardino | San Bernardino County Flood Control District | | | Winter 2005 Storm Report | 7/1/2009 | General Study | South Coast, South Lahontan and Colorado River | Performance | | ✓ | | | | ✓ | |
| San Diego | City of San Diego | | | City of San Diego Flood Mitigation Plan | 6/15/2007 | General Study | South Coast | Repetitive Loss Properties, Loading, Vulnerability | ✓ | | ✓ | ✓ | | | ✓ |
| San Diego | San Diego County Flood Control District | | County of San Diego | County of San Diego Floodplain Management Plan | 8/1/2007 | General Study | South Coast and Colorado River | Repetitive Loss Properties, Loading, Vulnerability | ✓ | | ✓ | ✓ | | | |
| San Diego | San Diego County Flood Control District | Yes | USACE | Flood Plain Information Agua Hedionda Creek Pacific Ocean to Bueana San Diego County, California | 7/1/1973 | Agua Hedionda | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Flood Plain Information Agua Hedionda Creek, San Diego County, CA Flooded Areas | 7/1/1973 | Agua Hedionda | South Coast | Flooded area maps, and water profiles | ✓ | | ✓ | | | | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Flood Plain Information Buena Vista Creek Pacific Ocean to Vista San Diego County, CA | 7/1/1973 | Buena Vista Creek | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Diego | San Diego County, City of San Diego | Yes | USACE Los Angeles District | Flood Plain Information Los Penasquitos Drainage Area San Diego County, CA | 5/1/1967 | Poway Creek | South Coast | Flood hazards, flood areas, flood frequency and delineation for 100-year and 50-year, cross sections | ✓ | | ✓ | | | ✓ | |
| San Diego | San Diego County Flood Control District | Yes | USACE | Flood Plain Information San Marcos Creek San Diego County, CA | 4/1/1971 | San Marcos Creek | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Flood Plain Information Spring Valley Creek San Diego County, CA | 9/1/1967 | Spring Valley Creek | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Flood Plain Information Sweetwater River San Diego County, CA | 2/1/1969 | Sweetwater River | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | | San Diego County Flood Control District | Floodplain Management Plan, County of San Diego, California | 8/1/2007 | General | South Coast | Risk assessment guidance | | | | | ✓ | | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Floodway Information Study Keys Creek San Diego County, CA | 4/1/1976 | Keys Creek | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Floodway Information Study Moosa Canyon San Diego County, CA | 11/1/1974 | Moosa Canyon | South Coast | Flood hazards and damage, flood history, future flood analysis (frequency, areas, damages, velocities, depths) | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | Yes | USACE | Floodway Information Study San Luis Rey River Loretta Street to Eastern City Limits Vicinity of Oceanside, CA | 12/1/1974 | San Luis Rey River | South Coast | Flood hazards and damage, flood history, future flood areas | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| San Diego | San Diego County Flood Control District | | County of San Diego Department of Public Works Flood Control Section | San Diego County Hydrology Manual | 6/1/2003 | General Study | South Coast and Colorado River | Hydrology Report | | | | | ✓ | | |
| San Francisco | USACE - | Yes | | Ocean Beach Storm Damage Reduction Reconnaissance Report | 3/1/1992 | Ocean Beach | San Francisco Bay | | ✓ | | ✓ | ✓ | | ✓ | |
| San Francisco | USACE | Yes | USACE | San Francisco Bay Shoreline Study - Hydraulics Analysis | 4/1/1989 | San Francisco Bay | San Francisco Bay | Examines adding levees and flood ways for flood hazards | ✓ | | | | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Francisco | USACE | Yes | | San Francisco Bay Tidal Stage vs. Frequency Study | 10/1/1984 | San Francisco Bay | San Francisco Bay | Hazard, exposure | ✓ | | ✓ | | | ✓ | ✓ |
| San Francisco | City and County of San Francisco | | | San Francisco Interim Floodplain Map | 7/1/2008 | General Study | San Francisco Bay | Flood Hazard Area Map | | ✓ | ✓ | | | ✓ | |
| San Francisco | San Francisco Public Utilities Commission | | | Wastewater System Overview and Challenges Presentation | 6/14/2011 | General Study | San Francisco Bay | Identifies flooding as a concern and flood mitigation as a priority | | | | | ✓ | ✓ | |
| San Joaquin | San Joaquin County FCWCD | | San Joaquin County Department of Public Works | Gill Creek and Woodbridge Road Watersheds Reconnaissance Study | 3/1/2004 | San Joaquin River | San Joaquin | | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| San Joaquin | San Joaquin Area Flood Control Agency | Yes | USACE | Sacramento and San Joaquin River Basins Comprehensive Study, Lower San Joaquin River Assessment, Volume 1 | 3/1/2002 | San Joaquin River | San Joaquin | | ✓ | ✓ | ✓ | | | ✓ | |
| San Joaquin | San Joaquin Area Flood Control Agency | | | San Joaquin Area Flood Control Agency Final Technical Memorandum #2 Hydraulics | 2/1/1998 | San Joaquin River | San Joaquin | Hydraulic Model Study | ✓ | | ✓ | | | ✓ | |
| San Luis Obispo | San Luis Obispo FCWCD | | | Cambria Drainage and Flood Control Study Final Report | 2/1/2004 | Santa Rosa Creek | Central Coast | Identifies common failure points and recommends projects for improvement. | | ✓ | | | | | |
| San Luis Obispo | San Luis Obispo FCWCD | | | Cayucos Drainage and Flood Control Study | 1/1/2004 | Cayucos Creek | Central Coast | Discusses cost-benefit analysis process. No actual risk info. | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| San Luis Obispo | San Luis Obispo County | | | County of San Luis Obispo Local Hazard Mitigation Plan (LHMP) | 11/1/2005 | General Study | Central Coast | Risk Assessment, potential losses, vulnerability, probability | ✓ | | ✓ | | | ✓ | ✓ |
| San Luis Obispo | San Luis Obispo FCWCD | | San Luis Obispo County FCWCD | Guide to Implementing Flood Control Projects | 12/30/2009 | General Study | Central Coast | Discusses how to develop/discuss cost-benefit of project. Community based decision. | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| San Luis Obispo | San Luis Obispo County FCWCD | | | Nipomo Drainage and Flood Control Study | 2/1/2004 | Nipomo Creek | Central Coast | Identifies common failure points and recommends projects for improvement. | | ✓ | | | | | |
| San Luis Obispo | San Luis Obispo County FCWCD | | | Oceano Drainage and Flood Control Study | 2/1/2004 | Arroyo Grande Creek | Central Coast | Identifies common failure points and recommends projects for improvement. | | ✓ | | | | | |
| San Luis Obispo | San Luis Obispo County FCWCD | | | San Miguel Drainage and Flood Control Study | 12/1/2003 | Salinas River | Central Coast | Identifies common failure points and recommends projects for improvement. | | ✓ | | | | | |
| San Luis Obispo | San Luis Obispo County FCWCD | | | Santa Margarita Drainage and Flood Control Study | 2/1/2004 | Yerba Buena Creek | Central Coast | Identifies common failure points and recommends projects for improvement. | | ✓ | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| San Luis Obispo | Coastal San Luis Resource Conservation District | | | Tally Ho Creek Planning Project - Tech Memo | 5/5/2010 | Tally Ho Creek | Central Coast | General risk discussion, high-low flood risk by reach along creek | ✓ | | ✓ | | | ✓ | ✓ |
| San Luis Obispo | City and County of San Luis Obispo | | City of San Luis Obispo | Waterway Management Plan: Volume 1 | 3/3/2003 | San Luis Obispo Creek | Central Coast | Damage cost percentage - flood depth in Table 7-2. Historical flooding damage info. | ✓ | | ✓ | | | ✓ | |
| San Mateo | San Francisquito Creek Joint Powers Authority | Yes | USACE | 100-year Fluvial Flood Inundation Map | 5/1/2010 | San Francisquito Creek | San Francisco Bay | Exposure, Performance | | ✓ | ✓ | | | ✓ | ✓ |
| San Mateo | San Mateo County | | | Draft Hydrology Study Atherton Creek at Haven Court | 7/8/2002 | | San Francisco Bay | Hazard information including flow rates, and project conditions | ✓ | | | | | ✓ | |
| San Mateo | USACE | Yes | | Final Report San Francisquito Creek Development and Calibration/Verification of Hydraulic Model | 5/26/2009 | San Francisquito Creek | San Francisco Bay | Historic flood information on three specific events used as basis for modeling | ✓ | | | | | ✓ | |
| San Mateo | USACE | Yes | | Final Report San Francisquito Creek Hydraulic Modeling and Floodplain Mapping Volume I: Channel Hydraulic Modeling | 1/22/2010 | San Francisquito Creek | San Francisco Bay | Historic and evaluation of flow capacity | ✓ | ✓ | | | | ✓ | |
| San Mateo | San Francisquito Creek Flood Control District | | San Mateo County Department of Public Works | San Francisquito Creek Flood Control District Flood Zone Map | N/A | San Francisquito Creek | San Francisco Bay | Has Flood Zones 1 & 2 delineated | | | ✓ | | ✓ | ✓ | |
| San Mateo | San Mateo County Flood Control District | | San Mateo County Department of Public Works | San Mateo County Flood Control District Flood Control Zones | 7/7/2009 | Colma Creek, San Bruno Creek and San Francisquito Creek | San Francisco Bay | Has Flood Zones delineated by Creek | | | ✓ | | ✓ | ✓ | |
| San Mateo | San Mateo County | | San Mateo County Department of Environmental Management | San Mateo Natural Hazards Report - Chapter 15 | N/A | General Study | San Francisco Bay | Has pop. count of affected area of potential dam failure, valuation of flood zones | ✓ | | ✓ | | ✓ | | |
| Santa Barbara | Santa Barbara County FCWCD | | | 1969 Floods | 5/9/1969 | General Study | Central Coast | Flood damage info, some general lives at risk information | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Santa Barbara | Santa Barbara County FCWCD | | | 1995 Floods Santa Barbara County | 12/1/1995 | All of Santa Barbara County | Central Coast | General - qualitative damage, exposure | | | | | ✓ | ✓ | |
| Santa Barbara | Santa Barbara County FCWCD | | | 1998 Flood Report | 12/1/1998 | All of Santa Barbara County | Central Coast | General - qualitative damage, exposure | | | | | ✓ | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santa Barbara | County of Santa Barbara | | City of Santa Barbara | 2011 HMP - Map, Airport | | Santa Barbara Airport area | Central Coast | Map showing flood areas, parcel numbers | | ✓ | ✓ | | | ✓ | |
| Santa Barbara | County of Santa Barbara | | City of Santa Barbara | 2011 HMP - Map, Coast Village | | Coast Village | Central Coast | Map showing flood areas, parcel numbers | | ✓ | ✓ | | | ✓ | |
| Santa Barbara | County of Santa Barbara | | City of Santa Barbara | 2011 HMP - Map, East | | General Study | Central Coast | Map showing flood areas, parcel numbers | | ✓ | ✓ | | | ✓ | |
| Santa Barbara | Santa Barbara FCWCD | | Santa Barbara County | 2011 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan | 9/1/2011 | All of Santa Barbara County | Central Coast | | ✓ | | ✓ | | | ✓ | |
| Santa Barbara | County of Santa Barbara | | | 2011 Santa Barbara County Multi-Jurisdictional Hazard Mitigation Plan | 9/1/2011 | General Study | Central Coast | Discussion of flood projects and flood mitigation action items, lists Priority, cost-benefit, general risk associated with each item, including information on completion of projects | | | | | ✓ | ✓ | ✓ |
| Santa Barbara | USACE | Yes | | Design Deficiency Report for the Santa Maria Levee Project | 12/1/2008 | Santa Maria River | Central Coast | Examines deficiencies of Santa Maria levee system | ✓ | | | | | ✓ | |
| Santa Barbara | Santa Barbara County FCWCD | | | Franklin Creek Wall Extension Project Report and Hydraulic Analysis | 4/30/2010 | Franklin Creek | Central Coast | Flood hazard info | ✓ | | | | | ✓ | |
| Santa Barbara | USACE | | | Lower Mission Creek Flood Control Feasibility Study - Appendix A: Hydrology | 9/1/2000 | Mission Creek | Central Coast | | ✓ | | | | | ✓ | |
| Santa Barbara | County of Santa Barbara | | Santa Barbara County Public Works Department | Public Works Department 2004-5 Winter Report | 8/31/2005 | General Study | Central Coast | Flood damage info, storm event depth | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| Santa Barbara | Santa Barbara FCWCD | | Santa Barbara County Department of Public Works | Santa Barbara County Hydrology Report Precipitation, Rivers/Streams, & Reservoirs | 10/1/2010 | All of Santa Barbara County | Central Coast | 2010 Hydrology report | ✓ | | | | | ✓ | |
| Santa Barbara | USACE | Yes | | Santa Barbara County Streams Lower Mission Creek Flood Control Feasibility Study | 9/1/2000 | Mission Creek | Central Coast | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Santa Barbara | Santa Barbara FCWCD | | | Santa Barbara Countywide Integrated Regional Water Management Plan | 5/1/2007 | All of Santa Barbara County | Central Coast | IRWM Plan | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Santa Clara | Santa Clara Valley Water District | | | Calera Creek Reconnaissance Study - Final Report | 4/1/2004 | Calera Creek | San Francisco Bay | Flow, cost estimates, 100-year event analysis | ✓ | ✓ | ✓ | | | ✓ | |
| Santa Clara | USACE | Yes | | Coyote Creek Final General Design Memorandum | 5/1/1993 | Coyote Creek | San Francisco Bay | Economic and risk analysis, exposure | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Santa Clara | Santa Clara Valley Water District | | | Report on Flooding & Flood Related Damages in February 2-9, 1998 | 10/13/2004 | Guadalupe River | San Francisco Bay | Damage and flow estimates | ✓ | | | ✓ | | ✓ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santa Clara | Santa Clara Valley Water District | | | Report on Flooding & Flood Related Damages, January 3 to March 11, 1995 | 12/1/1995 | Guadalupe River | San Francisco Bay | Summary of flood events, maps showing flooded areas and damage estimates | ✓ | | ✓ | ✓ | | ✓ | |
| Santa Clara | Santa Clara Valley Water District | | | Santa Clara County Major Flood Events Table | 1/27/2012 | Penitencia, Guadalupe, San Tomas Aquinas, Stevens, Permanente, Matadero, San Francisquito, Llagas, Hale, Saratoga, Wildcat, Ross, Coyote, Uvas, Berryessa, Calabazas, Los Animas, Los Gatos, Alamitos, Bodfish, Little Arthur | San Francisco Bay | Major flood, history | ✓ | | | | | ✓ | |
| Santa Cruz | USACE | Yes | | General Reevaluation Report Pajaro River Flood Control Project Residual Floodplain Analysis | 9/26/1998 | Pajaro River, Corralitos Creek, Salsipuedes Creek | Central Coast | Analysis of flooding occurrence and performance of proposed improvements, | ✓ | ✓ | ✓ | | | ✓ | |
| Santa Cruz | USACE | Yes | | Interim Report for Flood Control Pajaro River Basin | 6/1/1963 | Pajaro River, Corralitos Creek, Salsipuedes Creek | Central Coast | Analysis of flood damage including area exposed, costs, and mapping. | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| Santa Cruz | USACE | Yes | | Interim Study Report, San Lorenzo River Study | 3/27/1987 | San Lorenzo River | Central Coast | Cost, HEC-2 and 6 studies, flow, channel geometry, sediment study | ✓ | ✓ | ✓ | | | ✓ | |
| Santa Cruz | County of Santa Cruz | | | Northern Santa Cruz County Integrated Regional Water Management Plan - Preliminary Plan, October 2005 | 10/1/2005 | General Study | Central Coast | General risk discussion of damages if projects not constructed, etc. Mentions culvert failure related damage, historical flood damage. | | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Santa Cruz | USACE | Yes | | Pajaro River Basin Hydrologic Engineering Update to the Report of April 1997 | 4/1/2003 | Pajaro River, Corralitos Creek, Salsipuedes Creek | Central Coast | Frequency discharge curve; Frequency/design relationships; upstream storage capacity; 1997 report attached as well | ✓ | ✓ | ✓ | | | ✓ | |
| Santa Cruz | Santa Cruz FCWCD | | | Proposition 50 (2004) Implementation Agreement | 1/31/2008 | Pajaro River | Central Coast | Damage cost if project were not built | | | | | ✓ | ✓ | ✓ |
| Santa Cruz | USACE | Yes | | San Lorenzo River Flood Control Study | 7/1/1982 | San Lorenzo River | Central Coast | Cost, flow frequency, duration | ✓ | ✓ | ✓ | | | ✓ | |
| Siskiyou | Siskiyou County | | | Box Canyon Dam Failure - Probably Maximum Flood | | Box Canyon Dam | Sacramento River | Floodplain map | | ✓ | ✓ | | | ✓ | |
| Siskiyou | Siskiyou County | | | Domino Dam Failure - Probable Maximum Flood | | Domino Dam | North Coast | Floodplain map | | ✓ | ✓ | | | ✓ | |
| Siskiyou | FEMA | | | Flood Insurance Study Siskiyou County, California | 1/19/2011 | General Study | North Coast, Sacramento River | Hydrology and Hydraulic study, Loading | ✓ | | | | | ✓ | |
| Siskiyou | Siskiyou County | | | Iron Gate Dam Failure - Probable Maximum Flood | | Iron Gate Dam | North Coast | Floodplain map | | ✓ | ✓ | | | ✓ | |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Siskiyou | Siskiyou County | | | JC Boyle Dam Failure - Probable Maximum Flood | | JC Boyle Dam | North Coast | Floodplain map | | ✓ | ✓ | | | ✓ | |
| Siskiyou | Siskiyou County | | | Siskiyou County General Plan Land Use Policies | 10/9/1997 | | North Coast | General Policy | | | | | ✓ | ✓ | |
| Siskiyou | Siskiyou County | | | Special Flood Hazard Areas | | General Study | North Coast, Sacramento River | Floodplain map | | ✓ | ✓ | | | | |
| Solano | Solano County Water Agency | | | Addendum to the Preliminary Evaluation of Suisun Valley Creek | 12/9/2002 | Suisun Valley Creek | San Francisco Bay | General discussion of cost - benefit of project | | | | | ✓ | ✓ | ✓ |
| Solano | Solano County Water Agency | | | Annex to 2010 Association of Bay Area Governments Local Hazard Mitigation Plan - Taming Natural Disasters | 2/23/2011 | General Study | San Francisco Bay and Sacramento River | Repetitive loss amounts from flooding, general discussion of risk specific to county | ✓ | | | ✓ | | ✓ | ✓ |
| Solano | Solano County Water Agency | | | Design Rainfall for Solano | 11/19/1998 | Countywide | San Francisco Bay | Description of design rainfall around the county | ✓ | | | | | ✓ | |
| Solano | Solano County Water Agency | | | Draft Suisun Creek Flooding Impact Analysis | 7/7/2004 | Suisun Creek | San Francisco Bay | Flood damage costs, cost-benefit analysis, flood maps | | ✓ | ✓ | | | ✓ | |
| Solano | Solano County Water Agency | | | Evaluation of Return Frequency of December 31, 2005 Storm Event | 3/2/2006 | Gibson Canyon Creek, Horse Creek, Ulatis Creek, and Alamo Creek | San Francisco Bay | Flood intensity and flow information | ✓ | | | | ✓ | ✓ | |
| Solano | Solano County Water Agency | | Solano County Water Agency Flood Control Advisory Committee | Flood Control Advisory Committee - Meeting Notes | 1/28/2010 | General Study | San Francisco Bay and Sacramento River | Discussion of categorizing different types of flood damage | | | | | ✓ | ✓ | |
| Solano | Solano County Water Agency | | Solano County Water Agency Flood Control Advisory Committee | Flood Control Advisory Committee - Meeting Notes | 3/25/2010 | General Study | San Francisco Bay and Sacramento River | Discussion of requirement for projects to have cost-benefit discussion | | | | | ✓ | ✓ | ✓ |
| Solano | Solano County Water Agency | | | Flood Control Master Plan - Phase II Report | 5/1/1998 | General Study | San Francisco Bay and Sacramento River | Rankings of damage and frequency, general ranking by category per project, no valuation | | | | | ✓ | | ✓ |
| Solano | Solano County Water Agency | Yes | USACE | Hydraulic Appendix Authorities Program, Section 205, White Slough Flood Control Study | 6/1/2001 | Austin Creek and White Slough | San Francisco Bay | Verification study on calculation for White Slough Flood Control Study | ✓ | ✓ | ✓ | | | ✓ | |
| Solano | Solano County Water Agency | Yes | USACE | Hydraulic Appendix Authorities Program, Section 205, White Slough Flood Control Study | 6/1/2001 | Austin Creek and White Slough | San Francisco Bay | Risk Analysis of White Slough/Austin Creek | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| Solano | Solano County Water Agency | | Solano Agencies (City of Benicia, City of Dixon, City of Fairfield, City of Rio Vista, City of Suisun City, City of Vacaville) | Integrated Regional Water Management Plan and Strategic Plan | 2/1/2005 | General Study | San Francisco Bay and Sacramento River | Generally discusses need for risk assessment of facilities and the creation of an IRWM Plan | | | | | ✓ | | ✓ |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solano | Solano County | | | Middle Green Valley Specific Plan | 12/1/2010 | Middle Green Valley Area | San Francisco Bay and Sacramento River | Fig. 2-6 Flood Hazard Area Map | | ✓ | ✓ | | ✓ | | ✓ |
| Solano | Solano County | | | Middle Valley Specific Plan EIR | 12/23/2009 | Green Valley Creek and Hennessey Creek | San Francisco Bay | Inundation maps, general discussion of risks of project impacts | | ✓ | ✓ | | | | |
| Solano | Solano County Water Agency | | | Preliminary Evaluation of Ledgewood Creek | 10/1/2000 | Ledgewood Creek | San Francisco Bay | Examines flooding issues in Ledgewood Creek area, history, current system info and exposure. | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| Solano | Solano County | | Solano County Water Agency | Solano County Water Agency Rio Vista Flood Risk Assessment | 10/20/2009 | Sacramento River, Yolo Bypass and local creeks | Sacramento River | Flood zone maps, areas of concern, no valuation | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Solano | Solano County Water Agency | | | Storm Frequency Analysis | 3/1/2003 | Gibson Canyon Creek, Sweeney Creek, McCune Creek, Horse Creek, Alamo Creek, Green Valley Creek and New Alamo Creek. | San Francisco Bay | Info on hazard from specific storm event | ✓ | | | | | ✓ | |
| Solano | Solano County Water Agency | | | Sweeny Creek Flood Reduction Cost-Benefit Study | 1/31/2007 | Sweeny Creek | San Francisco Bay and Sacramento River | Cost-benefit study of Sweeny Creek flood project | | ✓ | ✓ | ✓ | | | ✓ |
| Sonoma | Sonoma County Water Agency | | | Russian River Estuary Management Project - Draft Environmental Impact Report | 12/1/2010 | Russian River | North Coast | General discussion of risk in considering project alternatives, loading | ✓ | | | | ✓ | ✓ | ✓ |
| Sonoma | Sonoma County Water Agency | | | Sonoma Valley Stormwater Management and Groundwater Recharge Scoping Study | 3/11/2011 | Sonoma Creek | North Coast | Generally discusses historical flooding along Sonoma creek, flood maps, flood areas, no valuation | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Sonoma | Sonoma County Water Agency | | | Stream Maintenance Program Draft Environmental Impact Report | 1/1/2009 | General Study | North Coast | Discusses managing flood risk with maintenance alternatives, ranks "level of significance before/after mitigation" | | | | | ✓ | | ✓ |
| Sonoma | Sonoma County Water Agency | | | Water Supply Strategies Action Plan | 9/21/2010 | General Study | North Coast | Generally discussed benefits of flood project and cost, no valuation of damage or risk | | | | | ✓ | ✓ | ✓ |
| Stanislaus | USACE | Yes | | Geomorphic Analysis and Bank Protection Alternative Report for Sacramento River (RM 78-194) and Feather River (RM 0-28) | 5/1/1990 | Sacramento and Feather Rivers | Sacramento River | Analysis of levees and their performance on Sacramento and Feather Rivers | ✓ | ✓ | | | | ✓ | |
| Stanislaus | Stanislaus County | | | Multi-Jurisdictional Hazard Mitigation Plan Updated 2010, Risk Assessment -Plan Update Flood | 2010 | General Study | San Joaquin River | Loading, Vulnerability | ✓ | | ✓ | ✓ | | ✓ | ✓ |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sutter | USACE | Yes | | Bear River - California. Feasibility Report for Water Resources Development | 9/1/1972 | Bear River | Sacramento River | Dated | | | | | | | |
| Sutter | USACE | | | Left Bank of Sutter Bypass and Right Bank of Feather River Levees - Supplemental Project Information Report | 3/1/1999 | Feather River | Sacramento River | Damage Costs | | | | ✓ | | ✓ | |
| Sutter | USACE | Yes | | Left Bank of Sutter Bypass and Right Bank of Feather River Levees - Supplemental Project Information Report | 3/1/1999 | Feather River | Sacramento River | Damage Costs | | | | ✓ | | ✓ | |
| Sutter | Sutter Butte Flood Control Agency | | | Preliminary Problem Identification and Conceptual Alternatives Analysis Report Sutter Butte Flood Control Agency Feather River West Levee Evaluation Thermalito Afterbay to Yuba City | 9/16/2009 | Feather River | Sacramento River | Performance | | ✓ | | | | ✓ | |
| Sutter | Sutter County | | | Sutter County - Butte Sink Interim Base Flood Elevation Maps | 2/18/2010 | Butte Sink | Sacramento River | Floodplain Study | | ✓ | ✓ | | | ✓ | |
| Sutter | Sutter County | | | Sutter County - Meridian and Robbins Basins Interim Base Flood Elevation Maps | 6/15/2010 | Meridian and Robbins Basins | Sacramento River | Hydraulic Study | | | | | ✓ | ✓ | |
| Sutter | Sutter County | | | Sutter County and Yuba City Base Flood Elevation Maps | 1/17/2008 | General Study | Sacramento River | Floodplain Study | | ✓ | ✓ | | | ✓ | |
| Sutter | Sutter County | | | Sutter County General Plan Update - Issue Discussion Paper Infrastructure | 6/5/2008 | | Sacramento River | General Discussion and Strategies | | | | | ✓ | ✓ | |
| Sutter | Sutter County | | | Sutter County Nicolaus Area Base Flood Elevation Map | 1/8/2009 | Nicolaus Basin | Sacramento River | Floodplain Study | | ✓ | ✓ | | | ✓ | |
| Sutter | Sutter County | | | Sutter-Placer Watershed Area Study | 4/1/1982 | Feather River | Sacramento River | Loading, Exposure, Performance, Damage Cost | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Sutter, Butte, Colusa, Glenn | USACE | Yes | | Sacramento and San Joaquin River Basins California Comprehensive Study Interim Report | 12/20/2002 | Sacramento River | Sacramento River | Hazard, Performance, Consequence, Exposure | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tehama | Tehama County Department of Public Works | | | Los Molinos Drainage Study Existing Condition Flood Hydrology | 12/13/2007 | Los Molinos | Sacramento River | Hydrologic Analysis | ✓ | | | | ✓ | ✓ | |
| Tehama | Tehama County Department of Public Works | | | Los Molinos Drainage Study Hydraulic Assessment of Primary Drainage Facilities | 12/31/2007 | Los Molinos | Sacramento River | Hydraulic Assessment | | | | | ✓ | ✓ | |
| Tulare | Tulare County Flood Control District | Yes | Kaweah Delta Water Conservation District | Draft Integrated Feasibility and Environmental Impact Statement. Kaweah River Basin Investigation, California | 9/1/1992 | Kaweah River | Tulare Lake | USACE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Tulare | USACE | Yes | Kings County | Kaweah River Basin Investigation, California. Draft Appendixes, Volume II. Appendixes B through K | 4/1/1992 | Kaweah River | Tulare Lake | Flow frequency, exceedance curve, damage, floodplain delineation | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| Tulare | Tulare County Flood Control District) | Yes | USACE | Kaweah River Basin, CA Hydrology | 8/1/1990 | Bull Creek | Tulare Lake | Flow curves, storage capacity, flood elevations | ✓ | ✓ | ✓ | | | ✓ | |
| Tulare | Tulare County Flood Control District | Yes | USACE | Kaweah River Basin, California. Terminus Dam Spillway Adequacy Study. Hydrology | 3/1/1998 | Kaweah River | Tulare Lake | USACE | ✓ | ✓ | ✓ | | | ✓ | ✓ |
| Tulare | Tulare County Flood Control District | | U.S. Environmental Protection Agency | Tulare Lake Basin. Hydrology and Hydrography: A Summary of the Movement of Water and Aquatic Species | 4/12/2007 | Tulare Lake | Tulare Lake | Hydrology Report, Loading | ✓ | | | | ✓ | ✓ | |
| Tuolumne | Tuolumne County | | | Hazard Identification and Analysis | | General Study | San Joaquin River | Exposure | | | ✓ | ✓ | | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | Addendum to Tapo Canyon and Dry Canyon Flood Control Studies Lost Canyons Simi Valley, California | 12/4/2008 | Tapo Canyon Tributary | South Coast | | ✓ | | | | | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | Arundell Barranca Deficiency Study, Volume I (page 1-25) | 9/1/2006 | Arundel Barranca | South Coast | Hydraulic Analysis of existing conditions | ✓ | | ✓ | ✓ | | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | Arundell Barranca Deficiency Study, Volume I (page 26-104) | 9/1/2006 | Arundel Barranca | South Coast | Hydraulic Analysis alternatives | ✓ | | ✓ | ✓ | | | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Calleguas Creek Integrated Watershed Protection Plan Phase I Management Strategy Study | 11/10/2004 | Arroyo Simi, Arroyo Las Posas, Calleguas Creek, Revolon Slough, Conejo Creek | South Coast | Future action recommendations | ✓ | | | | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Calleguas Creek Integrated Watershed Protection Plan Phase II Management Strategy Study | 4/15/2010 | Arroyo Simi, Arroyo Las Posas, Calleguas Creek, Revolon Slough, Conejo Creek | South Coast | Flow analysis | ✓ | | | | | ✓ | ✓ |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ventura | Ventura County Watershed Protection District | | | City of Oxnard Floodplain Analysis - Industrial Drain, Rice Road Drain, J-Street Drain, Hueneme Drain, and Ormond Lagoon | 11/1/2005 | J Street Drain, Hueneme Drain, Rice Road Drain, Industrial Drain | South Coast | Model and flood plain maps | ✓ | | ✓ | | | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | Dry Canyon Flood Control Alternatives for Lost Canyons Simi Valley, California | 10/8/2007 | Dry Canyon Channel | South Coast | Hydraulic analysis and cost benefit analysis | ✓ | | | | | ✓ | |
| Ventura | Ventura County Flood Control District | | | Dry Canyon Technical Analysis Phase I | 3/17/1994 | Dry Canyon | South Coast | Hydraulic Analysis | ✓ | | | | | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | Flood Mitigation Plan for Ventura County, California | 3/1/2005 | Ventura River, Santa Clara River, Calleguas Creek | South Coast | Current and future mitigation plans | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Flood Plain Information Revision Santa Clara River, Saticoy to Pacific Ocean, Ventura County California | 1/1/1973 | Santa Clara River | South Coast | Exposure maps | | | ✓ | | | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | Flood Plain Information San Antonio Creek and Tributaries, Vicinity of Ojai, Ventura County California | 6/1/1973 | San Antonio Creek | South Coast | Talks about different floods | | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Flood Plain Information Santa Clara River and Sespe Creek, Vicinity of Fillmore California | 6/1/1972 | Santa Clara River | South Coast | Talks about different floods | | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Flood Plain Information Santa Clara River, Saticoy to Pacific Ocean, Ventura County California | 6/1/1968 | Santa Clara River | South Coast | Talks about different floods - current and future | | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Flood Plain Information Santa Clara River, Vicinity of Santa Paula, Ventura County California | 3/1/1970 | Santa Clara River | South Coast | Talks about different floods - current and future | | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Flood Plain Information Ventura River, Including Coyote Creek, Ventura County California | 6/1/1971 | Ventura River | South Coast | Talks about different floods - current and future | | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Reclamation | Yes | USACE and Ventura County Flood Control District | Hydrology, Hydraulics, and Sediment Studies for the Matilija Dam Ecosystem Restoration Project, Ventura, CA – DRAFT Report | 11/1/2006 | Matilija Dam | South Coast | Hydrology - Flood frequency analysis | ✓ | | | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Industrial Drain Channel Improvements Final Feasibility Analyses and Pre-Design Study | 4/24/2006 | Industrial Street Drain | South Coast | | ✓ | ✓ | ✓ | | | ✓ | |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ventura | Ventura County Watershed Protection District | | | Integrated Watershed Protection Plan | 7/19/2005 | Ventura River, Santa Clara River, Calleguas Creek | South Coast | IRWM Plan | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Ventura | Ventura County Watershed Protection District | | | J Street Drain Channel Improvement Study and Preliminary Design Final Report | 11/17/2005 | J Street Drain | South Coast | HEC-RAS Model and estimated future flood damage | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Multi-Jurisdictional Hazard Mitigation Plan for Ventura County, California | 3/1/2005 | Ventura River, Santa Clara River, Calleguas Creek | South Coast | current and future implementation of HMP | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Santa Clara River 2006 Hydrology Update | 12/1/2006 | main stem of Santa Clara River, Santa Paula Creek, Sespe Creek, Pole Creek, and Hopper Canyon | South Coast | Frequency analysis | ✓ | | | | | ✓ | |
| Ventura | LACDPW | | | Santa Clara River Enhancement and Management Plan | 5/1/2005 | Santa Clara River | South Coast | Existing flow rates and flood protection facilities | ✓ | | | ✓ | | ✓ | ✓ |
| Ventura | Ventura County Watershed Protection District | | | Special Flood Hazard Study Point Mugu Missile Test Center | 3/1/1981 | Calleguas Creek | South Coast | Flood damage | ✓ | | ✓ | ✓ | | ✓ | |
| Yolo | USACE | Yes | | Cache Creek Hydraulic Analysis Road 94B to Cache Creek Settling Basin | August, 2001 | Cache Creek | Sacramento River | USACE | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| Yolo | Yolo County FCWCD | | | Covell Drainage System Comprehensive Drainage Plan WMP-92-01-3 | October, 1992 | Covell Drain, Willow Slough, Dry Slough, Willow Slough Bypass and Yolo Bypass | Sacramento River | Loading | ✓ | | ✓ | | | ✓ | |
| Yolo | Yolo County FCWCD | | | Integrated Regional Water Management Plan | 4/1/2007 | Yolo County | Sacramento River | IRWM Plan detailing flood information for the area | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Yolo | USACE | Yes | | Lower Cache Creek, Yolo County, Ca City of Woodland and Vicinity. Draft Feasibility Report For Potential Flood Damage Reduction Project. | March, 2003 | Lower Cache Creek | Sacramento River | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Yolo | USACE | Yes | | R-3 Preconference Material, Winters and Vicinity, California | November, 1994 | Sacramento River, South Fork Putah Creek, Solano Dam, Monticello Dam, Putah South Canal and Chapman Reservoir | Sacramento River | | ✓ | | ✓ | | | ✓ | ✓ |
| Yolo | Yolo County | Yes | USACE | R3 Pre-Conference Material Northern California Streams Westside Tributaries To Yolo Bypass, California. | November, 1993 | Yolo Bypass | Sacramento River | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Co-Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yolo | Yolo County | Yes | USACE | Reconnaissance Study, Hydrology For Cache Creek, Yolo County California. Appendix B. | August, 1995 | Cache Creek | Sacramento River | | ✓ | | ✓ | | | ✓ | |
| Yolo | Yolo County FCWCD | Yes | USACE | USACE Cache Creek Settling Basin Final General Design Memorandum | 1/1/1987 | Cache Creek Basin | Sacramento River | Risk information and recent flood damage from winter 96-97 for the Arboga area of Yuba County | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Yolo | Yolo County FCWCD | Yes | USACE | USACE Reconnaissance Report for Blue Ridge / Cache Creek Interim | 1/1/1988 | Cache Creek Blue Ridge | Sacramento River | Estimates cost benefit of flood control, damage, exposure and hazard information | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Yolo | City of West Sacramento | | City of West Sacramento and the West Sacramento Flood Control Agency | West Sacramento 200-Year Flood Protection In-Lieu Fee Study | 7/2/2007 | General Study | Sacramento River | Exposure ,Vulnerability, Consequence | | | ✓ | ✓ | ✓ | ✓ | |
| Yolo | City of West Sacramento | | City of West Sacramento and the West Sacramento Flood Control Agency | West Sacramento Area Flood Control Agency Assessment District. Final Engineer's Report | 7/16/2007 | General Study | Sacramento River | Exposure ,Vulnerability | | | ✓ | | ✓ | ✓ | ✓ |
| Yolo | City of Winters | Yes | Yolo County FCWCD | Winters & Vicinity , Ca Reconnaissance Report, Volume 1 | April, 1995 | Willow Slough and Putah Creek | Sacramento River | | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| Yolo | Yolo County | Yes | USACE | Yolo Bypass, California. Reconnaissance Report. | March, 1992 | Yolo Bypass | Sacramento River | | ✓ | | | ✓ | ✓ | ✓ | ✓ |
| Yolo | Yolo County FCWCD | Yes | USACE | Yolo Bypass, Engineering Basis of Design and Cost Estimates for Reconnaissance Report | 2/1/1992 | Yolo Bypass | Sacramento River | Basis of Design Study to modify levees for 100 year protection | | ✓ | | | | | |
| Yolo | City of West Sacramento | | | West Sacramento Levee Improvement Program: Economic and Risk Analysis -Supplemental Information | 2011 | American River, Yolo Bypass, Sacramento River and Sacramento Deep Water Ship Canal | Sacramento River | Exposure, Consequence, expected annual damage | | | ✓ | ✓ | | ✓ | ✓ |
| Yolo | City of West Sacramento | | | West Sacramento Levee Improvement Program: Economic and Risk Analysis. | 9/1/2010 | American River, Yolo Bypass, Sacramento River and Sacramento Deep Water Ship Canal | Sacramento River | Economic and risk analysis, exposure | | | ✓ | | | ✓ | |
| Yolo | USACE | Yes | West Sacramento Area Flood Control Agency | West Sacramento Levee Improvements Program. 408 Permission EIS/EIR Report. Draft - | 2010 | General Study | Sacramento River | Hydrologic/hydraulic analysis | ✓ | | | | ✓ | ✓ | |
| Yuba | USACE | Yes | | Community Assessment Study - Sacramento River Basin | 9/1/1997 | Feather River, Yuba River | Sacramento River | Risk information and recent flood damage from winter 96-97 for the Arboga area of Yuba County | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Yuba | Yuba County Water Agency | Yes | USACE | Yuba River Basin Investigation, California - Reconnaissance Report | 3/1/1990 | | Sacramento River | Hydrologic/Hydraulic Analysis, Vulnerability, Consequence | ✓ | | ✓ | ✓ | | ✓ | ✓ |

**Table G-B-1. Risk Relevant Information Inventory**

| County | Lead Agency | USACE Study | Sponsoring Agency | Document Title | Date Published | Stream Name | Hydrologic Region | Risk Info/ Notes | Hazard/Loading | Performance | Exposure/ Vulnerability | Consequence/ Repetitive Loss | General/Policy | Current | Future |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yuba | USACE | Yes | | Levee Failure Scenarios For the Yuba River Feasibility Investigation | 6/1/1993 | Yuba River | Sacramento River | Hydrologic/Hydraulic Analysis | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Yuba | USACE | Yes | | Yuba River Investigation California, Hydrology and Hydraulics and Risk Based Analysis | 10/1/1997 | Yuba River | Sacramento River | Hydrologic/Hydraulic Analysis | ✓ | | ✓ | | | ✓ | |

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# Appendix C: FEMA NFIP Insurance Claims Cost by County

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In Table G-C-1, the V-zone represents an area inundated within a 100-year (1 percent annual chance) floodplain with velocity hazard (wave action); no base flood elevations have been determined. The A-zone represents an area of special flood hazard without water surface elevations determined. Flood insurance is mandatory in areas within a 100-year (1 percent chance of annual flooding) floodplain. These claims do not include those paid to the State of California.

**Table G-C-1. FEMA Insurance Claims by County**

| County Name | Total Premiums to Date ($) | V-Zone | A-Zone | Number of Policies | Total Coverage ($) | Total Claims Since 1978 | Total Paid Since 1978 ($) |
|---|---|---|---|---|---|---|---|
| Alameda | 3,703,859 | 3 | 2,299 | 3,600 | 971,842,700 | 402 | 2,142,645 |
| Alpine | 14,560 | - | - | 117 | 1,564,500 | 4 | 48,078 |
| Amador | 194,804 | - | 139 | 214 | 50,719,500 | 56 | 337,764 |
| Butte | 2,045,102 | - | 1,645 | 2,549 | 551,952,700 | 232 | 3,307,522 |
| Calaveras | 240,704 | - | 103 | 369 | 94,571,800 | 33 | 761,972 |
| Colusa | 637,255 | - | 461 | 870 | 218,029,700 | 139 | 2,393,766 |
| Contra Costa | 5,550,258 | 5 | 3,726 | 5,344 | 1,335,844,200 | 998 | 6,825,715 |
| Del Norte | 255,576 | 13 | 100 | 184 | 44,201,100 | 31 | 481,116 |
| El Dorado | 513,084 | - | 222 | 493 | 132,433,800 | 146 | 1,863,295 |
| Fresno | 1,777,645 | - | 1,265 | 2,448 | 552,670,700 | 254 | 1,501,085 |
| Glenn | 467,431 | - | 493 | 649 | 117,973,400 | 180 | 1,657,617 |
| Humboldt | 993,483 | - | 823 | 1,081 | 211,002,200 | 186 | 2,328,739 |
| Imperial | 78,384 | - | 61 | 85 | 13,590,900 | 126 | 762,825 |
| Inyo | 20,490 | - | 3 | 43 | 11,629,000 | 3 | 7,608 |
| Kern | 4,040,587 | - | 4,637 | 5,884 | 1,115,260,300 | 192 | 928,566 |
| Kings | 192,772 | - | 118 | 289 | 64,229,800 | 6 | 16,700 |
| Lake | 1,818,168 | - | 1,950 | 2,256 | 464,202,100 | 1,248 | 11,419,563 |
| Lassen | 119,235 | - | 98 | 139 | 23,945,700 | 30 | 163,591 |
| Los Angeles | 17,120,497 | 296 | 9,430 | 19,630 | 5,101,598,000 | 7,820 | 53,787,626 |
| Madera | 933,700 | - | 953 | 1,173 | 224,758,700 | 46 | 267,859 |
| Marin | 9,323,819 | 123 | 5,807 | 8,601 | 2,184,722,500 | 3,017 | 46,177,682 |
| Mendocino | 742,364 | 1 | 624 | 792 | 161,211,700 | 164 | 4,239,130 |
| Merced | 3,394,535 | - | 5,926 | 6,327 | 1,211,015,100 | 246 | 4,237,861 |
| Modoc | 46,327 | - | 18 | 109 | 18,899,800 | 2 | 5,654 |
| Mono | 82,278 | - | 38 | 103 | 26,178,000 | 41 | 358,084 |
| Monterey | 2,403,013 | 91 | 1,694 | 2,479 | 581,970,000 | 1,202 | 25,627,863 |
| Napa | 2,461,248 | - | 1,622 | 2,283 | 599,714,800 | 1,306 | 29,378,390 |
| Nevada | 140,397 | - | 79 | 173 | 41,014,900 | 37 | 524,920 |
| Orange | 22,676,085 | 17 | 16,447 | 22,574 | 5,490,958,700 | 3,501 | 17,326,636 |
| Placer | 818,396 | - | 499 | 1,258 | 361,553,600 | 570 | 15,061,146 |
| Plumas | 171,278 | - | 102 | 177 | 39,790,900 | 49 | 718,275 |
| Riverside | 4,580,562 | - | 4,144 | 5,669 | 1,381,851,300 | 1,490 | 9,094,126 |
| Sacramento | 32,155,112 | - | 10,993 | 61,303 | 17,964,200,000 | 3,377 | 32,876,081 |

### Table G-C-1. FEMA Insurance Claims by County

| County Name | Total Premiums to Date ($) | V-Zone | A-Zone | Number of Policies | Total Coverage ($) | Total Claims Since 1978 | Total Paid Since 1978 ($) |
|---|---|---|---|---|---|---|---|
| San Benito | 175,853 | - | 120 | 152 | 37,415,200 | 52 | 640,523 |
| San Bernardino | 5,168,227 | - | 4,009 | 5,506 | 1,191,588,400 | 695 | 6,017,619 |
| San Diego | 7,644,293 | 2 | 4,952 | 8,958 | 2,064,591,800 | 1,682 | 14,539,146 |
| San Francisco | 12,499 | - | - | 26 | 7,696,200 | 1 | 0 |
| San Joaquin | 5,026,620 | - | 2,095 | 8,722 | 2,471,084,600 | 298 | 5,580,509 |
| San Luis Obispo | 1,905,144 | 4 | 1,278 | 2,045 | 517,643,000 | 467 | 4,265,257 |
| San Mateo | 9,524,780 | 9 | 5,315 | 8,592 | 2,176,746,400 | 795 | 8,532,238 |
| Santa Barbara | 4,072,561 | 28 | 2,388 | 4,109 | 1,037,502,300 | 903 | 7,842,883 |
| Santa Clara | 17,779,328 | 1 | 15,047 | 17,187 | 4,206,307,600 | 1,341 | 15,479,839 |
| Santa Cruz | 4,622,768 | 183 | 3,193 | 4,449 | 990,904,200 | 1,243 | 11,714,815 |
| Shasta | 940,380 | - | 737 | 1,297 | 291,412,000 | 156 | 1,245,590 |
| Sierra | 94,665 | - | 66 | 93 | 18,084,500 | 19 | 474,350 |
| Siskiyou | 418,414 | - | 349 | 525 | 100,905,600 | 69 | 523,796 |
| Solano | 2,837,199 | - | 1,787 | 3,513 | 869,293,900 | 533 | 9,451,147 |
| Sonoma | 3,595,307 | 4 | 2,755 | 3,816 | 889,812,600 | 6,491 | 99,751,821 |
| Stanislaus | 947,930 | - | 777 | 1,256 | 269,990,300 | 206 | 4,285,403 |
| Sutter | 3,455,350 | - | 286 | 7,551 | 2,301,691,900 | 147 | 2,389,710 |
| Tehama | 916,663 | - | 870 | 1,118 | 229,999,100 | 317 | 1,956,674 |
| Trinity | 85,315 | - | 61 | 114 | 24,990,800 | 23 | 52,924 |
| Tulare | 6,509,762 | - | 5,333 | 9,442 | 2,126,474,200 | 219 | 1,019,664 |
| Tuolumne | 23,523 | - | 5 | 42 | 11,810,300 | 8 | 12,836 |
| Ventura | 6,508,337 | 48 | 4,088 | 7,838 | 2,020,329,500 | 1,091 | 11,714,380 |
| Yolo | 5,714,267 | - | 2,467 | 8,059 | 2,159,750,100 | 329 | 3,316,885 |
| Yuba | 1,979,220 | - | 339 | 4,315 | 1,279,116,900 | 286 | 8,214,050 |
| **Total** | **$ 209,671,413** | **828** | **134,836** | **267,990** | **$ 68,660,243,500** | **44,505** | **$ 495,651,559** |

Notes:

1. Mariposa County is not a participant in the NFIP. Due to the steep terrain, hazards from flooding are relatively low in the county. However, there has been localized flooding in areas of low elevation and in areas where stream channels are not well defined.
2. The V-zone is an area inundated within a 100-year (annual chance flooding) floodplain with velocity hazard (wave action); no base flood elevations have been determined.
3. The A-zone is an area of special flood hazard without water surface elevations determined. Flood insurance is mandatory in areas within a 100-year (1 percent chance of annual flooding) floodplain.

# Appendix D: Risk Assessment Case Studies

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## San Francisquito Creek Risk Assessment

| Location | |
|---|---|
| City, County | Cities of Palo Alto, East Palo Alto, and Menlo Park between San Mateo and Santa Clara counties |
| Hydrologic Region | San Francisco Bay |
| Region of Integrated Regional Water Management (IRWM) | Bay Area |
| State Assembly District | 21 |
| State Senate District | 11 |
| U.S. Congressional District | 14 (CA) |

### *Sponsoring Agency*

San Francisquito Creek Joint Powers Authority (SFCJPA), which consists of the City of Palo Alto, City of East Palo Alto, City of Menlo Park, County of San Mateo, Santa Clara Valley Water District; and USACE

### *Motivation for Study*

The San Francisquito Creek watershed is 45 square miles in area and extends from the ridge of the Santa Cruz mountains to the San Francisco Bay. Most of the watershed lies in the Santa Cruz mountains and the bay foothills, northwest of Palo Alto. Approximately 7.5 square miles lie on the San Francisco alluvial fan.

Flooding has affected this creek for many years. The most recent event occurred in 1998, as result of record rainfall. The creek overtopped its banks and flooded more than 1,700 structures, causing more than $30 million in damages. Soon after this flood, the SFCJPA was formed to pursue flood protection and restoration improvements in the area.

USACE prepared a reconnaissance study, published in 2005, that identified the SFCJPA as the local sponsor and that justified further investigation through a USACE-sponsored economic feasibility study.

### *Summary of Tasks Completed For Study*

A detailed, full risk analysis was completed for this planning study. That analysis followed USACE guidance in ER 1105-2-101, EM 1110-2-1619, ER 1105-2-100, and Engineering Technical Letter (ETL) 110-2-556. Alternative flood management plans were formulated and evaluated following the guidelines, with benefits and costs expressed in average annual terms for both current and future conditions.

### *Hazard (Loading) Analysis*

San Francisquito Creek fluvial flooding was assessed, with loading determined for the 25-year (4 percent), 50-year (2 percent), 100-year (1 percent), 250-year (0.4 percent), and 500-year (0.2 percent) annual chance flood events. Depths of inundation in the floodplains were estimated for each event with a FLO-2D hydraulics model. Because loading is influenced in this watershed by sea level at the downstream boundary, a future sea level rise hazard scenario was analyzed. Coastal flooding models are currently being developed for that analysis.

## Exposure Analysis

Exposure for this study was identified through examination of USACE-developed floodplain maps showing property with flooded areas.

## Performance Analysis

The creek is bound by levees only in the coastal section of the project, downstream of State Highway 101. Performance of the coastal section levees was not analyzed because this study focused on flooding on the fluvial, not the coastal, reach of the creek. Only the fluvial flooding hazards were considered.

## Vulnerability Analysis

Data in a GIS database yielded elevation of each parcel. Damages to structures, contents, and vehicles were based on depth of flooding relative to the elevation of the first floor of the structure, with standard depth-percent damage relationships. The depth-percent damage relationships depended on structure type.

**San Francisquito Creek Flooding**

## Consequence Analysis

By combining information about depths of flooding (hazard) with information about exposure and vulnerability, damage-frequency relationships were estimated for each structure, aggregated, and then integrated. When integrated, these relationships yielded EAD for the watershed without-project conditions, thereby summarizing risk. The study/project Base Year, defined as the year when the project is expected to be operational and benefits begin to be realized, is 2017.

## Study Outcome

The study calculated expected annual damages of approximately $8.4 million/year. The upper bound of total project cost that could be supported was determined to be $175 million or, more conservatively, $140 million if only 80 percent of the damages are assumed to be prevented by the project.

## Reference

*San Francisquito Creek Flood Risk Management Feasibility Study Without-Project Economics (DRAFT) Fluvial Only,* August 2011, USACE, San Francisco District

## Chicken Ranch and Strong Ranch Slough Risk Assessment

| Location | |
|---|---|
| City, County | Sacramento, Sacramento |
| Hydrologic Region | Sacramento River |
| IRWM Region | American River Basin |
| State Assembly Districts | 5 and 10 |
| State Senate Districts | 1 and 6 |
| U.S. Congressional Districts | 3 and 5 (CA) |

### *Sponsoring Agency*

County of Sacramento; Sacramento Area Flood Control Agency (SAFCA); USACE Sacramento District

### *Motivation for Study*

The Strong Ranch Slough and Chicken Ranch Slough (SRS/CRS) watershed is an urban area of approximately 15 square miles within Sacramento County. It is an interior watershed, protected from lower American River (LAR) flooding by levees that are a part of the Federal-State flood management system. Floods in 1986, 1995, and 1997 caused significant damage in the watershed as a result of exceeding the interior drainage capacity. Sacramento County undertook risk analysis in the watershed, seeking cost-effective risk management options. Subsequently, SAFCA continued the studies, demonstrating a Federal interest and gaining USACE participation in a feasibility study.

### *Summary of Tasks Completed for Study*

A full analysis of risk in the watershed was completed. Existing and future "without-project" risks were assessed using methods consistent with those called out in USACE EM 1110-2-1619. Alternatives were formulated by the study team, and existing and future "with-project" risks were estimated for each. Comparisons yielded estimates of project economic benefits.

### *Hazard (Loading) Analysis*

Loading in the SRS/CRS watershed is a function of both LAR conditions and interior area runoff.

To assess the hazard in the watershed, coincident frequency analysis procedures, consistent with USACE EM 1110-2-1413, were used. Interior area runoff flow frequency curves were estimated with a rainfall-runoff-routing model. LAR stage frequency curves were fitted with flow-duration analysis. Flood stage throughout the watershed was computed for the 50 percent annual chance (2-year) flood event through the 0.2 percent annual chance (500-year) flood event with an open-channel flow model, coupled with a model of the performance and behavior of a pump-and-gravity outlet at the levee.

### *Exposure Analysis*

Exposure for this study was limited to consideration of economic impact of flooding. To identify property subject to inundation damage, county assessor parcel records were used to identify structures subject to inundation. Values of these structures

were estimated as a function of structure-usable area, with unit construction costs provided by a real estate appraiser from the region. Values were adjusted for depreciation based upon a structure-by-structure opinion of condition offered by a local realtor. Content value was estimated as a function of structure value.

### *Performance Analysis*

For this study, performance of the LAR levees was not analyzed; the hazard considered was that created by interior drainage. Performance of the pump-and-gravity outlet was analyzed with the hydraulic models described above. Alternatives considered included modifications to that performance.

### *Vulnerability Analysis*

Analysis of vulnerability of property considered location of the property (including elevation) and structure type. Location of each property within the floodplain was established from the assessor's record. Elevations were determined with GIS tools, using available digital elevation models, coupled with limited field surveys to confirm elevations. Vulnerability to flooding was represented with depth-damage functions appropriate for each structure type.

### *Consequence Analysis*

By combining information about depths of flooding (hazard) with information about exposure and vulnerability, damage-frequency relationships were estimated for each structure and aggregated. When integrated, these relationships yielded EAD for the watersheds for both existing and future without-project conditions, thus summarizing risk. For alternative risk management plans, EAD also was computed.

### *Study Outcome*

Sacramento County implemented limited-scale flood management solutions to provide some relief from flood damage. The USACE found no solutions that satisfied Federal requirements.

### *Reference*

*Strong and Chicken Ranch Sloughs, California—Feasibility Report: Phase I Studies*, August 2001, prepared for USACE, Sacramento District, Contract Number DACW05-00-P-0315, by David Ford Consulting Engineers, Inc.

**Flooding along Chicken Ranch and Strong Ranch Slough**

## SAFCA Natomas Levee Improvement Project

| Location | |
|---|---|
| City, County | Sutter and Sacramento |
| Hydrologic Region | Sacramento River |
| IRWM Region | Sacramento Valley |
| State Assembly Districts | 2, 5, and 9 |
| State Senate Districts | 4 and 6 |
| U.S. Congressional Districts | 2, 3, and 5 (CA) |

### *Sponsoring Agency*

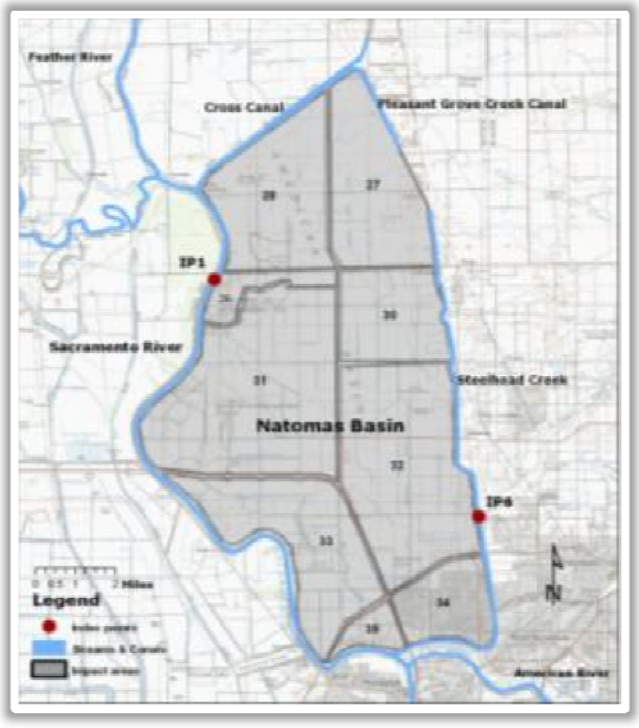
Sacramento Area Flood Control Agency (SAFCA)

### *Motivation for Study*

The Natomas Basin of Sacramento, California, is protected by levees on all sides from flooding of the Sacramento River, American River, and local streams. Investigations by the USACE and SAFCA found deficiencies in the protection provided by these levees. SAFCA initiated the Natomas Levee Improvement Program to rehabilitate and strengthen the Natomas levees, reducing the risk to people and property. A risk analysis quantified the economic benefit of the levee improvements and laid the foundation for further Federal involvement in the improvements and reimbursement for SAFCA's efforts.

### *Summary of Tasks Completed for Study*

A full risk analysis was completed, using methods consistent with USACE EM 1110-2-1619. Existing and future risks were assessed for the following three conditions—the without-project condition, with an early implementation project that provides protection from a 100-year (1 percent annual chance) flood event, and with a project that provides protection from a 0.5 percent annual chance (200-year) flood event. Comparisons yielded estimates of project economic benefits and risk reduction. For the analysis, 2 index points were used to represent loadings on the basin, and nine impact areas were defined to better represent the variations in loading throughout the area (as shown in the figure above).




### *Hazard (Loading) Analysis*

Flood hazard in the basin is a consequence of regulated flows in the Sacramento and American rivers, with potential back-water effects upstream of the confluence. To account for this, design events with specified annual exceedance probabilities of 50 percent (2-year) to 0.2 percent (500-year) were routed through the stream network using the USACE UNET unsteady open-channel flow model, thus

developing stage-frequency functions at the index points. Uncertainty in the functions was described with a statistical distribution. Interior loading that would occur if a levee breached was determined by postulating levee-breach scenarios and routing the water through an interconnected series of storages within the protected area.

### *Exposure Analysis*

Exposure for this study was limited to consideration of economic impact of flooding. To identify property subject to inundation damage, county assessor parcel records were used to identify structures subject to inundation. Values of these structures were estimated as a function of structure-usable area, with unit construction costs provided by a real estate appraiser from the region. Values were adjusted for depreciation based upon a structure-by-structure opinion of conditions offered by a local realtor. Content value was estimated implicitly as a function of structure value.

### *Performance Analysis*

For this study, performance of the levees was represented with levee fragility curves developed by geotechnical engineers. These curves represented the probability of a breach for the range of stages. Flood management alternatives were modeled by modifying these functions.

### *Vulnerability Analysis*

Analysis of vulnerability of property considered location of the property (including elevation) and structure type. Location of each property within the floodplain was established from the assessor's records. Elevations were determined with GIS tools, using available digital elevation models, coupled with limited field surveys to confirm elevations. Vulnerability to flooding was represented with depth-damage functions appropriate for each structure type. Functions from the USACE "Economic Guidance Memorandum 04-01" (October 2003) were used for residential structures, and depth-damage functions published in the USACE *American River Watershed Investigation* (USACE, 1991) were used for nonresidential structures. Displacement and temporary housing costs were estimated, using methods suggested by FEMA and included in this analysis.

### *Consequence Analysis*

By combining information about depths of flooding (hazard) with information about exposure and vulnerability, damage-frequency relationships were estimated for each structure and aggregated. When integrated, these relationships yielded EAD for the watershed for both existing and future without-project conditions, thus summarizing risk. Results for multiple index points were combined with statistical analysis procedures. For alternative risk management plans, EAD was computed.

### *Study Outcome*

SAFCA selected an alternative, and through its assessment authority, funded the initial phase of construction. SAFCA submitted requests for reimbursement to USACE, and USACE initiated an evaluation to confirm Federal interest and assess the Federal role.

## *Reference*

*Natomas Levee Improvement Project: Economic and Risk Analysis*, October 2007, prepared for Sacramento Area Flood Control Agency by David Ford Consulting Engineers, Inc.

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## Aliso Creek Watershed Management Feasibility Study

| Location | |
|---|---|
| City, County | Cities of Laguna Niguel, Aliso Viejo, Laguna Hills, Laguna Beach, Laguna Woods, Lake Forest, and Mission Viejo in Orange County |
| Hydrologic Region | South Coast |
| IRWM Region | South Orange County IRWM |
| State Assembly District | 71 and 73 |
| State Senate District | 33 and 35 |
| U.S. Congressional District | 14 (CA) |

### *Sponsoring Agency*

The project was sponsored by USACE and Orange County Public Works through the Orange County Watersheds Program. Other members of the Aliso Creek Study Management Team include the cities of Aliso Viejo, Lake Forest, Laguna Beach, Laguna Niguel, Laguna Woods, and Mission Viejo, as well as local water districts and the Aliso Water Management Agency.

### *Motivation for Study*

The Aliso Creek Watershed Management Plan (WMP) was developed as a collection of recommendations based on feedback from local, State, and Federal agency representatives, private citizens, and local citizen interest groups to educate landowners and managers in the watershed and develop a plan to ensure the long-term protection of the watershed in response to increasing population, intensity of land use, and concerns for potential flooding in the watershed.

### *Summary of Tasks Completed for Study*

The WMP summarizes the watershed issues, including flood risk, and develops recommended actions. A comprehensive list of problems in the Aliso Creek Watershed were identified, including creek instability due to the loss of historical floodplain vegetation, as well flooding damages to land and improvements. As part of this effort, hydrologic and hydraulic, geomorphic, sedimentation, and economic studies were performed.

### *Loading Analysis*

Hydrologic Engineering Center River Hydraulics (HEC-2) and Hydrologic Engineering Center-River Analysis System (HEC-RAS) were used by the USACE to compute water surface elevations for the 25-year (4 percent), 50-year (2 percent), 100-year (1 percent), 250-year (0.4 percent), and 500-year (0.2 percent) flood events for the 18.8-square-kilometer Aliso Creek Watershed.

## Exposure Analysis

Economic impacts of flooding and channel instability were accounted for in this study. Historical rates of development were calculated by digitizing historical information into a GIS. In addition, historical damage information was collected for major storms. A complete survey of structures within Aliso Creek Watershed was performed. The Aliso Creek Watershed Management Feasibility Study that was developed by USACE in 1999 indicated that most structures in the watershed have a low probability of flood inundation, with only a few schools and a church at the margins of the 100-year (1 percent annual chance flood event) floodplain. The exposure analysis was performed based on floodplain maps for the 100-year (1 percent annual chance) flood event occurring in the Aliso Creek Watershed.

**Flooding along Aliso Creek**

## Hazard Analysis

A geomorphic analysis was conducted to assess and characterize the stability of lower Aliso Creek Watershed. In general, the analysis found that Aliso Creek continues to move laterally; however, this movement is not in one direction (instead the stream moves laterally back and forth). The lower portion of Aliso Creek is degrading, but the upper portion has been stabilized by a number of structures. The SAM model was used to estimate sediment transport in the watershed. SAM is a USACE hydraulic design package for channels. It calculates the width, depth, slope and n-values for stable channels in alluvial material and can calculate riprap size, as well as normal depth and composite hydraulic parameters, for a cross section with variable roughness.

## Vulnerability Analysis

Vulnerability analysis of property considered its location. Location of each property within the floodplain was established from the survey of structures in the watershed. Elevations were determined with GIS tools, using available digital elevation models, coupled with limited field surveys to confirm elevations. Vulnerability to flooding was represented with depth-damage functions appropriate for each structure type. The property likely to experience the greatest damage in

the Aliso Creek Watershed is that of Aliso Creek Inn and Resort and a small number of properties in proximity. This site has been determined to be within a 25-year floodplain.

### *Consequence Analysis*

By combining information about depths of flooding (hazard) with information about exposure and vulnerability, damage-frequency relationships were estimated. When integrated, these relationships yielded EAD for the watershed, for existing and future without-project conditions, thus summarizing risk.

### *Study Outcome*

The WMP developed a list of recommended projects and activities to address creek instability and flooding damages. The study successfully identified the actions and/or projects that need to be taken to address the watershed issues and identified the agencies responsible for implementing and funding the recommended actions. These projects will "spin off" from the WMP.

### *Reference*

*Aliso Creek Watershed Management Plan*, USACE Los Angeles District and Orange County Public Works

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# Appendix E: Glossary

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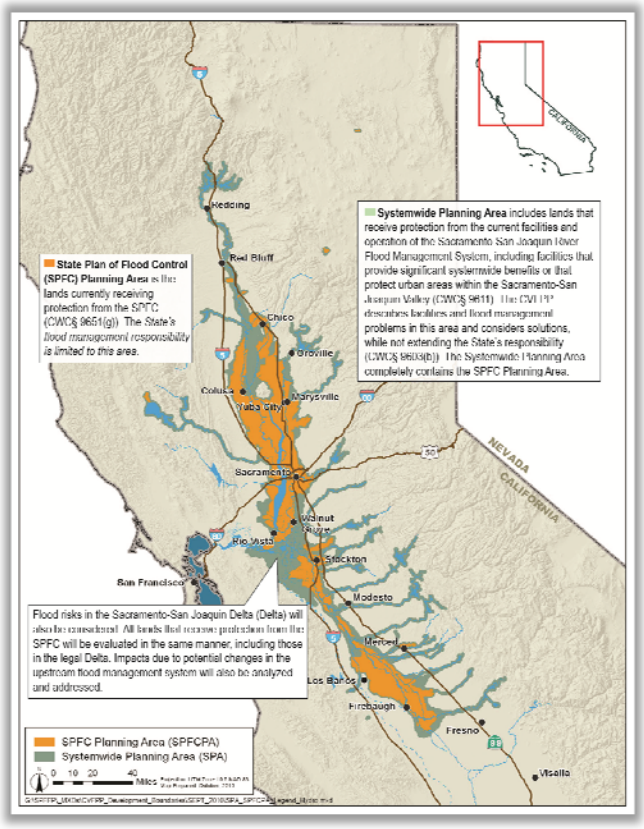
# Appendix E: Glossary

| | |
|---|---|
| 2-year event | 50 percent chance of exceedance in a given year |
| 20-year event | 5 percent chance of exceedance in a given year |
| 50-year event | 2 percent chance of exceedance in a given year |
| 100-year event | (also known as a base flood) 1 percent chance of exceedance in a given year |
| 200-year event | 0.5 percent chance of exceedance in a given year |
| 500-year event | 0.2 percent chance of exceedance in a given year |
| A-Zone | The A-zone is an area of special flood hazard without water surface elevations determined. Flood insurance is mandatory in areas with a 1 percent annual chance of flooding. |
| Actions | Informed by tools and guided by plans, actions include activities that fund, manage, and oversee implementation of the projects. Actions also include fostering innovation and developing agency alignment to improve flood management policies, planning, governance, and investments. Actions based on IWM principles and thorough planning efforts will provide the most benefit to Californians. |
| Alluvial Fan Flooding | Flows of shallow depth and high velocity, with sediment transport, along uncertain flow paths on the surface and at the toe of alluvial fans. Typically caused by localized rainstorms, often with snowmelt. |
| Atmospheric River | A weather pattern that forms a narrow corridor of concentrated moisture in the atmosphere that drops torrential rains as it passes over land. |
| Base Flood Elevation | The elevation of surface water resulting from a flood that has a 1 percent chance of equaling or exceeding that level in any given year. The base flood elevation is shown on Flood Insurance Rate Maps for zones AE, AH, A1-A30, AR, AR/A, AR/AE, AR/A1–A30, AR/AH, AR/AO, V1–V30, and VE. |
| Benefit-to-Cost (B/C) Analysis | The B/C analysis is a formalized procedure for estimating the benefits that a project is expected to generate and the costs necessary to produce the project, and then comparing project alternatives. When planning for flood protection, there will be construction and implementation costs, as well as flood risk reduction benefits. |
| California Data Exchange Center (CDEC) | The CDEC provides a centralized location to store and process real-time hydrologic information gathered from different contributors statewide. |
| California Water Plan (CWP) | The CWP provides a collaborative planning framework for elected officials, agencies, tribes, water and resource managers, businesses, academia, stakeholders, and the public to develop findings and recommendations and make informed decisions for California's water future. The plan, updated every 5 years, presents the status and trends of California's water-dependent natural resources; water supplies; and agricultural, urban, and environmental water demands for a range of plausible future scenarios. The CWP also evaluates different combinations of regional and statewide resource management strategies to reduce water demand, increase water supply, reduce flood risk, improve water quality, and enhance environmental and resource stewardship. |

| | |
|---|---|
| Capacity Exceedance | Capacity exceedance implies exceedance of the capacity of a water conveyance, storage facility, or damage-reduction measure. This includes levee or reservoir capacity exceeded before overtopping, channel capacity exceedance, or rise of water above the level of raised structures. |
| Central Valley Flood Management Planning (CVFMP) Program | CVFMP is one program within FloodSAFE California, a multi-year initiative led and managed by the California Department of Water Resources. Primary products of the CVFMP Program are the State Plan of Flood Control Descriptive Document, the State Plan of Flood Control History Document, the Flood Control System Status Report, and the Central Valley Flood Protection Plan. |
| Central Valley Flood Protection Plan (CVFPP) | The CVFPP is a State plan that will describe the challenges, opportunities, and a vision for improving flood management in the context of Integrated Water Management in the Central Valley. The CVFPP will document the current and future risks associated with flooding and recommend improvements to the Federal-State flood protection system to reduce the occurrence of major flooding and the consequence of flood damage that could result. The plan was submitted to the Central Valley Flood Protection Board in January 2012 for adoption by July and will be updated every 5 years. The planning area for the CVFPP is shown below. |



| | |
|---|---|
| Central Valley Flood Protection Plan (CVFPP) Floodplain | The floodplains used for the SFMP risk characterization within portions the Central Valley are the CVFPP No Action depth grid floodplains with the addition of the flood bypasses. SFMP received the draft CVFPP floodplains on October 4, 2011. The CVFPP floodplains were based on the floodplains of the *Sacramento and San Joaquin River Basins Comprehensive Study* (USACE, 2002) and modified by the CVFPP to reflect current hydrologic, hydraulic, and geotechnical information. For the SFMP analysis, the Yolo, East Side, Upper Sacramento, Mariposa, Sutter, and Tisdale bypasses were added to the CVFPP floodplains. |
| Coastal Flooding | Inundation at locations normally above the level of high tide. Often caused by storm surges occurring with high tides. Impacts include property damage and beach erosion. |
| Community | A political entity that has the authority to adopt and enforce floodplain ordinances for the area under its jurisdiction. |
| Consequences | Consequences are the quantitative measures of loss, such as direct tangible monetary loss or number of lives lost, when water inundates the people and property exposed. |
| Critical Facilities | Essential, high potential loss, lifeline, and transportation facilities, as defined by HAZUS-point shapefiles |
| Debris Flow Flooding | Flows made up of water, liquefied mud, and debris. Can form and accelerate quickly, reach high velocities, and travel great distances. Commonly caused by heavy localized rainfall on hillsides denuded of vegetation. |
| Economic Risk | Economic risk is the likelihood of flood damage to an identified area under a given climate and land use condition. |
| Engineered Structure Failure Flooding | Flooding as a result of dam failure or levee failure presents the potential of catastrophic impact, depending on amount of water impounded and location of populated areas downstream. |
| Essential Facilities | Care facilities, emergency centers, fire stations, police stations, and schools, as defined by HAZUS-point shapefiles. |
| Expected Annual Damage (EAD) | EAD is the value that measures the severity of flood loss in any given year. EAD does not mean that this amount of damage will occur in any particular year, but rather that over a long period, the average damages will tend to approach that amount. |
| Exposure | Exposure is a description of who or what is in harm's way. |
| Fetch | The distance along open water or land over which the wind blows, or the distance waves can traverse unobstructed. |
| Flash Flooding | Quickly forming floods with high-velocity flows. Often caused by stationary or slow-moving storms. Typically occurs on steep slopes and impermeable surfaces, and in areas adjacent to local streams and creeks. |

| | |
|---|---|
| Flood Emergency Response Information System (FERIS) | FERIS is a geospatial information system that allows for integration of existing California Data Exchange Center (CDEC) systems with real-time data collection and data exchange. |
| Flood Hazard | The Federal Emergency Management Agency defines a flood hazard as any flood event or condition with the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, environmental damage, business interruption, or other loss. |
| Flood Insurance Rate Map (FIRM) | A FIRM is the official map of a community on which the Federal Emergency Management Agency has delineated the Special Flood Hazard Areas, the Base Flood Elevations, and the risk premium zones applicable to the community. |
| Flood Management | See *flood risk management*. Generally, the terms *flood management* and *flood risk management* are used interchangeably throughout the Flood Future Report. |
| Flood Risk | Flood risk is the likelihood of consequence of inundation within an identified area, given a specified climate condition, land use condition, and flood management system (existing or planned) in place. The consequence may be direct or indirect economic cost, loss of life, environmental impact, or other specified measure of flood effect. Flood risk is a function of the following components:<br>• Loading, which is the frequency and magnitude of flooding<br>• Performance of flood management measures<br>• Exposure and vulnerability, which are the relationship between the flood hazard (rising or flowing water) and its effect on life loss, property, and/or environmental resources<br>• Consequence<br>Therefore, flood management actions may reduce risk by changing loading, performance, exposure, vulnerability, or consequence. |
| Flood Risk Management | Flood risk management seeks to reduce flood risks by managing the floodwaters to reduce the probability of flooding (including by levees and dams) and by managing the floodplains to reduce the consequences of flooding. Flood risk management requires integrating and synchronizing programs at various levels of government designed to reduce flood risk.<br>Source: USACE, Institute for Water Resources, a dynamic resource at http://nfrmp.us/frm_terminology.cfm#def17 (accessed March 11, 2013). |
| Floodplain | The extent of the flood hazard for a 100-year (1 percent chance of exceedance in a given year) or 500-year (0.2 percent chance of exceedance in a given year) event, as determined by the Central Valley Flood Protection Plan, Federal Emergency Management Agency, or U.S. Army Corps of Engineers. |

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| FloodSAFE California | FloodSAFE California refers to the California Department of Water Resources multi-faceted initiative launched in 2006 to improve public safety through flood management in the context of Integrated Water Management and to reduce potential flood damages in areas of the state with the highest risk. Although led at the State level and initially funded by bond money from Propositions 1E (2006) and 84 (2006), FloodSAFE implementation relies on the cooperation and assistance of Federal partners, Tribal entities, local sponsors, and other stakeholders. The FloodSAFE vision is a sustainable system of flood management with an IWM approach and emergency response throughout California that improves public safety, protects and enhances environmental and cultural resources, and supports economic growth by reducing the probability of destructive floods, promoting beneficial floodplain processes, and lowering the damages caused by flooding. |
| Hazard Mitigation Plan (HMP) | A community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage is described in an HMP. Results are accomplished through hazard mitigation, which is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. |
| Hazards United States (HAZUS) – Federal Emergency Management Agency (FEMA) | FEMA has developed a Geographic Information System-based U.S. multihazard assessment software, which contains a Flood Loss Estimation Model with flood hazard analysis and flood loss estimation modules for riverine and coastal analyses. The flood hazard analysis module (HAZUS) uses characteristics such as frequency, discharge, and ground elevation to estimate flood depth, flood elevation, and flow velocity. |
| High Potential-Loss Facility | Facilities such as dams and hazardous material sites, as defined by HAZUS-point shapefiles. |
| Hydrologic Engineering Center-Flood Damage Analysis (HEC-FDA) | The U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC) Flood Damage Analysis (FDA) model is designed to perform risk analysis as part of a flood risk study. The approach explicitly incorporates descriptions of uncertainty of key parameters and functions into project benefit and performance analyses. |
| Hydrologic Unit Code 8 (HUC8) | A Hydrologic Unit Code 8 is a watershed address consisting of a name and a number (for example, Lower James watershed, 02080206). The 8-digit number is a Hydrologic Unit Code or HUC. The Hydrologic Unit system is a standardized watershed classification system developed by the U.S. Geological Survey in the mid-1970s. Hydrologic units are watershed boundaries organized in a nested hierarchy by size. They range in size from regions to the smaller cataloging units, which are roughly equivalent to local watersheds. |
| Impact Area | Impact area is a term used for convenience to describe a geographic area for which risk is assessed. |
| Improvement Project | A project that will improve or add facilities to the State Plan of Flood Control to increase levels of flood protection for urban areas. Funding for improvement projects is authorized by California Public Resources Code section 5096.821(b). |

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| Integrated Regional Water Management (IRWM) | IRWM promotes the coordinated development and management of water, land, and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. |
| Integrated Water Management (IWM) | IWM is a strategic approach to planning and implementation that combines specific flood management, water supply, and ecosystem actions to deliver multiple benefits. IWM relies on blending knowledge from a variety of disciplines, including engineering, economics, environmental sciences, public policy, and public information. This approach also promotes system flexibility and resiliency to accommodate changing conditions such as regional preferences, ecosystem needs, climate change, flood or drought events, and financing capabilities. |
| Life-Safety Risk | Life-safety risk represents the number of lives in jeopardy in an identified portion of the state, considering a given climate and land use condition, with a specified plan of flood management in place. |
| Loading | In the context of flood risk, loading describes the likelihood of occurrence of conditions that lead to loss of life or damage to property if the conditions are not controlled or the consequence is not managed. Loading commonly is described with a discharge-frequency function, which identifies the probability that discharge at a specified location will exceed a specified value. |
| Local Maintaining Agency (LMA) | LMAs include reclamation districts, State maintaining agencies, improvement districts, and individual districts like American River Flood Control District or Lower San Joaquin Levee District. |
| Long-Term Average (or Expected) Annual Inundation Damage | See Expected Annual Damage (EAD). |
| Maintenance and Inspection | Actions required for the proper care and efficient operation of various project elements. These actions may be combined or separated, as best suits the particular project. The guidance for proper maintenance and inspection are contained in ER 1130-2-303. Adaptations needed to satisfy conditions not covered in the ER are encouraged. Outlines of the maintenance and inspection records are be maintained and available for Government inspection. Government inspections will be performed in consultation with the project's sponsor. (Source: ER 1110-2-401) |
| Management Action | A management action is a specific structural or nonstructural strategy, action, or tactic that contributes to stated goals and addresses identified problems. Management actions could range from potential policy or institutional changes to operational and physical changes to the flood management system. Management actions are broad (not location-specific), and they vary in their level of detail. |

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| Modification | Project modifications include changes in project operation, changes in real estate interests, the physical change of a project feature, addition of project features, or changes in the purposes of a project. (Source: ER 1165-2-119) |
| National Flood Insurance Program (NFIP) | The NFIP is a Federal program created by the U.S. Congress to mitigate future flood losses nationwide. The NFIP requires local communities to enforce building and zoning ordinances in exchange for access to affordable, Federally backed, flood insurance protection for property owners. |
| Operation | Actions that are necessary for the safe and efficient functioning of a project to produce the benefits set forth in the project authorization. The operational requirements for nonreservoir projects are to be presented as operation plans covering essentially the who, what, where, when, and how of the various project operations. An outline of operation records is to be maintained and available for inspection. The operation of reservoirs, covered in water control manuals shall be separate from this operation and maintenance manual. (Source: ER 1110-2-401) |
| Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) | For Federally funded projects the definition of operation and maintenance (O&M) includes the local entity's financial obligation to operate, maintain, repair, rehabilitate, and replace (OMRR&R) the implemented project. OMRR&R is a non-Federal responsibility when local, regional and/or State entities partner on a Federal project. References to O&M provided in the Flood Future Report include OMRR&R responsibilities when the project is a Federal/non-Federal partnership. |
| Performance | Performance refers to the effectiveness of flood or floodplain management measures. |
| Plans | Plans utilize information provided by tools, as well as input from stakeholders to guide the development of the flood management strategies. Plans take into account near- and long-term actions, as well as any additional considerations, such as multiple benefits, environmental concerns, overall water management, and climate change, to formulate long-lasting resilient strategies. Plans include identifying and evaluating possible multibenefit projects and the most effective means of implementing projects using an integrated, collaborative approach. |
| Project Management Plan | A project management plan defines how a project is executed, monitored, and controlled. It is used to define the approach, scope, and delivery of a project. |

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| Public Law 84-99 (33 U.S.C. 701n) | USACE has authority under Public Law (PL) 84-99, Flood Control and Coastal Emergencies (33 U.S.C. 701n) (69 Stat. 186) for emergency management activities to protect human life and improved property, reduce human suffering, help communities recover from the effects of disasters, and mitigate damage and future threats. Under PL 84-99, the Chief of Engineers, acting for the Secretary of the Army, is authorized to undertake activities, including disaster preparedness, advance measures, emergency operations (flood response and post-flood response), rehabilitation of flood control works threatened or destroyed by flood, protection or repair of Federally authorized shore-protective works threatened or damaged by coastal storm, and provisions of emergency water due to drought or contaminated source. |
| California Public Resources Code section 75003.5 | The people of California further find and declare that the growth in population of the State and the impacts of climate change pose significant challenges. These challenges must be addressed through careful planning and through improvements in land use and water management that both reduce contributions to global warming and improve the adaptability of our water and flood control systems. Improvements include better integration of water supply, water quality, flood control and ecosystem protection, as well greater water use efficiency and conservation to reduce energy consumption. |
| California Public Resources Code section 75032(a) | California Public Resources Code section 75032(a) provides funds for:<br>The inspection and evaluation of the integrity and capability of existing flood control project facilities and the development of an economically viable flood control rehabilitation plan. |
| Reconstruction | Reconstruction consists of addressing the major performance deficiencies caused by a long-term degradation of the foundation, construction materials, and engineering systems that have exceeded their expected service lives and the resulting inability of the project to perform its authorized project functions. (Source: USACE, Program Guidance Letter on Reconstruction, August 16, 2005, http://planning.usace.army.mil/toolbox/library/MemosandLetters/reconstruction.pdf) |
| Rehabilitation | Rehabilitation refers to a set of activities necessary to bring a deteriorated project back to its original condition. (Source: ER 1110-2-401) |
| Repair | Repair refers to those activities of a routine nature that maintain the project in a well kept condition. (Source: ER 1110-2-401) |
| Replacement | Replacement covers those activities taken when a worn-out element or portion of a project is replaced. (Source: ER 1110-2-401) |
| Residual Risk | Residual risk is the likelihood of damage or other adverse consequence remaining after flood management actions are taken. |
| Results | Robust tools, thorough planning, and integrated actions deliver results that provide value to California's residents, environment, and economy. Results are tracked using performance measures and sustainability indicators that help improve investment performance and increase flood management benefits. |

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| Severe Repetitive Loss (SRL) | Any NFIP-insured residential property that has met at least one of the following paid flood loss criteria since 1978, regardless of ownership:<br>• Four or more separate claim payments of more than $5,000 each (including building and contents payments)<br>• Two or more separate claim payments (building payments only) where the total of the payments exceeds the current value of the property<br>In either case, two of the claim payments must have occurred within 10 years of each other. Multiple losses at the same location within 10 days of each other are counted as one loss, with the payment amounts added together. The loss history includes all ownership of the property since 1978 or since the building's construction if built after 1978. |
| Slow Rise Flooding | Slow rise flooding occurs as a gradual inundation as waterways or lakes overflow their banks. Most often caused by heavy precipitation, especially with heavy snowmelt. Includes riverine flooding in deep floodplains and ponding of water in low-lying urban areas, as well as gradual flooding in areas adjacent to local streams and creeks. |
| Special Flood Hazard Area (SFHA) | SFHAs are areas subject to inundation from a flood that has a 1 percent chance of being equaled or exceeded in a given year. |
| State Plan of Flood Control (SPFC) | Collectively, the facilities, lands, programs, conditions, and mode of operation and maintenance for the State-Federal flood protection system in the Central Valley. This area is shown in the figure provided under CVFPP definition. |
| Tools | Tools include data, models, and assessments needed for decision making in all aspects of flood management. DWR continues enhancing and sharing technical resources (tools) across all programs and projects. This includes flood, environmental, and water management data gathering, modeling, and the technical aspects of flood readiness and emergency response. Technical and modeling information help inform thorough and thoughtful planning, along with accurate design of flood management facilities. |
| Transportation Facility | Runways, railway bridges, rail facilities, port facilities, light-rail facilities, highway bridges, ferry facilities, bus facilities, and airport facilities, as defined by HAZUS-point shapefiles. |
| Tsunami Flooding | Tsunami flooding occurs as a result of high-speed ocean waves triggered by mass movement that displaces a large volume of water. Causes include earthquakes and underwater landslides. Impact on land depends on wave height and inundation area. |
| Utilities | Wastewater, potable water, oil, natural gas, electric power, and communications facilities, as defined by HAZUS-point shapefiles. |
| V-Zone | The V-zone is an area inundated by 1 percent annual chance (100-year) flooding with velocity hazard (wave action); no base flood elevations have been determined. |

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| Vulnerability | Vulnerability is the susceptibility to loss or damage of people and property exposed to the flood hazard. |
| Water Data Library (WDL) | The WDL is a searchable Geographic Information System (GIS) interface on the Internet. WDL allows users to access information about monitoring gauges, groundwater data, and water quality. |

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

UNITED STATES ARMY CORPS OF ENGINEERS
FLOOD PLAIN MANAGEMENT SERVICES PROGRAM


US Army Corps
of Engineers ®

The complete report, *California's Flood Future: Recommendations for Managing the State's Flood Risk*, including technical attachments and other supporting information is available for review at:

**http://www.water.ca.gov/SFMP**