

# **AGENDA CITY OF IONE**

## **IONE CREEK COMMITTEE**

*Tom Bridges  
Steve Fredrick  
Sally Norris  
Don Vicari  
Lisa Vicari*

**Public Teleconference Line: 1-646-749-3122  
Access Code: 414-141-597**

**YOU MAY ALSO PARTICIPATE IN THE MEETING BY USING THIS LINK:**

**<https://global.gotomeeting.com/join/414141597>**

**DUE TO THE GOVERNOR'S EXECUTIVE ORDER N-25-20, THE IONE CREEK COMMITTEE WILL BE CONDUCTING THEIR MEETING VIA TELECONFERENCE. WHILE THIS MEETING WILL STILL BE CONDUCTED IN PERSON AT 1 E. MAIN STREET, WE STRONGLY ENCOURAGE THE PUBLIC TO PARTICIPATE FROM HOME BY CALLING IN USING THE NUMBERS LISTED ABOVE**

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**Thursday, July 9, 2020 at 7:00 p.m.  
City Council Chambers, 1 E. Main Street, Ione 95640**

**PLEASE LIMIT PUBLIC COMMENT/TESTIMONY TO FOUR MINUTES  
Government Code 54954.3**

The Ione Creek Committee welcomes, appreciates, and encourages participation in the Ione Creek Committee Meeting. The Creek Committee reserves the right to reasonably limit the total time for public comment on any particular noticed agenda item as it may deem necessary.

Full staff reports and associated documents are available for public review at the Office of the City Clerk, City Hall, 1 E. Main Street, Ione, California. Hard copies may be obtained for \$3.60 for pages 1-5 and \$.45 for each additional page. Documents that are not available when the agenda is posted, will be made available for public review at the meeting.

### **AGENDA**

- A. CALL TO ORDER: 7:00 PM**
- B. PLEDGE OF ALLEGIANCE**
- C. ROLL CALL**
- D. APPROVAL OF AGENDA**
- E. PRESENTATIONS/ANNOUNCEMENTS: None**
- F. PUBLIC COMMENT: EACH SPEAKER IS LIMITED TO 4 MINUTES**

*This is the time for members of the public who wish to be heard on matters that do not appear on the Agenda. Persons may address the Ione Creek Committee at this time on any subject within the jurisdiction of the Ione Creek Committee. **Please be mindful of the 4 minute time limit per person.***

*Pursuant to the Brown Act, the Lone Creek Committee may not take action or engage in a detailed discussion on an item that does not appear on the Agenda. However, matters that require Committee action will be referred to staff for a report and/or recommendation for possible action at a future Committee meeting.*

*Is there any person in the audience who wishes to address the Committee at this time?*

**H. REGULAR AGENDA:**

1. Committee Member Introductions
2. Election of Committee Chairman and Vice Chairman
3. Review of the Mission of the Creek Committee
4. Review of Brown Act Requirements
5. Review of Resources:
  - Natural Resources Conservation Service
  - California Department of Fish and Game
  - UC Cooperative Extension
6. Committee Discussion of Goals, Tasks and Priorities

**I. COMMITTEE MEMBER REPORTS/FUTURE AGENDA ITEMS**

**J. ADJOURNMENT**

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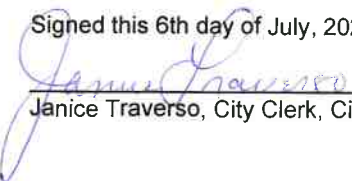
**ADA COMPLIANCE STATEMENT**

In compliance with the American with Disabilities Act, if you need special assistance to participate in this meeting, please contact City Clerk Janice Traverso at (209) 274-2412, 102. Notification 24 hours prior to the meeting will enable the City to make reasonable arrangements to ensure accessibility to this meeting.

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I, Janice Traverso, the City Clerk of the City of Lone, declare under the penalty that the foregoing agenda for the July 9, 2020 regular meeting of the Lone Creek Committee was posted on July 6, 2020 at the office of the City of Lone, City Hall at 1 East Main Street, Lone, CA 95640 and was available for public review at that location.

Signed this 6th day of July, 2020 at Lone, California

  
\_\_\_\_\_  
Janice Traverso, City Clerk, City of Lone

## IONE CREEK COMMITTEE OVERVIEW

Under the Ione Municipal Code, the Ione Creek Commission shall have the following duties and responsibilities:

- A. To act as an advisory body to the city council and to make recommendations to the city council regarding creek and related floodway uses, policies and ordinances;
- B. To make recommendations regarding programs or proposals which may facilitate public awareness, public participation, and public education with regard to safe and responsible utilization of all creeks and related floodways within the City of Ione;
- C. To make recommendations regarding creek bank restoration and stabilization, water flow obstructions, brush abatement, creek-bed buildup, litter abatement, sanitation, commercial uses, special events, licenses, permits, fees, collections, and funding;
- D. Recommend political action to the city council on riparian habitat measures, water runoff flows; and
- E. Recommend coordination of activities with other commissions, departments, or agencies, not limited to City Council, Planning Commission, Ione Volunteer Fire Department, Department of Fish and Game, F.E.M.A., and Mule Creek State Prison.

Council is looking to the Creek Committee to be the lead group in providing education to property owners adjoining the creeks related to their legal responsibilities for creek maintenance. Under California law (*Lux v. Haggin*, 69 Cal. 255 (1884)), ownership rights for land bordering on a non-navigable waterway extends to the center point of the stream. Thus, the owners on either side of the stream own the stream with their respective property lines meeting at the center of the stream for land use purposes (62 CalJur 3d § 15). Also according to *Randall v. Woods*, 8 Cal. 136 (1857), the owner of land through which a non-navigable stream flows is also the owner of the bed of such stream up to the midpoint of the stream which is the property line established by statute and the *Lux* case. Many adjoining creek property owners in Ione seem to be unaware of their legal obligations related to the streams. The Committee will develop educational materials to explain those obligations, which include removal of debris and foreign objects in the stream.

The Committee will also examine the storm water issues within the City and discuss ways to address them as the community continues to grow. Members will work with Amador County, Department of Fish and Wildlife, F.E.M.A., National Resource and Conservation Service, and the U.S. Department of Agriculture to assist property owners fund stream bank restoration projects.

Members of the Committee will be responsible for conducting their own research and meeting with other agencies to fulfill the mission of the committee. Topic research areas for storm water improvements may include such as storm water utility fees, impact fees, and Community Facility Districts. Topic Research areas for creek maintenance and improvements may include other counties. Research area for Creek improvements may include other counties governments, State agencies, institutions of higher learning, and not-for-profit groups. The Committee will have the ability to set its own course in helping the citizens of Ione improve the quality of the streams in our community.

THANK YOU FOR YOUR INTEREST IN THE IONE CREEK COMMITTEE

## California Civil Code

### § [830.]

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Section Eight Hundred and Thirty. Except where the grant under which the land is held indicates a different intent, the owner of the upland, when it borders on tide water, takes to ordinary high-water mark; when it borders upon a navigable lake or stream, where there is no tide, the owner takes to the edge of the lake or stream, at low-water mark; when it borders upon any other water, the owner takes to the middle of the lake or stream.

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*Location:*[https://california.public.law/codes/ca\\_civ\\_code\\_section\\_\[830.\]](https://california.public.law/codes/ca_civ_code_section_[830.]).

*Original Source:*§ [830.], [https://leginfo.legislature.ca.gov/faces/codes\\_displaySection.xhtml?lawCode=CIV&sectionNum=\[830.\]](https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=CIV&sectionNum=[830.]). (last accessed Jun. 6, 2016).



# THE BROWN ACT

OPEN MEETINGS FOR  
LOCAL LEGISLATIVE BODIES

2003

CALIFORNIA ATTORNEY  
GENERAL'S OFFICE

# THE --- BROWN --- ACT

## OPEN MEETINGS FOR LOCAL LEGISLATIVE BODIES

Office of the Attorney General  
Bill Lockyer  
Attorney General

Prepared by the Division of Civil Law

Chief Assistant Attorney General Andrea Lynn Hoch  
Deputy Attorney General Ted Prim, Editor



State of California  
**Office of the Attorney General**

Bill Lockyer  
Attorney General

Throughout California's history, local legislative bodies have played a vital role in bringing participatory democracy to the citizens of the state. Local legislative bodies - such as boards, councils and commissions - are created in recognition of the fact that several minds are better than one, and that through debate and discussion, the best ideas will emerge. The law which guarantees the public's right to attend and participate in meetings of local legislative bodies is the Ralph M. Brown Act.

While local legislative bodies generally are required to hold meetings in open forum, the Brown Act recognizes the need, under limited circumstances, for these bodies to meet in private in order to carry out their responsibilities in the best interests of the public. For example, the law contains a personnel exception based on notions of personal privacy, and a pending litigation exception based upon the precept that government agencies should not be disadvantaged in planning litigation strategy. Although the principle of open meetings initially seems simple, application of the law to real life situations can prove to be quite complex.

The purpose of this pamphlet is to provide a brief description of the Brown Act, along with a discussion of court decisions and opinions of this office that add to our understanding by applying it in specific factual contexts. We hope this pamphlet will assist both public officials and those who monitor the performance of local legislative bodies to minimize and resolve disputes over interpretations of the Brown Act. In recent years, both the California Supreme Court and the courts of appeal have recognized the benefit of pamphlets issued by our office. This recognition by the courts, along with many favorable comments from members of the public, strengthens our resolve to continue producing reliable informational materials on the Brown Act and other California laws. Publication of these materials constitutes a tradition of service that we value greatly.

Ideas and suggestions for future editions of this pamphlet are welcomed and should be addressed to the editor.

Sincerely,

BILL LOCKYER  
Attorney General

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## INTRODUCTION

This pamphlet concerns the provisions of the Ralph M. Brown Act, which govern open meetings for local government bodies. The Brown Act is contained in section 54950 et seq. of the Government Code. Accordingly, all statutory references in this pamphlet are to the Government Code unless otherwise noted. The pamphlet contains a table of contents, which may also serve as a topical outline for the reader. The pamphlet also includes a brief summary of the main provisions of the Brown Act, along with references to the appropriate Government Code sections and chapters of the text. The text includes a discussion of the law along with tips on how the law should be applied in particular situations. Numerous references are made to legal authorities throughout the text. A copy of the Brown Act in its entirety is set forth in the appendix to the pamphlet. Lastly, the pamphlet contains a table of authorities so that the reader can determine all of the places in the text where references are made to a particular authority.

In preparing this pamphlet, we relied on a variety of legal resources. Appellate court cases were consulted and are cited throughout the pamphlet. While most of the more significant cases are discussed, this pamphlet is not intended to be a compendium of all court cases in this area. In addition, we drew upon published opinions and unpublished letter opinions issued by this office. Attorney General opinions, unlike appellate court decisions, are advisory only and do not constitute the law of the state. However, with respect to the Brown Act, the courts have frequently adopted the analysis of Attorney General opinions, and have commented favorably on the service afforded by those opinions and this pamphlet. (*Bell v. Vista Unified School Dist.* (2000) 82 Cal.App.4th 672; *Freedom Newspapers v. Orange County Employees Retirement System* (1993) 6 Cal. 4th 821, 829.)

Published opinions are cited by volume and page number (e.g., 32 Ops.Cal.Atty.Gen. 240 (1958)). Unpublished letter opinions are cited as indexed letters by year and page number (e.g., Cal.Atty.Gen., Indexed Letter, No. IL 76-201 (October 20, 1976).) Published opinions are available through law libraries and some attorneys' offices. As a general rule, indexed letters are available only in the Office of the Attorney General. Copies may be obtained by a request to the Public Inquiry Unit of the Office of the Attorney General.

If you have specific questions or problems, the statutes, cases and opinions should be consulted. You also may wish to refer the matter to the attorney for the agency in question, a private attorney or the district attorney.

The pamphlet is current through January 2003 with respect to statutes, case law, and Attorney General opinions.

## SUMMARY OF KEY BROWN ACT PROVISIONS

### COVERAGE

#### PREAMBLE:

Public commissions, boards, councils and other legislative bodies of local government agencies exist to aid in the conduct of the people's business. The people do not yield their sovereignty to the bodies that serve them. The people insist on remaining informed to retain control over the legislative bodies they have created.

54950 Ch. I

#### GOVERNING BODIES:

Includes city councils, boards of supervisors, and district boards. Also covered are other legislative bodies of local government agencies created by state or federal law.

54952(a) Ch. I & II

#### SUBSIDIARY BODIES:

Includes boards or commissions of a local government agency as well as standing committees of a legislative body. A standing committee has continuing subject matter jurisdiction or a meeting schedule set by its parent body. Less-than-a-quorum advisory committees, other than standing committees, are exempt.

54952(b) Ch. II

#### PRIVATE OR NONPROFIT CORPORATIONS OR ENTITIES:

Covered only if:

- a. A legislative body delegates some of its functions to a private corporation or entity; or 54952(c)(1)(A) Ch. II
- b. If a legislative body provides some funding to a private corporation or entity and appoints one of its members to serve as a voting member of entity's board of directors. 54952(c)(1)(B)

## **MEETING DEFINED**

### **INCLUDES:**

Any gathering of a quorum of a legislative body to discuss or transact business under the body's jurisdiction; serial meetings are prohibited. 54952.2 Ch. III

### **EXEMPTS:**

- (1) Individual contacts between board members and others which do not constitute serial meetings; 54952.2(c)(1) Ch. III
- (2) Attendance at conferences and other gatherings which are open to public so long as members of legislative bodies do not discuss among themselves business of a specific nature under the body's jurisdiction; 54952.2(c)(2), (3) and (4)
- (3) Attendance at social or ceremonial events where no business of the body is discussed. 54952.2(c)(5)

### **LOCATIONS OF MEETINGS:**

A body must conduct its meetings within the boundaries of its jurisdiction unless it qualifies for a specific exemption. 54954 Ch. IV

### **TELECONFERENCE MEETINGS:**

Teleconference meetings may be held under carefully defined conditions. The meeting notice must specifically identify all teleconference locations, and each such location must be fully accessible to members of the public. 54953 Ch. III

## **PUBLIC RIGHTS**

### **PUBLIC TESTIMONY:**

Public may comment on agenda items before or during consideration by legislative body. Time must be set aside for public to comment on any other matters under the body's jurisdiction. 54954.3 Ch. IV & V



#### NON-DISCRIMINATORY FACILITIES:

Meetings may not be conducted in a facility that excludes persons on the basis of their race, religion, color, national origin, ancestry, or sex, or that is inaccessible to disabled persons, or where members of the public may not be present without making a payment or purchase. 54953.2; 54961 Ch. V

#### COPY OF RECORDING:

Public may obtain a copy, at cost, of an existing tape recording made by the legislative body of its public sessions, and to listen to or view the body's original tape on a tape recorder or viewing device provided by the agency. 54953.5 Ch. V

#### PUBLIC VOTE:

All votes, except for those cast in permissible closed session, must be cast in public. No secret ballots, whether preliminary or final, are permitted. 54953(c) Ch. VI

#### CLOSED MEETING ACTIONS/DOCUMENTS:

At an open session following a closed session, the body must report on final action taken in closed session under specified circumstances. Where final action is taken with respect to contracts, settlement agreements and other specified records, the public may receive copies of such records upon request. 54957.1 Ch. IV, V & VI

#### TAPING OR BROADCASTING:

Meetings may be broadcast, audio-recorded or video-recorded so long as the activity does not constitute a disruption of the proceeding. 54953.5; 54953.6 Ch. V

#### CONDITIONS TO ATTENDANCE:

Public may not be asked to register or identify themselves or to pay fees in order to attend public meetings. 54953.3; 54961 Ch. V

#### PUBLIC RECORDS:

Materials provided to a majority of a body which are not exempt from disclosure under the Public Records Act must be provided, upon request, to members of the public without delay. 54957.5 Ch. V

## **REQUIRED NOTICES AND AGENDAS**

### **REGULAR MEETINGS:**

Agenda containing brief general description (approximately twenty words in length) of each matter to be considered or discussed must be posted at least 72 hours prior to meeting.	54954.2	Ch. IV
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### **SPECIAL MEETINGS:**

Twenty-four hour notice must be provided to members of legislative body and media outlets including brief general description of matters to be considered or discussed.	54956	Ch. IV
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### **EMERGENCY MEETINGS:**

One hour notice in case of work stoppage or crippling activity, except in the case of a dire emergency.	54956.5	Ch. IV
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### **CLOSED SESSION AGENDAS:**

All items to be considered in closed session must be described in the notice or agenda for the meeting. A model format for closed-session agendas appears in section 54954.5. Prior to each closed session, the body must orally announce the subject matter of the closed session. If final action is taken in closed session, the body generally must report the action at the conclusion of the closed session.	54954.2; 54954.5; 54957.1 and 54957.7	Ch. IV
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### **AGENDA EXCEPTION:**

Special procedures permit a body to proceed without an agenda in the case of emergency circumstances, or where a need for immediate action came to the attention of the body after posting of the agenda.	54954.2(b)	Ch. IV
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## **CLOSED-SESSION MEETINGS**

### **PERSONNEL EXEMPTION:**

The body may conduct a closed session to consider appointment, employment, evaluation of performance, discipline or dismissal of an employee. With respect to complaints or charges against an employee brought by another person or another employee, the employee must be notified, at least 24 hours in advance, of his or her right to have the hearing conducted in public.	54957	Ch. VI
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### **PUBLIC SECURITY:**

A body may meet with law enforcement or security personnel concerning the security of public buildings and services.	54957	Ch. VI
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### **PENDING LITIGATION:**

A body may meet in closed session to receive advice from its legal counsel concerning existing litigation, initiating litigation, or situations involving a significant exposure to litigation. The circumstances which constitute significant exposure to litigation are expressly defined in section 54956.9(b)(3).	54956.9	Ch. VI
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### **LABOR NEGOTIATIONS:**

A body may meet in closed session with its negotiator to consider labor negotiations with represented and unrepresented employees. Issues related to budgets and available funds may be considered in closed session, although final decisions concerning salaries of unrepresented employees must be made in public.	54957.6	Ch. VI
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### **REAL PROPERTY NEGOTIATIONS:**

A body may meet in closed session with its negotiator to consider price and terms of payment in connection with the purchase, sale, exchange or lease of real property.	54956.8	Ch. VI
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## **REMEDIES AND SANCTIONS**

### **CIVIL REMEDIES:**

Individuals or the district attorney may file civil lawsuits for 54960; Ch. VII  
injunctive, mandatory or declaratory relief, or to void action 54960.1  
taken in violation of the Act.

Attorneys' fees are available to prevailing plaintiffs. 54960.5

### **CRIMINAL SANCTIONS:**

The district attorney may seek misdemeanor penalties against 54959 Ch. VII  
a member of a body who attends a meeting where action is  
taken in violation of the Act, and where the member intended  
to deprive the public of information which the member knew  
or has reason to know the public was entitled to receive.

**Return to Main Body**

# NRCS California

## Office Contact List & Phone Numbers

### NRCS State Office, Davis

(530) 792-5600

#### Area 1: Red Bluff Area Office

(530) 527-2667

• Alturas Service Center	(530) 233-4137
• Colusa Service Center	(530) 458-2931
• Del Norte Local Partnership Office	(707) 487-7630
• Eureka Service Center	(707) 442-6058
• Lakeport Local Partnership Office	(707) 263-4180
• McArthur Local Partnership Office	(530) 336-5604
• Oroville Service Center	(530) 534-0112
• Quincy Local Partnership Office	(530) 283-7511
• Red Bluff Service Center	(530) 527-3013
• Redding Service Center	(530) 691-5836
• Susanville Service Center	(530) 257-7271
• Tulelake Basin Project Office	(530) 667-4247
• Ukiah Service Center	(707) 485-3236
• Weaverville Service Center	(530) 623-3991
• Willows Service Center	(530) 934-4601
• Woodland Service Center	(530) 662-2037
• Yreka Service Center	(530) 842-6123
• Yuba City Service Center	(530) 671-0850

#### Area 2: Salinas Area Office

(831) 424-7377

• Capitola Local Partnership Office	(831) 475-1967
• Concord Service Center	(925) 672-4577
• Half Moon Bay Local Partnership Office	(650) 726-4660
• Hollister Service Center	(831) 637-4360
• Livermore Local Partnership Office	(925) 371-0154
• Modesto Service Center	(209) 491-9320
• Napa Field Office	(707) 252-4189
• Petaluma Service Center	(707) 794-1242
• Salinas Service Center	(831) 424-7377
• Santa Maria Service Center	(805) 928-9269
• Stockton Service Center	(209) 337-2124
• Templeton Service Center	(805) 434-0396
• Vacaville Service Center	(707) 448-0106

### Area 3: Fresno Area Office

(559) 252-2191

• Auburn Service Center	(530) 217-6263
• Bakersfield Service Center	(661) 281-2765
• Elk Grove Service Center	(916) 714-1104
• Fresno Service Center	(559) 276-7494
• Grass Valley Field Office	(530) 272-3417
• Hanford Service Center	(559) 585-8732
• Jackson Local Partnership Office	(209) 223-3581
• Madera Service Center	(559) 674-4628
• Mariposa Local Partnership Office	(209) 966-3431
• Merced Service Center	(209) 722-4119
• Placerville Field Office	(530) 295-0120
• Sonora Local Partnership Office	(209) 984-0500
• South Lake Tahoe Field Office ( <i>contact Placerville</i> )	(530) 295-0120
• Visalia Service Center	(559) 734-8732

### Area 4: San Bernardino Area Office (951) 684-3722

• Bishop Field Office	(760) 872-6111
• Blythe Field Office	(760) 922-3446
• Escondido Field Office	(760) 745-2061
• Imperial Service Center	(760) 355-2208
• Indio Service Center	(760) 347-3675
• Lancaster Service Center	(661) 945-2604
• Minden Service Center (Minden, NV)	(775) 782-3661
• Oxnard Field Office	(805) 984-2358
• Redlands Service Center	(909) 799-7407
• San Jacinto Local Partnership Office	(951) 654-7139
• Victorville Service Center	(760) 843-6882

### MLRA Soil Survey Region 2 Offices

• MLRA Arcata SSO	(707) 822-7090
• MLRA Chico SSO	(530) 343-2731
• MLRA Hanford SSO	(559) 584-9209
• MLRA Sonora SSO	(209) 591-8283
• MLRA Templeton SSO	(805) 434-0396
• MLRA Victorville SSO	(760) 843-6882

**Plant Materials Center, Lockeford (209) 727-3129**



United States  
Department of  
Agriculture

[www.ca.nrcs.usda.gov](http://www.ca.nrcs.usda.gov)

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Updated: January 2020

# Natural Resources Conservation Service

## Service Areas and Office Locations



Source of Data:  
USDA - Natural Resources Conservation Service



Map prepared using ArcGIS  
GIS Services Team, NRCS, Davis, CA  
Map ID: nrscs\_ca\_areas 1/7/2020



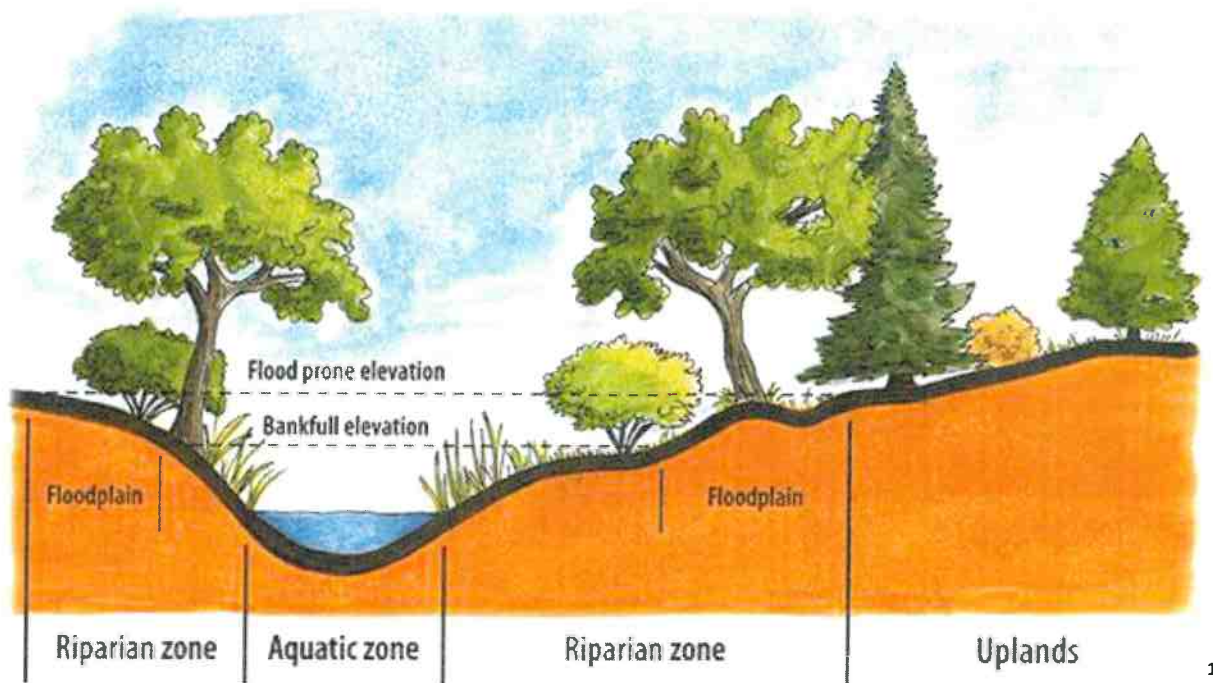


# Stream Maintenance

## *Preparing Creeks before the Rainy Season*

This document is intended to provide guidance to municipalities, Community Service Districts and private property owners that live along creeks. This document is for use in urban streams that are flood prone and fall within existing zones at the Marin County Flood Control District (see map titled 'Flood Control Zones in Marin County').

'Riparian Zone' or 'Riparian Area' or 'Riparian Corridor' is the interface between a stream and the upland area of land that includes hydrophilic (water-loving) vegetation supporting an array of beneficial services. Some benefits include; pollutant filtration, creek bank stability, habitat and food for wildlife (i.e. hazelnuts, bay nuts, nectar, thimbleberries, etc.), stream channel complexity, heat refugia, protection from predators, erosion control, migratory corridors, input for nutrient cycling (leaf litter and insect-drop), air quality, and more.



### The Law

It is a violation of Marin County Code and CA Department of Fish & Wildlife (CDFW) Code to remove native riparian vegetation without a permit (1602) or RMA (Routine Maintenance Agreement) in place from CDFW. Maintenance of a majority of the creeks in Marin is the responsibility of the neighbors whose properties border the creek and it is their responsibility to secure the necessary permits in advance of work in or around creeks. Start the permitting process early as permits can take 30-90 days to process and secure. While it may be within a

<sup>1</sup> Source: <http://slco.org/watershed/streams-101/the-riparian-zone>

County Flood Control Zone, the County has easements on some but not on every creek. CA Civil Code Section 830 says in summary: *homeowners are responsible for creek care, bordering a non-navigable stream where there is no tide, from the middle of the stream channel to their creek bank or to both banks if they own both sides of the creek. The purpose of the Code is to ensure flows are not impeded in order to reduce flooding.*

### Timing

The best time of year for creek “cleaning” or rather, “preparation” activities is in September and early October, before the rainy season. There are many reasons to carry out these actions in a timely manner:

- Once it rains, everything drains from the landscape into the waterways, which impairs water quality.
- Once the creek is flowing, removing trash becomes a safety hazard.
- Starting as early as December, many of Marin’s watersheds have federally listed steelhead trout migrating from the ocean to spawn (reproduce) in the upstream reaches of the creeks. Starting as early as October, some creeks will also have federally listed coho salmon migrating upstream to spawn. For their protection and safety, please stay out of the creeks.



Image 1: Litter adds up and can clog culverts causing flooding



Image 2: Branches that obstruct flow should be removed to prevent floods



Image 3: Neighbors coming together in east Marin to clean their creek

### The Do's

- Remove obstacles from the creek channel; wood panels, stream crossing boards, toys, litter, debris, etc. (see image 1)
- Remove low-hanging branches or fallen trees that would otherwise impair or obstruct creek flow during storm events (see image 2). Note, wood is great instream habitat for salmon and trout but are not permitted in flood control areas in order to protect homes and infrastructure from flood damage. Refer to map ‘Flood Control Zones in Marin County’ at the end of this document to see if your creekside parcel is within such a zone.
  - If the tree branches are not going to come in contact with the water (i.e. overhanging vegetation) then **do not** remove them. They contribute to ‘canopy cover’ and provide the following benefits:



Image 4: The proper method to cut and limb branches

- *Shade* – keeps water temperatures cooler. Warm water is lethal for many aquatic organisms, such as Marin’s endangered and threatened salmonid species.
- *Dissolved Oxygen* – cooler water temperatures enable more oxygen to be available for aquatic organisms, necessary for respiration.
- *Nutrient Cycling* – leaf litter drops in to decay and becomes a vital food source for insects such as benthic macroinvertebrates (BMs), which are then food for aquatic organisms such as salmon.
- *Food* – insects drop in from overhanging branches to feed salmon and amphibians.
- *Habitat* – birds and many other animals thrive in riparian environments and use them as migratory corridors.

- Cut branches an inch above the collar for the health of the tree, preventing the potential for plant pathogens and diseases to do harm (see image 4).
- 👉 Remove hazardous materials from the riparian area and store them in a safe place or dispose of them properly by visiting this website to locate your closest drop off location: <http://zerowastemarin.org/residents/household-hazardous-waste/>.
- 👉 Report illegal discharges of pollution into streams by contacting Marin County Stormwater Pollution Prevention Program (MCSTOPPP) or SF Regional Water Quality Control Board (RWQCB).
- 👉 Many hands make light work: Invite your neighbors to work together on a ‘creek clean-up day’ where everyone can lighten the load by pitching in together (see image 3).
- 👉 Remove non-native invasive vegetation when possible. Non-natives harm a watershed by displacing native vegetation that local wildlife relies on for survival. Employ erosion control measures upon invasive species removal to keep fine sediment from impairing water quality.
  - Remove non-natives during spring while the ground is still soft but the rains have finished, reducing the chance of erosion allowing fine sediment to enter the waterway.
  - Plant native riparian species in fall during the wet season to help them become established. Natives may need additional water in summer until they become fully established.

## The Don'ts

- 👉 Do not remove native vegetation unless necessary as native riparian vegetation is critical to a healthy functional stream. Click [HERE](#) to view a booklet about Marin’s native vegetation.



- ☛ Do not denude a creek bank in effort to speed up conveyance. If the banks are not vegetated, they will erode, leading to landslides and bank failures that fill up the creek with sediment, reducing the volume available to carry flow.
- ☛ Do not straighten creek channels out as that speeds up the water that in turn exacerbates creek bank erosion, incision and can lead to flooding downstream areas.
- ☛ Do not leave or place yard clippings/yard waste in or near the creek.
- ☛ Do not spray herbicide or pesticide near a creek as they are toxic to aquatic organisms.

### **Good for Bank Stabilization, Conveyance, and Shading of Water**



### **Protecting Your Streambank**

A majority of creek banks in Marin are subject to erosion, especially those on the outside bend of a stream AND those lacking vegetation such as native riparian trees where the robust root system holds the soil in place, protecting the bank (see images above). The best techniques to use, that promote a healthy riparian corridor, include soil bioengineering methods which are considered 'soft engineering' that are eco-friendly and nature-based solutions to creek bank erosion. Some examples of these techniques include but are not limited to;

- Willow/dogwood staking & sprigging (note: willows prefer sun and dogwoods prefer shade)
- Willow/dogwood walls
- Brush layering\*
- Willow/dogwood mattress
- Laying the bank back to a 2:1 slope then vegetating it with natives\*
- Using large pieces of wood to deflect flows away from the toe of your bank\*

\* These activities will necessitate engineered designs. Contact Sarah Phillips for a list of *Creek-Friendly Engineers* [Sarah@Marinrcd.org](mailto:Sarah@Marinrcd.org). Learn more about willows in Marin County [HERE](#).

## Permitting and Regulations (i.e. all the RED TAPE)

Any work performed in or near a creek (perennial, ephemeral or intermittent) will likely require a permit from at least one regulatory agency. If you are in unincorporated Marin, most actions carried out within or near the creek channel will require a Creek Permit which can be obtained through Marin County's Department of Public Works, Land Development Division. To confirm whether you need a permit, contact them directly at 415-473-6549. If you live in an incorporated area of Marin, contact your local Department of Public Works to confirm whether your proposed actions will or will not trigger permitting.

Other regulatory agencies to check in with **before** you carry out any work around any waterway, whether it flows year-round (perennial) or only seasonally (ephemeral & intermittent);

- Army Corps of Engineers, *Roberta Morganstern*,  
[Roberta.a.morganstern@usace.army.mil](mailto:Roberta.a.morganstern@usace.army.mil), (415) 503-6782
- SF Regional Water Quality Control Board, *Nicole Fairley*,  
[Nicole.Fairley@Waterboards.ca.gov](mailto:Nicole.Fairley@Waterboards.ca.gov), (510) 622-2424
- CA Department of Fish & Wildlife, *James Hansen*,  
[James.Hansen@Wildlife.ca.gov](mailto:James.Hansen@Wildlife.ca.gov), (707) 576-2869

If ever in doubt, Marin County offers FREE monthly meetings where you can discuss your proposed actions with the appropriate regulatory authorities in a non-formal setting to determine which permits you will need and how best to proceed with your project. To get on the *Marin Project Coordination* meeting agenda, contact Howard Bunce at Marin County Stormwater Pollution Prevention Program (MCSTOPPP) at [HBunce@marincounty.org](mailto:HBunce@marincounty.org) or (415) 473-3748.

## Key Watershed Contacts

Marin County Flood Control, Bene Da Silva, [BDaSilva@marincounty.org](mailto:BDaSilva@marincounty.org) (415) 473-6538

Marin County Flood Control, Gerhard Epke, [GEpke@marincounty.org](mailto:GEpke@marincounty.org) (415) 473-6562

Marin County Flood Control, Alekz Pang, [APang@marincounty.org](mailto:APang@marincounty.org) (415) 473-2667

Marin County Watershed Program, Liz Lewis, [LizLewis@marincounty.org](mailto:LizLewis@marincounty.org) (415) 608-8688

Marin County Stormwater Pollution Prevention Program, Howard Bunce,  
[HBunce@marincounty.org](mailto:HBunce@marincounty.org) (415) 473-3748

Marin Resource Conservation District, Sarah Phillips, [Sarah@marinrccd.org](mailto:Sarah@marinrccd.org) (415) 663-1170

## Learn More!

### General Creek Guidance

Various Creek Information per Marin County:

<http://www.marincounty.org/depts/pw/divisions/mcstoppp/general-public/creeks-and-watersheds>

Sonoma County Water Agency:

[http://www.waterboards.ca.gov/sanfranciscobay/board\\_info/agendas/2011/April/SCWA/Stream\\_Manual.pdf](http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2011/April/SCWA/Stream_Manual.pdf)

Regional Water Quality Control Board:

[http://www.waterboards.ca.gov/sanfranciscobay/board\\_info/agendas/2014/April/7.pdf](http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2014/April/7.pdf)

Best Management Practices for Stream Protection: <http://www.fayetteville-ar.gov/DocumentCenter/Home/View/1556> (\*note pg 17 lists species for Arkansas, please plant according to native species for Marin County with guidance provided below)

Plethora of Resources on Marin RCD's Urban Streams Coordination Page:

<http://www.marinrcd.org/resources/>

### Regulatory

Marin County Creek Permit Guide:

<https://www.marincounty.org/~media/files/departments/pw/mcstoppp/residents/creek-permit-guide.pdf?la=en>

State and Federal Regulatory Guide for Creeks:

[http://www.swrcb.ca.gov/sanfranciscobay/press\\_room/documents/Stream\\_Maintenance\\_Enhancement\\_Fact\\_Sheet\\_Final.pdf](http://www.swrcb.ca.gov/sanfranciscobay/press_room/documents/Stream_Maintenance_Enhancement_Fact_Sheet_Final.pdf)

### Erosion Control and Native Plants

Small Scale Erosion Control: <http://www.marinrcd.org/wp/wp-content/uploads/2014/01/Groundwork-A-Handbook-for-Small-Scale-Erosion-Control-in-Coastal-California.pdf>

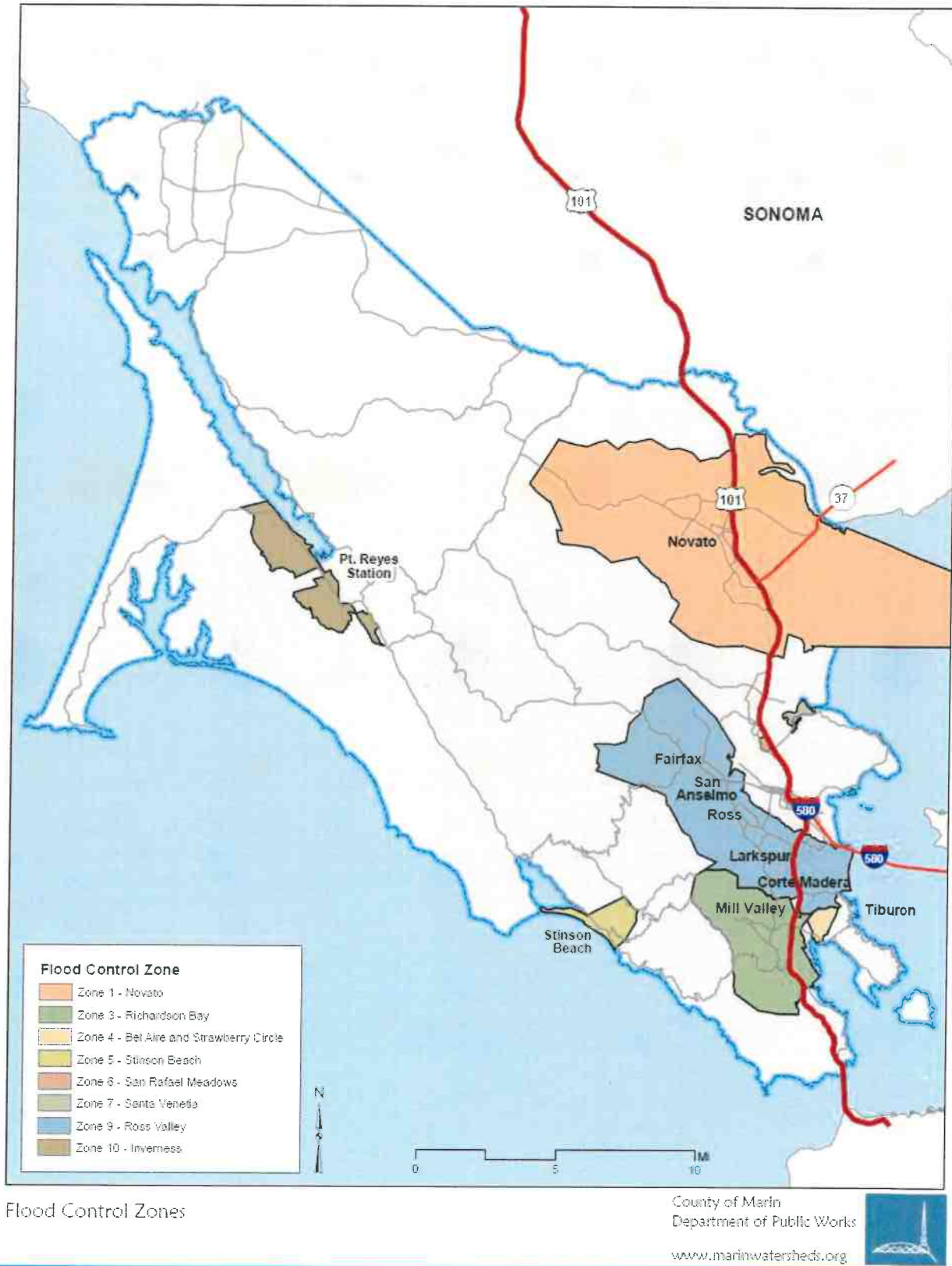
Go Native Booklet:

<https://www.marincountyparks.org/~media/files/departments/pw/mcstoppp/residents/go-native-2013.pdf>

CA Native Plant Society's Marin Chapter: <https://www.cnpsmarin.org/>



## Flood Control Zones in Marin County<sup>2</sup>



<sup>2</sup> Map can be found online at: [http://marinwatersheds.org/sites/default/files/2017-05/FC\\_All.pdf](http://marinwatersheds.org/sites/default/files/2017-05/FC_All.pdf)



Sponsored by the  
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(707) 794-1242, ext. 3



# CREEK CARE



A Guide for Rural Landowners  
and Residents of Petaluma and  
Sonoma Creek  
Watersheds



### **Many thanks to those who helped review the creek care guide:**

Bill Cox, California Department of Fish and Game; Leandra Swent, Paul Sheffer, Jennifer Allen, David Luther, Susan Haydon, Christine Molina, and Tish Ward of the Southern Sonoma County Resource Conservation District; Sean White, Sonoma County Water Agency; Vicki Mali; and Marjorie Peterson

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### **Copies of this guide can be obtained from:**

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[www.SonomaMarinRCDs.org](http://www.SonomaMarinRCDs.org)

### **INFORMATION USED BY PERMISSION**

- Portions of this Creek Care Guide were published in *Creek Care: A Guide for Rural Landowners* © 1995 by U.C. Cooperative Extension and *Creek Care: A Guide for Urban Marin Residents* © 1997 by Marin County Storm Water Pollution Prevention Program. The original guide was developed as part of the Marin Coastal Watershed Enhancement Project, which was coordinated by U.C. Cooperative Extension. Marin Community Foundation is gratefully acknowledged for their permission to adapt the original source material used in this guide.
- Versions of Fish Facts and Managing Woody Debris appeared in *How You Can Help Improve Salmon and Steelhead Habitat* by Prunuske Chatham, Inc. © 1995 by Marin Municipal Water District.
- Horse facility management information is drawn from the Equine Facilities Assistance Program fact sheets. 1998. Council of Bay Area Resource Conservation Districts.
- Information for Minimizing Soil Erosion is drawn from *Groundwork* by Liza Prunuske. © 1987 by Marin County Resource Conservation District.

### **DISCLAIMER**

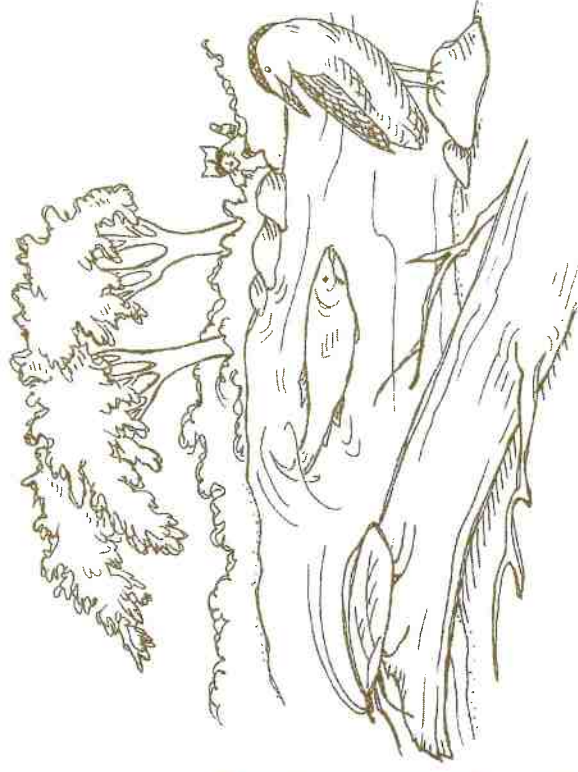
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## Preface

Wherever you live, your daily activities can affect our creeks.

Recently, members of our local communities came together to look at the history of our creeks and developed plans to make sure that they are well taken care of into the future. An important goal of these plans is to let neighbors know about creek concerns and how they can help. This creek care guide was created as a result.

This booklet covers what some of the issues are, how you can contribute to maintaining healthy creeks, and where you can get advice if needed. This guide will hopefully encourage and support your efforts.





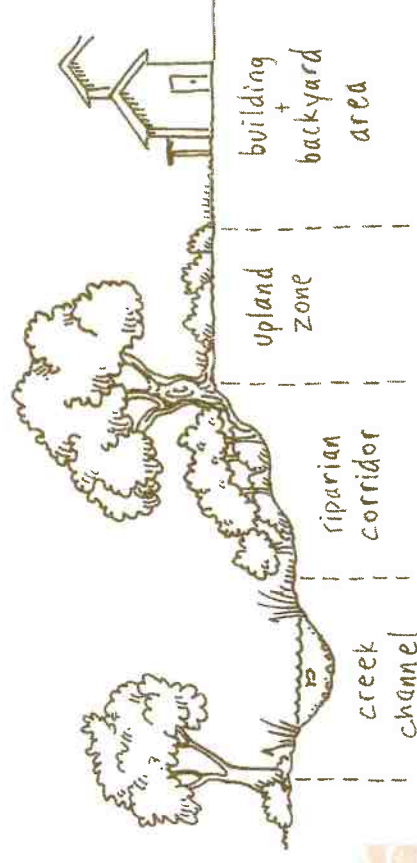
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## What is a Watershed?

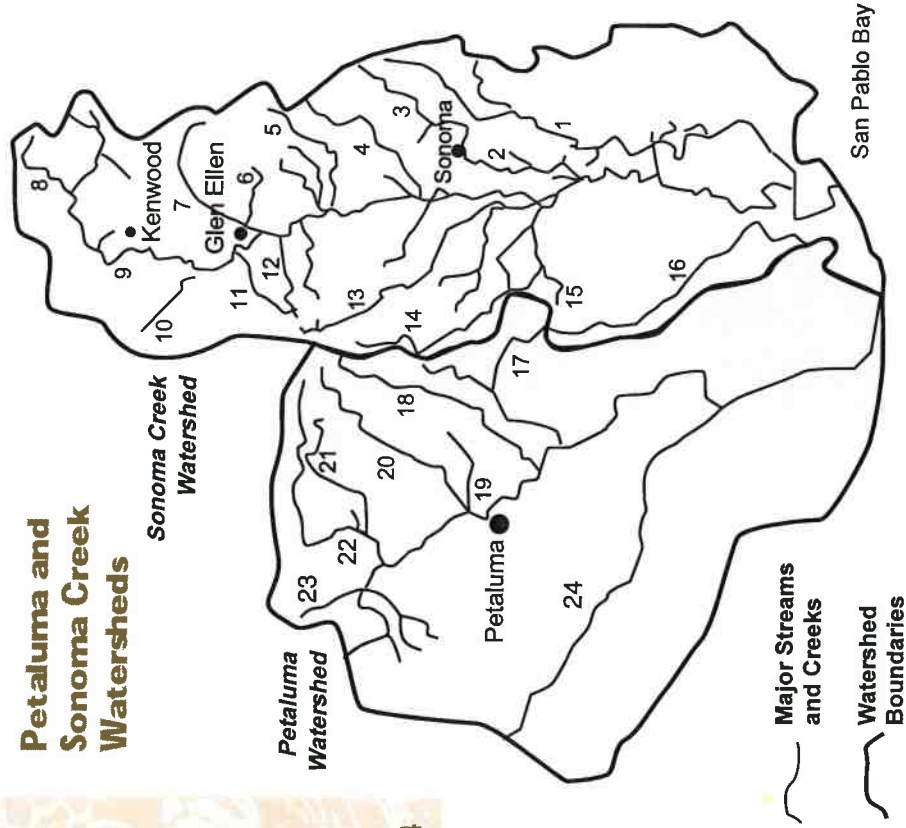
A watershed is the entire area of land that drains into a distinct creek or river system. It includes creeks, drainage areas, ditches, storm drains, flood plains, and land that water flows over or under on the way to a creek or bay.

Watersheds catch and store rain. Climate, elevation, soil, plants, steepness of the land, and size of the watershed affect the rate at which stored water is released from the watershed into creeks.



Large watersheds often have distinct subwatersheds that drain into a main creek or river. For example, San Antonio and Lynch Creeks are tributaries to the Petaluma watershed and subwatersheds to the Petaluma watershed. Graham and Calabazas Creeks are tributaries to Sonoma Creek and subwatersheds to the Sonoma Creek watershed.

## Petaluma and Sonoma Creek Watersheds



## Creeks

1	Arroyo Seco	9	Sonoma	17	Ellis
2	Schell	10	Yulupa	18	Adobe
3	Nathanson	11	Graham	19	Washington
4	Agua Caliente	12	Asbury	20	Lynch
5	Hooker	13	Carriger	21	Willowbrook
6	Stuart	14	Rodgers	22	Lichau
7	Calabazas	15	Champlin	23	Petaluma
8	Bear	16	Tolay	24	San Antonio

Natural conditions and human activities influence the condition of a creek. What takes place in the upstream areas will affect the downstream area. Changes may happen suddenly as the result of a storm (such as new stream bank erosion), or accumulated problems in the watershed may take many decades to develop (such as pools in the creek becoming filled with soil that has washed off the land). Plants and animals that live in or near the water are highly susceptible to changes caused by human actions.

In suburban and urban areas, rooftops and roads cover much of the land. In these areas, rainwater that normally would have soaked into the soil is shed off (like water from an umbrella) and can create flooding in streams and increase erosion.

Healthy watersheds keep water quality high, provide food and shelter for fish and wildlife, control soil from washing into the creek (erosion), maintain creek flows in the dry season, and reduce flooding.

Locally, healthy watersheds keep San Francisco and San Pablo Bays clean. Our stream and bay systems provide valuable nursery habitat for many fish, and contribute to commercial and sport fishing industries, as well as recreational activities.

In a healthy watershed, water quality and other resources are maintained for the benefit of humans and wildlife.



## A Healthy Creek, A Healthy Watershed

Healthy creeks reflect a healthy watershed. Creek channels are constantly being reshaped through natural processes. All creeks are important, whether they flow year-round (perennial), part of the year (intermittent), or just during storms (ephemeral). Even the small grass-lined ditches, known as swales, are important because they eventually carry water, soil, and food for aquatic animals into larger creeks.



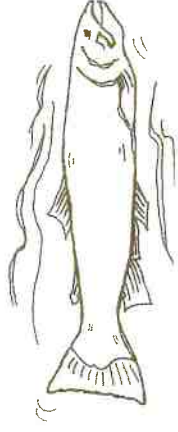
Creeks reflect what is happening on the surrounding land. A healthy creek will have:

- **Cool water.** This is critical for water-loving plants and animals. For example, steelhead and coho salmon need water temperatures between 40° and 60° F to survive. Cool water also helps reduce toxic levels of ammonia that come from decomposing waste such as animal manure.
- **Clean, clear water.** Fast moving water in streams usually has plenty of dissolved oxygen for fish to breathe, but stagnant pools in the summer or ponds may not. Also, salmon and steelhead need clear water to see and capture their food (small fish and insects).
- **A variety of slow and fast water,** with abundant rocks and gravel for spawning and young fish.
- **A high level of groundwater,** known as a high water table.
- **Thriving fish, amphibians (such as salamanders), and insect populations** that are important for fish food.
- **Dense, overhanging native trees and other plants** along the creek with minimal stream bank erosion and some undercut banks for aquatic habitat. Trees provide shade to keep the water cool and provide homes for many insects.

## What's Happening in our Watersheds?

Since the 1850s, the **Petaluma Watershed** has been an agricultural center for eggs, poultry, dairy, and most recently, vineyards. Petaluma is the urban center and small rural communities and ranchettes are found throughout the watershed. Watershed residents have set goals to establish a watershed council, improve water quality and groundwater recharge, support the viability of agriculture, and conserve and enhance existing wildlife habitat.

The **Sonoma Creek Watershed** supports vineyards, livestock ranching, croplands, state parks, open space, and urban activities. Wine grapes and tourism are key parts of the local economy. Sonoma and other small towns are found throughout the watershed. Citizen goals for the watershed include maintaining local control of watershed planning and enhancement, conserving and improving natural resources, managing streams for wildlife habitat and flood control, and educating the community about the watershed.



## Do we have Fish in Our Creeks?

Steelhead were historically found in the Petaluma watershed, including Lichau, Adobe, and San Antonio Creeks, and possibly Lynch, Willow Brook, and Thompson Creeks. Other tributaries were, and still are, too small and dry for steelhead. The Petaluma watershed is not believed to have had historical coho salmon runs.

In the Sonoma Creek watershed, steelhead are found in Sonoma Creek and the major tributaries of Calabazas, Stuart, Graham, Asbury, and Bear Creeks. Coho salmon have been reported in Sonoma Creek but are not officially documented.

Chinook salmon seen in the Petaluma watershed and Sonoma Creek are believed to be hatchery strays from the Sacramento River.

In both watersheds, salmon and steelhead habitat problems include lack of plant cover and shade, lack of summer water flows, too much soil in streambeds, fish passage barriers, lack of woody debris (big logs), non-native predatory fish, and poor water quality—including high temperatures.

## FISH FACTS

Salmon and steelhead are anadromous fish—meaning they are born in fresh water and mature at sea. Coho salmon spend their first year in freshwater creeks, then migrate out to sea where they mature for two years before returning to their native creek to lay eggs (spawn) and die. Steelhead have a similar life cycle, but they live in fresh water for one or two years, spend one to four years at sea, and return to spawn as many as four times. This variable life cycle and migration timing make steelhead more resilient to change.

The number of native coho salmon and steelhead has dropped dramatically in the past 30 years. Many creeks have lost their entire runs of these fish. Both are federally listed as threatened species—this means that they are at risk of extinction.



Good quality instream habitat is essential for these fish. They need:

- A year-round supply of cool, high quality water (less than 60° F).
- Diverse habitat with deep, quiet pools and shallow, rocky areas with faster moving water known as riffles.
- Clean spawning cobble (rounded rocks) and gravels without fine soil.
- Relatively stable creek banks.
- Dense shade canopy from creekside plants that will cool water, provide insect habitat, and contribute nutrients.
- Lots of woody debris from fallen trees and branches.
- Adequate food supply—primarily insects.
- Abundant cover for refuge from predators and storm flows. This includes undercut banks, rocks, tree roots, overhanging creekside plants, deep quiet pools, and large logs.

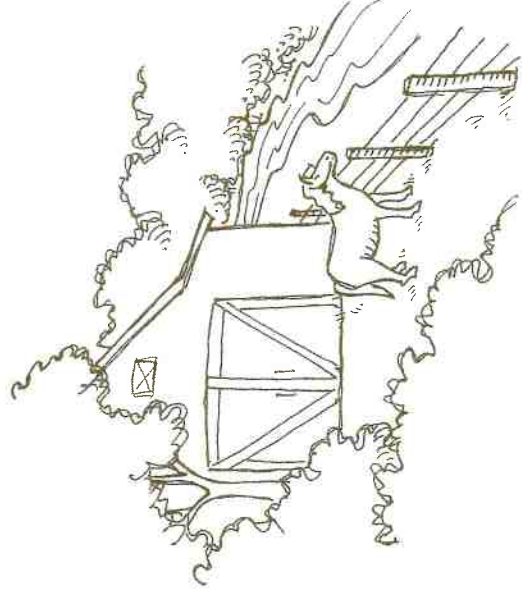
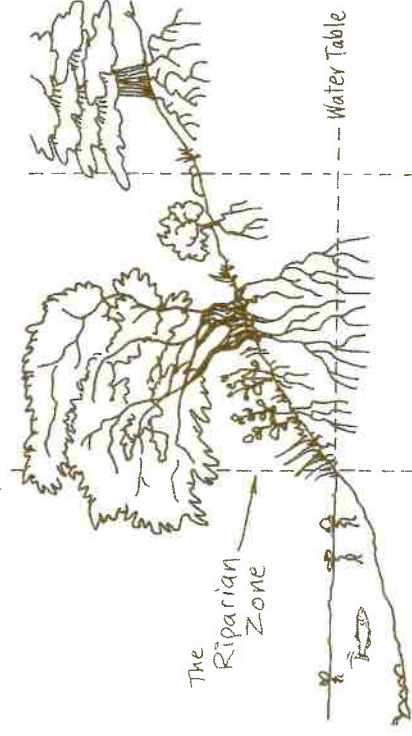
This same habitat benefits other native species found in the Petaluma watershed and Sonoma Creek such as sticklebacks, sculpin, suckers, Sacramento squawfish, California roach, lampreys, and the California freshwater shrimp. Many other native wildlife species, such as herons, egrets, kingfishers, dragonflies, weasels, deer, muskrats, river otters, and raccoons rely on healthy creek habitat.



## Plants Along the Creek

A diversity of native trees, shrubs, and grasses are a key part of creek health. Dense plants and roots stabilize creek banks, help reduce soil loss, filter soil, and slow flood waters. Trees and shrubs help raise the water table, and their canopies cool the water. They provide food, shelter, and shade for fish, amphibians, and other wildlife such as deer and birds. Leaves, fallen branches, and logs form the base of the food chain by providing habitat for insects. Healthy creek areas are used by more species of wildlife than any other type of habitat.

### Riparian Corridor



Common plants along creeks in our local watersheds are:

**Petaluma watershed.** Willows, coast live oak, valley oak, California bay, buckeye, box elder, white alder, and Oregon ash.

**Sonoma Creek watershed.** Willows, alders, buckeye, and coast live oak.

In both watersheds, other typical creekside trees are California black oak, California black walnut, and big leaf maple.

Shrubs common to both watersheds include California blackberry, blue elderberry, California hazelnut, coffeeberry, dogwood, ninebark, salmonberry, snowberry, spice bush, thimbleberry, twinberry, toyon, and western azalea.

## Common Watershed Concerns

Common, inter-connected watershed problems are water quality, water quantity, and fish and wildlife habitat. Typical concerns include the following.

- **Excess nutrients** from fertilizer or manure can cause algae to grow at a high rate. When algae decompose, they use up oxygen in the water—stressing or killing fish.
- **Excessive soil from bare ground** fills in the creek and reduces its ability to carry flood waters, destroys habitat pools, smothers fish eggs in the gravel, and kills insects that fish eat.
- **Pollutants** such as metals, pesticides, oil, grease, and illegally dumped yard waste, trash, tires, and construction debris harm wildlife and their habitat. Excess landscape irrigation, household water, swimming pool or spa water, as well as sewage from leaking septic systems are also considered to be pollutants.
- **Warm water** (>60° F) from lack of shade will stress fish. Water over 75° F will kill both coho salmon and steelhead.
- **Bare, unstable stream banks** with little or no plants do not provide overhanging shade or wildlife cover. Plants are often removed by agricultural operations, hobby farms, home building, landscaping, or livestock. Creek channels that have cut too wide or deep with vertical and actively eroding banks can signal a problem.

Loss of habitat can also occur from non-native plants or wooden or concrete walls along stream banks.

- **Illegal water pumps** that take creek water from small, instream pools (especially during the dry season) destroy summertime fish habitat.
- **Impervious (or hard) surfaces** such as roofs and roads that reduce the amount of water that soaks into the soil for groundwater recharge. This can increase flooding and lead to erosion problems.



## How Can I Care for Our Creeks?

Good stewardship is essential for healthy creeks and wildlife habitat. Whether or not you live right next to a creek, you can still be a good watershed steward. Those who live along creeks can most easily help improve our creeks. Good land management, as well as landscape and home maintenance, will help improve wildlife habitat, reduce runoff and pollutants, and improve water quality. These guidelines are a starting point for keeping creeks and watersheds healthy.

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## Creeks and Creek Banks

Here are some basic ways to protect creek banks and riparian areas:

- **Leave native plants on the banks.** If clearing must occur, leave as many plants as possible and replant with native plants. Contact the Resource Conservation District (RCD) for assistance (see resource directory in the back of this guide).
- **Leave rocks in the creek.** These are homes for creek critters. Don't remove for landscaping projects.
- **Divert water only if it is legal for you to do so.** Water diversions have many legal requirements. Contact the State Water Resources Control Board, Division of Water Rights and the California Department of Fish and Game for information (see resource directory in the back of this guide).
- **Avoid building structures such as sheds, barns, or decks near creeks.** Check your local building department for setback requirements.
- **Avoid building livestock corrals and feeding and watering areas near creeks.**
- **Store manure and animal waste so that runoff doesn't enter creeks.**
- **Restrict or control livestock and horse access to the creeks.**

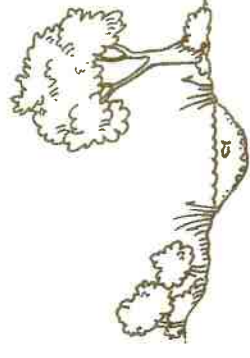
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- **Leave a strip of trees and other plants between buildings or pastures and the creek to create a natural "buffer."**
- **Graze seasonally in riparian areas.**
- **Plant woody plants such as native trees and shrubs** to protect creek banks against the force of flowing water. Contact the RCD for plant information (see resource directory).
- **Use carefully placed rock around pipe outlets.**
- **Avoid planting invasive non-native plants.** They often crowd out native plants and do not provide the same wildlife habitat. **Some plants to avoid are:**

Giant reed ( <i>Arundo donax</i> )	Bamboo
Periwinkle ( <i>Vinca major</i> )	Pampas grass
Scotch, French, or Spanish broom	Ice plant
German or English ivy	Acacia
Himalayan blackberry	Tree-of-heaven

If removing non-native plants, use caution to minimize erosion. Be sure to replant with native plants.



## Tips for Planting Along a Creek

Although many creeks have not had riparian plants for decades, they were not always bare. Plants or trees removed by humans, livestock, or high intensity storms should be replaced.

Use native species for replanting and select plants that already grow along the creek. Local plant stock is best adapted to specific local conditions and will be the easiest to grow. For example, oak trees that grow in flood prone areas are better adapted to saturated soil than oaks from drier upland areas. Local plants form the base of the food chain and are part of the complex web between insects, birds, fish, and other species.

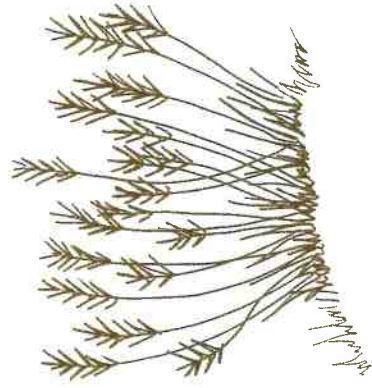
Native plants often require less water and do not need fertilizers and pesticides. They can be more resilient to disease than many ornamental, non-native plants and many are good for erosion control.

Care for your new plants during the first few years to help them become established. Dry season watering and regular weeding will increase survival rates. Be sure to replant plants that die. For more information sources, see resources directory in back of this guide.

### Watch Out for *Arundo donax*!

*Arundo donax*, or giant reed, is a dense, fast growing bamboo-like plant that originally came from Europe to the United States. It reaches heights of 25 feet and forms large, continuous root masses. It consumes three times more water than native plants, is a fire hazard, and creates serious flood control problems. *Arundo donax* quickly chokes and kills other plants in its path, destroying wildlife habitat. Biologists and land managers consider this invasive species to be one of the primary threats to healthy streams in the western United States.

*Arundo donax* is a major problem in both the Petaluma and Sonoma Creek watersheds. Contact the Sonoma Ecology Center for information about local eradication efforts (see resource directory in the back of this guide).

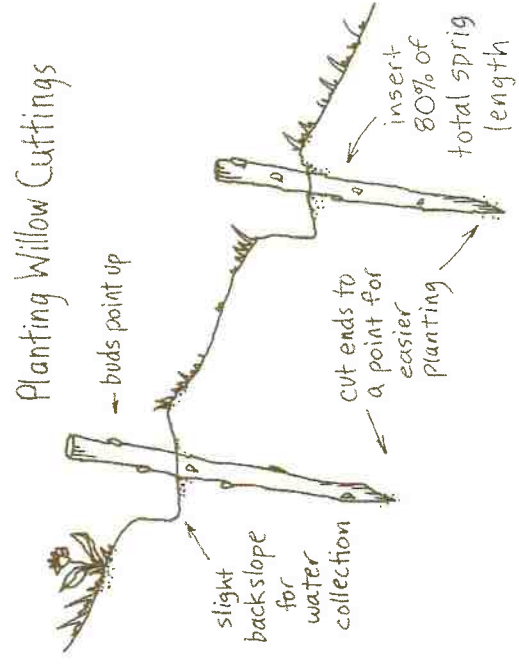


### How to Plant Willows

Historically, willows grew along most of the creeks in coastal California, and they still do. Willows are an effective and inexpensive way to armor creek banks and gullies and to provide important wildlife habitat.

Allowing trees to grow tall will help shade out the lower growing branches and reduce willow stems growing into the creek. Lower branches may need occasional pruning to prevent them from growing into the bottom of the creek. Native red and yellow willows are less likely to grow into the bottom of the creek than arroyo willows.

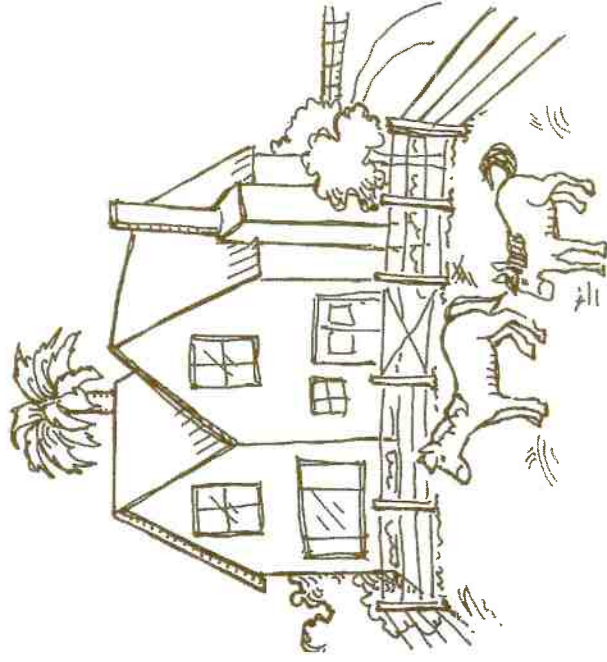
Adequate year-round water and sun are key for willows to establish and survive. Even if a creek doesn't have year-round, above ground flows, the ground water may be close enough to the surface to support willows.





Willow cuttings can be harvested and planted from mature willow plants following these steps:

1. Cut willows in the fall as soon as the plant has stopped growing for the season. This is indicated by the leaves dropping to the ground. The ground should be soft and wet. It is critical to plant willows as early as possible. This gives them a chance to develop good root systems before they sprout leaves in the spring. Planting too late is the most common cause of failure.
2. Willow cuttings should be at least  $3/4$  inches in diameter. Bigger is better. Cuttings should be at least 14 inches long.
3. Plant cuttings by pushing the cut end into soft soil, or make a hole with a sharp stick or pick. If you make a hole, be sure to compress soil tightly around the cuttings. They may need to be pounded in with a hammer. To give plenty of area for root growth, bury at least two-thirds of the length of the cutting. Angle sprigs slightly downstream to prevent them from being undermined by storm flows.
4. Plant willows low enough on the bank to ensure adequate soil moisture during the summer. Even if streams or gullies have year-round water, willows that are planted too high are likely to dry out and die. Cuttings should not need water if they are planted in an appropriate area.



## Soil Protection

Erosion is a natural process by which soil is moved by wind or moving water. Some soil, also known as sediment, is needed to bring nutrients to creeks and create habitat for aquatic plants and animals, but too much soil causes problems.

Erosion can occur in bare areas such as creek banks, pastures, fields, roads, stockpiled soil, areas cleared for the construction of new homes and buildings, or other places where soil is not protected from the erosive forces of rainfall, gravity, or wind. When water flows over bare ground, the exposed soil moves downhill and often ends up in a creek.

## Ways to Prevent Soil Loss

Basic strategies to prevent erosion are:

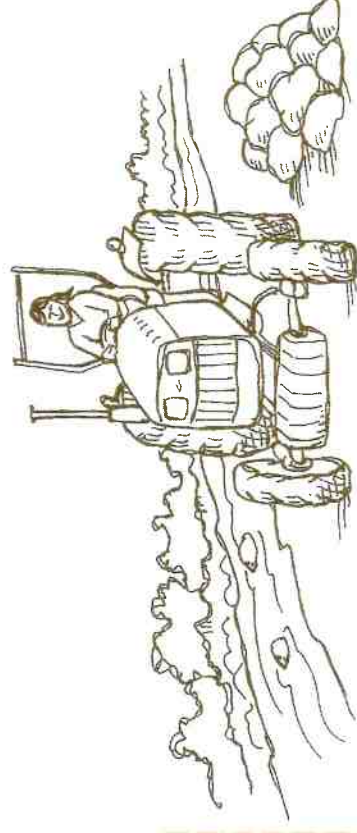
- **Protect bare soil surfaces.** Native trees, shrubs, grasses, and cover crops hold the soil in place and allow water to soak into the soil. Use erosion control methods in construction areas.
- **Minimize disturbing existing plants.**
- **Avoid concentrating water flows.** Protect water or pipe outlets by using carefully placed rock.
- **Limit livestock and human use** near creek banks, gullies, seasonal drainage areas, unsurfaced roads, replanted areas, and landslides.
- **Prevent heavy grazing.** Use cross fencing to create pastures.
- **Seed and fertilize pastures.**
- **Use no-till and minimum till cultivation.** Planting seed through old stubble will not expose soil to winter rains.
- **Maintain plant and/or grass borders** around horse paddocks to act as a filter.
- **Separate water and salt blocks** to spread animals more evenly in grazed areas.
- **Develop springs or water troughs for livestock and horses** that are located away from the creek.

## Guidelines for Repairing Erosion

Not all erosion is harmful. Along streams, undercut banks and fallen trees provide important habitat for steelhead and other aquatic animals. Repairs may be necessary if property, structures, roads, or riparian habitat are threatened.

Most creek repair work requires permits. Before starting work, contact the California Department of Fish and Game, Sonoma County, U.S. Army Corps of Engineers, and Regional Water Quality Control Board. See the back of this guide for permit information.

The Southern Sonoma County RCD and the Natural Resources Conservation Service provide free technical assistance and information about potential funding for projects (see resource directory for more information).



When repairing erosion areas:

- **Give priority to sites near creeks or that bring excess soil into creeks.** Vertical, actively eroding creek banks and active gullies are likely to need repair.
- **Determine the severity of the problem.** Treating a problem early may prevent costly fixes later.
- **Determine the cause of the problem.** Watch problems during storm events. Is surface water or groundwater flow causing trouble? Have riparian plants been removed? Has the creek channel been changed on site or upstream? Are lawns being over-watered?
- **Use native plants in the repair.** Plant willows and other plants in areas where rock has been placed to provide habitat.
- **Don't use old car bodies, tires, old appliances, or concrete debris.** It's illegal to use these and they are not as effective as carefully placed rock and willow. They can be undermined by water flows and may be hazardous to creek life.
- **Be sure not to constrict the channel.** Flooding is a potential problem on any creek.
- **Monitor and maintain your projects.** Be sure to water plants and make sure fences are in good repair. Taking before and after pictures is a great way to show success.
- **Consult with qualified professionals** (civil engineers, biologists, and other restoration specialists) for assistance.

## Create a Riparian Pasture

Livestock (including horses) can destroy plants, trample creek banks, and reduce water quality. In some situations, fencing can

be used to create a

riparian pasture. This

protects the creek

corridor by keeping

livestock out of the

creek and allows

for controlled

grazing.

After the fencing is

installed, the

pasture may need

to be rested for a

few seasons until

the plants become

established. Native

trees and shrubs may need to be planted in bare

areas. Developing other water sources and stable

creek crossings will create a successful riparian

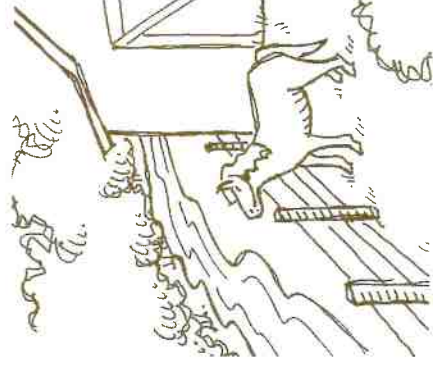
pasture. With short duration grazing, animals can

take advantage of late spring/early summer forage.

During this time of year, creek banks are firm, there

is soil moisture for riparian plants to regrow before

winter, and plants may still be green.





## Vineyard Planting and Replanting Ordinance

Sonoma County's Vineyard Planting and Replanting Ordinance restricts vineyard development on steep slopes. All vineyards must register with the Agricultural Commissioner and erosion control plans are required for vineyards on steep slopes and erodible soils. A minimum 25-foot riparian setback is required on each side of the creek. For information, contact the Sonoma County Agricultural Commissioner's Office.

Two resources for vineyard operators are *The Vineyard Manual: A Grapegrowers Manual for Vineyard Development and Maintenance* (available from the Southern Sonoma County RCD) and the *Fish Friendly Farming Farm Assessment and Conservation Plan Workbook* (available from Sotoyome RCD). See resource directory for contact information.



Tree blocking creek flow

## Logs in the Creek

Natural debris in the creek—branches, logs, and root wads—creates food and shelter for fish and wildlife. This woody debris may need to be repositioned, removed, or partially removed if it threatens life or property. Because removing woody debris can harm fish habitat, it is important to observe a situation before taking action. It's often best to take small, incremental steps toward resolving a problem.

**Consider repositioning or removing woody debris if it blocks creek flow and causes upstream flooding, or if it causes stream bank erosion by redirecting flow. This work requires permits.**

**Leave logs in the creek** unless they cause flooding or erosion that threatens life or property (a house, utility pole, or other structure) or speeds up natural erosion processes.

**Remember that most fish can swim through or around debris barriers.** If you know that fish can't swim through a barrier, contact the RCD or California Department of Fish and Game. Removing barriers requires permits. For more information, see the resources directory.



## Landscaping and Yards

Managing your landscape properly will help keep creeks healthy.

- **Compost leaves, grass clippings, and other organic waste away from the creek.** Never dump leaves, grass clippings, or prunings onto creek banks or into the creek. Although leaves and organic waste are biodegradable, adding them to a creek system depletes oxygen in the water. This can stress or even kill fish and other aquatic life.

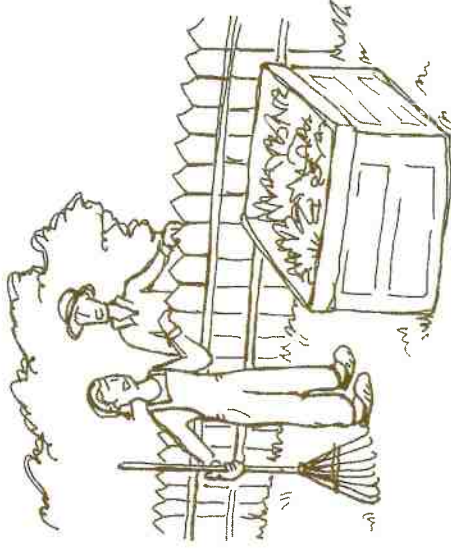
Yard waste pick up services are listed in the resource directory at the back of this guide.

- **Keep leaves and litter out of street gutters and ditches** so they won't clog storm drains.
- **Avoid or minimize use of fertilizers and pesticides** (including insecticides and herbicides). Follow the directions. Many home gardeners over-apply fertilizers and pesticides. Excessive nitrogen and phosphorus that wash into creeks directly or through ditches and storm drains can create algal blooms that deplete the oxygen supply in the water. Excessive amounts of some nutrients are toxic to aquatic life.

Use slow-release fertilizers to minimize nitrogen runoff. Consider using more ecologically-friendly landscape methods and products, including native plants and ground covers.

Avoid applying fertilizers or pesticides during the rainy season or on windy days. Pesticide drift threatens riparian plants and aquatic life.

- **Properly irrigate lawns and gardens.** Use meters and timers to control water use. Overwatering adds excess water, fertilizers, pesticides, and soil to ditches and storm drains. It is also a common cause of stream bank erosion.



### Care of Household Waste

Even in small amounts, hazardous materials such as paint, motor oil, solvents, pool chemicals, batteries, and many cleaners will contaminate a creek and harm fish and wildlife. It's illegal to dispose of or dump hazardous materials on roadways or into storm drains or ditches. Violators are liable for cleanup costs and fines.

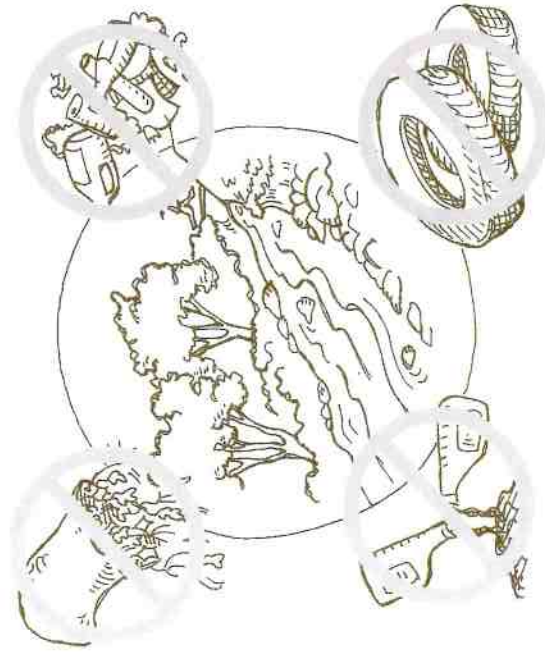
- **Keep trash and dumped debris out of the creek, off the street, and out of ditches and storm drains.** Remove trash that may have piled up in the creek. (See the "Logs in the Creek" section of this guide for information about natural debris).
- **Take all hazardous items (paint, solvent, pesticides, etc.) to a household hazardous waste collection event.** Call the Sonoma County EcoDesk for dates, times, and locations (see the resource directory).

- **Use water-based paint and paint removers** when possible.
- **Place paint thinner or turpentine in a container to clean oil-based paintbrushes and rollers.** Allow the solids to settle out and carefully transfer liquid to another container for reuse. Take the solids to a hazardous waste collection event.
- **Clean latex paint brushes so that wash water does not reach a gutter, ditch, or creek.**
- **Dispose of water used to clean carpets, upholstery, or floors down sinks or toilets.** If you are on a septic tank, use septic safe products.
- **Use non-toxic cleaning products** in your home.
- **Use mechanical methods to clean drains** that are blocked by roots. Avoid copper-based root control products.
- **Avoid hosing down paved surfaces like driveways.** Use a broom instead and put debris in a trash can.
- **Discharge water from your washing machine away from creeks, ditches, or storm drains.**
- **Drain water-filled mattresses to the sanitary sewer.** Waterbed chemicals can be toxic to aquatic life.
- **Wash vehicles and equipment in a grassy or gravel area where soapy water can filter into the soil.** Soap—even biodegradable—can harm fish and other aquatic life. Commercial and coin-operated car washes must recycle water before discharging to a sewer system.



- **Properly care for pools and spas.** Water and backwash filter rinse water should be drained to the sewer or be allowed to dissipate and drain into a field. Make sure discharges don't reach creeks or cause erosion. Chlorine and algaecides used in pools and spas are toxic to plants and aquatic life. Use diatomaceous earth (DE) cautiously. If DE gets into the creek, it can cut the gills of aquatic animals, making them more susceptible to infection and disease.

- **Properly care for your cars and boats.** For proper disposal of used motor oil and other automotive products, call the Eco-Desk (see resources directory in this guide). Motor oil can coat fish gills (depriving them of needed oxygen) and bird feathers (interfering with their ability to keep warm and dry). Oil can also poison animals when they ingest it in an effort to clean themselves.



## Metal Matters

Lead, nickel, cadmium, copper, and acid can be found in household and automotive batteries. Metals are in antifreeze and in brake and transmission fluids. Car exhaust, motor oil, grease, worn metal plating, and brake linings deposit lead, zinc, and copper onto roads and parking lots. Stormwater washes these metals into ditches and storm drains. Excessive levels of some metals can lead to adverse health effects in humans and wildlife.

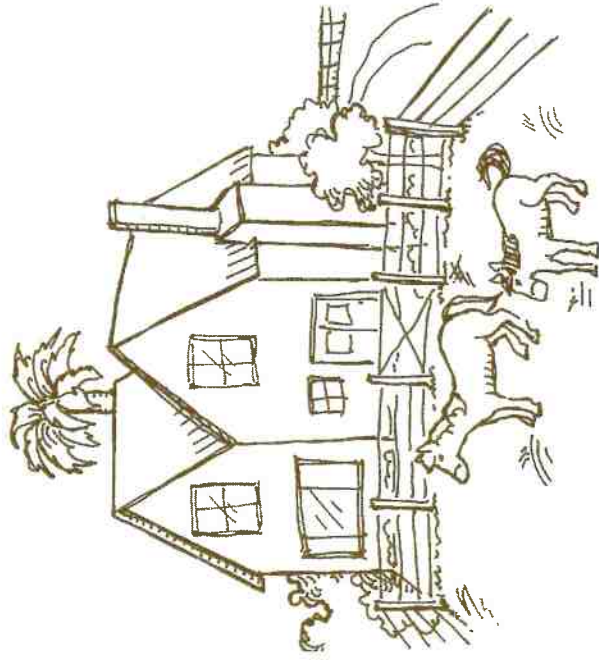


## Animal Waste and Nutrients

Animal wastes, decaying plant matter (such as silage), and pasture fertilization can contribute excess nutrients to creeks. Animal waste can come from a thousand cows or five dogs.

While nutrients are an important part of the food chain, excessive amounts, especially when combined with warm water temperatures, will consume the oxygen in the water and can cause harm or even kill fish or other aquatic life.

Most animal waste contamination is from confined livestock areas where the waste is concentrated. Corrals, horse paddocks, and feeding or watering areas are potential sources of water quality problems, especially if these areas are located near creeks or where runoff could carry wastes into creeks.



## Ways to Minimize Animal Waste Impacts

- **Apply manure and other fertilizers at rates appropriate** for the crop being fertilized.
- **Store silage properly.** Improper storage can allow highly concentrated nutrients to run off into creeks or percolate into the groundwater.
- **Relocate corrals, paddocks, manure or compost piles, and feeding and watering areas away from creeks.**
- **Manage horse waste** by regular clean up and proper storage, maintaining moisture in paddocks, diverting clean runoff around bare and manured areas, and capturing runoff before it reaches grass-lined ditches and creeks. Consider developing a compost program for horse waste and used bedding.

The Equine Facilities Assistance Program is a Bay Area-wide effort to work with horse owners to protect the water quality in the San Francisco Bay area. Contact the RCD for more information (see resources directory at the back of this guide).

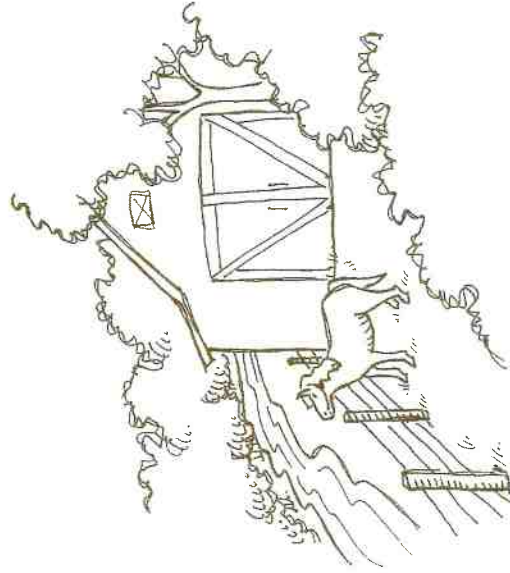


## Runoff Management

All water flowing off pastures, corrals, crop land, bare areas, lawns, gardens, roofs, and paved areas can flow directly into creeks, or it can flow through ditches and underground pipes before reaching a creek. This runoff can pick up soil, manure, chemicals, and garbage that is carried directly into creeks and then on to San Francisco and San Pablo Bay without treatment.

It's important to both minimize the runoff from your property and keep stormwater runoff from picking up pollutants such as soil before reaching a swale or creek.

Storm water that flows off land without soaking into the ground can add to creek flows and reduces ground water recharge. The higher flows in the creek can cause erosion of the creek bed and banks and flooding problems downstream.



## Ways to Minimize Runoff

- **Direct all gutters or downspouts to areas where the water can soak into the ground.**
- **Minimize paved or other hard-surfaced areas.** Driveways, walkways, and patios increase the amount of water that flows into creeks, ditches, and storm drains. Instead of concrete, use wooden decks, brick or stone paths, gravel, paving stones, or concrete blocks so that water can permeate through spaces and soak into the ground.
- **Keep water and pipes from flowing directly to the creek or onto creek banks.** Guide water to the creek in a protected way and use carefully placed rock at the outlet.
- **Keep plants on stream banks.** Roots of riparian plants will help stabilize the banks.

For more ideas, consult *Start at the Source: Design Guidance Manual for Stormwater Quality Protection* (see the resource directory at the end of this guide).



## Ways to Keep Stormwater Clean

Agricultural areas to be concerned about are milking and loafing barns, waste storage facilities, paddocks, corrals, horse arenas, horse wash areas, and areas with bare soil.

- **Direct runoff around areas that may contain manure or are bare.** Make sure that runoff isn't diverted in a way that later causes erosion problems.
- **Use gutters, downspouts, and drains to carry roof runoff away from manure or bare areas.**
- **Route runoff water that has picked up manure or soil** into a filter area with grasses, shrubs, and trees.
- **Keep horse wash water from running into swales and creeks.**



## Septic Systems

Most rural residences use septic systems for sewage disposal. Septic systems operate by collecting sewage in a concrete tank and allowing the liquid portion to percolate into the ground through perforated pipe (leach lines). Solids are pumped out of the collection tank and hauled off-site for disposal.

Septic systems are safe and effective, as long as they are properly designed, installed, and maintained. If not, they can be a source of groundwater and surface water contamination. Leaky septic systems can pollute domestic water systems by contaminating the aquifer from which a residential well draws. Older homes may have a primitive system composed of a redwood or metal box with no leach lines. These systems are now illegal.

Human waste leaking from faulty septic systems can be a source of water pollution. Like livestock waste, human sewage contains nutrients and pathogens. Human sewage poses a more serious health risk than livestock waste because there is a much greater chance that it contains human disease organisms.

Septic tanks should be pumped regularly—usually every two to three years. A licensed septic tank pumper can recommend appropriate service. Minimizing the amount of liquid that goes into the system and avoiding unnecessary solid waste (such as paper towels, rags, diapers, etc.) helps a septic system operate properly.

## Resource Directory

### Technical Assistance

**Southern Sonoma County Resource Conservation District (RCD)** ..... (707) 794-1242, ext. 3  
1301 Redwood Way, Suite 170, Petaluma, CA 94954  
ssrcrd@ca.nacdn.net.org  
www.SonomaMarinRCDs.org

The RCD assists rural landowners with stewardship and conservation through technical assistance and funding for on-the-ground projects. The RCD sponsors and supports outreach and educational programs, watershed planning projects, and implementation projects to improve water quality while supporting agricultural viability. They have publications on a wide variety of topics. The RCD serves residents in southern Sonoma County, primarily in the Sonoma Creek, Petaluma, and Stemple Creek watersheds.

**U.S.D.A. Natural Resources Conservation Service (NRCS)** ..... (707) 794-1242, ext. 3  
1301 Redwood Way, Suite 170, Petaluma, CA 94954

The NRCS can provide free technical assistance to agricultural landowners, as well as information about possible financial assistance through U.S.D.A. programs.

**California Department of Fish and Game**  
P.O. Box 47, Yountville, CA 94599 ..... (707) 944-5500  
**Area Biologist: Bill Cox** ..... (707) 823-1001  
Biologists can also provide free practical advice on making effective repairs that reduce erosion and help wildlife.

**University of California Cooperative Extension**  
2604 Ventura Avenue, Santa Rosa, CA 95403  
**Farm Advisor** ..... (707) 565-2621

**Watershed Management Advisor** ... (707) 565-2621  
U.C. Advisors offer educational workshops, demonstrations of best management practices, and individual consultation. The U.C.C.E. office has an extensive list of publications.

**Sonoma County Master Gardeners** .. (707) 565-2608  
**www.mastergardeners.org**  
Master Gardeners provide information on plant health and gardening practices for vegetables, trees, soils, lawns, ornamental horticulture, insects, diseases, and use of pesticides.

**Sonoma County** ..... (707) 565-2371  
**Agricultural Commissioner's Office**  
2604 Ventura Avenue, Rm. 101  
Santa Rosa, CA 95403-2810

The Agriculture and Vineyard Conservation Coordinator manages the Vineyard Erosion Control and Sediment Control Ordinance.

**Sonoma Ecology Center** ..... (707) 996-9744  
205 First Street West, Sonoma, CA 95476  
The Sonoma Ecology Center is an environmental group working in the Sonoma Creek watershed, providing guidance and technical assistance on a wide variety of topics.

**Sonoma County Waste Management Agency**  
**Eco-Desk Hotline** ..... (707) 565-3375  
**www.recyclenow.org**

Comprehensive information on recycling programs and reuse programs for a wide variety of materials, as well as hazardous waste collection events. They publish an annual recycling guide.

### Local Watershed Groups

To find out about the **Sonoma Creek Conservancy** and the **Petaluma Watershed Partnership**, contact the Southern Sonoma County Resource Conservation District at 794-1242, ext. 3.



## Useful Publications

*Groundwork: A Handbook for Erosion Control in North Coastal California.* 1987. Liza Prunuske for the Marin County Resource Conservation District. To review a copy, contact the Southern Sonoma County Resource Conservation District at 794-1242, ext. 3.

*Rangeland Watershed Program Fact Sheets.* U.C. Cooperative Extension and U.S.D.A. Natural Resource Conservation Service. For an order form, call the U.C.C.E. office in Santa Rosa at (707) 565-2621. The fact sheets cover a wide range of topics, some of which include water quality, different monitoring techniques, grazing management, ranch plans, and riparian areas.

*Ranch Plan Workbook.* 1995. U.C. Cooperative Extension Service. Copies are available from U.C.C.E. in Novato at (415) 499-4204 or Santa Rosa at (707) 565-2621.

*Simply the Facts.* 1995. NRCS and AmeriCorps Water Quality Fact Sheets. This clear, easy to follow information on conducting different types of water quality tests is available from the NRCS at (707) 794-1242, ext. 3.

*Handbook for Forest and Ranch Roads.* 1994. William Weaver, PhD., and Danny Hagans for the Mendocino County Resource Conservation District. This \$20 book is available from the Mendocino County Resource Conservation District. Call (707) 468-9223.

*Sonoma Creek Watershed Enhancement Plan.* 1997.

Southern Sonoma County Resource Conservation District. Call RCD at 794-1242, ext.3, for more information.

*Petaluma Watershed Enhancement Plan.* 1999. Southern Sonoma County Resource Conservation District. Call the RCD at 794-1242, ext.3, for more information.

*Stemple Creek/Estero San Antonio Watershed Enhancement Plan.* 1994. Prunuske Chatman, Inc. for the Marin County and Southern Sonoma County RCDs. Call the RCD at 794-1242, ext.3, for more information.

*Restoration Design and Management Guidelines for the Petaluma River.* Vols. I & II. 1996. Questa Engineering Corporation and Waxman Environmental Consulting & Services for the City of Petaluma and the Sonoma County Water Agency. Call SSCRCD at 794-1242, ext.3, to review a copy.

*Informational Manual: Riparian Vegetation Management for Pierce's Disease in North Coast California Vineyards.* 2000. The Pierce's Disease/Riparian Habitat Workgroup. Contact the RCD at 794-1242, ext.3, to review or purchase a copy.

*The Vineyard Manual: A Grapegrowers Manual for Vineyard Development and Maintenance.* Revised July, 1999. Southern Sonoma County Resource Conservation District. Reference manual for environmentally-sound vineyard design, development, and maintenance. Contact the RCD at 794-1242, ext.3, to purchase a copy.

*Equine Facilities Assistance Program Fact Sheets.* 1998. Council of Bay Area Resource Conservation Districts. Covers a range of topics for both small landowners and large-scale operations. Contact the RCD at 794-1242, ext.3, for more information.

*Horsekeeping: A Guide to Land Management for Clean Water.* 2001. Council of Bay Area Resource Conservation Districts. Contact the RCD at 794-1242, ext.3, for more information.

*Start at the Source: Design Guidance Manual for Stormwater Quality Protection.* 1997. Tom Richman and Associates. Bay Area Stormwater Management Agencies Association (BASMAA). New York: Forbes Custom Publishing. Resource on stormwater management in the greater Bay Area and north coast. Contact [www.basmaa.org](http://www.basmaa.org) for more information.

*Fish Friendly Farming Certification Program and Farm Assessment and Conservation Plan Workbook.* Sotoyome Resource Conservation District. Program and workbook focus on vineyards. Contact the Sotoyome RCD at (707) 569-1448.

## Permitting Agencies

**Sonoma County ..... (707) 565-1900**  
**Permit and Resource Management Department**  
2550 Ventura Avenue, Santa Rosa, CA 95403  
*PRMD issues any necessary grading permits for stream bank stabilization in unincorporated areas. The Well and Septic Division provides information on septic management issues and County requirements.*

**San Francisco Bay Conservation and Development Commission ..... (415) 557-8778**  
30 Van Ness Avenue, San Francisco, CA 94102  
*BCDC requires a permit for levee maintenance or work within 100 feet of Bay waters.*

**San Francisco Bay Regional Water Quality Control Board ..... (510) 622-2300**  
1515 Clay Street, Suite 1400, Oakland, CA 94612  
*RWQCB issues water quality certifications for all projects requiring a permit from the U.S. Army Corps of Engineers. They also issue permits for animal facilities.*

**California Department of Fish and Game ..... (707) 944-5500**  
P.O. Box 47, Yountville, CA 94599  
Area Biologist: Bill Cox ..... (707) 823-1001  
*CDF&G requires a 1600 series permit for stream bank alterations.*

**State Water Resources Control Board Division of Water Rights ..... (916) 341-5300**  
P.O. Box 2000, Sacramento, CA 95812-2000  
[www.waterrights.ca.gov](http://www.waterrights.ca.gov)  
*SWRCB provides information on water rights and diversions.*

**U.S. Army Corps of Engineers ..... (415) 977-8462**  
333 Market Street, 8th Floor, San Francisco, CA 94105  
*The ACOE issues permits for work done in waters under their jurisdiction, which includes most creeks, rivers, and wetlands.*

**National Marine Fisheries Service.. (707) 525-6050**  
777 Sonoma Ave, Suite 325, Santa Rosa, CA 95404  
*The National Marine Fisheries Service has authority over salmon and steelhead resources.*

**University of California  
UCCE Marin County 2011 Annual Report**

## Watershed Management

**David Lewis, Watershed Advisor**

**Michael Lennox, Ranch Planning & Conservation Monitoring Coordinator**

### Program Summary

Our watershed management program partners with county ranches and dairies to deliver land stewardship solutions.

#### **Stream restoration and its potential for reducing greenhouse gases**

Our watershed management team is leading a project to understand the potential benefit that stream restoration has in capturing and sequestering carbon and as a result, reducing its availability in the atmosphere. Stream and river corridors on Marin's farms and ranches are hot spots for plant growth because of available water. In response to this potential, and because of the many habitat and water quality values that well-vegetated streams provide, Marin's farmers and ranchers have restored



more than 25 miles of Marin's streams in partnership with the Marin Resource Conservation Service and others. We are documenting the amount of carbon in streamside soil and vegetation so that the practice of stream restoration is advanced and Marin's conservation partnership, including most importantly its farmers and ranchers, has a fuller understanding and appreciation for what they are accomplishing and how to improve upon it.

#### **County commission recommends restoration projects**

The [Marin County Fish & Wildlife Commission](#) recommended that the Board of Supervisors fund 9 projects totaling \$9,233 on restoration and education about wildlife and fisheries in Marin County, including awards to: Point Reyes Community Center/Dance Palace, Friends of Corte Madera Creek Watershed, Marin Audubon Society, Mill Valley Streamkeepers, North Bay Trout Unlimited, Pacific Coast Hunter Education Association, Point Reyes National Seashore, Tyee Foundation, and Wildcare - Terwilliger Nature Education Program.





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**Division of Agriculture and Natural Resources, University of California**

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# Managing Floods in California



MAC TAYLOR • LEGISLATIVE ANALYST • MARCH 22, 2017

# AN LAO REPORT

**Cover Photo:** The cover photo displays flooding from storms in January 2017, and was provided courtesy of the California Department of Water Resources.

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# AN LAO REPORT

## EXECUTIVE SUMMARY

Recent months have highlighted how quickly statewide concerns can turn from the devastating impacts of too *little* water during a prolonged drought, to the comparably destructive effects of too *much* water and resulting floods. Flood management is a complicated and expensive undertaking in California, given the state's size, its extensive and aging infrastructure, the number of agencies involved, and the magnitude of its flood risk. In light of these complexities, this report provides basic information about floods and flood management in California.

***Extensive Flood Risk Across the State.*** California has experienced destructive flood events throughout its history. While certain flood disasters from the state's earlier years—such as the “Great Flood” of 1862—are famous for their large impacts, California has also experienced more recent flood events. For example, in the early part of 2017 the Governor declared a state of emergency in 52 of the state's 58 counties due to damage from winter storms and floods. All areas of the state are subject to at least some form of flooding—since 1992, every county in California has been declared a federal disaster area at least once for a flooding event. Estimates suggest 7.3 million people (one-in-five Californians), structures valued at \$575 billion, and crops valued at \$7.5 billion are located in areas that have at least a 1 in 500 probability of flooding in any given year.

***Floods Can Also Have Beneficial Impacts.*** Despite their potential to cause harmful damage, in some cases floods can have positive effects for both humans and the environment. Examples of such benefits include replenishing groundwater basins, creating habitat for fish and wildlife, carrying and depositing sediments that improve agricultural productivity, and improving water quality by flushing out contaminants. For these reasons, flood management strategies often incorporate leaving certain floodplains undeveloped and encouraging flooding in certain areas.

***Numerous Governmental Entities Involved in Flood Management Activities.*** Flood-related responsibilities are shared across a number of agencies at all levels of government, although most activities to protect communities from floods—such as establishing land use policies or maintaining flood infrastructure like levees—are undertaken by local agencies. Local jurisdictions differ in how they organize flood-related activities, and whether local flood management responsibilities are assigned to cities, counties, or special districts (such as flood control or reclamation districts). Federal agencies with significant flood management responsibilities include the U.S. Army Corps of Engineers (USACE) and Federal Emergency Management Agency, and state agencies include the Department of Water Resources and Central Valley Flood Protection Board.

The state has special responsibility for—and liability related to—a system of flood protection infrastructure along the main stem and certain tributaries of the Sacramento and San Joaquin Rivers, known as the State Plan of Flood Control system.

***Both Structural and Nonstructural Approaches Used to Manage Floods.*** Local, federal, and state agencies have developed a variety of physical structures to convey and control water flows and floods. Such structures include levees, weirs, detention basins, dams, seawalls, and bypasses. In addition to physical infrastructure—which mitigates risk by controlling floods—flood managers also employ nonstructural approaches that adapt to and accommodate the potential of floods occurring.



Key nonstructural approaches include (1) adopting land use policies designed to minimize flood damage, (2) enhancing natural floodplain functions so that undeveloped lands can slow and absorb floodwaters before they reach developed areas, and (3) preparing ahead of time for how to effectively respond when a flood does occur.

***Billions of Public Dollars Provided Annually for Flood Management Activities.*** Estimates suggest that statewide expenditures on flood management activities lie somewhere between \$2 billion and \$3 billion annually. As primary responsibility for managing flood risk rests with local governments, the majority of this funding is generated and spent at the local level from a variety of revenue sources, including property taxes, assessments, and other taxes and fees. The federal government also provides several hundred millions of dollars annually for flood management activities in California, primarily for USACE to undertake large infrastructure projects in partnership with the state and local agencies. Additionally, the state provides several hundred millions of dollars annually for flood management activities, largely through voter-approved general obligation bonds (which are then repaid by the state's General Fund).

Despite these significant expenditures, several studies have estimated that reducing flood risk across the state will cost tens of billions of dollars above current expenditure levels over the next couple of decades.

***California Faces Several Key Flood Management Challenges.*** The state's extensive flood management infrastructure is aged and in need of improvements, and it was not designed to account for evolving statewide goals, scientific knowledge, or conditions. Yet, while additional investments are required to both maintain and upgrade the existing system, generating funding for flood management activities can be challenging—particularly at the local level, where the ability to generate additional tax and assessment revenues is constrained by certain state constitutional provisions. Moreover, both the state and local governments face challenges in determining how to balance flood risk with expanding population and development. As the state population grows, so too does the push to develop into new areas. However, development in flood-prone areas increases the potential for flood damage. Additionally, the overlapping and fragmented nature of flood-related responsibilities among various local, federal, and state governments can complicate flood management efforts and make the process of implementing flood projects exceptionally protracted and difficult. Addressing these challenges will be key to California's efforts to effectively manage its flood risk in the future.

## INTRODUCTION

Recent years have shown how variable California’s weather and hydrology can be. The four-year stretch of 2012 through 2015 was the driest since statewide record-keeping began in 1896. Just a year later, 2017 is on track to be among the wettest years on record, with precipitation in the northern part of the state registering more than 200 percent of normal at the end of February.

Recent months have also highlighted how quickly statewide concerns can turn from the devastating impacts of too *little* water during a prolonged drought, to the comparably destructive effects of too *much* water and resulting floods. According to the state’s Hazard Mitigation Plan, “Floods represent the second most destructive source of hazard, vulnerability and risk, both in terms of recent state history and the probability of future destruction at greater magnitudes than previously recorded.” Recent incidents of damaged spillways at Oroville Dam and breached levees in the Sacramento-San Joaquin Delta have highlighted the state’s dependence on aged flood management infrastructure. One-in-five Californians live in a flood plain, and state officials estimate that

\$575 billion in structures are at risk of flood damage. However, when managed appropriately, floods can bring beneficial impacts, including enhanced ecosystems, increased future water supply, and improved water quality.

This report is intended to provide basic information about floods and flood management in California. (Whereas previous generations referred to “flood control” or “flood prevention” activities, experts now prefer the term “flood management” in acknowledgement that floodwaters are recurring and inevitable.) We begin by summarizing the history, causes, and risk of floods across the state. We then describe flood management agencies, infrastructure, and strategies, as well as how governmental agencies typically respond when floods occur. Next, we describe the spending levels and funding sources currently supporting flood management efforts, as well as estimates for how much additional funding may be needed to improve those efforts. We conclude by highlighting some key challenges confronting the state in contemplating how best to manage floods in California.

## FLOOD HISTORY, CAUSES, AND RISK

### Flood History and Impacts

#### *Long History of Floods Across the State.*

California has experienced destructive flood events throughout its history, as highlighted in Figure 1 (see next page). While certain flood disasters from the state’s earlier years—such as the “Great Flood” of 1862 and floods along the Los Angeles River in the 1930s—are famous for their large impacts, California has also experienced more recent flood events. In early 2017, Governor Brown declared a state of emergency in 52 of the state’s 58 counties

due to winter storm and flood damage, and 34 of those counties were declared federal disaster areas. (See page 22 for a discussion of federal and state emergency and disaster declarations.) Since February 1954, the state has had 50 federally declared flood disasters, representing nearly two-thirds of all federally declared major disasters in California over that period.

The variety of locations noted in Figure 1 shows how major flood events are not limited to certain areas of the state. Rather, the state’s diverse geography means floods occur throughout the

state and from a number of different causes. Over the course of one week in February 2017, flood evacuations occurred across Northern California, from rural San Joaquin County to the urban hub of San Jose, as well as for nearly 200,000 people living downstream from the storm-damaged Oroville












Dam. Since 1992, every county in California has been declared a federal disaster area at least once for a flooding event.

***Floods Have Caused Extensive Damage.***

Throughout the state's history, flood events have caused significant damage. Impacts from

Figure 1

**Significant Flood-Related Events in California**

-  **1825**  
**Los Angeles River Course Change.** Flood created by large mountain storms caused the Los Angeles River to jump its banks, establishing the southerly course it follows today.
-  **1862**  
**"The Great Flood."** Weeks of heavy precipitation created the largest flood in California's recorded history, lasting several weeks and inundating the entire Central Valley and most of Orange County.
-  **1905**  
**Formation of Salton Sea.** Large breaches in irrigation canals inadvertently diverted the Colorado River into a desert basin in the Imperial Valley, reestablishing a long-dry prehistoric lake.
-  **1917**  
**Authorization of Sacramento River Flood Control Project.** Through the Flood Control Act of 1917, U.S. Congress provided funding to begin developing a system of flood relief structures and bypasses along the Sacramento River. System eventually expanded to include portions of the San Joaquin River and became the State Plan of Flood Control (SPFC).
-  **1928**  
**Collapse of St. Francis Dam.** Catastrophic failure of dam in Los Angeles County caused flood wave that killed around 450 people.
-  **1933**  
**Authorization of Central Valley Project.** Legislature authorized sale of revenue bonds to construct system for both water supply and flood control along the Sacramento and San Joaquin Rivers. Project funding and construction ultimately assumed by federal government.
-  **1938**  
**Southern California Floods.** Flash flooding and debris flow from heavy rainfall led the Los Angeles, San Gabriel, and Santa Ana Rivers to burst their banks, **resulting** in more than 100 deaths and massive damage across much of the region.
-  **1941**  
**Los Angeles River Channelization.** Destruction from Southern California floods led Congress to enact the Flood Control Act of 1941, which authorized the U.S. Army Corps of Engineers to begin constructing concrete channels and dams to control the Los Angeles River's flows.
-  **1953**  
**Beginning of State Responsibility for SPFC.** State signed first of several memorandums of understanding with federal government, committing to operating and maintaining SPFC facilities.
-  **1955**  
**Yuba City Flood.** Feather River overtook its banks and levees on Christmas Eve, destroying much of Yuba City, nearly destroying Marysville, killing 38 people, and forcing 30,000 people to flee.
-  **1956**  
**Establishment of California Department of Water Resources.** Special legislative session called by Governor Goodwin Knight following Yuba City Flood merged several existing state offices and created new department for statewide water management.

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the 1862 flood were the most massive in scale: one-quarter of the state's 800,000 cattle died, ultimately contributing to a large-scale shift in statewide land use from ranching to agriculture. This flood also destroyed one-in-eight homes and one-third of the state's taxable property, with the

resulting loss of property tax revenue bankrupting the state such that state employees (including the Governor and Legislature) were not paid wages for a year and a half. In more recent history, between 1954 and 2015, federally declared flood disasters in California claimed 292 lives and resulted in

### Significant Flood-Related Events in California

(Continued)



**1960**

**Enactment of Burns-Porter Act and State Water Project.** Voters authorized \$1.75 billion bond to construct new water conveyance system that would also play a role in statewide flood management.



**1964**

**North Coast Tsunami.** Tsunami caused by earthquake in Alaska destroyed several towns in Northern California.



**1964**

**"Christmas Flood."** Severe flooding from heavy precipitation in the northern part of the state, particularly along the coast. State of disaster declared in 34 counties.



**1969**

**Winter Storms and Floods.** Serious flooding from thaw of heavy snowfall across numerous mountain ranges across the state. Resulted in disaster declarations in 40 counties, 47 people killed, 161 people injured, and \$300 million in economic losses.



**1982**

**Northern California Flooding and Landslides.** Massive landslides and debris flows from rainfall throughout Northern California. Santa Cruz received 25 inches of rain in 36 hours.



**1997**

**"New Year's Flood."** Major flooding in Central and Northern California from week of heavy rainfall. Resulted in disaster declarations in 48 counties and \$1.8 billion in economic losses.



**2003**

**Paterno Decision.** Appellate court found that the state is liable for flood damage in 1986 resulting from failure of SPFC levee.



**2006**

**Passage of Propositions 1E and 84.** Voters authorized \$9.4 billion in general obligation bonds for water-related projects, including \$5 billion for flood management.



**2007**

**Enactment of Central Valley Flood Legislation.** Passage of legislation including new planning and flood protection requirements for areas of the Central Valley.



**2014**

**Passage of Proposition 1.** Voters authorized \$7.5 billion in general obligation bonds for water-related projects, including \$400 million for flood management.



**2017**

**Winter Storms and Oroville Dam Damage.** Exceptionally high rates of precipitation caused localized flooding, mudslides, flood warnings, and road damage around the state. Governor declared state of emergency in 52 counties. Erosion damage to spillways at Oroville Dam led to risk of catastrophic flooding and evacuation of nearly 200,000 residents.



759 injuries. While comprehensive data on total public and private flood-related damage costs are not available, state and federal government expenditures for flood damage have totaled billions of dollars over the past 60 years. Although damage estimates from the recent winter 2017 floods are still being calculated, the California Department of Transportation has estimated nearly \$700 million just to repair storm damage to highways.

***Floods Can Have Far-Reaching Impacts.***

Besides causing damage to adjacent communities, floodwaters can also negatively affect areas outside of inundation zones. For example, a flood event that breaches levees in the Sacramento-San Joaquin Delta could have negative consequences not only for Delta farmers and residents, but also communities far downstream. This is because the Delta is a key component in the state's comprehensive water delivery system, and a levee breach could result in increased salt water flowing into the Delta,

disrupting deliveries of fresh irrigation water to 3 million acres of farmland and drinking water to 25 million people. Similarly, floods that damage infrastructure important to commerce (such as highways, rail lines, or ports) or industry (such as information technology companies located along the San Francisco Bay) could have statewide, national, or international impacts.

In contrast to such negative impacts, in some cases floods can have beneficial effects for both humans and the environment (such as creating habitat for migrating fish and birds). For these reasons, flood management strategies often incorporate leaving certain floodplains undeveloped and encouraging flooding in certain areas, as discussed later in this report.

**Flood Types and Causes**

***Flood Conditions Vary Across State.*** Figure 2 summarizes the types of floods that occur in

**Figure 2**

**Types of Flooding in California**

Type	Regions/Areas Affected	Description
<b>Slow rise</b>	Statewide, deep floodplains, and low-lying urban areas	Gradual flooding as waterways overflow their banks from heavy precipitation and/or snowmelt.
<b>Stormwater</b>	Statewide, localized urban areas	Localized flooding during or after a storm, generally due to blocked storm drain systems failing to properly convey stormwater runoff.
<b>Flash</b>	Statewide, steep slopes, and near streams or creeks	Quick-forming and fast-moving floods, often from heavy rain falling on saturated or dry soil that has poor absorption ability.
<b>Debris flow</b>	Statewide, downstream of denuded hillsides	Quick-forming and fast-moving floods made up of water, liquefied mud, and debris, from rain falling on hillsides lacking vegetation.
<b>Engineered structure</b>	Statewide, downstream of structures	Flows released due to failure of flood control structures such as dams or levees.
<b>Coastal</b>	Coast and San Francisco Bay Area	Encroaching seas due to storm surges, high winds, and/or exceptionally high tides.
<b>Alluvial fan</b>	Southern and Central California, where canyons fan out from mountains	Shallow and fast-moving floods from rainfall and/or snowmelt displacing sediment along alluvial fans.
<b>Tsunami</b>	Coast	High-speed sea waves caused by earthquakes and/or underwater landslides.



California, as well as the geographic regions in which they typically occur. In general, the figure displays the different types in order of frequency of occurrence. As shown, some types of floods—such as coastal or alluvial fan—only occur in certain regions of the state, whereas other types—such as slow rise or flash—can occur throughout the state. All areas of the state are subject to at least some form of flooding. The variance in flood type, cause, and likelihood of occurrence is driven by factors such as regional weather conditions, hydrologic conditions, and geology, as well as by human development and engineering.

## **Flood Risk**

***Flood Risk Defined Based on Estimated Flood Likelihood.*** Flood managers define flood risk as the likelihood of negative consequences or damages occurring from flood inundation. Frequently, flood risk is described based on the calculated probability that a flood will occur in a given area. For example, a “100-year flood” is estimated to have a 1 in 100 (or 1 percent) probability of occurring in any given year. Calculated flood probabilities are simply predictions and are not meant to imply that a 100-year flood, for example, will occur *only* every 100 years. Flood managers and insurance companies calculate these probabilities by examining flood hazards (such as a building’s elevation or proximity to a river), history (such as how often flooding has occurred in the past), and flood management structures (such as the presence and height of levees). While flood management structures help reduce risk, a floodplain can never be fully protected with 100 percent certainty. Flood managers sometimes refer to the remaining risk of damage after implementation of flood management actions—such as constructing levees—as “residual risk.”

***Widespread Flood Risk to People, Infrastructure, and Crops.*** Exposure to flood hazards exists across the state, with the potential

for greatest damage concentrated in highly developed urban areas. Figure 3 (see next page) shows data compiled by the Department of Water Resources (DWR) and U.S. Army Corps of Engineers (USACE) for the population, value of structures, and crop values located in 500-year floodplains—areas with a 1 in 500 probability of flooding in any given year—across different hydrologic regions of the state. (Hydrologic regions are the geographic areas encompassing the drainage of a river or series of rivers.) In total, 7.3 million people (one-in-five Californians), structures valued at \$575 billion, and crops valued at \$7.5 billion are located within a 500-year floodplain in California.

The South Coast region (which includes Los Angeles and San Diego) has the largest exposure, with more than 3 million people and structures valued at more than \$230 billion located within the 500-year floodplain. The region has 250,000 residents living within the 100-year floodplain. Santa Clara, Orange, and Los Angeles are the three California counties with both the greatest population and the highest structure values located within 500-year floodplains. In contrast, the greatest exposure for crop values exists in the three Central Valley hydrologic regions (Sacramento River, San Joaquin River, and Tulare Lake). Fresno, Tulare, and San Joaquin are the counties with the largest value of agricultural crops located within the 500-year floodplain, together totaling over \$2 billion.

### ***Human Development Influences Flood Risk.***

Human influences can have both positive and negative effects on flood risk and the magnitude of potential damage. Humans have developed extensive flood management structures and practices to control floodwaters and significantly reduce flood occurrences. However, human development has also increased the risk for potential damage from floods, particularly when

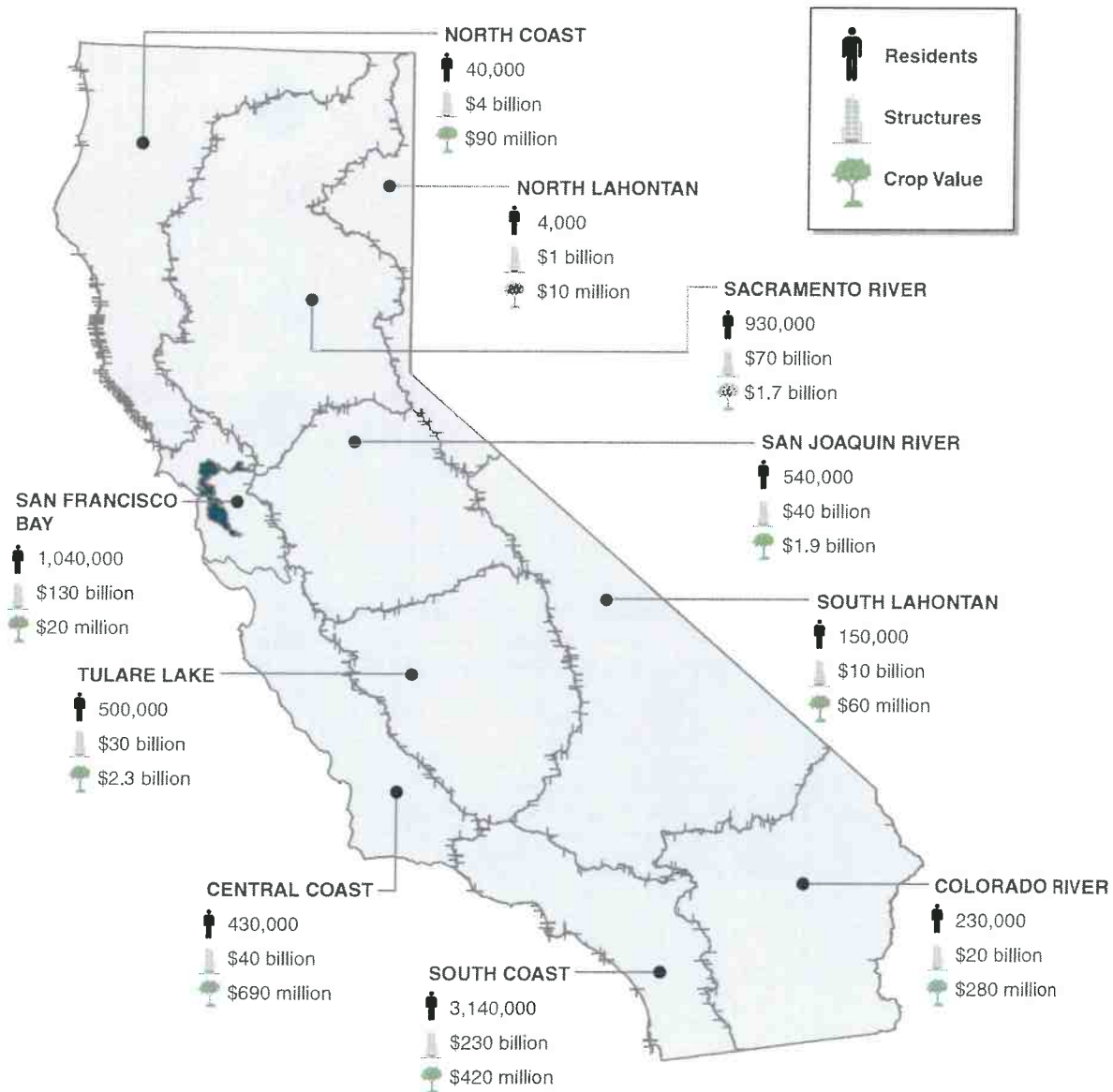
development takes place in areas that are especially prone to flooding. In such cases, flood events that might otherwise have been natural occurrences with little impact instead can have significant effects on developed infrastructure.

California's Central Valley offers an example of how development decisions have increased impacts from floods. This region has experienced many of the largest and most destructive floods in the state's history. This is due in part to the way the course of

Figure 3

### Exposure to 500-Year Flood by Region

By Hydrologic Region



Source: *California's Flood Future: Recommendations for Managing the State's Flood Risk* (Department of Water Resources and U.S. Army Corps of Engineers, 2013).

the Sacramento River was engineered beginning in the late 1800s to address the by-products of widespread hydraulic mining during the gold rush era. Levees along the river were constructed into narrow channels to help speed river flows in order to flush mining debris out to sea and preserve the river's navigability. Additionally, areas within the region that had been natural floodplains have been "reclaimed" and developed—originally for agriculture, but over time increasingly for residential and other urban uses. The impacts of these decisions include (1) swift river flows in narrow channels that place stress on and risk overtopping levees, (2) a river that has been forcibly redirected away from its natural course and

floodplains, and (3) significant public and private infrastructure existing in close proximity to the river. All of these conditions contribute to flood risk for valley residents. (As described below, the state has taken various steps to help address this risk, including strengthening levees and developing an extensive bypass system.)

There are other examples across the state where building in areas with particular geographical features has increased the potential for flood damage. These include development on hillsides prone to flash floods, within alluvial fans, or along the coast. Rising sea levels are also increasing the risk of flood damage for coastal communities.

## FLOOD MANAGEMENT RESPONSIBILITIES

***Numerous Government Entities Involved in Flood-Related Activities.*** Responsibilities for managing flood risk and responding to floods have evolved over time. In the early decades after the state's founding, flood management fell primarily to private entities. Local landowners would build levees—with varying strategies, materials, and effectiveness—to direct and divert rivers, streams, and floodwaters. Major flood disasters in the late 1800s and early 1900s, however, spurred the state and federal governments to play greater roles, including passing flood management policies and building public flood control infrastructure. As shown in Figure 4 (see next page), various flood-related responsibilities are now shared across a number of local, federal, and state agencies.

### Local Responsibilities

***Local Government Flood Management Arrangements Vary.*** Statewide, most activities to protect communities from floods are undertaken by local agencies. These activities include establishing and implementing land use policies,

constructing and maintaining flood infrastructure such as levees, and emergency preparedness efforts. These activities are carried out by various local entities, depending upon how agency roles and responsibilities have been assigned and defined in a particular jurisdiction. In some cases, a city and/or county may assume primary flood management responsibilities. In other cases, jurisdictions have established government agencies called special districts—such as flood control, levee, or reclamation districts—to provide flood-related services. Other communities have pooled resources to address regional issues by forming joint powers authorities. Some special districts and joint powers authorities have the authority to assess, levy, and collect tax revenues to support their activities.

In some communities, various flood management responsibilities are shared by multiple agencies, whereas in others a single agency handles multiple water and flood management responsibilities. One recent report estimated that flood management responsibilities are spread across over 1,300 local agencies across the state.

## Federal Responsibilities

**USACE.** USACE has built, conducts major repairs on, and holds regulatory authority over certain flood management facilities that were authorized by Congress. The agency, however, typically hands over operations and maintenance to a “nonfederal sponsor” after construction projects are complete. Major flood control projects built in cooperation with USACE in California include the

levees of the State Plan of Flood Control (SPFC), the channelization of the Los Angeles River, and many of the large dams in the state (including Shasta and Oroville). As described later, USACE maintains certain flood regulation authority over many of the dams it helped construct.

Under its Public Law (PL) 84-99 program, USACE also provides some emergency preparedness assistance to states and local

**Figure 4**

### Public Agencies With Major Flood Management Responsibilities

Agency	Primary Responsibilities
<b>Local</b>	
<b>Cities, counties, and special districts (such as reclamation or flood control districts)</b>	Conduct various activities based on local arrangements, including: constructing, maintaining, and improving levees and flood management structures; developing land use policies; developing disaster mitigation and emergency response plans; leading emergency response and recovery efforts; and levying assessments on landowners to fund flood management efforts.
<b>Federal</b>	
<b>U.S. Army Corps of Engineers</b>	Undertake and authorize changes to capital flood protection projects when authorized by Congress, generally in partnership with state and local agencies (including SPFC levees). Inspect federally constructed levees for compliance with federal standards. Provide planning and assistance to state and local agencies, including during flood events. Provide funding to repair flood-damaged levees if they meet federal criteria. Establish flood storage and release standards for certain reservoirs.
<b>Federal Emergency Management Agency</b>	Operate National Flood Insurance Program, which includes developing flood hazard maps that define flood risk, establishing floodplain management standards, and offering federally backed insurance policies. Provide coordination, assistance, and funding for federally declared flood disasters.
<b>State</b>	
<b>Department of Water Resources</b>	Conduct flood forecasting, hydrology, and climatology studies. Undertake statewide flood management data collection and planning. Inspect, oversee maintenance of, and in some cases conduct projects on, SPFC levees. Operate and maintain SPFC dams, channels, and other structures. Implement flood-related state grant programs. Help coordinate emergency flood response operations.
<b>Central Valley Flood Protection Board</b>	Ensure that appropriate standards are met for the construction, maintenance, and protection of the SPFC.
<b>Office of Emergency Services</b>	Assist local agencies in responding to floods. Provide coordination, assistance, and funding for state-declared flood emergencies.

SPFC = State Plan of Flood Control.

communities, including planning, training, response exercises, and stockpiling of flood-fight supplies such as sandbags. Additionally, during a flood event USACE will provide advice, staff support, equipment, supplies, and whatever other assistance is requested by state or local flood managers.

***Other Federal Agencies Also Involved.***

The Federal Emergency Management Agency (FEMA) plays an important role in providing disaster assistance during and following a flood event. Some additional federal agencies not highlighted in Figure 4 also play supporting roles in flood management activities. These include the U.S. Environmental Protection Agency, which sets stormwater discharge standards, and the Bureau of Reclamation, which operates some dams as part of the Central Valley Project. Additionally, the U.S. Fish and Wildlife Service and National Marine Fisheries Service monitor and regulate the potential impacts of flood management efforts on fish and wildlife and issue permits for certain flood projects. The U.S. Geological Survey collects and disseminates flood-related data, including real-time streamflow and runoff rates, as well as maps that model potential flood inundation patterns. The Federal Energy Regulatory Commission sets some operational requirements for dams that also produce hydroelectric power.

**State Responsibilities**

**DWR.** DWR is the state's lead agency in flood-related activities. The department's responsibilities include the full cycle of flood-related activities,

including preparing for future floods, forecasting imminent floods, and responding to actual floods. Besides providing guidance and assistance to local agencies, DWR also maintains certain SPFC levees and facilities.

***Central Valley Flood Protection Board (CVFPB).*** Formerly called the State Reclamation Board, CVFPB was created in 1911 to address flood issues in the Central Valley. The board holds responsibility, on behalf of the state, for overseeing the SPFC. Its activities include collaborating with other agencies to improve the SPFC's flood protection structures, issuing permits for work on the system's levees and structures, enforcing removal of problematic levee encroachments, and serving as the intermediary between USACE and SPFC permit applicants.

***Other State Agencies Also Involved.*** Like FEMA, the state's Office of Emergency Services (OES) provides disaster assistance during and after a flood event. The State Water Resources Control Board and regional water boards set and regulate stormwater discharge requirements. The California Department of Fish and Wildlife monitors and regulates the potential impacts of flood management efforts on fish and wildlife, including issuing permits for certain projects. Additionally, the Delta Stewardship Council evaluates flood projects proposed within the Delta to ensure they are consistent with established state goals for the region, and is developing a Delta Levees Investment Strategy to guide the state in prioritizing levee funding.

## FLOOD MANAGEMENT INFRASTRUCTURE

In this section, we discuss the physical structures developed for managing floodwaters in California. We begin by providing an overview

of flood-related facilities, then provide additional detail on the SPFC system for which the state has special responsibilities.



## Overview of Physical Flood Management System

***Many Types of Flood Management Facilities Across State.*** Local, federal, and state agencies have developed a variety of physical structures to convey and control water flows and floodwaters. Such structures include levees and floodwalls, channels, weirs, and culverts. Additionally, flood managers use detention and retention basins, dams and reservoirs, and bypasses to collect or store water and thereby regulate flood flows. Seawalls and breakwaters are used to armor the shoreline against coastal flooding. Figure 5 defines and illustrates some key flood infrastructure components.

Physical structures—like levees and weirs—are also sometimes paired with nonstructural approaches—like the use of floodplains—for flood management. Additionally, flood management structures—such as dams and reservoirs—frequently are also used for water supply purposes, as discussed below.

***Most Flood Infrastructure Locally Owned and Managed.*** Flood management infrastructure across California includes more than 20,000 miles of levees and channels and more than 1,500 dams and reservoirs. Most of these facilities are owned and managed by local governments. This reflects the history of how most of the facilities were developed, aligns responsibility with beneficiaries (because local communities generally have the most to lose or gain from the efficacy of flood management actions), and is consistent with ownership of most public infrastructure across the state. Large locally owned flood projects around the state include concrete channels and dams on the Los Angeles River (managed by the Los Angeles County Department of Public Works) and the Santa Ana River (managed by the Orange County Public Works Division). Additionally, some levees in the state, particularly in very rural areas and along smaller streams, are privately owned and maintained.

These statewide totals also include 1,600 miles of levees and four dams in the Central Valley that are overseen by the state and considered part of the SPFC system. With the exception of several dams operated by USACE or the Bureau of Reclamation, the federal government generally does not directly operate or maintain many flood control facilities in California.

***Water Supply Facilities Also Play Role in Flood Management.*** In addition to structures built explicitly to manage floods, other water-related facilities across the state are used for flood management. For example, components of the State Water Project and federal Central Valley Project—including dams such as Oroville and Shasta—are operated not only for water supply purposes, but also to store and release water to minimize downriver flood risk during storms and periods of high snowmelt. This is also true of many local dams and reservoirs.

USACE maintains flood control authority over around 20 reservoirs in California that are owned and operated by other governmental agencies but for which construction was partially federally funded. These include some of the largest reservoirs in the state, including Shasta, Oroville, New Melones, and New Don Pedro. Specifically, USACE has computed a specific amount of “flood control space” that must be maintained within these reservoirs to capture runoff and avoid exceeding the maximum capacity of the dam or harming downstream entities. USACE can require dam operators to release water from these reservoirs to ensure this amount of storage capacity is reserved for flood safety—for example, if a storm is forecast and additional runoff is projected to flow into the reservoir.

## SPFC

***SPFC Provides Flood Protection in Central Valley.*** The SPFC is a system of flood protection

infrastructure along the main stem and certain tributaries of the Sacramento River and the San Joaquin River, as shown in Figure 6 (see next page). The system includes about 1,600 miles of levees,

four dams, five major weirs, seven major drainage pumping plants, and seven bypasses that are used to divert water during periods of high flow. These features have been built over time and by multiple

**Figure 5**

**Illustration of Key Flood Infrastructure Components**

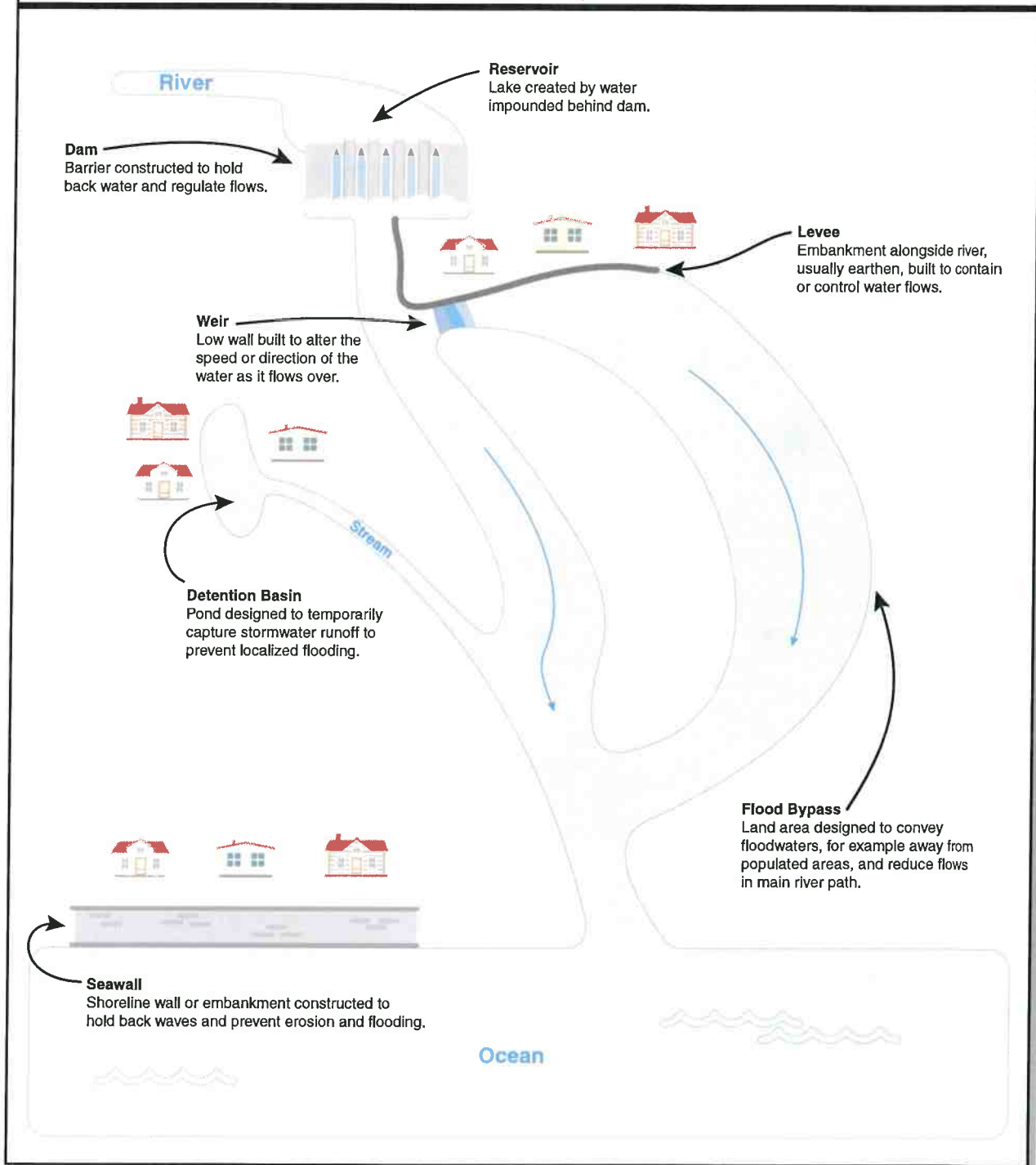
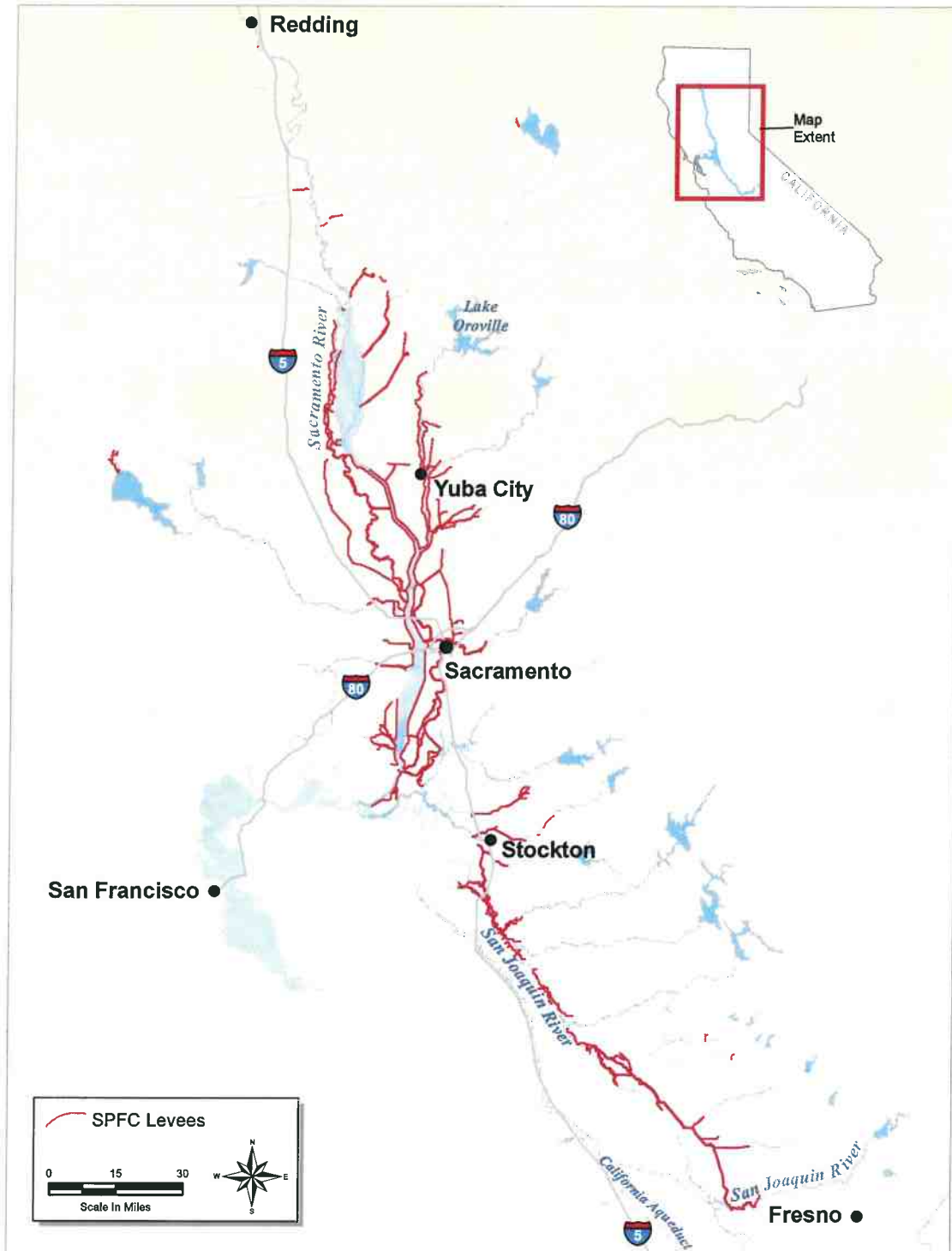


Figure 6

**State Plan of Flood Control (SPFC)**



Source: California Department of Water Resources.

entities, beginning with private citizens creating levees out of local sands and soils in the mid-1800s. Federally authorized flood control projects to improve the SPFC—undertaken by USACE—began in 1917 in the Sacramento River basin and in 1944 in the San Joaquin River basin.

***State Responsible for—but Local Agencies Primarily Maintain—SPFC.*** Although many SPFC components were locally or federally constructed, in the 1950s the state committed to the federal government that it would oversee the SPFC system and maintain its facilities pursuant to federal standards. (SPFC levees are also commonly referred to as “project levees,” in reference to the SPFC being a joint state and federal project.) Only levees and structures along certain tributaries and stretches of river are considered part of the SPFC system and subject to this state-federal agreement. The state has not assumed responsibility for all flood protection facilities in the Central Valley. For example, within the 1,100 miles of levees located in the Sacramento-San Joaquin Delta, only about 380 miles are part of the SPFC—the remaining 720 miles are locally owned and maintained.

CVFPB oversees SPFC facilities on behalf of the state, including issuing permits for modifications and enforcing that levees are maintained up to required standards. For most segments of SPFC levees, the state has developed formal agreements with local governments (primarily local reclamation districts) to handle regular

operations and maintenance responsibilities. These responsibilities include conducting daily inspections, ensuring levees stay structurally sound and meet standards, clearing excessive vegetation, and undertaking projects to improve levee effectiveness. DWR maintains approximately 300 miles of SPFC levee segments not covered by such agreements.

***Paterno Court Decision Established State Liability for SPFC.*** In 2003, a state appellate court found the state responsible for a SPFC levee failure along the Yuba River, thereby establishing a new standard for the state’s flood liability. The 2003 decision in the *Paterno v. California* case found that the state had failed to properly maintain the Linda Levee (located south of Marysville) and therefore was liable for resulting flood damage when it failed in 1986. Although the levee was both originally constructed and maintained at the time by local entities—not the state—and reportedly had *never* met engineering standards, the court found that the state undertook liability when it assumed control of the SPFC in the 1950s. Specifically, courts found that the state “had ample opportunity to examine” and repair the levee. The state eventually paid a \$464 million settlement to the nearly 3,000 plaintiffs. The *Paterno* decision’s precedent makes it possible that the state could ultimately be held responsible for the structural integrity of all SPFC facilities.

## NONSTRUCTURAL FLOOD MANAGEMENT EFFORTS

In contrast to physical infrastructure—which mitigates risk by controlling floodwaters—nonstructural management approaches adapt to and accommodate the potential of floods occurring. In this section, we describe three major nonstructural approaches: land use policies, floodplain restoration, and emergency preparation.

### Land Use Policies

***Land Use Policies Can Seek to Minimize Potential Damage.*** A key nonstructural approach to limiting damage from floods is to control the amount and type of development that occurs in flood-prone areas. For example, jurisdictions might



develop land use policies and building codes that discourage construction within floodplains. Other policies might allow development but require that buildings be elevated to a certain height to withstand flooding.

***Federal and State Policies Can Influence Local Land Use Decisions.*** Land use decisions are made primarily by local governments. However, in some cases, they can be influenced by federal and state policies. For example, the federal government identifies areas with a high risk of flooding and requires home and business owners

in those areas to have flood insurance in order to be eligible for a federally backed mortgage. Additionally, participation in the federal National Flood Insurance Program (NFIP) is only available in communities that have agreed to adopt and enforce local ordinances that meet or exceed federal floodplain management standards. (Please see the nearby box for more detailed information about NFIP.) Thus, while local jurisdictions are not *required* to meet federal standards for restricting development in flood-prone areas, federal policies strongly encourage them to do so, in order to avoid

### **National Flood Insurance Program (NFIP)**

***Program Intended to Reduce Flood Impacts.*** Congress established the NFIP in 1968 to address a number of policy objectives, including (1) offering affordable insurance premiums to residents in flood-prone areas, (2) reducing federal disaster assistance costs, (3) encouraging better community-based floodplain management, and (4) identifying flood risk across the nation. Under the program, private insurance companies sell and service federally backed flood insurance policies to private property owners. The NFIP is funded through roughly \$3.5 billion in annual insurance premium revenues and, when necessary to cover claim payments, loans from the U.S. Treasury. The program currently owes over \$20 billion to the Treasury due to substantial hurricane-related claims in 2005 and 2012.

***Flood Insurance Required in Certain Circumstances.*** While federal law does not explicitly require property owners to purchase flood insurance, it does require that federally regulated or insured mortgage lenders mandate flood insurance as a loan condition for buildings located in high-risk flood areas—making it a de facto requirement for certain home and business owners. Additionally, property owners who receive federal disaster assistance after a flood must purchase flood insurance to remain eligible for future disaster relief. The Federal Emergency Management Agency (FEMA), which manages the NFIP, creates maps classifying flood hazard risk as high, moderate, or low based on various characteristics including geography, elevation, and flood history. High-risk areas have at least a one-in-four chance of flooding during a 30-year mortgage.

Mortgage lenders can also require that borrowers purchase flood insurance for non-federally backed loans and/or for properties in low- or moderate-risk areas. Indeed, FEMA notes that over 20 percent of all flood insurance claims come from areas outside of mapped high-risk flood zones. Even when not required by their lenders, some property owners opt to purchase flood insurance, as flood damage is not typically covered by traditional homeowner's insurance.

***Eligibility Dependent on Local Flood Management Actions.*** Federally backed NFIP policies are only available for buildings located in communities that have agreed to adopt and enforce

limiting mortgage financing options for their local property owners.

Similarly, the state has adopted certain policies designed to encourage local jurisdictions to avoid making land use decisions that increase flood risks. For example, several such policies were included in a package of flood-related legislation passed in 2007, as summarized in Figure 7 (see next page). The legislation states that local governments in urban areas of the Central Valley shall plan for an even higher level of protection than the federal floodplain management standards required by the

NFIP—200-year protection rather than 100-year protection. They can meet these requirements either by limiting development or by building or improving structural flood infrastructure such as levees. While state policies encourage local actions to limit flood damage, these policies have some notable limitations. Specifically, the policies (1) only apply to the Central Valley, (2) only pertain to new development, and (3) are self-enforced by local governments (with repercussions for lack of compliance somewhat unclear).

local ordinances that meet or exceed FEMA floodplain management standards. FEMA's standards are designed to reduce flood damage, such as requirements that new development does not cause obstructions to the natural flow of floodwaters or increase flood risk for neighboring properties. To encourage even more effective floodplain management, FEMA offers reduced flood insurance premiums through its Community Rating System program for communities that exceed its minimum standards.

***California's Participation Somewhat Limited.*** As of September 2016, Californians held around 296,000 NFIP policies—about 6 percent of the nationwide total. By comparison, Florida residents held 35 percent of national NFIP policies, and Texas represented 12 percent of the nationwide total. (Data regarding the number of properties in high-risk areas in each state are not readily available.) NFIP participation rates in California declined in recent years, likely because the state had been in a drought and had not experienced a major flood for several years so residents had a lower perceived risk. These numbers likely have increased in recent months as a result of winter 2017 floods, though associated data are not yet available. According to researchers at the University of California, Davis (UC Davis), as of October 2016, California's NFIP policies cover \$82.6 billion of insured assets and are supported by \$213 million in annual premiums payments.

Between October 2015 and September 2016, NFIP policyholders in California submitted 337 insurance claims and received about \$4.6 million in claim payments—representing less than 1 percent of both claims and payments nationwide. The UC Davis researchers found that between 1994 and 2014, NFIP damage payouts in California totaled just 14 percent of the amount its residents paid in premiums—an imbalance of over \$3 billion, adjusted for inflation. By comparison, North Dakota had the highest rate of NFIP payments as a percentage of the amount paid in premiums—188 percent—over that 20-year period. (These data exclude each state's single largest claim year to avoid skewing the data with a single catastrophic event, otherwise Mississippi would be the greatest net NFIP beneficiary.)

***Federal Government Recently Increased Standards for Federally Funded Construction.*** In January 2015, the federal government announced new flood standards for building federally funded structures such as buildings or roads. The new standards apply when federal funds are used to build or significantly retrofit or repair structures and facilities in and around floodplains. The standards are somewhat flexible, allowing agencies to choose one of three options for how their projects comply:

- Build the structure at an elevation that is above the projected 500-year flood level.
- Build the structure at an elevation that is two feet above the projected level of a 100-year flood for standard projects, and three feet above for critical buildings like hospitals and evacuation centers.
- Build the structure based on data and methods informed by the best-available, actionable climate science.

**Figure 7**

**Major Components of 2007 Central Valley Flood Legislation<sup>a</sup>**

- ✓ **State Planning Requirements.** Required DWR and CVFPB to prepare, adopt, and implement a CVFPP by 2012, then update that plan every five years. The plan must include (1) a description of existing flood risk and facilities within the SPFC area, (2) an evaluation of the improvements necessary to bring SPFC facilities up to current design standards, and (3) recommendations for improving the SPFC's performance that incorporate multiple benefits (such as to the ecosystem).
- ✓ **Local Planning Requirements.** Required Central Valley cities and counties to (1) develop flood emergency response plans and (2) amend general plans to conform to the data, policies, and implementation measures included in the CVFPP, including adopting goals and policies intended to protect lives and property and reduce flood risk.
- ✓ **Higher Flood Protection Standards.** Established 200-year flood event (flood with a 1-in-200 chance of occurring in any year) as the minimum level of flood protection to be provided for new development in urban and urbanizing areas.
- ✓ **Local Zoning and Development Requirements.** Required Central Valley cities and counties to amend zoning ordinances to conform to the CVFPP and to their amended general plans, including by prohibiting new development in areas not protected up to the 200-year flood standard.
- ✓ **State Mapping and Notification Requirements.** Required DWR and CVFPB to (1) map flood risk areas in the Central Valley, (2) prepare levee flood protection zone maps, and (3) annually notify applicable property owners that they live in a flood zone protected by a levee.

<sup>a</sup> Chapters 364 (SB 5, Machado); 365 (SB 17, Florez); 366 (AB 5, Wolk); 367 (AB 70, Jones); 368 (AB 156, Laird), and 369 (AB 162, Wolk) of 2007.

DWR = Department of Water Resources; CVFPB = Central Valley Flood Protection Board; CVFPP = Central Valley Flood Protection Plan; and SPFC = State Plan of Flood Control.

**Floodplain Preservation, Expansion, and Restoration**

***Floodplains Can Help Keep Floodwaters Away From Development.***

Nonstructural approaches also include preserving and enhancing natural floodplain functions such that undeveloped lands can slow and absorb floodwaters before they reach developed areas. Actions include purchasing easements to preserve lands so they remain available for periodic inundation, or setting back levees and widening channels to allow the river greater access to its original floodplain and accommodate a higher volume of flows. Efforts can also be undertaken to

improve the effectiveness of existing floodplains, such as removing vegetation or sediment that impede floodwater flows. (Please see the nearby box for two examples of recent efforts to restore floodplains in order to reduce potential damage to urban areas.) Another approach to accommodating natural floodwaters is to cultivate wetlands along shorelines to serve as buffers to high tides or surges. Specifically, wetlands can absorb and dissipate seawater surges before they reach and inundate near-shore development.

***Bypasses Use Flood Structures to Convey Waters Into Floodplains.*** Flood bypasses combine structural approaches to control floodwaters with the nonstructural approach of utilizing natural floodplain functions. Specifically, levees and weirs are used to direct waters out of river channels into large floodplains—“bypassing” the normal path of the river—so the water can spread and the flow velocity can dissipate. Bypasses are a particularly important part of the SPFC system, which includes seven “relief” bypasses. During periods of high water flows, more than 80 percent of Sacramento River waters can end up flowing through the Yolo

Bypass instead of through the main stem of the river near the City of Sacramento.

***Floodplains Provide Additional Benefits.*** Utilizing floodplains can provide benefits beyond just reducing the risk of flood damage. One example of a positive impact is percolation of water into the ground, helping to replenish groundwater basins for future agricultural and residential uses. Additionally, inundation in natural floodplains can improve habitat conditions for plants and wildlife, such as by providing seasonal flows and creating wetlands needed by migrating fish and birds. For example, recent experiments found that juvenile salmon raised in the flooded Yolo Bypass grew much faster and bigger than those in the main stem of the Sacramento River. Sediments carried and deposited by flood waters can also enrich soils for agricultural purposes. Finally, floodplains can help dilute and flush out pollutants and contaminants and thereby improve water quality when the flows join streams, rivers, and the ocean.

***Increasing Shift to Multi-Benefit Flood Management Approach.*** Flood managers, particularly at the state and local levels, have

## Two Examples of Floodplain Restoration Efforts

Floodplain restoration efforts are being implemented across the state. One example of an effort to enhance floodplain capacity is currently underway in West Sacramento. The Southport Levee Setback Project—a collaborative effort between the City of West Sacramento, the local flood control agency, the Department of Water Resources, and the U.S. Army Corps of Engineers—will set back four miles of the existing levee on the Sacramento River. This will expand the river’s width, allowing it greater access to its original floodplain, as well as create 152 acres of new riparian habitat.

Another example is the Napa River/Napa Creek Flood Protection Project, which utilized strategies including (1) riverbank terracing (allowing rising floodwaters room to spread into defined areas), (2) converting pastureland to wetlands that are available to hold excess waters, (3) replacing a number of old bridges that had blocked flows, and (4) incorporating a dry bypass channel to provide a shortcut for fast-moving water that historically had overtopped the normal pathway of the river. The bypass, completed in 2015, flooded for the first time in February 2017 and helped prevent the type of widespread flooding in downtown Napa that occurred during storms in 2005.



made efforts in recent years to encourage flood management projects that take advantage of the multiple benefits associated with natural floodplain functions. Recent statewide planning documents—including *California’s Flood Future: Recommendations for Managing California’s Flood Risk* (2013), *The Water Action Plan* (2014), and the *Central Valley Flood Protection Plan Update* (2017)—emphasize the need for an integrated water management approach. These plans highlight that in addition to protecting public safety, flood management projects also can and should achieve additional benefits such as ecosystem restoration, wildlife habitat development, and groundwater recharge. One component of the *Central Valley Flood Protection Plan Update*, the “Conservation Strategy,” identifies specific tools and approaches that should be incorporated into local flood management plans to restore natural areas in ways that benefit fish and wildlife. Specifically, the document describes (1) targeted species to assist (such as Central Valley spring-run Chinook salmon), (2) ecological objectives to pursue (such as increased shaded riverine aquatic cover), (3) environmental stressors to address (such as invasive species or fish passage barriers), (4) potential approaches to implement (such as relocating levees), and (5) strategies for facilitating such approaches (such as streamlining and coordinating project permitting requirements).

The state has also structured certain funding grants to encourage or require multi-benefit flood management projects, including projects funded by Proposition 1, the 2014 water bond. For example, Proposition 1 included \$395 million for flood-related projects and explicitly required that “funds shall be allocated to multibenefit projects that achieve public safety and include fish and wildlife habitat enhancement.” Recent water bonds—including Proposition 1—have also included a total of \$2.3 billion for Integrated Regional Water

Management projects. This program provides grants for regionally driven multi-benefit projects that often pair flood-related activities with other water management goals such as water supply.

### Emergency Preparation

Another nonstructural approach that can minimize life and property loss from floodwaters is to plan ahead for how to effectively respond when a flood does occur.

***Both Federal and State Laws Include Some Flood Emergency Planning Requirements.*** In order to remain eligible for some federal funding, local jurisdictions are required to plan for flood emergencies and mitigate flood risk. For example, maintaining eligibility for certain federal disaster assistance grants requires local jurisdictions to develop—and submit to FEMA for approval—local hazard mitigation plans. For areas in FEMA-identified flood hazard zones (as described earlier with relation to the NFIP), these plans must include flood mitigation strategies.

The 2007 flood legislation referenced earlier also included some state-level flood planning requirements for Central Valley residents. Specifically, for a local levee-maintaining agency to be eligible for state funds to improve an SPFC levee, the local jurisdiction located behind the levee must develop a flood safety plan. This plan must include (1) flood preparedness measures, including storage of materials that may be used to reinforce or protect a levee; (2) a levee patrol plan for high water events; (3) anticipated flood-fight procedures; (4) an evacuation plan, including for schools and elderly care facilities; and (5) a floodwater removal plan. (The FEMA plan can be used to meet this state planning requirement provided it contains all of the necessary elements.)

***Effective Local Preparation Can Help Reduce Flood Impacts.*** Preparedness activities include training local emergency responders, developing

systems or purchasing equipment for emergency communication, establishing and communicating evacuation procedures, and acquiring flood-fight material stockpiles such as sandbags. Flood managers also prepare for potential responses to particular flood conditions—for example, by developing engineering plans for making emergency relief cuts in levees to relieve pressure from floodwaters. Understanding potential resulting impacts of such actions ahead of time can allow them to be undertaken quickly in emergency situations.

Flood managers also help educate individuals on how they can prepare for floods to minimize risk. For example, individual residents can have emergency supplies prepared and develop family evacuation plans. Farmers can plan for how to quickly get their livestock to higher ground. Individuals, businesses, or farmers can also

“floodproof” structures so they are prepared to handle occasional floodwaters. For example, this could include raising the structure’s elevation by building impermeable walls and entry points (“dry” floodproofing), or by ensuring anything located on the ground floor can get wet (“wet” floodproofing).

***Increasing Warning Time Can Improve Ability to Respond.*** The state has also undertaken efforts to improve its flood-forecasting ability in order to provide flood managers and local communities with additional warning time to respond to potential floods. These proactive efforts have included improving stream gauges and sensors to get real-time flow information and improving communication procedures to shorten the length of time between when a flood threat is determined and when the public is notified.

## FLOOD RESPONSE ACTIVITIES

### ***Flood Response Typically Has Four Stages.***

The governmental process for responding to an imminent flood typically consists of four stages:

- ***Detection*** by flood managers that a flood could occur, informed by weather forecasts and flow gauges on rivers and streams.
- ***Decision-making*** by local emergency responders regarding what immediate response steps and mitigation actions will be implemented to minimize the potential property damage and loss of life.
- ***Notification*** of the public—through methods such as automated phone and text alerts—about the flood threat and the recommended or required response actions.

- ***Mitigation*** actions by both governmental agencies and local residents. These might include undertaking evacuations, deploying flood-fighting teams, applying sandbags, or removing sensitive equipment to higher ground.

As noted above, increased warning time before a flood occurs can improve response effectiveness, thereby reducing the potential loss of life or damage to property. As such, state and local jurisdictions make efforts to minimize the amount of time spent on the first three steps so that mitigation efforts can be implemented as soon as possible before floodwaters hit.

***Emergency Response Typically Collaborative Effort.*** Emergency response often entails the collaboration of multiple levels of government. Local governments are typically the first entities

to respond to disasters—such as floods—affecting their communities. When faced with flooding, local governments take various actions to protect public safety and mitigate damage to public and private infrastructure. For example, they frequently deploy local government staff—such as law enforcement or firefighting personnel—to provide on-the-ground disaster response. Additionally, if necessary, local governments will activate their local emergency operations center, which serves as a centralized location for staff to coordinate emergency activities, such as tracking and securing disaster response resources and sharing information.

Many flood events are handled entirely at the local level, without the assistance of the state or federal government. However, when floods are large enough to exceed local capacity to respond,

local governments typically seek support from the state government through OES. OES provides various types of support to local governments responding to floods, including coordinating the provision of additional resources—such as staff and equipment—from other jurisdictions through the state’s system of mutual aid. OES also coordinates the emergency response activities of DWR and all other state agencies to ensure that state resources are provided as needed. Finally, when a flood event is significant, OES coordinates with the federal government to ensure that the state receives federal assistance, such as supplies and personnel. OES maintains Regional Operations Centers as well as State Operations Centers, which it activates, as necessary, to facilitate its disaster coordination efforts.

## FLOOD RECOVERY PROGRAMS

***State and Federal Programs Provide Certain Post-Flood Assistance.*** The state and federal governments provide disaster recovery programs through the California Disaster Assistance Act (CDAA) and Stafford Act, respectively. These programs provide financial and other forms of assistance to public agencies and—in some cases—to individuals following a disaster such as a flood. For both programs, a first step in the process is for the local, state, and federal agency representatives, as relevant, to conduct a Preliminary Damage Assessment in order to determine the extent of the damage from the disaster.

***State Assistance Provided Through CDAA Based on Request From Local Government.*** If a local jurisdiction experiences a flood disaster that exceeds its ability to respond, local officials can declare a local emergency and request assistance from the Governor. Depending on the amount of damage, the Governor may declare an official

State of Emergency and, through OES, provide funding to the affected local jurisdiction through CDAA. While there is no specific dollar threshold for the amount of damage to qualify for CDAA funding, OES typically provides local governments with assistance when it determines that local financial capacity has been exceeded. A variety of types of local government costs are eligible for reimbursement under CDAA, such as emergency response personnel overtime costs, infrastructure repair and replacement costs, and certain administrative costs. CDAA typically covers no more than 75 percent of eligible costs, with the relevant local agency covering the remaining 25 percent of eligible costs. These ratios apply to both state-declared eligible disaster costs, as well as to the nonfederal share of federally declared disaster costs, as described below. CDAA does not typically pay any funding for individual losses.

***Federal Recovery Assistance Based on Request From State.*** If the Governor determines that the flood disaster exceeds both local and state capacity, he or she can request a federal disaster declaration and disaster assistance from the President. If this request is granted, the federal government typically provides affected state and local governments with disaster assistance when certain per capita dollar thresholds for damage are reached. The federal government may also consider various other factors—such as a state’s history of disasters—when determining whether to provide assistance. The federal government

provides disaster assistance funding for a somewhat broader range of activities than CDAA, including some limited individual assistance. The federal government typically covers 75 percent of eligible public recovery costs, with the nonfederal share covered by the state (18.75 percent) and local governments (6.25 percent). In addition, the federal Small Business Administration provides disaster recovery loans to individuals and businesses to repair and replace damaged or destroyed property. (We describe state and federal funding programs in greater detail below.)

## FLOOD-RELATED SPENDING

In this section, we discuss overall flood management and response expenditures, including the amounts and types of funding supporting these activities from state, federal, and local sources.

### Overall Spending

***Flood-Related Expenditure Data Difficult to Delineate.*** Estimating how much funding supports flood management efforts is difficult for several reasons. First, as described earlier, such efforts are undertaken by a multitude of agencies at the local, federal, and state levels. Second, expenditures for large flood management projects—such as reengineering levees or expanding floodplains—can stretch over several years and involve multiple funding partners, sources, and mechanisms. Third, activities that provide flood-related benefits may have other primary or secondary water management goals, such as ecosystem restoration or stormwater management. For example, a local project to capture stormwater in underground basins might reduce flood risk but also decrease the pollution flowing into streams and increase local water supplies. Determining what share of this project to “score” as a flood-related expenditure is difficult.

### ***Estimates for Current Flood Expenditures.***

Despite these difficulties, some estimates exist for current flood-related expenditures in California. Specifically, *California’s Flood Future*, a report produced by DWR and USACE in 2013, estimated average annual statewide expenditures on flood management between 2000 and 2010 to be \$2.8 billion. A 2014 report by the Public Policy Institute of California (PPIC), *Paying for Water in California*, had a slightly lower estimate for a more recent time frame: \$2.2 billion annually between 2008 and 2011. Figure 8 (see next page) displays the estimates from these two reports. The differences between the estimates probably reflect a combination of the different methodologies and time frames used, as well as some of the data challenges discussed above.

### Local Government Spending

As primary responsibility for managing flood risk rests with local governments, the majority of funding for flood management activities is generated and spent at the local level. DWR/USACE estimated that local funding for flood-related activities averaged \$2 billion annually between



**Figure 8****Two Recent Studies Estimate Statewide Flood-Related Spending by Source***(Average Annual Spending in Millions)*

	<b>DWR/USACE 2000-2010</b>	<b>PPIC 2008-2011</b>
<b>Spending</b>		
Local	\$2,040	\$1,324
Federal	470	254
State	330	574
<b>Totals</b>	<b>\$2,840</b>	<b>\$2,152</b>

DWR = Department of Water Resources; USACE = U.S. Army Corps of Engineers; and PPIC = Public Policy Institute of California.  
Sources: *California's Flood Future: Recommendations for Managing the State's Flood Risk* (DWR/USACE, 2013); and *Paying for Water in California* (PPIC, 2014).

2000 and 2010. PPIC's estimate for 2008 through 2011 was \$1.3 billion a year.

**Local Agencies Rely on Variety of Funding Sources for Flood Protection.** Local governments generate revenues for flood management activities—including planning, construction, operations, and maintenance—from a number of sources. One of the main sources is property taxes, which in some cases is dedicated specifically to a special district with flood management responsibilities based on local tax formulas, and in other cases is allocated within the annual budget of a city or county for flood-related activities. Some local governments also levy special assessments to cover flood management activities. Under the State Constitution, as amended by Proposition 218 (1996), voters can approve assessments with a majority rather than a two-thirds vote if the amount paid by each homeowner is directly related to the benefit his or her property receives. As such, some local flood assessments are structured with different payment tiers for particular neighborhoods based on factors such as historic flood depths.

Other sources of local revenues for flood-related activities include general taxes (such as

sales taxes), special taxes (which could be dedicated just for flood or for a range of water management activities), revenues from water sales or service charges (often included in local water bills), fees (such as development impact fees), and proceeds from locally issued bonds.

PPIC conducted an analysis of data from special districts (not including cities or counties) and found that on average between 2008 and 2011, property taxes were the single largest local revenue source for flood-related activities each year (just over one-third of total revenues). Revenues from sales or service charges made up about one-fifth of flood-related revenues, with various other sources comprising the remainder.

**Level of Local Special District Expenditures Varies Across the State.** PPIC found that per capita flood spending from special districts varied significantly across regions of the state. (Data were not available for cities and counties that have flood management responsibilities.) The researchers estimated that statewide average per capita flood spending from special districts was \$31 in 2011, but was as high as \$77 in the North Coast region of the state and as low as \$0 in the Colorado River hydrologic region. There was also variability across the regions identified as having the greatest magnitude of population and structures at risk (as displayed in Figure 3 on page 8). Residents in the South Coast region paid \$26 per capita in 2011 while residents in the Bay Area paid \$39. The special districts from the regions where PPIC estimated the greatest capital flood improvement needs exist—the Sacramento and San Joaquin River regions—spent \$46 and \$24 per capita in 2011, respectively.

### **Federal Government Spending**

States and local communities can access federal funding for certain flood-related activities, but special conditions apply and these funds generally

are more limited than state funding. As shown in Figure 8, annual federal flood management expenditures in California have been estimated at between \$254 million and \$470 million.

***Some Federal Funding for USACE to Conduct Flood Management Projects.*** Federal funding for USACE to conduct a flood management project is dependent on congressional authorization. Generally, USACE first undertakes an “investigation” of a project to see whether it would merit federal involvement. Then, if Congress approves *and* appropriates funding for the project, USACE will undertake the project with a nonfederal partner (usually a local agency) and the state. Often these projects are large, and the federal government generally funds 65 percent to 75 percent of the project cost, with local partners and the state sharing the remainder. (As noted below, portions of state bond funding have been dedicated to covering some of the local share of these costs not supported by the federal government.) Some of these projects are upgrades to prior USACE efforts, such as the construction of a new spillway for Folsom Dam. USACE is also in the process of strengthening and raising existing levees along the American River. Annual USACE expenditures in California ranged from \$310 million to \$970 million between 2000 and 2010.

The recent federal Water Infrastructure Improvements for the Nation Act, which authorizes nearly \$16 billion in nationwide spending, was enacted in December 2016. The bill provided appropriations for USACE to undertake flood-related projects in California, including \$880 million for projects along the American and Sacramento Rivers, \$780 million for projects in West Sacramento, and \$70 million for a shoreline project along the South San Francisco Bay in Santa Clara County. Additionally, the act authorized USACE to conduct feasibility studies for potential

future flood-related projects, including along creeks in Merced and Yolo Counties.

***Federal Levee Repair Assistance Contingent Upon Meeting Federal Standards and Criteria.***

The federal PL 84-99 program funds the rehabilitation and repair of certain levees that are damaged during flood events. The program fully funds the rehabilitation and repair of eligible levees originally constructed as part of a USACE project (including SPFC levees). Certain nonfederally constructed levees can participate in the PL 84-99 program but require a state or local partner to pay 20 percent of rehabilitation costs.

In order to qualify for this federal funding, a levee must meet two key criteria. First, the levee must maintain “active status” in the program by meeting established national levee standards and passing USACE inspections before flood events occur. For example, the levee must not display cracking, ruts, erosion, excessive vegetation, or encroachments (structures or obstructions). (The requirement around encroachments is among the most problematic for many California levees, given structures built over time on top of 100-year old levees.) Second, USACE must calculate that the benefits of repairing the levee exceed the costs. Under USACE’s current cost-benefit methodology, meeting this criterion can be hard for some rural communities to achieve. That is, the protection of areas with more sparse population and property located behind the levees might not be calculated to generate sufficient economic benefit to offset the costs of levee rehabilitation. As such, some of the local agencies maintaining rural levees have opted not to pursue active status in the PL 84-99 program.

Currently, only 40 percent of SPFC levee miles (610 miles) maintain active PL 84-99 status and qualify for federal rehabilitation funding. These qualifying levees represent about 85 percent of the total population who live behind SPFC levees.

Given their higher population and greater number of structures, agencies maintaining levees that protect urban areas have more certainty that they would meet USACE's cost-benefit threshold and, therefore, greater incentive to maintain levees up to federal standards. Within the Delta region, which is largely rural, only about one-third of the 412 levee miles that have historically been part of the PL 84-99 program currently maintain active status.

***Some Limited Direct Federal Grants Also Available.*** FEMA offers several hazard mitigation grants to help states and local communities prepare for and lessen the impacts of disasters, including floods. These include the Flood Mitigation Assistance grant program, which annually funds competitive grants for states or local communities to plan or undertake actions that would reduce NFIP claims in the case of a flood. Nationally, \$150 million was available for these grants in 2015 and \$200 million in 2016. As these are competitive grants, however, California does not receive funding every year. For example, the state applied for \$2.8 million to conduct a project in Sonoma County in 2015 and for \$11 million for a project along the Carmel River in Monterey County in 2016, but was not awarded funding for either project.

***Federal Government Funds Share of State and Local Disaster Assistance Costs in Some Cases.***

In certain cases, as described earlier, the federal government provides funding assistance through the Stafford Act to states and local governments that experience flood disasters. Over the past decade, California communities have received nearly \$300 million in federal assistance grants for federally declared flood disasters. In addition to or in lieu of funding, the federal government may provide direct assistance including food, personnel, or temporary living arrangements like trailers or hotel vouchers. At the time this report was prepared, the Governor had requested federal

assistance under the Stafford Act four different times in 2017—three times for funding to bolster state and local response and recovery efforts to damage from storms in January and February 2017—including the damage to the spillway at Oroville Dam—as well as for direct assistance to support evacuations of residents living near Oroville.

***Individuals in Federally Declared Disasters May Qualify for Low-Interest Federal Recovery Loans.*** In certain cases, individuals and businesses that experience flood damage may be able to access federal recovery loans through the U.S. Small Business Administration disaster loan program. Specifically, individuals may qualify for a low-interest loan of up to \$200,000 to help cover flood damage to a primary residence and up to \$40,000 to repair or replace personal property such as clothing, cars, and appliances. Businesses may apply for a loan of up to \$2 million for physical damage or economic injury. Such flood recovery loans, however, typically are available only if the President declares a federal disaster. According to FEMA, federal disaster assistance declarations are issued in fewer than 50 percent of flooding events. Moreover, typically the loans must be repaid along with any existing mortgage, although in some cases the federal government will help refinance mortgage terms.

***State Government Spending***

Although flood management is largely a local responsibility, the state has a strong interest in avoiding major damage and losses, especially when state-owned infrastructure, such as highways and buildings, is at risk. The state, therefore, provides some funding to local flood agencies for improvements to levees and other flood-related infrastructure, as well as for nonstructural flood projects and activities. These state programs are funded primarily by state general obligation bonds.

As shown in Figure 8, DWR/USACE estimated average annual expenditures for flood management by state agencies to be \$330 million between 2000 and 2010, whereas PPIC estimated an average of \$574 million annually between 2008 and 2011.

**Voters Have Authorized \$5.1 Billion in State Bonds for Flood Management Over Past Two Decades.** Figure 9 summarizes general obligation bonds authorized by voters for flood-related activities since 2000. Nearly all of this funding was provided to DWR to use mostly for grants to local agencies, but also for some state-level activities. As shown in the figure, the bulk of this funding was approved through two 2006 bonds, Propositions 84 and 1E. These propositions were passed in the wake of Hurricane Katrina, when widespread destruction in Louisiana led to increased concerns about California's flood risk. With the exception

of the \$395 million from Proposition 1, all of this funding has been appropriated by the Legislature and nearly all of it has already been either expended or committed for specific projects. These bonds will be repaid with interest from the state General Fund over the next couple of decades. In response to recent winter storms and flooding, in late February 2017 the Governor requested that the Legislature make an urgency appropriation of the Proposition 1 funds to undertake additional flood-related projects. That request was still pending at the time of this publication.

**Bond Funding Used for Broad Variety of Efforts.** As shown in Figure 9, the recent bonds have funded a variety of flood management activities and regions. Efforts have focused on both structural flood projects (such as levee improvements) as well as nonstructural efforts

Figure 9

**Recent Bonds Provided \$5.1 Billion for Flood Management Activities<sup>a</sup>**

(In Millions)

Category	Types of Activities	Proposition				Totals
		13 (2000)	1E (2006)	84 (2006)	1 (2014)	
<b>Flood control projects: SPFC</b>	Evaluate, repair, reconstruct, and replace levees or structures within SPFC system; develop Central Valley Flood Protection Plan; improve emergency response preparedness at both state and local levels.	—	\$3,000	—	—	\$3,000
<b>Flood control projects: federal</b>	Assist local agencies in paying required nonfederal share of federally authorized flood control projects.	—	500	\$180	—	680
<b>Flood control projects: Delta</b>	Repair levees, conduct flood risk reduction initiatives, and make habitat improvements—all in the Delta.	—	—	275	\$295	570
<b>Flood control projects: statewide</b>	Improve levees, conduct feasibility studies, improve emergency response preparedness at both state and local levels, and support multi-benefit projects.	—	—	275	100	375
<b>Flood corridors and bypasses</b>	Conduct projects to restore and preserve natural floodplain processes, including acquiring easements.	\$140	290	40	—	470
<b>Floodplain planning</b>	Map floodplains and assist local land use planning efforts.	—	—	30	—	30
<b>Totals</b>		<b>\$140</b>	<b>\$3,790</b>	<b>\$800</b>	<b>\$395</b>	<b>\$5,125</b>

<sup>a</sup> Includes only the portion of bond funding dedicated for flood-related activities.  
SPFC = State Plan of Flood Control.



(such as floodplain restoration and emergency preparedness). While more than half of the funding has focused on improving the SPFC system—due to the state’s responsibility for those facilities—funds have also supported flood improvements for non-SPFC facilities. As shown in the figure, the funds have supported both projects within and outside of the Delta, both federal and nonfederal projects, and activities at both the state and local levels. Some of the specific projects funded have been completed, and others are still underway.

***Some General Fund Used for Flood-Related Activities.*** The state also relies on the General Fund for some flood-related activities. For example, the *2016-17 Budget Act* included more than \$50 million from the General Fund for staff at DWR to conduct its routine flood-related activities, including flood forecasting and planning, levee and channel inspections, and maintenance of the SPFC levees it manages. The annual budget provides additional General Fund—about \$6 million in 2016-17—to CVFPB to conduct SPFC permitting and oversight. The state also dedicates annual General Fund to pay the debt service costs for the aforementioned bonds that fund flood-related activities. Furthermore, the state provided \$100 million in the 2016-17

budget on a one-time basis from the General Fund to conduct deferred maintenance on levees, in particular to address pipes or other encroachments that might be compromising levee integrity. In February 2017, however, the Governor announced plans to repurpose at least half of this funding to address emergency levee repairs resulting from winter storms.

The state also dedicates some General Fund annually to support disaster response and recovery efforts through the CDAA program. As described above, CDAA authorizes the Director of OES to provide financial assistance to support emergency response and to repair and restore damaged public infrastructure. CDAA funds are also used to provide state matching funds for federal disaster assistance programs. In recent years, the CDAA program has had a base budget of \$39 million annually from the General Fund. Frequently, the process for local governments to tally eligible disaster-related costs, submit claims, and receive reimbursement funds through CDAA can take years. Between 2004 and 2014, CDAA paid around \$300 million to local governments for flood and severe storm-related disasters.

## ESTIMATED FLOOD MANAGEMENT FUNDING NEEDS

Given the age and condition of most of the state’s dams, levees, and other flood management infrastructure, several studies have estimated that upgrading the existing system will cost many billion dollars above current expenditure levels. Developing such estimates is difficult, in part because no comprehensive statewide assessment defining specific risk—or the projects that would reduce that risk—exists. For example, the state has not defined what projects and level of expenditures would be necessary to prepare all regions for a 100-year or 200-year flood. What is clear is that

the gap between existing spending levels and the expenditures that would be needed to significantly reduce the risk of flood damage across the state is substantial.

Below, we summarize the estimates contained in several flood-related reports for additional spending needed beyond current expenditures to address the state’s flood risk. In most cases, these estimates were developed by aggregating lists of identified flood management projects created by local flood management agencies. Moreover, the studies do not specify what level of risk reduction

these additional expenditures would yield (such as protection against a 500-year flood). Both the publication dates for the reports and the time frames for their projected costs are somewhat different, which accounts for some of the variance in the estimates.

***DWR and USACE—\$52 Billion Statewide.***

The 2013 *California's Flood Future* report estimated costs of \$52 billion for 836 flood management improvements and projects across the state that were in the planning or implementation stages. This estimate did not include a time frame for these expenditures. The report also estimated that additional funding of more than \$100 billion might be needed to address flood risk that has not yet been comprehensively assessed and for which specific projects are not yet in the planning or implementation stages.

***PPIC—\$34 Billion Statewide Over 25 Years.***

The 2014 report, *Paying for Water in California*, combined appraisals from various sources to estimate that it would take \$34 billion, or about \$1.4 billion annually for 25 years, to implement identified flood risk reduction projects to reduce flood exposure in California. The report also included a cost-benefit analysis which found that “in some regions the avoided costs of private property damage are enough to justify the added expenditures on flood protection, but in

others—notably, the Sacramento River, the North Coast, and possibly also the San Joaquin River regions—other benefits will likely be needed to justify these new investments.”

***American Society of Civil***

***Engineers—\$28 Billion Statewide Over Ten Years.***

In 2012, this group issued its quadrennial *Infrastructure Report Card*, and assigned the state’s levees and flood control infrastructure a “D” grade. The authors estimated it would cost an additional \$2.8 billion per year for ten years to bring statewide levees and flood control systems up to levels it determined would be safe enough to achieve a passing “B” Grade.

***DWR—Around \$20 Billion Over 30 Years for SPFC.*** The *Central Valley Flood Protection Plan 2017 Update*, prepared by DWR for adoption by the CVFPB—and still in public draft form when we published this report—developed a portfolio of prioritized systemwide capital improvements for the SPFC estimated to cost between \$13 billion and \$17 billion over 30 years. These include multi-benefit efforts that would also promote ecosystem improvements. The plan also calls for additional spending for the SPFC of around \$5 billion spread over 30 years for ongoing annual activities such as planning, emergency management, and operations and maintenance.

## KEY FLOOD MANAGEMENT CHALLENGES IN CALIFORNIA

As described throughout this report, flood management is a complicated and expensive undertaking in California, given the state’s size, its extensive and aging infrastructure, the number of agencies involved, and the magnitude of its flood risk. In this section we highlight some of the key challenges confronting the state as it pursues more

effective flood management approaches, which are summarized in Figure 10 (see next page). These are issues the Legislature will face as it seeks to develop additional policies and define budgetary priorities that effectively address California’s flood risk.

***Existing Infrastructure Is Many Years Old.*** Much of the state’s extensive flood

**Figure 10****Key Flood Management Challenges in California**

- ✓ Existing Infrastructure Is Many Years Old
- ✓ Infrastructure Not Always Designed to Meet Evolving Goals and Conditions
- ✓ Flood Management Needs Are Great, but Funding Is Limited and Inconsistent
- ✓ Certain Land Use Decisions Can Increase Flood Risk
- ✓ Involvement of Multiple Agencies Complicates Flood Management Efforts

management infrastructure is aged and in need of improvements. Most of the dams and weirs in the state are at least 60 years old, and many levees—particularly in the Central Valley—were built over 100 years ago and not to modern design standards. Even well-designed flood infrastructure can become less effective over time—for example, as reservoirs fill with sediment behind dams (reducing their capacity) or as earthen levees erode under stress from river flows. As infrastructure ages, it faces a greater risk of malfunction and requires increasing maintenance and repair to remain effectual. Many have raised concerns that statewide maintenance practices—and funding—for flood infrastructure have not kept pace with these demands, contributing to the high estimated infrastructure costs cited in the previous section. For example, the state’s *Central Valley Flood Protection Plan 2017 Update* asserts that operations and maintenance activities have been “chronically underfunded” for the SPFC. The recent damage at Oroville Dam highlights both the latent risk inherent in, as well as the state’s critical dependence on, its aging infrastructure.

***Infrastructure Not Always Designed to Meet Evolving Goals and Conditions.*** Most of the state’s flood management infrastructure was developed in another era, which means much

of it is not necessarily consistent with current statewide goals, scientific knowledge, or conditions. For example, narrow or concrete-lined river channels were designed to rapidly direct floodwaters to the ocean. However, this design disrupts the natural floodplain and riverine habitats upon which native fish depend.

It also precludes some opportunities to increase water supply because it discharges flood or storm waters before they have the chance to infiltrate into groundwater basins.

Much of the existing system was also developed prior to more recent growth in statewide population and current development patterns, so it was not designed to protect newly developed areas. For example, certain segments of Central Valley levees were originally constructed to protect agricultural lands and could occasionally flood cropland without serious consequences. Those same levees now protect populated communities where similar occasional floods would yield significant damage. Scientific knowledge about earthquake fault lines and seismic risks has also progressed over the past several decades, raising concerns about how well structures such as dams meet current seismic engineering standards. For example, the San Francisco Public Utilities Commission is in the process of completely replacing the Calaveras Dam (straddling the Calaveras fault line in Alameda and Santa Clara Counties) to address serious seismic concerns, at an estimated cost of \$810 million.

Moreover, the effects of a changing climate are placing new demands on the state’s flood management system. The climate impacts that

scientists predict California will face include rising seas levels, more frequent king tides and storm surges, more frequent periods of drought, more precipitation falling as rain rather than snow, and the mountain snowpack melting more rapidly and earlier in the season. All of these changes have the potential to place increased stress on coastal development, seawalls, dams, levees, and channels that were not necessarily designed to withstand such conditions.

***Flood Management Needs Are Great, but Funding Is Limited and Inconsistent.*** To meet these challenges, additional investments are required to both maintain and upgrade the existing flood management system. As noted earlier, studies have estimated associated costs to be in the tens of billions of dollars. Some of the identified funding needs represent one-time capital projects to upgrade existing infrastructure, while others require ongoing funding for more regular maintenance activities. However, generating funding for flood management activities can be challenging. Some of the key funding challenges include:

- ***Most State Funding Is From Bonds, Creating Difficulties for Meeting Ongoing Needs.*** Bond funds—the primary source the state has traditionally used for flood management activities—are available intermittently and therefore not appropriate for sustaining ongoing operations and maintenance costs. This creates challenges both for local agencies that depend on state grants for many of their activities, as well as for DWR to identify how to maintain its components of the SPFC.
- ***Local Funds Hard to Raise.*** Raising additional local funds for flood-related activities is complicated by certain state constitutional provisions. Proposition 13 (1978) prohibits local governments from

raising additional ad valorem property tax revenue (except for voter-approved bond debt). Additionally, to assess a supplemental tax on a property to support flood-related activities, Proposition 218 (1996) can require the community to approve the tax by a two-thirds vote, which can be difficult to attain. Alternatively, a local jurisdiction can levy an assessment for flood-related activities with a lower vote threshold, however, this requires proving that flood projects explicitly benefit each property owner in direct proportion to how much he or she pays. Flood-related projects often provide diffuse benefits, including to downstream residents in other tax districts, making this requirement particularly complicated. Generating sufficient tax and assessment revenue is also challenging in many rural areas where the tax base is relatively small, making it difficult to spread out the cost of large levee projects.

- ***Funding Constraints Can Complicate Multi-Benefit Projects.*** Sometimes funding that is available for flood-related projects is restricted for meeting one particular outcome, making funding all the components of multi-benefit projects difficult. For example, both federal funding for USACE projects and local flood assessments typically can only be used to mitigate flood risk. Such funds often cannot be used for complementary efforts that might improve the ecosystem and provide additional habitat for fish and wildlife if they are not directly necessary for flood protection.
- ***Need for Flood-Related Investments Fades From Public Awareness Between Major Floods.*** Public support for flood-related



funding typically wanes and waxes depending on how recently a flood event has occurred. During extended periods without significant flood events, the need for investment and protection fades from public attention even though the risk has not changed. Generating sufficient public support for passing local assessments or statewide bonds can be difficult during these years, even though the best time to maintain and upgrade flood infrastructure is ahead of the next flood occurring. Flood insurance enrollment rates—the primary source of recovery funding for individuals and businesses—also decline during extended flood-free periods, which can exacerbate the impacts of damages when floods do inevitably occur.

***Certain Land Use Decisions Can Increase Flood Risk.*** Both the state and local governments face challenges in determining how to balance flood risk with expanding population and development. As the state population grows, so too does the push to develop into new areas. This development can be both necessary to accommodate additional residents and generate additional tax and fee revenue for certain local jurisdictions. Development in flood-prone areas, however, increases the potential for flood damage. Even with structural protection such as levees in place, the residual risk of flooding remains, particularly in historic floodplains. While the state typically leaves land use decisions up to local governments, in some cases the state bears financial liability if a flood were to occur. For example, the state may be found responsible for damages caused by failures of SPFC levees, need to repair damage to state-owned infrastructure such as highways or buildings, or face pressure to pay a share of local government recovery costs through CDAA. Additionally, the state has an interest in protecting

public safety. While the state implemented higher flood protection standards and some land use planning requirements in 2007, they only apply in certain areas of the Central Valley and are enforced at the local (not state) level, so are limited in both scope and effect.

***Involvement of Multiple Agencies Complicates Flood Management Efforts.*** The overlapping and fragmented nature of flood-related responsibilities between various local, federal, and state governments can complicate flood management efforts, particularly for multi-benefit projects. Water-related activities can be assigned to various different local agencies within the same jurisdiction. As such, undertaking a project to capture and retain stormwater flows for future water supply, for example, could involve separate local government agencies that respectively have sewer, flood, groundwater, and drinking water responsibilities. Such coordination needs can make funding, permitting, overseeing, and implementing such a project difficult. Similarly, large flood management projects typically can involve attaining permits and approvals from multiple federal and state agencies, including state and regional water boards, federal and state fish and wildlife agencies, USACE, and CVFPB. There are even instances where these agencies impose permit requirements that contradict each other—for example, when USACE requires removal of vegetation or sediment from a levee or channel, but those conditions are providing habitat for protected fish and wildlife that the fisheries agencies prohibit disturbing.

In part due to the complication of involving multiple agencies, flood management projects can take many years to complete. For example, the recent construction of an auxiliary spillway at Folsom Dam took roughly 30 years to complete, beginning with flood concerns in 1986, to USACE conducting its first project feasibility study in

1991, to the spillway's anticipated completion in 2017. (Additional features of the project, including raising the dam and updating USACE's flood-release requirements, have yet to be completed.) This type of extended implementation timeline helps explain why ten years after voters approved Propositions 84 and 1E, only about 60 percent of the bond funding has yet been spent. While

nearly all of the funding has been *committed* for specific projects, the projects are still underway and a significant share remains unspent. (The state typically funds projects on a reimbursement basis after actual costs have been incurred, and therefore generally does not sell bonds and provide funding to grantees until projects are at or near completion.)

## CONCLUSION

Damage from storms in the winter of 2017 highlight the state's flood risk and vulnerability. After several years of drought, multiple series of wet storms resulted in instances of overflowing rivers and creeks, crumbling dam spillways, breaching levees, mudslides, and collapsing roads and highways. Moreover, scientists predict that such alternating extremely dry and extremely wet years will occur more frequently as the result of a changing climate, placing additional stress on the state's existing flood infrastructure. However,

at the time this report was prepared, the aged statewide flood management system has also performed admirably well, with no catastrophic failures or widespread damages. The billions of dollars that local, federal, and state agencies have invested in flood-related efforts over the past years have borne benefits. Such efforts remain essential and ongoing—particularly given the costs and coordination challenges confronting the state as it seeks to better manage its flood risk.

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This report was prepared by Rachel Ehlers and reviewed by Brian Brown. The Legislative Analyst's Office (LAO) is a nonpartisan office that provides fiscal and policy information and advice to the Legislature.

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