Recreation

Sacramento River Basin Major recreation areas in the Sacramento River Basin include lakes, reservoirs, rivers, streams, federal wildlife refuges, and State WMAs. Lakes, reservoirs and streams are shown on Figure 2-3 in Section 2.1.2, Infrastructure. Federal wildlife refuges are shown on Figure 2-20. Private lands also support considerable waterfowl hunting activity in the river basin. Overall, recreation use in the Sacramento River Basin has paralleled increased population growth. Consequently, recreation-related spending associated with increased visitation has become an important contributor to the local and regional economies.

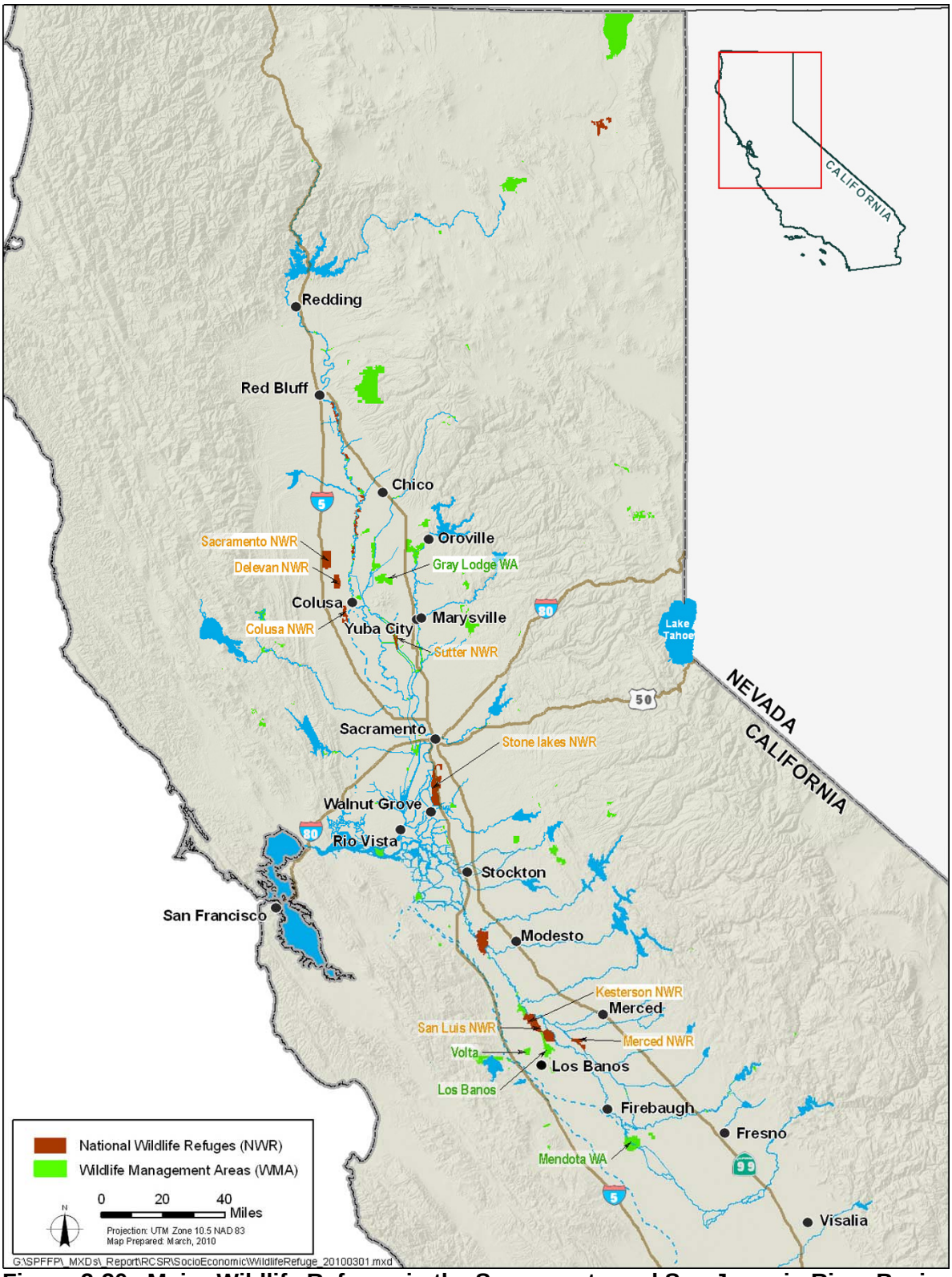


Figure 2-20. Major Wildlife Refuges in the Sacramento and San Joaquin River Basins

Recreation opportunities in the Sacramento River Basin have been shaped by the construction of large reservoirs and the alteration of major rivers. Creation of Shasta Lake, Whiskeytown Lake, Lake Oroville, Folsom Lake, New Bullards Bar Reservoir, and Englebright Lake have provided extensive reservoir recreation opportunities, including flat-water recreation. Before major dams were constructed, flows and water temperatures fluctuated seasonally. Low flows and relatively high water temperatures occurred in summer, and high flows and low water temperatures occurred in winter. In some instances, modified river flows resulted in substantial changes to sport fisheries. After Shasta Lake was created, water temperatures and flows in the Sacramento River were altered to such a degree that a year-round salmonid sport fishery was created. Chinook salmon, steelhead trout, and rainbow trout made the greatest contribution to the fishery (CALFED, 2000c).

Major rivers in the basin include the Sacramento, American, and Feather rivers. Tributaries to the Sacramento River include Cottonwood, Cow, Deer, Bear, Battle, Mill, Paynes, Antelope, Butte, Big Chico, Thomes, and Elder creeks and the Colusa Basin Drain.

Wildlife refuges in the Sacramento River Basin provide fishing, hunting, and wildlife viewing opportunities. These refuges include the Sacramento, Colusa, Sutter, and Delevan NWRs, Yolo Basin Wildlife Area, and Gray Lodge WMA. The Gray Lodge WMA, the first wildlife refuge in the Sacramento River Basin, was established in 1931. Historically, the Gray Lodge WMA has been the most popular of the refuges in the basin. These areas are used for activities such as hiking, wildlife watching, festivals, and environmental education programs.

The lower American River and the Feather River, Middle Fork, are currently listed as two of California's Wild and Scenic Rivers. In addition, federal, State, and private agencies have identified Sacramento River segments and key tributaries as eligible for designation as Wild and Scenic because of endangered fisheries, rare wildlife populations, riparian habitat, and diverse recreation opportunities (USACE and Board, 2001).

San Joaquin River Basin Reservoirs, rivers, and wildlife refuges in the San Joaquin River Basin support a variety of recreational activities, including sportfishing, hunting, boating, camping, swimming, picnicking, and sightseeing. Private lands also support considerable waterfowl hunting activity in the river basin.

Reservoirs and lakes in the San Joaquin River Basin include San Luis, Millerton, New Melones, New Don Pedro, McClure, McSwain, Eastman Lake, Lake Comanche, and New Hogan. Except New Melones Reservoir,

these reservoirs were constructed in the 1960s and 1970s. Rivers in the San Joaquin River Basin include the San Joaquin, Stanislaus, Tuolumne, and Merced. Millerton Lake has modified the flows and temperature of the San Joaquin River.

Wildlife refuges in the San Joaquin River Basin provide fishing, hunting and wildlife viewing opportunities. Refuges in the San Joaquin River Basin include the Los Banos and Volta WMAs, and Kern, Kesterson, Merced, Mendota, Pixley, and San Luis NWRs. Recreation opportunities for both nonconsumptive and consumptive activities are provided at all wildlife refuges in the region.

Overall, recreation use at major reservoirs, rivers, and wildlife refuges in the San Joaquin River Basin has been increasing since the 1940s. Consequently, recreation-related spending associated with increased use by visitors to the recreation areas has been increasing, and has become an important contributor to local and regional economies (CALFED, 2000).

Federally designated Wild and Scenic Rivers in the San Joaquin River Basin include the South Fork of the Merced River, Middle and South forks of the Kern River, and Tuolumne River (USACE and Board, 2001).

Delta Recreation in the Delta is primarily water-oriented but some agri-tourism activities occur. Figure 2-21 shows major recreation areas in the Delta, fishing and boating are the most popular activities. Almost every type of recreation boat can be found in Delta waterways, including houseboats, sailboats, fishing boats, personal watercraft, speedboats, canoes, rowboats, and inflatable boats. Water-based recreation activities include fishing from a boat, water-skiing, bird watching, sailing, cruising, operating personal watercraft, canoeing, kayaking, houseboating, hunting from a boat, swimming from a boat, boat camping, swimming from shore, bank fishing, and windsurfing (CALFED, 2000c).

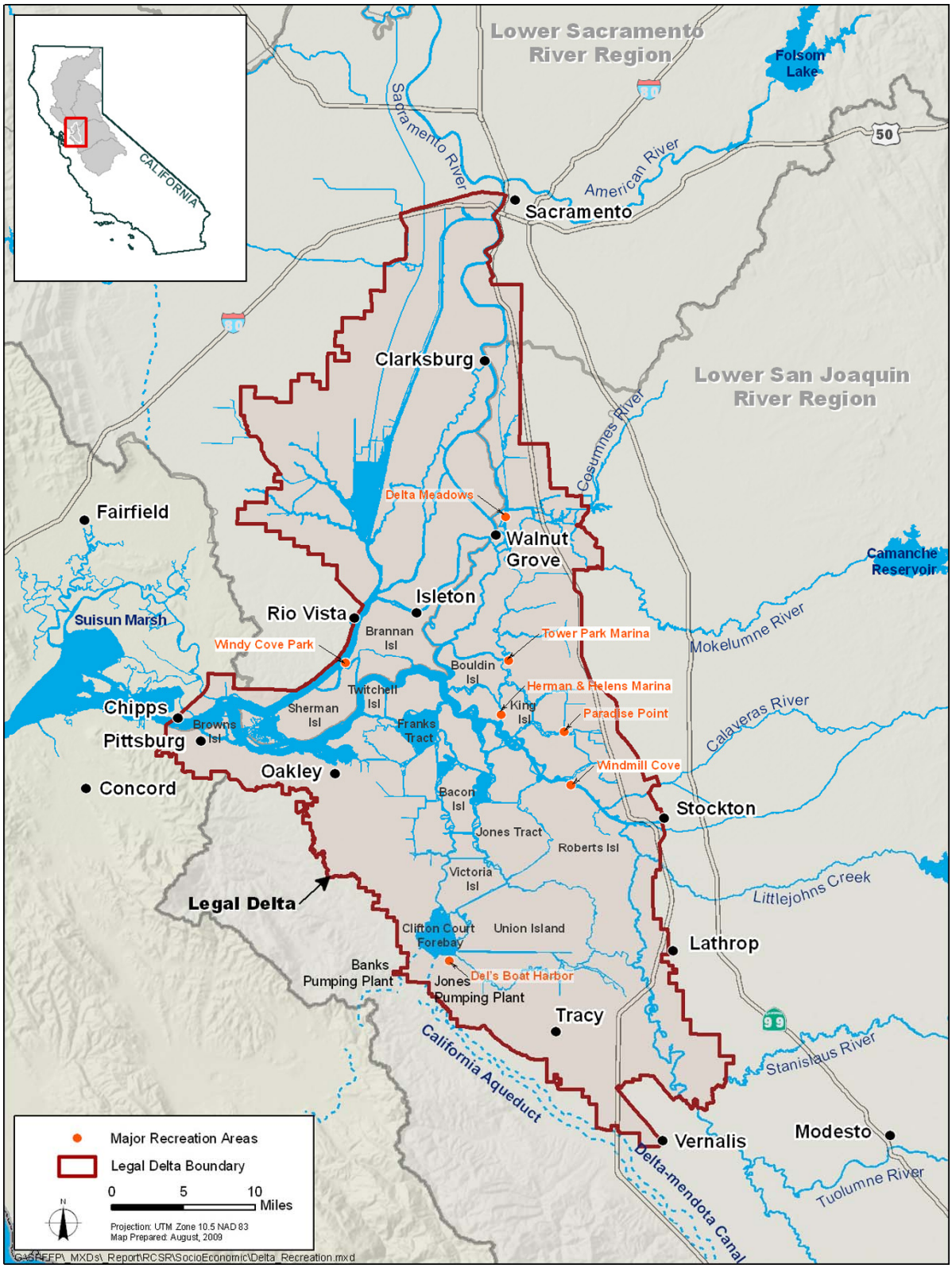


Figure 2-21. Major Recreation Areas in the Delta

Most of the navigable waterways in the Delta are public, and most of the land is private. The lack of public lands limits use of the Delta for recreation. Public use of the Delta is concentrated in a few areas where marinas and other facilities provide recreational opportunities and access to Delta waterways. There are few public parks. Some of the recreation areas in the Delta are accessible only by boat (DPC, 1996).

Most of the recreation facilities are provided through private marinas. Of the public facilities, Brannan Island State Recreation Area provides boat launching, camping, swimming, nature interpretation and wind surfing, and the DFG owns five fishing access/launching facilities that are managed by Sacramento and Yolo Counties. Other public facilities include a Department of Parks and Recreation trail and access behind Locke, limited access to the USFWS Stone Lakes Refuge, several East Bay Regional Park District sites, San Joaquin County parks, fishing access at Clifton Court Forebay (DWR) and many urban recreational sites in Antioch, Pittsburg, Rio Vista, Sacramento, West Sacramento, and Stockton (DPC, 1996).

The more popular land-based recreation activities include hunting, camping, picnicking, walking for pleasure, bicycling, wildlife viewing, photographing wildlife, sightseeing (driving for pleasure), and attending special events. Since 1990, hunting has continued on private lands, as well as in public areas, on waterways, and on various small Delta islands. Popular areas include Sherman Island WMA, Twitchell Island, Franks Tract State Recreation Area, and Clifton Court Forebay (CALFED, 2000c).

Much of the open space in the Delta is used for public parks and wildlife refuges. The California Department of Parks and Recreation owns 5,000 acres in the Delta, including Brannan Island; Franks Tract State Recreation Area (flooded) for recreation; Delta Meadows River Park, a scenic waterway near Locke that is popular with boaters; and more than 1,000 acres in the Stone Lakes NWR. Significant amounts of acreage in the Delta have been purchased in recent years by State, federal, and nonprofit agencies for enhancement and management as wildlife habitat. Approximately 23 public recreation facilities are located in the Delta (CALFED, 2000c).

Visual Resources

Sacramento River Basin Visual resources in the Sacramento River Basin are characterized by agricultural uses, grasslands and woodlands in the foothills, and forests in the upper watersheds. Historical changes in the Sacramento River Basin from grasslands, floodplains, and extensive riparian areas to cropland, rice fields, and orchards have reduced visual variety. Before the 1940s, the Sacramento River Basin was made up of grasslands, scattered oak woodlands, wetlands, vernal pools, and riparian

areas. The Sacramento River Basin's upper watershed retained its predominantly oak woodland, grasslands, forests, and small rural communities despite substantial development along State and federal highways in the foothills and mountain areas. These areas are framed by the forested ridgelines of the Sierra Nevada to the east, the Cascade Range to the north, and the Coast Ranges to the west. Little urbanization in these areas has preserved pristine wildernesses, mountains, and other dramatic landscapes (CALFED, 2000c).

Construction of dams and reservoirs has substantially changed the visual landscape. Whiskeytown, Shasta, Oroville and Black Butte reservoirs have added visual variety to this region. Viewer sensitivity is high in these areas because of high recreation use and easy public access.

Scenic highways are roads designated as scenic by the State of California or local agencies, and are recognized as having exceptional scenic qualities or affording panoramic vistas. Officially designated State scenic highways within the river basin are SR 151 (from Shasta Dam to near Summit City) and SR 160 (from the Contra Costa County line to the southern limit of the City of Sacramento (CALFED, 2000c)).

San Joaquin River Basin The visual landscape of the San Joaquin River Basin has changed considerably since before World War II. In the 1940s, the valley was largely open grasslands with scattered expanses of oak woodland. Wetlands, vernal pools, and riparian corridors added visual variety to the landscape. Settlement was sparse, with small communities located primarily along the rivers, and scattered rural ranches. A significantly smaller area of the landscape was irrigated and few of the rivers were regulated. Much of the view opportunity was limited to the road and railroad corridors. After the population influx following World War II, rapid agricultural development and the growth of communities changed the visual landscape substantially and relatively quickly. Much of the grassland was replaced by irrigated cropland, rice fields, and orchards (USACE, 2000).

As mentioned scenic highways are roads designated as scenic by the State of California or local agencies and are recognized as having exceptional scenic qualities or affording panoramic vistas. Officially designated State Scenic Highways (Caltrans, 2007), including State routes and Interstates within the region, are I-5 between Interstate 205 (I-205) (San Joaquin County) and just south of SR 152 in Merced County (provides views of the Delta-Mendota Canal), SR 152 from I-5 to the Madera County line (passes San Luis Reservoir), and Interstate 580 (I-580) (San Joaquin County).

The upper watershed areas of the San Joaquin River Basin have remained relatively untouched over the last 150 years. The upper watershed is still predominantly oak woodland, grassland, and forest, with some limited rural development. These areas are framed by the forested ridgeline of the Sierra Nevada to the east and the Tehachapi Mountains to the south. Lack of development has preserved the scenic qualities of these areas; however, over the past 30 years, increasingly developed viewscapes have encroached along the major roadways in this region.

Delta Major visual resources in the Delta region include the SRAs of Franks Tract, Brannon Island, and Windy Cove; Stone Lakes NWR; the Cosumnes-Mokelumne River confluence wildlife preserve; and several private marinas, and camping and fishing sites. SR 160 is a State-designated Scenic Highway from Antioch to Freeport. Resources viewed from the Delta include Mount Diablo in Contra Costa County and the Vaca Range in Napa and Solano counties.

Main roads from which travelers can view the Delta are SR 160, SR 4, and SR 12. In many sections of SR 4 and SR 12, it is impossible to view the Delta waterways, as nearby levees block such views, but features such as Mount Diablo can be seen.

Environmental Justice

Environmental justice refers to the fair treatment of people of all races, cultures, and income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Executive Order 12898, Section 2-2, signed by President Clinton in 1994, requires all federal agencies to conduct "programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons the benefits of, or subjecting persons to discrimination because of their race, color or national origin." Section 1-101 requires federal agencies to identify and address, as appropriate, "disproportionately high and adverse human health or environmental effects" of programs on minority and low-income populations (Executive Order 12898, 1994). California Government Code (CGC), Section 65040.12 (c), defines environmental justice as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation and enforcement of environmental laws and policies." It is important to consider environmental justice when evaluating the location, effectiveness, equity, strengthening, and construction of flood protection.

In the Central Valley, people living in predominantly rural areas tend to have lower incomes, higher poverty rates, and higher unemployment rates

than those living in urban areas. Urban centers offer the greatest employment opportunities for all skill levels, while employment opportunities in rural areas tend to involve industries such as agriculture, logging, and fishing. Urban centers also typically contain the social structure and programs to assist minority and low-income populations. Analysis of potential environmental justice issues focuses on farm and agribusiness workers because they are more likely to be directly affected by Central Valley Flood Management Planning (CVFMP) Program elements than minority and low-income populations in urban areas.

Disadvantaged Communities A disadvantaged community is defined as a community with an annual median household income of less than 80 percent of the statewide annual median household income. According to the 2000 census data, 80 percent of California's statewide annual median household income is $37,994.

Table 2-19 and Figure 2-22 show a list of cities and census-defined places that qualify as disadvantaged communities.

Table 2-19. Disadvantaged Cities and Census-Defined Places Within the Sacramento and San Joaquin River Basins

City	2000 Population	2002 Median Income	County
Biggs	1,793	$33,250	Butte
Byron	826	$35,938	Contra Costa
Colusa	5,402	$35,250	Colusa
Dos Palos	4,385	$29,147	Merced
Firebaugh	5,743	$31,533	Fresno
Florin	27,181	$33,793	Sacramento
French Camp	2,678	$28,295	San Joaquin
Gerber	1,369	$24,107	Tehama
Gridley	5,408	$24,368	Butte
Hamilton City	1,883	$33,169	Glenn
Isleton	828	$33,958	Sacramento
Linda	13,264	$22,753	Yuba
Live Oak	6,087	$25,754	Sutter
Marysville	11,758	$28,494	Yuba
Olivehurst	10,912	$29,854	Yuba
Parkway	36,281	$31,194	Sacramento
Sacramento	398,894	$37,049	Sacramento
South Dos Palos	1,283	$18,500	Merced
Stockton	243,771	$35,453	San Joaquin
Tehama	434	$27,500	Tehama
West Sacramento	31,381	$31,718	Yolo
Wheatland	2,264	$34,861	Yuba
Yuba City	35,633	$32,858	Sutter

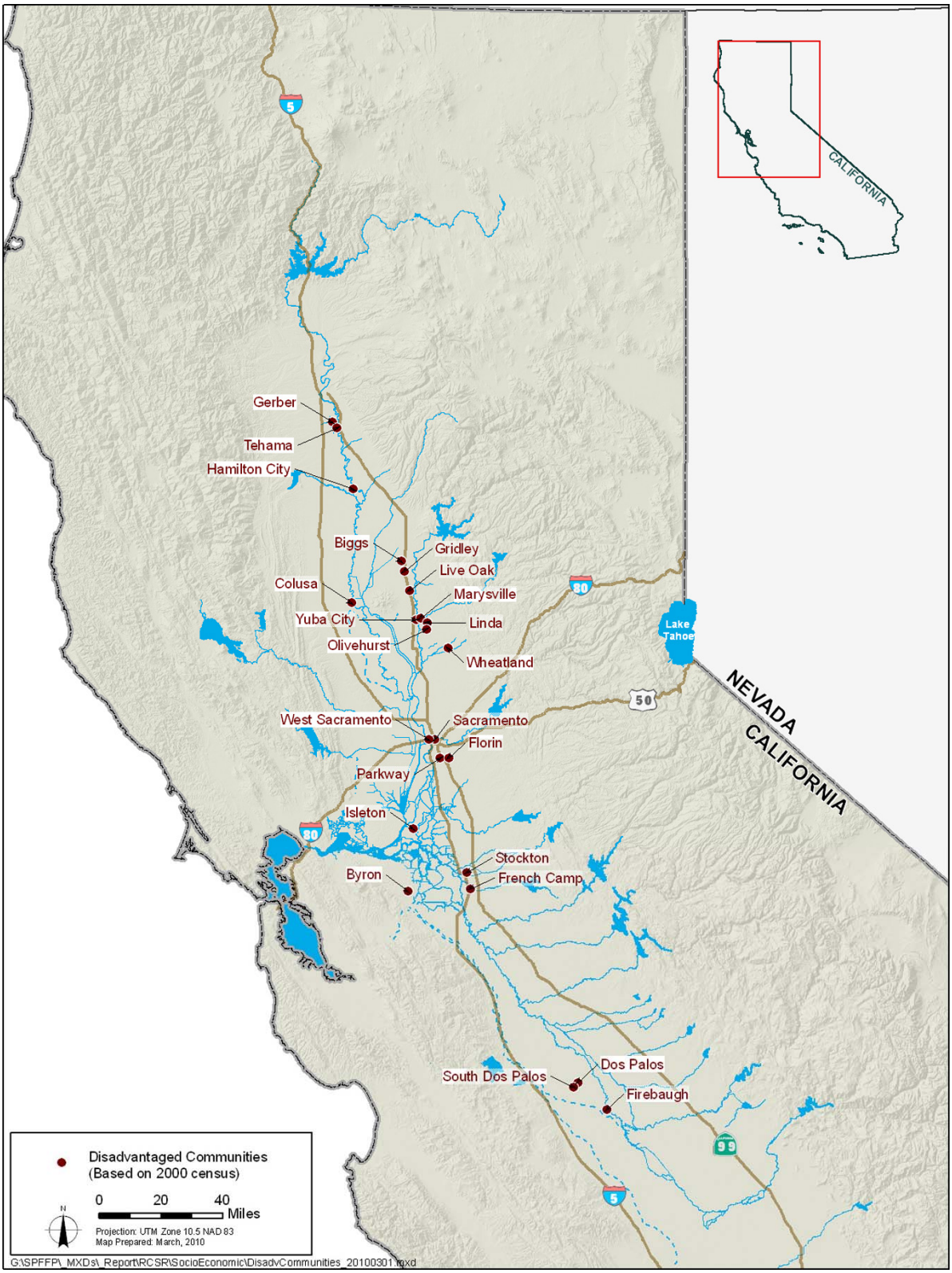


Figure 2-22. Disadvantaged Communities Within the Sacramento and San Joaquin River Basins

Farmworkers The vast majority of U.S. farmworkers have been Mexican immigrants and their children since the Bracero Program brought in more than 4 million laborers from Mexico from 1942 to 1964. Earlier decades saw substantial numbers of Chinese, Japanese, Filipinos, Native Americans, and African-Americans working on farms. By 1983, an estimated 90 percent of the seasonal farm laborers in California were Mexicans or Chicanos, while nationwide, the figure was 60 percent. Waves of farmworkers helped create the modern Delta through construction of hand-built levees and excavation and maintenance of irrigation ditches. Many of the Chinese, Japanese, Portuguese, and other groups of immigrants who first labored on the Delta farms stayed on as tenant farmers or landowners (DPC, 1995).

Subsistence Fishing Anglers from a broad range of ethnic groups in the Delta region fish both for recreation and for basic subsistence as a result of cultural practices or economic need. While the exact number of people relying on subsistence fishing is unknown, many Delta populations have close cultural ties to fishing, and/or are disadvantaged and depend on fishing to provide nutritious food for their families. Because they consume fish from the Delta as a regular part of their diets, members of these populations may bear a disproportionate health risk from mercury accumulation in Delta fish species.

Relationship Between Flood Management and Economic Development

In the Central Valley, much of the new development resulting from population growth is occurring in areas that are susceptible to flooding. In some cases, land-use decisions are based on poor or outdated information regarding the seriousness of the flood threat. For example, many flood maps used by public agencies and the general public are decades old and do not reflect the most accurate information regarding potential flooding. Even worse, many maps were made under the assumption that federal project levees provided protection from 100-year flood events. The national focus on the 100-year standard for levee accreditation by the National Flood Insurance Program (NFIP) has resulted in development that is clustered just outside the 1-percent floodplain boundary. This area is not free from flood risk and is possibly subject to considerable risk now that watersheds have been urbanized and runoff thereby increased.

Land use decisions at the local level that allow development in floodplains protected by the State-federal levee system in the Central Valley greatly increase the risk of State liability for loss of life and property damage. As the risks of levee failure and corresponding damage increase, California's courts have generally exposed public agencies, and the State specifically, to enormous financial liability for flood damages. The November 2003

Paterno vs. State of California decision found that when a public entity operates a flood management system built by someone else, it accepts liability as if it had planned and built the system. The Paterno ruling held the State responsible for defects in a Yuba County levee foundation that existed when the levee was constructed by local agricultural interests in the 1930s. The Paterno decision makes it possible that the State will ultimately be held responsible for the structural integrity of much of the Central Valley flood management system – 1,600 miles of levees that protect more than half a million people, 2 million acres of cultivated land, and approximately 200,000 structures with an estimated value of $47 billion (DWR, 2005c; Independent Review Panel to DWR, 2007).

Zoning ordinances regulating development in floodplains have been adopted by all counties within the last 30 years. Additionally, numerous cities restrict construction on floodplains via building codes. In 2008, portions of the CGC were amended, requiring local agencies, cities, and counties to amend various elements of their general plans to address flood-related matters (CGC Section 65302) and adopt zoning revisions consistent with the amended general plans (CGC Section 65860.1). The Central Valley Flood Management Board has adopted designated floodways on the Sacramento, Yuba, Feather, American, Cosumnes, Mokelumne, San Joaquin, Tuolumne, Merced, Chowchilla, Fresno, Kings, Kaweah, Tule, and Kern rivers; Stony, Clear, Cow, Cottonwood, Willow, and Dry creeks; and Ash, Berenda, and Porter sloughs (SWRCB, 2009).

2.1.5 Cultural Resources

The following discussion presents a broad overview of the cultural resource context for the CVFPP geographic area. For ease of discussion, descriptions of cultural resources are organized by regions. Historic and prehistoric contexts are linked to actual historic properties through the concept of property or resource types or, in the case of prehistoric resources, expected data types. Further, a discussion of Native American tribal territories and potential areas of concern to those tribes is provided. No specific locations of known cultural resources are included in this discussion. For purposes of definition, cultural resources are sites, buildings, structures, objects, and districts that may have traditional or cultural value for the historical significance they may possess or convey. Cultural resources include a broad range of resources, including archaeological materials, historic roadways and railroad tracks, and buildings of architectural significance. Generally, for a cultural resource to be considered a historical resource (i.e., eligible for listing in the California Register of Historical Resources) or an historical property (i.e., eligible for the National Register of Historic Places), it must be 50 years or older. However, properties under 50 years of age that are of exceptional importance or are contributors to a district can also be included on the National Register.

Overview

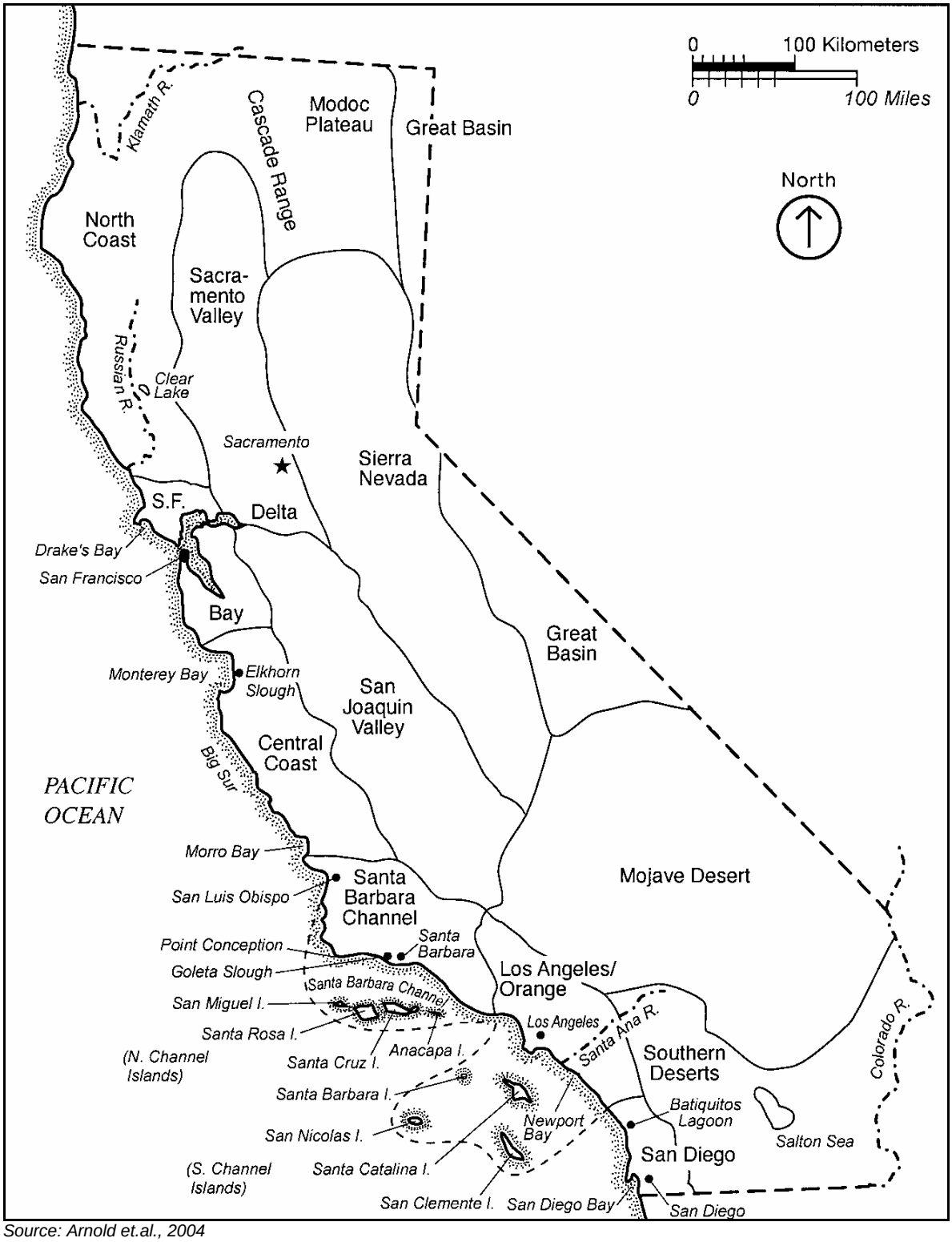
The cultural resources setting for Sacramento and San Joaquin river basins will vary largely because of differences in climate, vegetation, landform, and prehistoric/historical land use. Data is presented for six areas of California: the North Coast, Sacramento River Basin, San Joaquin River Basin, Delta, the western edge of the Sierra Nevada, and Modoc Plateau (see Figure 2-23). These areas are highly generalized in the discussion below and should not be interpreted as a comprehensive review of these archaeological regions. The Central Valley area (Sacramento and San Joaquin river basins) consists primarily of a broad alluvial plain, and before large-scale agriculture, presented a vast savanna environment with the sloughs and meandering tributaries of the Sacramento, American, and San Joaquin rivers. The Sierra Nevada geographic section includes the foothills of the Sierra Nevada, and the southwestern end of the Cascade Ranges, adjacent to the Central Valley, and portions of the western Sierra Nevada mountain range. The Modoc Plateau of northeast California is characterized as an undulating flatland desert averaging between 4,000 to 5,000 feet in elevation (Schoenherr, 1992).

The archaeological record for extends back thousands of years. The overall prehistoric pattern is one of early game hunters followed by more sedentary

hunters and gatherers, followed by groups who focused on collecting, and lived in large permanent and semipermanent villages. Historical resources are associated with activities that began with the arrival in California of the first Europeans in the 16th century, and extend from that time through the present day.

Predating human habitation, paleontological resources in the form of fossilized remains of organisms that lived in the region in the geologic past are also present in the soil and preserve an additional aspect of prehistory. These resources are also present.

The locations of known archaeological and historical sites are confidential to prevent scavenging of artifacts. Artifacts are considered nonrenewable resources. Detailed information on artifacts, especially their location, is considered proprietary by State law. Therefore, the following discussion only gives generalities of a topic that could span many volumes of information.



Source: Arnold et.al., 2004

Figure 2-23. Archaeological Regions of California

The Sacramento and San Joaquin river basins were occupied during both the prehistoric and proto-historic[15] periods; therefore, archaeological sites are widespread and numerous. Rock outcrops, river and stream drainages, and coastal strips were often prime locations for Native American village sites or processing camps. The Sacramento and San Joaquin river basins represent a wide diversity of land uses that now include highly urbanized locations, such as cities, to undeveloped areas of the high desert, Sierran foothills, and Sierra Nevada montane zones. Often, archaeological sites are covered by several meters of sediments, thereby protecting the remains even after an area has either been fully urbanized or has undergone landform alteration or evolution.

Cultural Context

Prehistoric Period by Archaeological Region

North Coast

The Sacramento River Basin includes a small section of the North Coast archaeological region, which includes Clear Lake and most of Napa County. Much of the prehistoric occupation of the Napa Valley was very similar to the cultural sequences of the lower Sacramento River Basin to the east (Heizer, 1953). Later patterns that exemplified Sacramento River Basin sequences and Bay Area regions were represented in the Napa Valley, but demonstrated a lack of similarity to the earliest Sacramento River Basin material culture called the Windmiller Pattern (4,750 to 3,750 before Christ (BC)). The artifactual remains of the Windmiller sites reflected a people well adapted to riverine and marshland environments with common mortar fragments and fishing implements (Ragir, 1972). However, those who inhabited the Napa Valley contemporaneously with the Windmiller peoples, referred to as the Bale Phase, appears to have been influenced by artifactual patterns seen in the Bay Area, often called the Berkeley Pattern (Moratto, 1984).

Subsistence-settlement system through 4,000 years of prehistory existed on the coast and were occupied during the historic period by Pomoans (north) and the Coast Miwok (south) (Dowdall, 2002). The southern people apparently moved into the area from San Francisco Bay at about 500 BC.

A few early sites were discovered in the upper Napa Valley, as well as near the drought-exposed shoreline of Lake Berryessa, approximately 15 miles north of the City of Napa, often called the Hultman Phase sites (dated at 6,000 to 3,000 BC) (Fredrickson, 1961; True et al., 1979). These sites contained crude and heavy core stone tools, milling stones, and manos, or

[15] Proto-historic is defined as the study of a culture just before the time of its earliest recorded history.

hand-sized grinding stones. The previously mentioned Bale Phase showed a greater emphasis on mortar and pestle, as well as spear and dart points. Similarities to the Berkeley Pattern of the Bay Area continued to evolve and demonstrate increasing complexity, both technologically and socially. This sequence ultimately led to the Augustine Pattern, also very similar to assemblages found in the Bay Area, with increasing emphasis on ornamentation, such as Olivella and Haliotis beads and bone tool forms. The introduction of the Augustine Pattern is posited to be an indication of the first Wappo entry into the area (Moratto, 1984).

Sacramento River Basin

The Sacramento River Basin and northern Sierra foothills supported a number of groups, including the Patwin, Maidu, Nomlaki, and Wintun. Diverse food resources included acorns and salmon. Winter villages could contain as many as several hundred persons, and the form of sociopolitical organization was the tribelet (Basgall and Hildebrandt, 1989). A dietary emphasis on storable seeds and nuts was reflected in considerable labor investments in bedrock mortars and granaries, found in large villages along with family dwellings, sweathouses, and a communal ceremonial structure. Extensive trans-Sierran trade networks moved material, people, and ideas over large territories and among tribelets (Moratto, 1984).

San Joaquin River Basin and Western Sierra Nevada

The Central California Taxonomic System has influenced many scholarly developments in the Sacramento Delta and San Joaquin and Sacramento river basins. Significant essays on the Central California Taxonomic System by James Bennyhoff and David Fredrickson (written over the last 30 years and revised into the 1990s) were recently published (Hughes, 1994). Most current projects in Central California, including the San Joaquin River Basin and western Sierra Nevada foothills, draw extensively on the findings of the vast New Melones Archaeological Project (Moratto, 2002; Moratto et al., 1988).

Details of these efforts are summarized in Moratto (1984:189, 191–193, 215, 573) and are briefly presented below. Intensive archaeological investigations within the northern San Joaquin River Basin were initiated during the 1960s (Olsen and Payen, 1968, 1969; Riddel and Olsen, 1969; Treganza, 1960). Artifacts recovered from four archaeological sites near the Delta are similar to materials associated with Phase 2 of the Late Horizon described by Bennyhoff and Heizer (1958), which has been dated to circa (ca.) Anno Domini (AD) 1500 (Wallace, 1978:463). Studies conducted along the eastern Diablo Mountain Range resulted in identification of a cultural sequence similar to, but distinct from, that identified for the Delta region. Excavations conducted for construction of several reservoirs, including Little Panoche Reservoir, revealed a series of

four cultural complexes focused on exploitation of the foothill valley biotic zone. This sequence indicates that prehistoric people occupied the valley for a period extending from ca. 3000 BC to AD 1850, with a 500-year hiatus between ca. AD 1000 and 1500. The earliest complex identified is the Positas Complex (ca. 3300 to 2600 BC), followed by the Pacheco Complex (ca. 2600 BC to AD 300), the Gonzaga Complex (ca. AD 300 to 1000), and the Panoche Complex (ca. AD 1500 to 1850) (Olsen and Payen, 1968).

It is difficult to clearly determine the ancestry of these early peoples. However, artifact assemblages associated with occupation ca. 1000 BC to AD 500 suggest that the inhabitants were possibly the ancestors of the ethnographic Yokuts (Moratto, 1984). The latest occupation, the Panoche Creek Complex (AD 1500 to 1850), is associated with the time period in which the ethnographic Yokuts inhabited the region.

Delta

The Delta Region has many parallels with the San Joaquin River Basin and San Francisco Bay regions. As mentioned above, a three-part cultural chronological sequence, the Central California Taxonomic System appeared to apply to the Delta Region as well in some respects.

Inhabitants of the Delta Region also appeared to exhibit examples of the Windmiller Pattern in the early phases of the terminal-Paleo-Indian Period to Lower Archaic (~6000 BC to ~3000 BC) (Beardsley, 1954; Heizer and Fenenga, 1939; Ragir, 1972). This cultural horizon reflected a people well adapted to riverine and marshland environments. Scholars have maintained that these Penutian speakers came from the Columbia Plateau or western Great Basin and settled in the bountiful Delta Region where they gave rise to many of the Bay Area cultures that survived up to historic times, such as the Costanoan, Miwok, Yokut, and Wintun (Fagan, 1995).

The Windmiller economy was diffuse in breadth, a common trait among peoples during this time, whereby the people would make use of a wide range of resources to reduce risk in times of resource shortfall, such as those caused by climatic instability (e.g., ocean temperatures and drought cycles) along the Pacific coast during the course of human occupation of California (10,000 years BC). The artifactual evidence of the Windmiller tradition suggests a wide range of specialized technology suited to the diffuse nature of their diet. These artifacts included large projectile points (spear or dart tips), baked-clay net sinkers, bone fish hooks, and spears. Mortars and milling slabs are predominant during this time period, as well as charmstones, and abalone shell and olive snail ornaments and beads (Beardsley, 1948; Heizer, 1949; Heizer and Fenenga, 1939; Ragir, 1972).

The subsequent Berkeley Pattern or Cosumnes culture (~2,000 BC to AD 300), comparable to the emerging Archaic Period in California prehistory (3000 BC to AD 1000), reflected a change in socioeconomic complexity and settlement patterns (Chartkoff and Chartkoff, 1984). Out of the Cosumnes Tradition came the Hotchkiss Tradition (or "Late Horizon") by the Emergent Period, or about 500 AD. The peoples of the Hotchkiss Tradition were likely flourishing in the Stockton and Delta Region up to contact with Europeans. The materials recovered related to the Hotchkiss Tradition – mortars and pestles, bone awls, bow and arrow – were in many ways similar to those identified at Buena Vista Lake – further indicating the trade relationships that were maintained between the Delta inhabitants and southern San Joaquin River Basin peoples.

Modoc Plateau and Cascade Range

Archaeologists use the Cascade Range to divide far Northern California into northeastern and northwestern areas. Mount Shasta and the Shasta Valley lie directly on this boundary. Archaeological overviews of northeastern California have tended to focus on the Modoc Plateau east of Mount Shasta and, as a result, the eastern slope of the Cascades (otherwise known as the western portion of northeastern California) has received less attention.

Archaeology in the western portion of northeastern California, from the northern margin of the Sacramento River Basin to the point where the Klamath River enters the state of Oregon, presents an even less well-articulated body of fact gathering. In part, this owes to the marginality of the area and the complexity of its external relations; chronology-building, for instance has had to rely on sequences developed for the North Coast Ranges, Central California, Columbia Plateau, and northern Great Basin (Raven in Moratto, 1984).

Archaeologist Luther Cressman established the first regional chronology for northeastern California in the years between the World Wars. Cressman identified several early archaeological sites later characterized as examples of the Western Pluvial Lakes Tradition, an archaeological assemblage 12,000 to 8,000 years old found throughout California, identified by Stephen Bedwell in the 1970s (Moratto, 1984). The oldest archaeological site in the region is located at Tule Lake in northeastern Siskiyou County and dates to 11450 BC (McGuire, 2007). The archaeological constituents at the Tule Lake site are consistent with sites of the Western Pluvial Lakes Tradition.

Archaeological sites from the Early and Middle Archaic periods are abundant on the Modoc Plateau and in the foothills near present day Shasta Lake. Beginning as early as 4500 BC, the Early Archaic in northeastern

California marks a transition toward an increasingly sedentary lifestyle. The trend toward sedentism continues through the Middle Archaic, beginning approximately 3700 years BC in northeastern California. Archaeological sites from this era contain numerous hearths, house structure remnants, midden deposits, and burials (McGuire, 2007).

Late period occupation of the Sacramento and San Joaquin river basins is represented by CA-SIS-13. This site contained many of the artifact types normally found at late period sites in Northern California, with the notable addition of mano and metate groundstone artifacts more commonly found in early period sites from the region. The presence of such groundstone implements at CA-SIS-13 differentiates the site from the late period Shasta Complex sites south of Mount Shasta along the McCloud River (Raven in Moratto, 1984).

Historic Period Prehistory ended, and historic cultural activities began in California, between the late 1500s and early 1900s. These cultural activities provide a record of Spanish, Mexican, and American rule, occupation and land use. An abbreviated history of this area is presented to provide a background of the presence, chronological significance, and historical relationship of cultural resources.

During the Spanish Period (1769 to 1822), European political powers created renewed interest in California. The Spanish government established a series of forts (presidios), missions, and towns along the Alta California coast. Throughout the Spanish Period, California remained largely unsettled. During the Mexican Period (1822 to 1848), the Catholic missions were secularized, and the Indians were left to fend for themselves. Many governments ruled or vied for power over California during this time. California was formally annexed to the United States by the Treaty of Guadalupe Hidalgo, ending the Mexican War and beginning the American Period. During the American Period (1848 to present), gold was discovered and droves of foreigners poured into California. San Francisco grew from a small settlement to a “boom” town, and roads, churches, schools, and other towns were built throughout California. A system of laws and a government were created, leading to the admission of California as a free state. Although California’s involvement in the American Civil War was minimal; construction of the railroad may have been the most important immediate effect of the Civil War on California. Easy access to rail lines made citrus growing and other large-scale agricultural pursuits an important element in the State economy.

Native American and Ethnographic Resources

The Sacramento and San Joaquin river basins as a whole represent a vast area that once was the home to at least 25 distinct Native American groups

(see Figure 2-24). As with all California Indians, these groups subsisted by hunting and gathering, with coastal groups relying to a significant degree on marine food resources such as fish, shellfish, and marine mammals as well as terrestrial resources for shelter and sustenance, while interior groups relied primarily on terrestrial resources for subsistence. These ethnographically defined groups, which are described below, were still occupying the project counties during the eighteenth and nineteenth centuries when European explorers and early ethnographers studied them. Included below are brief summaries and citations of ethnographies conducted on California native groups; this is not an exhaustive review of the current state of knowledge on Native California, nor does this narrative include all groups potentially affected by the CFVPP. Probably the two most comprehensive and oft-cited ethnographic works on California native groups are Alfred Kroeber's Handbook of the Indians of California (1925), and the Handbook of North American Indians (Johnson, 1978). Another useful resource is Five Views: An Ethnic Historic Site Survey for California (California Department of Parks and Recreation, 1988), which emphasizes the range of ethnicities (not only Native Americans) that have shaped California history.

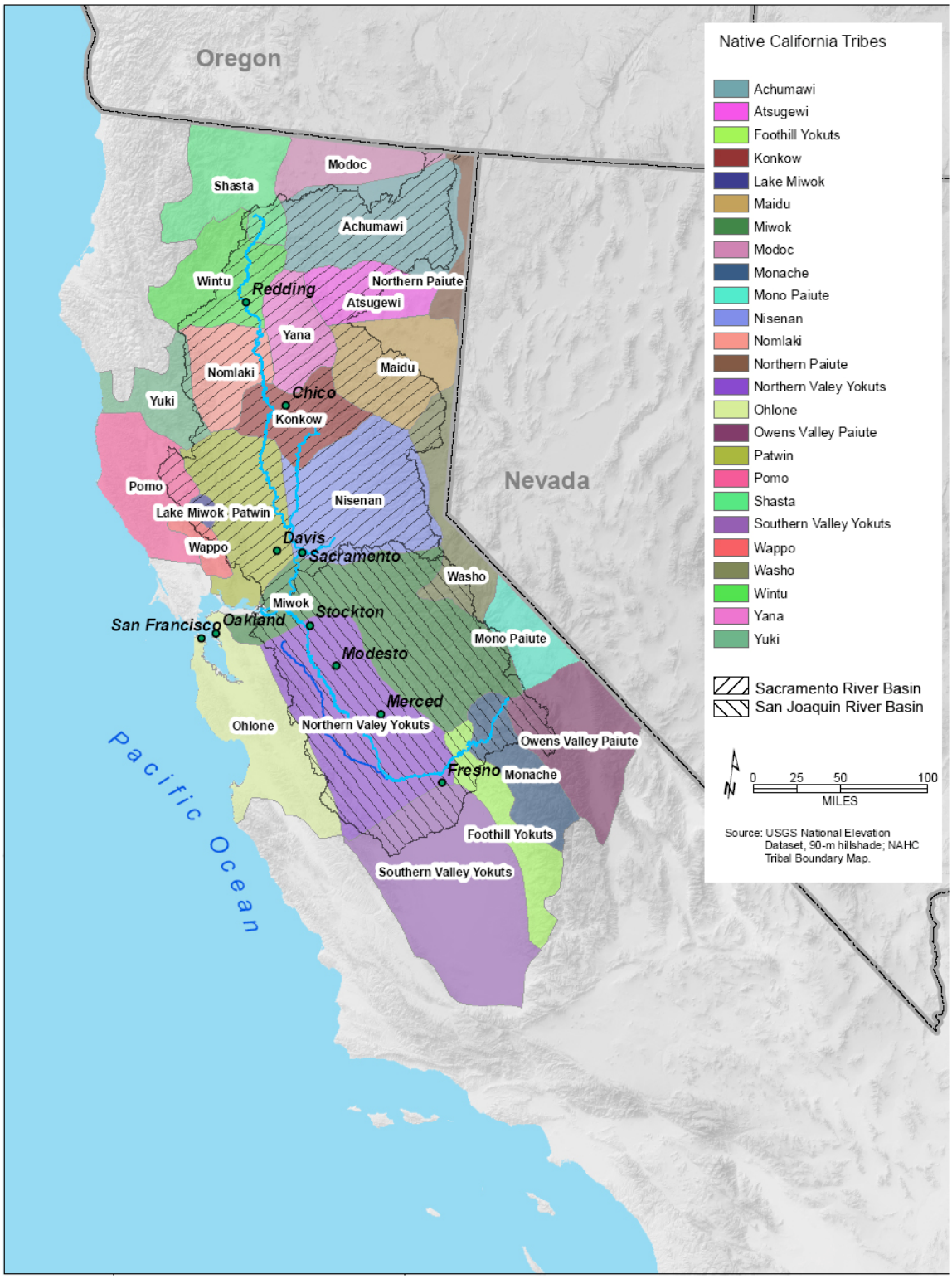


Figure 2-24. Native American Tribal Areas Within the Sacramento and San Joaquin River Basins

2.1.5

The territorial boundaries defined by early ethnographers for Native American groups have, however, fluctuated through time and are often ill-defined. Moreover, many tribal boundaries overlapped. The boundaries should not be considered fixed; they reflect general areas in which Native American groups resided. Most groups migrated within these general boundaries throughout the year, as discussed below. Consequently, the groups designated below to have inhabited the various county areas are those that appear to represent principal groups in those areas. They may not, however, represent every group that lived in the area.

The Coastanoan (Ohlone), a Penutian linguistic group, inhabited the San Francisco Bay area at the time of first European contact (ca. 1579). In Contra Costa County, in addition to the Ohlone, the Northern Valley Yokuts and Eastern Miwok inhabited portions of the county. Two Penutian derived groups the Nisinan (Southern Maidu) and the Eastern Miwok to the south, inhabited most of the Sacramento area before, and at the time, of first European contact. The Nisenan, together with other adjacent Maidu groups, and the Eastern Miwok form subgroups of the California Penutian linguistic family (Wilson and Towne, 1978; Levy, 1978:398-413; Kroeber, 1925:393). In Fresno County, three other Penutian groups, the Northern Valley Yokuts, Southern Valley Yokuts, and Foothill Yokuts inhabited the northern Central Valley and the eastern Sierra Nevada foothill area of the county (Kroeber, 1925; Wallace, 1978: 448-470; Spier, 1978:471-484).

By the time of first contact with Europeans, much of present day Napa Valley was occupied by the Wappo, but was bordered by the territory of the Patwin to the east, and the Coast Miwok to the southwest. Given the eastern Napa County location of the area, it was likely occupied by Patwin, who are also known as Southern Wintuan speakers. The Wintuan linguistic family was composed of three divisions: Northern Wintun, Central Wintun, and Southern Wintun. The Patwin, who lived in smaller groups, or tribelets, were divided among speakers of different dialects, including Kabalmem, Cache Creek, Cortina, Tebti, Colusa and Grimes, Knights Landing, and Suisun (Johnson, 1978).

The Patwin occupied the southern portion of the Sacramento River Basin west of the Sacramento River almost to the Napa River. Their territory extended from the town of Princeton in the north to Suisun Bay and Benicia in the south. Subsistence was based on hunting and fishing, as well as gathering of acorns, buckeye, pine nuts, sunflower seeds, clover, wild oats juniper berries, manzanita berries, blackberries, wild grapes, Brodiaea bulbs, and tule roots (Johnson, 1978).

The Patwin participated in the Kuksu cult, though they may have come into it later than many groups in California, as evidenced by variations that had

been created elsewhere (Bennyhoff, 1961). The cult included membership in secret societies, primarily for men, although higher status women were sometimes allowed to join. The ritualistic practices varied from village to village, but all included dances with spiritual beings. The Kuksu beliefs were supplanted or modified by the introduction of the Ghost Dance in the 1870s (Johnson, 1978).

North of the Sacramento River Basin are the Cascade Range and Modoc Plateau. Adaptations in this area consisted of tribelets centered around large lakes. The native peoples include the Shastans, northern Yana, Achomawi, and Atsugewi. The Shastans traded obsidian to the Yurok, Karuk, and Hupa for subsistence goods and shell beads (Raven, 1984).

During the historic period beginning in the mid-1700s, the natives of the project regions largely suffered at the hands of the Spanish missionaries and settlers (Chartkoff and Chartkoff, 1984). While no missions were established in the immediate Sacramento and Fresno areas, the local people were affected by missions built in San Francisco de Solano (present-day Sonoma), San Rafael, and San Jose. As the populations of coastal Indians were depleted, the Spaniards turned inland for new sources of converts and labor. The introduction of diseases for which the natives did not have immunity, coupled with the rapid changes in cultural patterns forced upon them by the Spaniards, led to the death and displacement of thousands of native people. This situation was true for the natives in all of California, both north and south, during the Spanish period. Likewise, during the Mexican period (ca. 1821), following the Mexican Revolution, land use by Europeans intensified and the natives continued to lose land and power as the Hispanics spread across each of the areas. This was the era of large cattle ranches and the consolidation of power by a relatively small number of Mexican families. Following the Mexican American War in 1848, California became first a territory of the United States and then a State. The discovery of gold in the Sierra foothills in 1848 led to an immense influx of Americans and other gold seekers. With as many as 10,000 men a month pouring into the territory, the Northern and Central California areas grew virtually overnight and became a major supply center for the nearby goldfields. The native people, already weakened by seven decades of Hispanic rule, were pushed into the foothills, forced into involuntary labor, and denied any land rights. While the immediate effects of the Gold Rush were less pronounced in the Southern California area, eventually, with California statehood and conflicts between State and federal control, the native people were further marginalized in all areas of the State.

Traditional Cultural Properties

In light of the diversity of Native American cultures, elements of the environment that are of traditional importance to Native Californians need also be considered when discussing cultural phenomena.

"Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. The traditional cultural significance of a historic property, then, is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices. Examples of properties possessing such significance include the following:

- Location associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world
- Rural community whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents
- Urban neighborhood that is the traditional home of a particular cultural group, and that reflects its beliefs and practices
- Location where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice
- Location where a community has traditionally carried out economic, artistic, or other cultural practices important in maintaining its historic identity

A traditional cultural property, then, can be defined generally as one that is eligible for inclusion on the National Register because of its association with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community (Parker and King, 1998).

Therefore, traditional cultural properties, and the beliefs and institutions that give them significance, should be systematically addressed in programs of preservation planning and in the historic preservation components of land-use plans, such as the CVFPP.

Expected Resource Types

To convey the diversity of potential resources that can be encountered, the following provides a brief list of site type categories expected based on the contexts discussed above. This list does not include the entire spectrum of possible resource types that can occur within a particular geographic area.

Prehistoric archaeological sites in California are places where Native Americans lived or carried out activities during the prehistoric period, before AD 1769. Prehistoric sites contain artifacts and subsistence remains, and may contain human burials. Artifacts are objects made by people and include tools (projectile points, scrapers, and grinding implements, for example), waste products from making flaked stone tools (debitage), and nonutilitarian artifacts (beads, ornaments, ceremonial items, and rock art). Subsistence remains include the nonedible portions of foods, such as animal bone and shell, and edible parts that were lost and not consumed, such as charred seeds.

Historical archaeological sites in California are places where human activities were carried out during the historic period, dating between AD 1769 and 50 years ago. Some of these sites may be the result of Native American activities during the historic period, but most are the result of Spanish, Mexican, or Anglo-American activities. Many historical archaeological sites are places where houses or other concentrated activity took place or formerly existed and contain deposits of ceramic, metal, and glass refuse resulting from the transport, preparation, and consumption of food. Such sites may also contain house foundations and other structural remnants, such as window pane glass, lumber, and nails. Historical archaeological sites may also include debris associated with nonresidential use such as ranching, farming, industry, and other activities. The lists below include, but are not limited to, the potential site types that would be likely encountered in the Sacramento and San Joaquin river basins.

Archaeological Resources

Prehistoric Period

- Burials
- Isolates
- Lithic scatters
- Habitation sites

Historic Period

- Trash scatters
- Building foundations
- Structural remains
- Mining structures

Multicomponent

- Trash scatters with lithics
- Historic habitation with prehistoric features/artifacts

Historic Resources or Built Environment Structures throughout the Sacramento and San Joaquin river basins from the historic period consist of houses, outbuildings, stores, offices, factories, barns, corrals, mines, dams, bridges, roads, canals, or other facilities that served residential, commercial, industrial, agricultural, transportation, or other use more than 50 years ago.

- Bridges
- Canals, levees, water systems
- Cemeteries
- Commemorative plaques
- Roads
- Railroad segments, features
- Railroad stations
- Structures

2.1.6 Institutional

Flood management in the Central Valley rests on a complex institutional landscape. Laws and regulations exist at multiple levels (local, State, and federal), and are administered and/or enforced by numerous public agencies and organizations with varying jurisdictions and responsibilities. This section is organized into four parts describing pertinent laws and regulations, governance structures and responsibilities, funding, and coordination.

Laws and Regulations

This section describes local, regional, State, and federal laws and regulations governing flood management.

Federal This section describes federal authorization for planning, designing, and constructing flood management facilities, and federal laws related to floodplains and flood insurance. Key federal legislation affecting the Central Valley is summarized in Table 2-20.

Regulatory oversight and permitting for flood management projects and maintenance is conducted by USACE (Clean Water Act Section 404 permit) and USFWS.

Beginning in 1974, flood control projects were included in WRDA as federal legislation designated to address problems associated with various aspects of water resources, in addition to flood control. WRDA legislation passed that applies to flood control in the Sacramento and San Joaquin river basins includes the following:

- **Water Resources Development Act of 1986** – Federal legislation that directed the Secretary of the Army to issue guidelines for crediting against the nonfederal share of project costs for flood control any compatible work carried out by local interests. WRDA of 1986 prohibited the federal government from initiating any feasibility study for a water resources project until nonfederal interests agree to cover 50 percent of the costs during the period of study, but exempted from such prohibition any study designed for purposes of navigational improvements. It also prohibited the federal government from initiating any planning or engineering authorized by the act until nonfederal interests agree to contribute 50 percent of the costs during the period of planning and engineering. Nonfederal interests were required to cover at least 25 percent of flood control project construction costs, and 100 percent of maintenance costs.

- **Water Resources Development Act of 1990** – Federal legislation that amended WRDA of 1986 to treat the cost of planning and engineering project components as construction of projects for which nonfederal interests contributed 50 percent or more of the cost of the feasibility study.

- **Water Resources Development Act of 1996** – In 1996, federal legislation that amended the WRDA of 1986 to require nonfederal interests to cover at least 35 percent of flood control project construction costs.

- **Water Resources Development Act of 1999** – Federal legislation that amended the Flood Control Act of 1936 to authorize funds contributed by states and other political subdivisions for environmental restoration (not just flood control) work.

- **Water Resources Development Act of 2000** – Federal legislation that continued project authorization for flood control along the Sacramento River. The act authorized federal participation in planning and management associated with the CALFED, an ecosystem restoration program for the Sacramento and San Joaquin river basins and Delta.

- **Water Resources Development Act of 2007** – Federal legislation that allowed federal funds to be contributed toward the nonfederal cost-share for planning and design work on the Sacramento Deep Water Ship Channel. The act authorized planning, design, and construction of an auxiliary spillway on Folsom Dam. The act also authorized design and construction of the Middle Creek Flood Damage Reduction and Ecosystem Restoration Project. In addition, the act authorized a feasibility study for the beneficial use of dredged material from San Francisco Bay in the Delta, including benefits and impacts on salinity in the Delta and benefits to navigation, flood damage reduction, ecosystem restoration, water quality, salinity control, water supply reliability, and recreation.

State Flood management laws and regulations at the State level are established in various sections of the CWC, PRC, and CGC. Key State legislation affecting the Central Valley is summarized in Table 2-21.

Regulatory oversight for flood management construction projects and maintenance is provided by various state agencies, including DFG (Lake and Streambed Alteration Program, DFG Code Section 1602) and SWRCB (Clean Water Act Section 401 permit).

Table 2-20. Flood-Related Legislation Summary

Legislation	Year	Effect on SPFC
Arkansas Act	1850	Allows agriculture and development on overflow and swamp lands
Rivers and Harbors Act	1880	Directs USACE to oversee hydraulic mining debris removal in streams
Reclamation Act	1902	Creates the Reclamation Service, which later becomes U.S. Department of Interior, Bureau of Reclamation
Flood Control Act	1917	Authorizes Sacramento River Flood Control Project
Flood Control Act	1928	Amends and continues authorization for Sacramento River Flood Control Project
Central Valley Project Act	1933	Authorizes the CVP
Fish and Wildlife Coordination Act	1934	Requires federal agencies to consult with USFWS and DFG before undertaking projects that control or modify surface water
Flood Control Act	1936	Declares flooding a matter of national welfare; authorizes levee improvements where benefits exceed costs
Flood Control Act	1941	Amends and continues authorization for Sacramento River Flood Control Project
Flood Control Act	1944	Formally assigns flood control and navigation duties to USACE; authorizes Sacramento River Major and Minor Tributaries Project and Lower San Joaquin River and Tributaries Project
American River Act	1949	Authorizes construction of American River Division of CVP, converting Folsom Dam from a single-purpose flood management reservoir into a larger, multipurpose reservoir
American River Basin Development Act	1949	Modifies authorization in American River Act
Flood Control Act	1950	Continues authorization for the Sacramento River Major and Minor Tributaries Project
Flood Control Act	1954	Authorizes north bank American River levee
Emergency Flood Control Funds Act (Public Law 84-99)	1955	Authorizes flood control facilities on the San Joaquin River above the Merced River and repairs to levees throughout the Central Valley that had been damaged in the 1955 flood. Under this authority, USACE assists in flood fights during an emergency, and repairs damages to qualified flood management facilities after the emergency ends.
Flood Control Act	1958	Authorizes the Chico Landing to Red Bluff Bank Protection Project on the Sacramento River

Table 2-20. Flood-Related Legislation Summary (Contd.)

Legislation	Year	Effect on SPFC
Flood Control Act	1960	Authorizes the Sacramento River Bank Protection Project
Flood Control Act	1962	Authorizes responsibilities for O&M below Goodwin Dam on the Stanislaus River
Master Plan for Flood Control in Butte Basin	1964	Action taken at the Reclamation Board meeting of June 4, 1964
National Historic Preservation Act	1966	Requires federal agencies to take into account the effects of federal undertakings on historical and archaeological resources
Wild and Scenic River Act	1968	Preserves and protects wild and scenic rivers and immediate environments for the benefit of present and future generations
National Environmental Policy Act	1969	Requires federal agencies to integrate environmental values into decision-making process and consider alternatives
Endangered Species Act	1973	Provides for conservation and protection of threatened and endangered species and their habitat
Clean Water Act	1976	Controls placing of fill in waters of the United States
Farmland Protection Policy Act	1981	Requires a federal agency to consider the effects of its action and programs on the nation's farmlands
Water Resources Development Act	1986	Directs the Secretary of the Army to issue guidelines for crediting against the nonfederal share of project costs for flood control any compatible work carried out by local interests
Water Resources Development Act	1990	Amends WRDA of 1986; treats the cost of planning and engineering project components as construction of projects for which nonfederal interests contributed 50 percent or more of the cost of the feasibility study; environmental protection added as a primary USACE mission
Water Resources Development Act	1996	Amends WRDA of 1986; requires nonfederal interests to cover at least 35 percent of flood control project construction costs
Water Resources Development Act	1999	Amends the Flood Control Act of 1936; authorizes funds contributed by states and other political subdivisions for environmental restoration (not just flood control) work
Water Resources Development Act	2000	Continues project authorization for flood control along the Sacramento River, specifically the CALFED Bay-Delta Program

Table 2-20. Flood-Related Legislation Summary (Contd.)

Legislation	Year	Effect on SPFC
Water Resources Development Act	2007	Allows federal funds to be contributed for planning and design work on the Sacramento Deep Water Ship Channel, auxiliary spillway at Folsom Dam, the beneficial use of dredged material from San Francisco Bay in the Delta, and the Hamilton City setback levee project

Key:
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DFG = California Department of Fish and Game
O&M = operations and maintenance
SPFC = State Plan of Flood Control
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service
WRDA = Water Resources Development Act

Table 2-21. State Flood-Related Legislation Summary

Legislation	Year	Effect on SPFC
Reclamation District Act	1855	Allows for sale of overflow and swamp lands
Green Act	1878	Enables county boards to authorize Reclamation Districts with no limit on purchase acreage
Drainage Act	1880	Allows state to control all drainage ways in California
Caminetti Act	1893	Creates California Debris Commission
SB 1324	1955	Provides that the "Board, with the approval of the Department of Finance, may execute in connection with any flood control project a substitute plan which includes provision for the state to construct works of the project when in lieu of acquiring all or any portion of the lands, easements, or rights-of-way in connection therewith, a saving to the State will result"
Burns-Porter Act	1960	Authorizes construction of the SWP
California Environmental Quality Act	1969	Requires State agencies to integrate environmental concerns into decision-making process and mitigate for these effects
California Wild and Scenic Rivers Act	1972	Preserves and protects wild and scenic rivers and immediate environments for the benefit of present and future generations
California Endangered Species Act	1984	Parallels provisions of the federal ESA; administered by DFG
Delta Protection Act	1992	Improves flood protection by structural and nonstructural means for an increased level of public health and safety
Fish and Game Code, Sections 1601 and 1603	Rev. 1998	Requires that any (State) governmental entity or private party altering a river, stream, lakebed, bottom, or channel enter into an agreement with DFG
Propositions 1E and 84	2006	Provides nearly $5 billion in funding for flood management projects in the Central Valley
SB 5 Flood Management	2007	Requires DWR to prepare the Central Valley Flood Protection Plan for the Sacramento and San Joaquin river basins. Requires local governments to revise general plans to address flood risks, collaborate with local flood agencies to identify parcels that may be protected by a flood protection plan or other flood management facilities, develop funding mechanisms to finance local flood responsibilities, and provide public notice of specific areas that may be protected by a flood control facility or that are located in a flood hazard area. This bill was contingent on enactment of AB 162 and SB 17.

Table 2-21. State Flood-Related Legislation Summary (Contd.)

Legislation	Year	Effect on SPFC
SB 17 Flood Protection	2007	Changes various provisions of law regarding The Reclamation Board and its operations, renaming it the Central Valley Flood Protection Board (Board), increasing Board's membership and placing new requirements on Board regarding its prescribed duties
AB 5 Flood Protection: Local Plans	2007	Makes changes to provisions of law being added to or amended by SB 5 relating to flood protection, SB 17 relating to Board and AB 156 relating to flood control
AB 70 Flood Liability	2007	Provides that after January 1, 2008, a city or county may be responsible for its reasonable share of property damage caused by a flood, if that the city or county has increased the State's exposure to liability for property damage by approving new development
AB 156 Flood Control	2007	Makes changes to DWR's flood management activities, including mapping of areas at risk of flooding, preparation of a flood control system status report on the SPFC, notification of property owners at risk of flooding, environmental enhancement activities, and maintenance area formation
AB 162 Land Use: Water Supply	2007	Requires that a city or county's general plan identify areas subject to flooding; that the conservation element of general plans identify rivers, flood corridors, and other land that may accommodate floodwater; and would require cities and counties to establish policies to minimize flood risk for new development

Key:
AB = Assembly Bill
Board = Central Valley Flood Protection Board
DFG = California Department of Fish and Game
DWR = California Department of Water Resources
ESA = Endangered Species Act
SB = Senate Bill
SPFC = State Plan of Flood Control
SWP = State Water Project

Local and Regional This section describes the types of local/regional laws and regulations that affect flood management in the Central Valley. Evaluating the level of compliance with locally adopted plans can be complicated because of the following: (1) intentionally broad and unspecific goals articulated in local general plans, (2) potential of a federal or State project to influence the location, density, and rate of development in ways that differ from existing local plans and policies, and (3) currency of local plans.

Regulatory oversight and permitting for flood management projects and maintenance also occurs at the local and regional level (e.g., grading and encroachment permits) and varies by jurisdiction.

Governance Structures and Responsibilities

O&M responsibilities for California's flood management systems are shared among multiple federal, State, and local entities. This section describes agencies and governance structures with responsibilities or directives related to flood management.

Federal

U.S. Army Corps of Engineers

USACE has nationwide responsibility for flood management. In California, flood management on the Sacramento River Basin, the San Joaquin River Basin, and other rivers is a combination of USACE, Reclamation, State, and private projects, all operated under USACE Water Control Plans. Traditionally, Congress authorizes and appropriates funds for specific USACE flood protection projects using a WRDA (an authorizing law that passes every 2 to 5 years), and appropriates funds through an "Energy and Water Development Act" (annually). Any substantial change to those projects requires an updated or new Congressional authorization.

USACE roles and responsibilities are described below:

- **Regulatory** – USACE has permitting authority over activities affecting waters of the United States. Waters of the United States include surface waters such as navigable waters and their tributaries, all interstate waters and their tributaries, natural lakes, all wetlands adjacent to other waters, and all impoundments of these waters. Two federal statutes mandate USACE jurisdiction over navigable waterways and adjacent wetlands: Section 10 of the Rivers and Harbors Act of 1899, and Section 404 of the Clean Water Act. Section 10 of the Rivers and Harbors Act applies to all navigable waters of the United States, and Section 404 of the Clean Water Act applies to all waters, including wetlands that have sufficient nexus to interstate commerce (USACE, 2009). The term "sufficient nexus" means an impact to water that is currently used, or was used in the past, or maybe susceptible to use in interstate or foreign commerce, including all water subject to the ebb and flow of the tide.

- **Water Management** – USACE monitors the status of all projects for which it has issued a Water Control Plan to regulate seasonally reserved flood storage purchased by USACE.

- **Public Law 84-99 Authority** – USACE has emergency authority under Public Law 84-99, enacted in June 1955, to fight any flood to protect life and property and to rehabilitate federal flood management facilities that are maintained by State and local entities. Under this authority,

USACE assists in flood fights during an emergency, and repairs damages to qualified flood management facilities after the emergency ends. Emergency response under Public Law 84-99 is extended at the request of the Governor, who must determine and certify that local forces cannot meet the emergency physically or financially, and that State assistance is not available. USACE response can include providing technical assistance, supplying materials otherwise unobtainable, or actual flood fighting using heavy construction equipment. After the Central Valley's 1997 flood, USACE Sacramento District categorized levee rehabilitation into three phases (I, II, and III) to distinguish between various levels of repair.

- **Section 408 Authority** – USACE has approval authority over modifications to federally authorized flood control facilities. Before modifying any component of the federal flood control system, the local sponsor (namely, the Board) must seek authorization and Section 408 approval from the USACE Chief Engineer in Washington, D.C.

- **Section 104 Credits** – If local sponsors, such as Board and/or local flood control entities, desire to obtain federal cost-sharing credit(s) for modifications and/or additions to federally authorized flood control system, they must secure Section 104 credit approval from USACE. USACE has approval authority over modifications to federally authorized flood control facilities.

  - Emergency Flood fight (Phase I) – Emergency flood fight assistance can be extended when USACE determines that there is an immediate danger to life or property. Assistance may be extended as long as there is immediate danger, but must end when the situation stabilizes, even if facilities remain in disrepair. Local agencies are responsible for providing real estate access and cleaning up debris afterwards.

  - Initial Recovery (Phase II) – In Phase II, repairs may include closing breached levees or repairing damaged facilities to provide an interim level of flood protection for the remainder of a storm season.

  - Final Restoration (Phase III) – Phase III repairs are performed after the storm season and would restore damaged facilities to preflood levels of protection.

Federal Emergency Management Agency

FEMA, part of the U.S. Department of Homeland Security, is responsible for coordinating the federal response to floods, earthquakes, hurricanes,

and other natural or man-made disasters and providing disaster assistance to states, communities and individuals. Floodplain management at the national level is administered through FEMA's NFIP. The NFIP has three major components: flood insurance, floodplain mapping, and floodplain management.

- **Flood Insurance** – The NFIP enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. Community participation is voluntary. Federal agencies and federally insured or regulated lenders require flood insurance on all grants and loans for acquisition or construction of buildings in designated Special Flood Hazard Areas (SFHA) in communities that participate in the NFIP. This requirement is referred to as the Mandatory Flood Insurance Purchase Requirement. SFHAs are land within the floodplain of a community subject to a 1-percent or greater chance of flooding in any given year, commonly referred to as a 100-year flood. The NFIP has also established building standards to reduce damages when floods occur.

- **Floodplain Mapping** – Mapping of floodplains and floodways is an important reference used by both the flood insurance and floodplain management arms of the NFIP. Communities have a FEMA map that, at the least, delineates the boundary of the 1-percent-annual-chance flood (also referred to as the 100-year or base flood). Where detailed studies have been completed, these maps also identify water surface elevations of the base flood. FEMA recognizes only a levee system or floodwall system that meets, and continues to meet, minimum design standards that provide protection from the 1-percent-annual-chance flood. Specifically, the criteria established in 44 Code of Federal Regulations (CFR) Section 65.10 must be satisfied before a levee may be credited and mapped as providing protection from a base flood event.

- **Floodplain Management** – FEMA works closely with states and communities and provides financial and technical assistance, flood hazard maps, and other data to better manage floodplains. FEMA has no direct involvement in administering of local floodplain management ordinances. Since the federal government does not have land use authority, the NFIP is based on the federal government's power to spend under the Constitution rather than any federal authority to regulate land use. Under the NFIP, participating communities must adopt and enforce a floodplain management ordinance that meets or exceeds minimum NFIP requirements established under 44 CFR Section 59.24(a) and (d).

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) provides technical and financial assistance to communities for restoring watersheds impaired by natural disasters. Through the Emergency Watershed Protection program, NRCS helps safeguard people and property after natural disasters, such as floods, fires, windstorms, earthquakes, and drought. NRCS helps repair overtopped levees, dikes, and other flood-retarding structures. To prevent future flooding, NRCS provides assistance to help clear watercourses clogged by sediment and debris. The 1996 Farm Bill gave USDA the authority to purchase floodplain easements as an emergency measure when the long-term economic, social, and environmental benefits of purchasing the easement are greater than repeated repairs to the same land. Where willing sellers are available, land retirement provides a more permanent solution from damages associated with flooding or products of erosion, giving a landowner fair value for the land and providing an opportunity to enhance the environmental functions of the riparian corridor. In many cases, agricultural production is still possible on an easement, leaving residual value such as the ability to plant crops when the land is not flooded.

National Weather Service

The National Weather Service (NWS), part of the National Oceanic and Atmospheric Administration (NOAA), provides weather, hydrologic, and climate forecasts and warnings for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure that can be used by governmental agencies and the public. With respect to flood management, NWS operates NWS Forecast Offices and River Forecast Centers (RFC) across the nation to forecast high water events and assist in the operation of flood management systems. In California, NWS operates six forecast offices, including the California Nevada RFC in Sacramento. California Nevada RFC network consists of more than 1,200 rain gages, 600 air temperature sensors, 500 river gages, and 120 gages that measure reservoir elevation. The California Nevada RFC provides quantitative precipitation forecasts and uses the NWS River Forecasting System, a collection of hydrologic models and data, to simulate and project river flows and stages in its area of responsibility. NWS works with USACE, DWR, Reclamation, and local flood operators to support real-time flood operations (NWS, 2009).

Other Federal Agencies

Reclamation operates several multipurpose projects throughout the Central Valley. These multipurpose reservoirs include flood protection space, which Reclamation operates under USACE direction. Reclamation's flood

hydrologists also assist in interpreting flood-related data, and Reclamation participates in joint studies for reservoir operation and optimization.

USGS, in cooperation with DWR, has responsibility to collect surface water data; this information forms the essential database used to develop flood hydrology, which in turn is used to define floodplains shown on Flood Insurance Rate Maps.

The National Park Service, along with NRCS, is active in watershed planning approaches that include flood management.

State State agencies with direct responsibilities related to flood management in the Central Valley are described below.

Central Valley Flood Protection Board
The Board (formerly known as The Reclamation Board) was established by the Legislature in 1911, originally as The Reclamation Board, to oversee the construction of flood protection levees and help Californians reclaim lands of the Central Valley, primarily for agriculture. The Board's mission is to oversee flood control along the Sacramento and San Joaquin rivers and their tributaries in cooperation with USACE. The Board works with various agencies of the federal, State, and local governments in establishing, planning, constructing, and O&M for flood control works. In addition, the Board raises public awareness of flood management issues, and establishes policy for input and oversight on capital outlay, and operational and maintenance area budgets. The Board helps maintain the integrity of the existing flood control system and designated floodways through its regulatory authority by issuing permits for encroachments.

The Board has the legal responsibility for oversight of the entire Central Valley flood management system. Its jurisdiction extends through 14 counties, and comprises 1.7 million acres in the most flood-prone portions of the Sacramento and San Joaquin rivers. The Board has authority within its jurisdiction to do the following:

- Cooperate with USACE in building and operating SPFC facilities
- Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction of a project under the adopted plan of flood control
- Hold and save the United States free from damage due to construction works

- Provide O&M for all works after completion in accordance with regulations prescribed by the Secretary of Defense
- Approve or deny plans for reclamation of flood control, drainage, improvement, dredging, or work that includes or contemplates the construction, enlargement, revetment, or alteration of any levee, embankment, canal, or other excavation in the bed of or along or near the banks of the Sacramento or San Joaquin rivers or any of their tributaries (involving excavation near rivers)
- Provide oversight of flood management facility O&M
- Designate and administer floodways throughout the Sacramento River and San Joaquin river basins
- Acquire property necessary for flood management
- Construct, clear, and maintain bypasses, levees, canals, sumps, overflow channels and basins, reservoirs, and other flood control works
- Construct, maintain, and operate ditches, canals, pumping plants, and other drainage works
- Collaborate with State and federal agencies, if appropriate, regarding multiobjective flood management strategies that incorporate agricultural conservation, ecosystem protection and restoration, or recreational components
- May maintain actions in the name of people of the State to restrain, or to recover damages for, any act that may be injurious to any of the works necessary to the plan of flood control, or that may interfere with successful execution of the plan
- Establish a standard for levee construction
- Maintain any actions in the name of the people of the State to restrain the diversion of the water of any stream that will increase the flow of water in the Sacramento or San Joaquin rivers or their tributaries
- Rent, lease for oil, gas, or other hydrocarbons, or dispose by sale, exchange, or in payment for work done or services rendered, of any land, property, material, equipment, or any other thing in the possession of a drainage district, which, in the opinion of the Board, is no longer needed for the purposes of flood control works or other necessary or convenient purposes

- Regulate encroachments on the flood management system
- Cooperate, as authorized, with other State agencies, cities, counties, and districts within the Sacramento and San Joaquin rivers and their tributaries, and furnish money, services, equipment, and property
- Establish and enforce standards for O&M of flood management works along the Sacramento River, the San Joaquin River, their tributaries, and related areas
- Hear and adjudicate complaints on flood control matters
- Establish and enforce standards for the O&M of flood management works along the Sacramento River, the San Joaquin River, their tributaries, and related areas

The Board has regulatory authority over projects carried out along or near the Sacramento and San Joaquin rivers and their tributaries, as listed in Table 8.1 in Title 23 of the CCR. A Board permit is required for any project or plan that meets one or more of the following criteria:

- Is within federal flood control project levees and within a Board easement
- May have an effect on the flood control functions of project levees
- Is within a Board-designated floodway
- Is within regulated Central Valley streams listed in Table 8.1 of Title 23 of the CCR

Activities or projects that may require a Board permit include boat docks, ramps, bridges, sand and gravel mining, placement of fill, fences, landscaping, utility crossings, and irrigation facilities.

Under Section 8609 of the CWC, the Board has the authority to designate floodways in the Central Valley. “Designated Floodway” refers to a channel of a stream and that portion of the adjoining floodplain reasonably required for passing a design flood; it is also the floodway between existing levees, as adopted by the Board or the Legislature. The Board administers the Designated Floodway Program, a nonstructural flood management approach intended to promote the safe passage of flood flows through flood-prone areas.

Board has provided assurances to USACE for O&M of various flood control projects in the Central Valley. In turn, the Board assigns O&M responsibilities for these facilities to various local districts, including RDs, LDs, and others (Board, 2009a).

Other Board roles and responsibilities include the following:

- The Board participates with USACE under Public Law 84-99 to restore or repair flood-damaged facilities after a flood. Under this program, the Board provides all lands, easements, rights-of-way, and relocations for USACE projects.

- The Board disburses funds for maintenance and rehabilitation of Delta levees maintained by local agencies under the Delta Levees Subvention Program.

- The Board is responsible for holding public hearings and adopting the CVFPP by July 2012. The 200-year flood maps will be developed by DWR according to requirements of the CVFPP.

- The Board is responsible for reviewing and commenting on local flood emergency management plans and updates to general plans for consistency with the CVFPP. The Board is authorized to address the uses of land in areas subject to unreasonable flood risks, and recommend strategies for reducing those flood risks.

Department of Water Resources
DWR is the primary State agency responsible for flood management planning, construction, operation, and maintenance. DWR works with the Board and provides staff and technical services to carry out many Board responsibilities. DWR operates the SWP (which includes multipurpose reservoirs); assists NWS in flood forecasting; and is responsible for regulating dams, providing flood protection, and assisting in emergency management. DWR also engages in planning activities related to flood management and flood risk reduction, watershed management, and integrated regional water management.

California State law authorizes DWR to either act independently or to cooperate with federal agencies or others in collecting data for river forecasting, making forecasts of streamflow, providing for flood warning, and providing communications for collection and dissemination of such information. To support its forecasting function, DWR collects year-round hydrologic data through a network of State weather sensors and surveys, providing information dissemination through the California Data Exchange

Center (CDEC). CDEC provides flood forecasts for all major tributaries influencing the Central Valley.

DWR has the responsibility for structural integrity and hydraulic capacity of existing flood protection facilities in the Central Valley, in cooperation with local maintaining agencies and in coordination with the Board, which shares some responsibilities with DWR in the Central Valley. DWR inspects and evaluates maintenance of all State-federal portions of the flood management system in the Central Valley.

DWR also has the responsibility for hydraulic capacity, and has supervisorial powers over the O&M of the SRFCP, in cooperation with local maintaining agencies and in coordination with the Board. The Board has supervisory powers over maintenance of the flood management facilities on the San Joaquin River Basin, in cooperation with local maintaining agencies. Most project levees are maintained by local agencies; however, DWR performs levee maintenance where levees provide broad system benefits and local interests are unable to perform satisfactory maintenance. DWR also maintains some of the Sacramento River system channels, while local agencies maintain the San Joaquin River system channels. When local maintaining agencies are unable to operate or maintain project levees to acceptable standards, DWR is authorized to form maintenance areas and take responsibility for the levees when in the best interest of the State (CWC Section 12878.21).

The CWC entrusts the regulatory Dam Safety Program to DWR. DWR is responsible for reviewing and approving applications, plans, and specifications for dam construction or alteration. DWR conducts inspections of dams, reviews performance of existing dams, and identifies illegal dams for removal or supervises remedial work to bring such dams into compliance.

The principal goal of emergency management assistance is to fulfill the emergency response functions of DWR established in the California State Emergency Plan and the CWC, including provision of technical and physical assistance to FEMA, the California Emergency Management Agency (CalEMA), and other agencies that make State and federal resources available to local communities. DWR inspects State jurisdictional dams, SWP facilities, Delta levees, and federal project levees for damage due to natural disasters. DWR continues essential services and directs all other resources, as necessary and appropriate, to accomplish specific objectives in the State Emergency Plan. DWR investigates and reports disaster conditions, provides technical assistance for damage assessment, and helps to develop hazard mitigation plans.

CWC Section 128(a) authorizes DWR in times of storms or floods to take any remedial measures necessary to avert, alleviate, repair, or restore damage or destruction to property having a general public or State interest. This includes active flood fighting and flood fight assistance and advice to local maintaining agencies.

DWR provides assistance to community officials in preparing floodplain management plans and evaluating impacts of proposed development in flood-prone areas. DWR discourages unwise development in areas subject to flooding and promotes flood proofing of existing and proposed structures in floodplains where development is already under way.

Beginning in 2010, DWR is responsible for sending annual notices to owners of property that is either completely or partially within levee flood protection zones. These notices are intended to educate property owners about potential flood risks and available resources, such as flood insurance.

Beginning in 2012, and every 5 years thereafter, DWR is responsible for preparing and updating the CVFPP, in cooperation with the Board, USACE, and local agencies.

California Emergency Management Agency
The mission of CalEMA is to ensure that the State is ready and able to mitigate against, prepare for, respond to, and recover from the effects of emergencies that threaten lives, property, and the environment. CalEMA may allocate funds for investigation, estimates, reports, and repairs regarding disaster recovery, and financial assistance for flood management works that do not come under the provisions of another authority.

CalEMA maintains the State Emergency Plan, which outlines the organizational structure for State management of the response to natural and man-made disasters. CalEMA also assists local governments and other State agencies in developing their own emergency preparedness and response plans, in accordance with the Standardized Emergency Management System and State Emergency Plan, for floods, earthquakes, fires, and other disasters. CalEMA coordinates the disaster response efforts of State and local agencies, and coordinates the integration of federal resources into State and local response and recovery operations, consistent with the Standardized Emergency Management System (SEMS).

CalEMA led the effort to complete the 2007 Enhanced State of California Multi-Hazard Mitigation Plan (SHMP), which includes a flood component. The SHMP is the official statement of the State's hazard identification, vulnerability analysis, and hazard mitigation strategy. The SHMP is the

result of a collaborative multiagency planning process, which involved DWR, and public participation.

CalEMA also coordinates FEMA's Repetitive Flood Loss Program within the NFIP, Flood Mitigation Assistance Program, Pre-Disaster Mitigation Grant Program, and Hazard Mitigation Grant Program. DWR's Alluvial Fan Task Force is funded 75 percent via a Pre-Disaster Mitigation Grant through CalEMA (CalEMA, 2009a).

Other State Agencies
DFG works with DWR in managing environmental resources associated with planning, construction, operation, and inspection of flood management facilities in the State.

Joint State-Federal

State-Federal Flood Operations Center
The joint State-Federal Flood Operations Center (FOC), co-located with the NWS RFC in Sacramento, is the focal point for the gathering, analysis, and dissemination of flood- and water-related information. During emergency situations, the FOC provides a facility from which DWR can centrally coordinate emergency response statewide with multiple agencies. USACE, NWS, Reclamation, and DWR work together during flood season to share information and coordinate their jurisdictional activities.

The FOC provides forecasts and warnings of severe weather events that may endanger human life and property, and coordinates flood management operations and flood response. Gage information, forecasts, and warnings are generated by NWS and DWR and disseminated through the CDEC computer system, managed by DWR, and NWS information systems. The FOC also sends flood warnings to local agencies once predetermined river stages are forecast, and coordinates flood fighting and recovery efforts. The FOC operates according to the CalEMA SEMS, which provides for the mobilization, deployment, use, communication, tracking, and demobilization of mutual aid resources in an emergency. North coast flood coordination is conducted through the Eureka Flood Center.

Local and Regional This section describes pertinent local and regional agencies, special districts, joint power authorities, and other entities in the Central Valley with responsibility for flood management. It also describes, in general terms, the roles and responsibilities of cities and counties in flood management. Lastly, it notes regional organizations and associations that advocate for flood management, or collectively coordinate on common flood management issues.

The nonfederal sponsor for the two major flood management projects in the Sacramento and San Joaquin river basins is the Board, which has accepted the assurances of O&M for federal projects under the authority of the Flood Control Act of 1944. In accordance with State law, most of the O&M responsibilities have been delegated to local districts (USACE, 2002a). For this reason, local and regional entities play a significant role in flood management. Their activities and responsibilities are as diverse as their legal structures, and include LDs, RDs, counties, cities, and water districts, agencies, and authorities. In many areas, these local entities maintain, operate, and assume responsibility for project levees and other flood management facilities on the State's behalf.

Special Districts

DWR inspects and evaluates the maintenance of all of the State's federally designated project levees and channels. Most project levees are maintained by special districts, such as RDs and LDs. Special districts in the Sacramento and San Joaquin river basins are shown on Figures 2-25 and 2-26. Because the flood control system has developed over time, there are at least four variations of the distribution of maintenance responsibilities: (1) maintenance performed by DWR under CWC Section 8361 funded by the General Fund, (2) maintenance funded by local landowners, but performed by DWR in Maintenance Areas (MA), (3) maintenance performed by local landowners without formal districts, and (4) the most common, maintenance by local LDs, MAs, or RDs set up by the California Legislature.

The formation of RDs was originally authorized in 1868 to facilitate reclamation of swamplands by building levees and drainage systems. The formation and regulation of RDs is incorporated into CWC Section 50000 and following. Today, landowners within these RDs support operation, maintenance, and improvement of their levees.

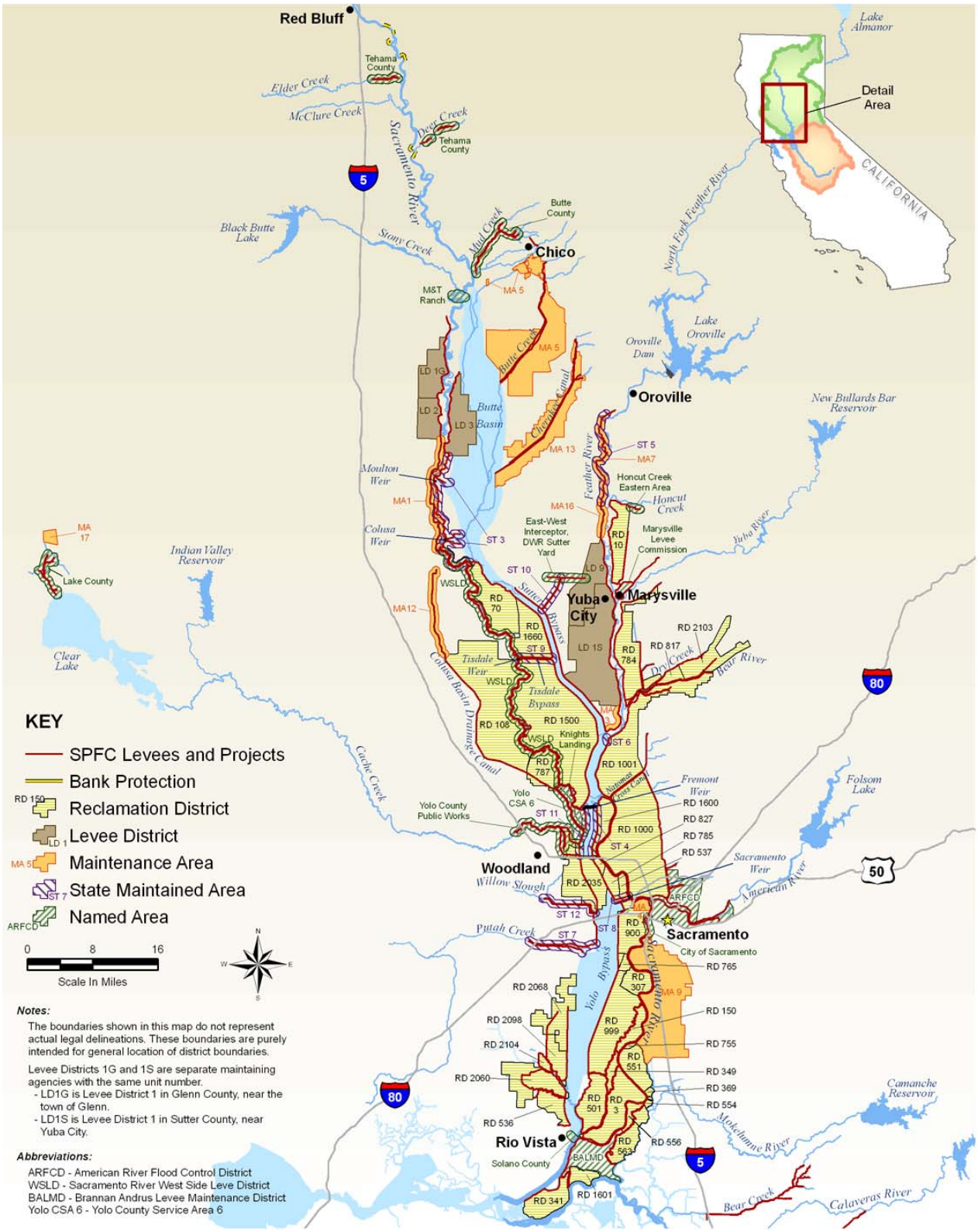


Figure 2-25. Locations of Local Maintaining Agencies Within the Sacramento River Watershed

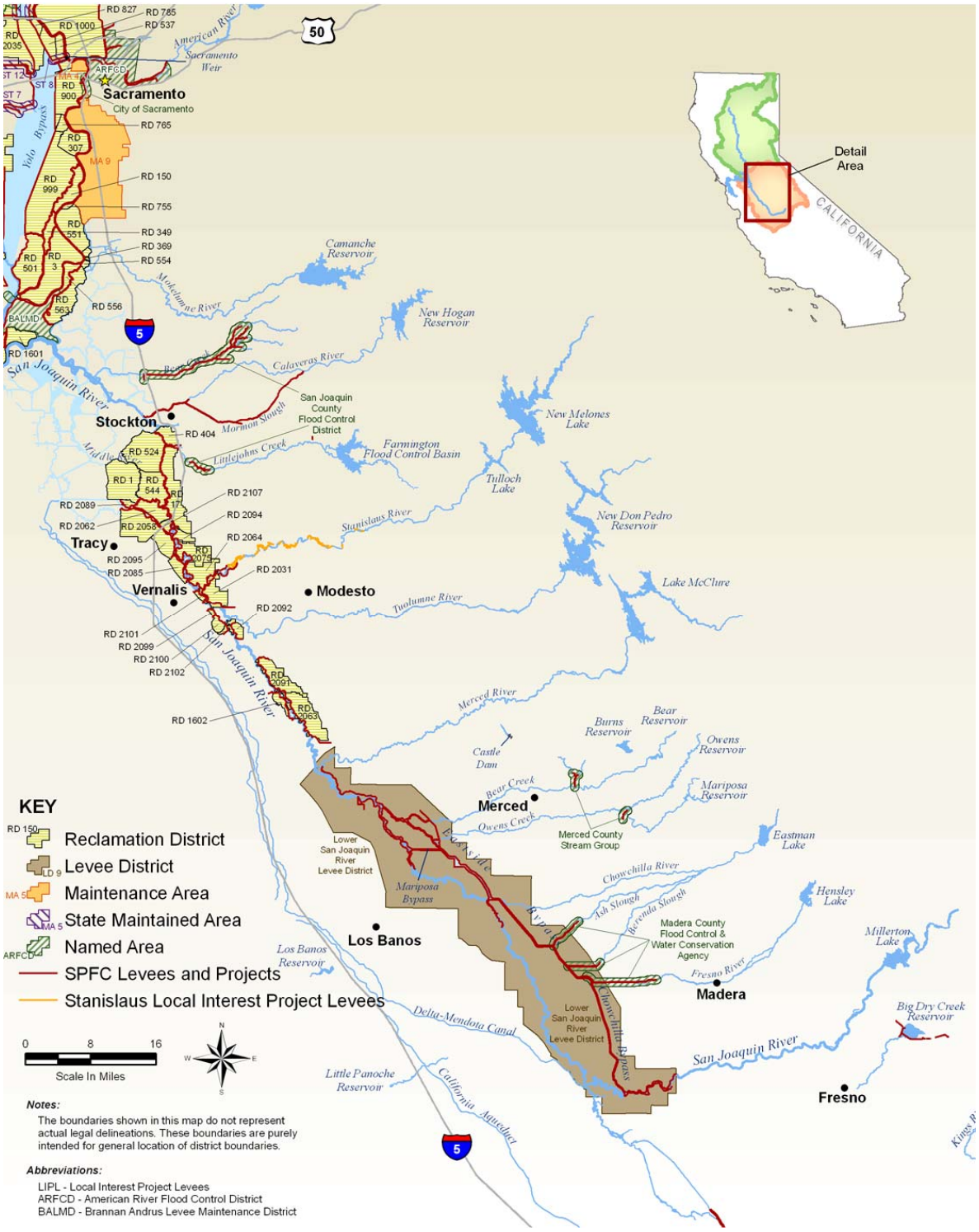


Figure 2-26. Locations of Local Maintaining Agencies Within the San Joaquin River Watershed

LDs and RDs maintain and repair levees and other flood control facilities within their boundaries; RDs also assume responsibility for internal drainage systems for agriculture such as canals, ditches, and pump stations.

Some of the key flood management-related roles these agencies provide include the following: (USACE, 2002a):

- Plan, design and construct improvements to components of the flood management system in cooperation with DWR and USACE
- Lead collaborative efforts between urban, rural, and environmental interests to develop integrated regional plans
- Conduct sound levee inspections and maintenance, including repairing erosion sites as they occur
- Establish robust emergency response plans
- Inform residents on flood risks regardless of level of flood protection
- Provide political support to help secure federal funding
- Establish assessments and provide funds as local cost shares
- Fund and carry out inspections, and O&M of flood management facilities
- Promote appropriate land-use planning to meet FloodSAFE California (FloodSAFE) goals and objectives

In areas with no RDs or LDs, DWR maintains the project levees.

Maintenance Areas
MAs are formed to maintain flood control levees when local agencies cannot fulfill their responsibilities. The MAs are formed under CWC Section 12878 by the Board. Maintenance work is performed by DWR. Authorized services include levee maintenance, flood patrolling, and emergency repairs. The boundaries of an MA are determined by study. The area within the boundaries of an MA includes lands protected from flooding by the levee. Assessment as part of an MA is determined by the benefit to each landowner based on assessed valuation of each property, and the protection afforded.

Other Local Entities
Joint Powers Authorities, such as those formed in the Sacramento and San Joaquin river basins in response to floods in the 1980s and 1990s, facilitate the cooperation of local agencies for flood management in urban (and urbanizing) areas. In addition, a host of other local entities often have roles and responsibilities related to flood management. These agencies include the following:

- Flood control districts
- Improvement districts
- Associations
- Cities
- Counties
- Water districts
- Drainage districts
- Utility districts
- Irrigation districts
- Conservation districts
- Flood control agencies, flood protection agencies, and levee improvement authorities
- Water and power districts

These local entities have a wide range of organizations, objectives, and authorities with respect to flood management. Therefore, their roles, responsibilities, and jurisdictions vary throughout the Sacramento and San Joaquin river basins.

Cities and Counties Cities are involved in levee construction and maintenance. Cities are authorized to incur indebtedness to construct flood control works, including levees, for flood protection purposes. If a city incurs indebtedness for this purpose, its city council is empowered to adopt needed rules and regulations for acquisition, construction, and completion of the works; appoint agents, supervisors, and engineers to supervise and

construct the works; and protect and preserve the city's rights in respect to the works.

County Boards of Supervisors are authorized to spend money from their counties' general funds to construct levees and other flood control works. If the affected bodies of water flow in or through more than one county, an affected county can carry out work outside of its boundaries. Boards of Supervisors may also pass ordinances establishing local districts to "protect and preserve the banks of rivers and streams and, with the permission of a majority of those proposed to be taxed, lands lying contiguous thereto" from flood damage, and levy taxes within these districts.

Cities and counties that prepare and implement general plans and other local planning elements have both direct and indirect roles and responsibilities related to flood management in the Central Valley. Jurisdiction over land use and land-use decision-making in floodplains, in particular, occurs at the city/county level. City and county general plans are required to identify flood-prone areas and address flood hazards in those areas.

Regional Organizations and Associations Various regional organizations and associations have been formed in the Central Valley to discuss and coordinate on common issues, and advocate for flood management and related topics. While these entities do not have regulatory roles or responsibilities, they often engage in integrated planning activities and participate in State and federal studies, projects, and programs.

Tribal Governments There are more than 100 federally recognized tribal governments in California, each with its own form of government and laws. Tribes have a unique government-to-government relationship with the United States government through federal case law and executive orders. Tribal governments are responsible for providing for the health, safety, and welfare of all citizens within their territory, and also have roles in flood management. Many tribal lands are adjacent to local, State, and federal infrastructure that could impact lives, agriculture, and economic enterprises. Tribes maintain, operate, and have responsibility for flood management facilities in coordination with counties, the State, and the United States government.

Funding

Funding for flood management activities is a provided by a combination of local, State, and federal appropriations and financing. This section describes some of the key aspects of funding for construction, operation, maintenance, and post-flood recovery of flood management facilities in the Central Valley.

Construction Traditionally, Congress authorizes and appropriates funds for specific USACE flood protection projects using the WRDA, which passes every 2 to 3 years. Any substantial change to those water projects requires an updated and sometimes new authorization. Authorizing language identifies funding and federal/local cost-sharing arrangements for a project. In addition, the Energy and Water Development Act is an annual appropriations mechanism that is often used to appropriate funding for studies, design, and construction of federal flood management projects. Most federal flood control projects in the Central Valley were authorized and funded in this traditional manner, although some elements of the system were originally constructed by local entities and became part of the larger State-federal system later.

Federal funding for flood control and related water resources projects requires a local entity to share in the cost of construction. Unless specified differently in authorizing legislation, current cost-sharing for federal flood control purposes is 65 percent federal, 35 percent nonfederal. In return for federal funding assistance, nonfederal partners must hold the United States government harmless from liability and agree to pay the nonfederal cost share, purchase any necessary lands and easements, and operate/maintain the facilities in perpetuity. In the Central Valley, DWR and/or local entities have been, and continue to be, nonfederal cost-sharing partners to USACE, and are entirely responsible for the cost of operating and maintaining completed State-federal facilities. The Board is responsible for providing all easements and rights-of-way required to implement a USACE project.

In recent years, heightened awareness of flood risk has stimulated an increase in State funding through voter-approved bonds and special budget appropriations. This includes passage of Propositions 84 and 1E, which provided about $5 billion in bond funding for flood management and related projects in the State. As a result, State spending on flood management has overtaken federal funding from its traditional source, USACE. Local flood agencies in some high-risk, urban areas have also been successful in raising public funds for flood risk reduction projects (Hanak, 2008).

In response to the shift in funding, the State of California has recently developed its own cost-sharing guidelines for certain flood management projects, outlining local and regional financing responsibilities for construction of repairs or improvements to the State-federal flood management system.

Maintenance Funding for routine maintenance of the State-federal flood system is generated through fees assessed by RDs, LDs, other maintenance

assessment areas, and local governments. These special districts, created by the State, can assess landowners, with appropriate voter approval, for the purpose of levee maintenance and drainage, and typically comprise lands reclaimed and/or protected by the State-federal facilities. Districts can also generate funds through the sale of public bonds. The State funds DWR's maintenance activities for State-federal facilities through special assessment districts. Although currently no programs are in place, in the past, the State has provided some funds for maintaining local levees (not part of the State-federal system), notably in the Delta.

Flood Response and Recovery Financing and reimbursement for flood fighting are governed by the State Emergency Services Act and other applicable State and federal laws. In general, the local levee maintaining agency (LMA) has primary authority and fiscal responsibility for flood fights within its jurisdiction. If the LMA has exhausted its resources or abilities, it may seek assistance from the appropriate higher entity with emergency response authority (typically a city or county), which then accepts fiscal responsibility. If the Governor declares a state of emergency in the jurisdiction, State assistance is provided without the expectation of reimbursement.

Public Law 84-99, authorizes USACE, at the request of the Governor, to conduct emergency flood fighting when USACE determines that an immediate danger to life or property exists and local and State resources are insufficient for the task. Funding for USACE emergency response under this authority is provided by Congress through the annual Energy and Water Development Appropriation Act.

Federal funding for post-flood repairs to State-federal facilities is also provided through Public Law 84-99, under which an eligible flood protection system can be rehabilitated and restored to its predisaster status at no cost to the federal system owner, and at 20 percent cost to the eligible nonfederal system owner. Levees and other flood facilities are only eligible to receive Public Law 84-99 assistance if they meet minimum design and maintenance standards.

Local levees must meet the State's Flood Hazard Mitigation Plan minimum standards to be eligible for federal financial assistance in the event of a flood. This standard requires a levee crown elevation 1 foot above the 1-percent-chance-flood elevation. In addition, to be eligible for USACE assistance, local levees must meet or be able to show attempts to meet the Public Law 84-99 standard of 1.5 feet above the 1-percent-flood elevation.

Coordination

Coordination is an essential element of flood management in the Central Valley because of the large number of agencies and governance structures involved, and their multilayered jurisdictions and responsibilities. This section describes some of the key coordination occurring between local, regional, State, and federal entities in terms of system policies and practices, and flood system operations.

Policies, Practices, and Information Various forums have been established to promote coordination with respect to the policies, practices, and information that govern flood management:

- **Interagency Flood Risk Management Committee** – Beginning in 2005, USACE and FEMA have cooperated to develop and coordinate federal flood management programs and policies through the Interagency Flood Risk Management Committee. This committee has reviewed the standards, practices, and policies related to flood management of various federal agencies, resulting in more consistent, and stringent, standards for levee design, construction, O&M, floodplain mapping, and levee accreditation.

- **Central Valley Flood System Improvement Framework** – In early 2009, a partnership of local, State, and federal agencies known as the California Levees Roundtable completed the Central Valley Flood System Improvement Framework. This cooperative effort demonstrates a commitment to flood system improvement that allows Central Valley levees to maintain Public Law 84-99 eligibility while long-term system improvements are being studied. Although the Roundtable began as a forum to discuss issues related to vegetation management, it now addresses multiple threats to levee integrity. The Framework was approved by Board in February 2009.

- **California Levees Database** – FEMA is a sponsor of DWR's California Levee Database, a GIS resource tool for storing and retrieving statewide levee attribute information and technical resources data for levee evaluation. The information stored in the database can be used for FEMA's Digital Flood Insurance Rate Map production, USACE flood damage reduction feasibility studies, DWR planning studies, and local needs.

Flood System Operations Information on possible flood hazards, weather conditions, inflows to the project and upstream reservoirs, flows in the system downstream from the project, and integrity of facilities are essential to effectively managing flood projects in the Central Valley. This requires close liaison among USACE, NWS, Reclamation, DWR, local

operating agencies, and downstream interests on a daily or hourly basis, as required. As described previously, the joint FOC provides a single base for agency coordination and information dissemination during the flood operation season.

Both DWR and NWS collect and interpret climate and hydrologic data in California. Therefore, DWR and NWS California Nevada RFC personnel work together to develop flood forecast guidance, information systems, and data. Public dissemination of information is accomplished through NWS systems as well as the State-federal FOC and DWR's CDEC. This close working relationship eliminates duplication of effort, takes advantage of the resources of both agencies, and provides consistent information dissemination to emergency managers and the public (NWS, 2009).

Coordination between USACE and project operators occurs year-round, but generally intensifies in August or September before flood season. During flood season, flood management decisions for each project are made based on an approved Water Control Plan from the Water Control Manual for that project. These decisions are a reaction to rain or snow on the ground. Currently, weather forecasts are not used for reservoir operations except in a very broad sense of preparing for large storms coming from the Pacific Ocean.

Operators manage releases to maintain flood management space while at the same time considering downstream conditions. Although dam operators are required to follow the Water Control Plan and maintain the stated flood management reservations for adequate downstream protection, operators also consider both upstream and downstream conditions when making release decisions. An objective release is the maximum allowable outflow from a dam, as specified in the Water Control Plan. Objective flows pertain to specific reaches of a river based on local conditions, and are established through coordination with local entities. An objective flow is intended to reflect nondamaging conditions.

Dam operators closely monitor downstream flows for comparison against channel capacities, which need to accommodate the objective releases from dams, flows from other flood management projects, and flows from uncontrolled streams and drainage areas. Downstream considerations may include levee seepage, erosion, and/or strength, and channel capacity. Additionally, operators consider the impact of flow fluctuations on fish spawning habitat. In limited cases, operations may deviate from the approved Water Control Plan based on local conditions and considerations. For example, major releases made after a flood event to evacuate flood management storage space can potentially affect downstream property owners or threaten levees damaged during the event. Releases must

balance the potential for damage with the need to evacuate flood management storage.

In many cases, the operation of upstream dams owned and operated by other agencies must be considered. Often, informal cooperation with these upstream facility agencies allows flood management operators to take advantage of available upstream storage while adjusting downstream releases to provide flood protection.

2.1.7 Emergency Planning, Response, and Recovery

This section presents the existing framework for emergency planning and response to floods in the Central Valley. A sustainable Emergency Response System is an important component of flood management that improves public safety, protects and enhances environmental and cultural resources, and supports economic growth by reducing the probability of destructive floods, promoting beneficial floodplain processes, and lowering the damages caused by flooding (DWR, 2008b). In California, DWR is the lead organization in providing effective flood emergency response, which is based on a shared responsibility of governments at all levels, and partnerships with different private-sector entities. The following subsections discuss the structure of the emergency planning framework, including key response principles, participating agencies, roles, and capacities that guide flood-related emergency response operations in the Central Valley.

Emergency Planning and Management

Emergency response planning occurs at both the State and local levels in California. The State plans and coordinates its emergency response using SEMS, required for managing incidents involving multiple jurisdictions and agencies. SEMS provides the framework for California's State and local governments to communicate and share information, mobilize resources, and maintain operations in the event of a disaster or emergency. The California Emergency Services Act directs DWR, and all other State agencies, to use SEMS for emergency planning and response (CGC Section 8607(a)). The National Incident Management System is the federal government's nationwide counterpart to SEMS; the State system integrates these federal guidelines (CalEMA, 2009a).

Although California law does not mandate that local jurisdictions produce emergency response plans incorporating SEMS, State law and policy strongly encourage this by making it a prerequisite for deploying any State resources or funds for local emergency response or recovery (CGC Section 8607). Therefore, all 58 counties and 98 percent of the State's cities have produced such plans and submitted them for State review (CalEMA, 2009b).

California Emergency Management System Understanding the ways in which agencies and communities prepare for and operate during a flood fight first requires knowledge of the principles and design of the Incident Command System (ICS), which underlies both State and federal approaches to emergency and management (CalEMA, 2009a). A special State wildfire response task force developed the ICS in the 1970s to standardize roles and procedures that would facilitate organized and swift

mobilization and response during the chaos of an emergency situation (CalEMA, 2009a).

The California Department of Forestry and Fire Protection (CAL FIRE) defines ICS as a standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries (CAL FIRE, 2008).

Simply, the ICS is a way for organizations to communicate and combine resources, as needed, to manage emergency situations of any size and complexity. If a local, State, or federal agency has developed an emergency plan that identifies the appropriate officials and their roles in an emergency, ICS provides a readymade framework for action when the incident occurs. The system is designed to be flexible enough to use in response to an incident of any type; standardized to reduce problems or the potential for miscommunication during emergencies; and cost effective by avoiding duplication of efforts (CalEMA, 2009a).

Basic Incident Command Structure The SEMS/ICS hierarchy contains five government or operational levels that may be involved in emergency response efforts:

- **Field** – The field level includes emergency personnel who respond at the scene.

- **Local** – At the local level, cities, counties, and special districts coordinate responses to incidents fully within their jurisdictions.

- **Operational Area** – Operational areas encompass all local governments and jurisdictions within a county's geographic boundaries. They manage the flow of resources to the local level and also facilitate communication between the local level and the regional level.

- **Regional** – The regional level is represented by one of CalEMA's administrative regions: the Inland Region for the Sacramento and San Joaquin river basins, and the Coastal Region for the Delta. These regions are responsible for coordinating information-sharing and managing resources among operational areas within a mutual aid region, and also between operational areas and the State level.

- **State** – The State level prioritizes and coordinates resources to the regional levels and also integrates State and federal emergency

response systems and interstate aid agreements as directed by the Governor (CalEMA, 2009a).

When a single emergency event occurs, first responders establish a physical Incident Command Post in the field, managed on site by an Incident Commander who oversees all activities and releases resources, as needed (FEMA, 2008). All field response staff report to the Incident Commander through a standard chain of command. Five functional sections, each headed by a Section Chief and containing multiple units, are formed within the Incident Command Post structure:

- **Command/Management** – Headed by the Incident Commander; also includes public information, safety, and liaison leads. The Liaison Officer is the point of contact for all participating agencies, and the Public Information Officer directs the flow of information among personnel assisting in the response and to the media and public.
- **Operations** – Conducts specific tactical actions in the field.
- **Planning** – Collects intelligence and provides status updates about operations, available resources, and the situation overall, and also evaluates this information to develop and update action plans to be implemented by Operations.
- **Logistics** – Orders and provides personnel, facilities, communications equipment, food, and all additional available resources needed to support the emergency response effort.
- **Finance/Administration** – Keeps track of costs related to responding to the event, and handles all other financial and administrative matters.

When the emergency situation requires or grows in complexity such that multiple agencies or jurisdictions have legal responsibilities to respond, ICS scales up to establish a common set of objectives and strategies for responding and cooperating operationally under a Unified Command (CalEMA, 2009a; FEMA, 2008).

Each of the ICS organizational levels contains the same functions and standardized personnel roles as all other levels (CalEMA, 2009a). This facilitates the flow of information and requests for resources up the chain, and tactical guidance and resources down the chain, through the appropriate officials.

Multiagency Coordination Under SEMS/ICS, multiple agencies may be involved in emergency response, especially once an incident moves beyond

the field response level. At each successive SEMS level, multiagency resource-sharing and support for emergency response operations is usually coordinated at an Emergency Operations Center (EOC). When an agency has specific duties to respond, it may also establish its own EOC; during or before a flood emergency. For instance, DWR activates its FOC located in Sacramento (DWR, 2007).

Resources Sharing and Cost Reimbursement Emergency response financing and reimbursement is governed by the Emergency Services Act and other applicable State and federal laws. Local agencies, or other organizations with jurisdictional or functional duties to respond to a particular type of emergency, have the primary responsibility to pay for related emergency planning, preparation, and response activities. Under SEMS, agencies assisting in a response at other SEMS levels are responsible for the cost of providing these resources.

Mutual Aid Agreements

Written mutual aid agreements between different levels of government and between the public- and private-sector facilitate resource mobilization during an emergency to guarantee that effective response to an emergency event will not be hindered by a lack of personnel or supplies. For example, some RDs in the Delta have mutual aid agreements with San Joaquin County to provide flood fight assistance.

Although many local agencies or governments have their own mutual aid agreements with one another, California also has a statewide mutual aid agreement to which all of the State's counties and most of its cities are signatories, as shown in Table 2-22 (CalEMA, 2009b). By entering into the California Disaster and Civil Defense Master Mutual Aid Agreement (MMAA) with the State and its departments and agencies, California's political subdivisions, private corporations, and public agencies agree to provide each other aid during an emergency without the expectation of reimbursement (CalEMA 2009a). During an emergency, each signatory retains control of its own resources but gives and receives help, as needed, to other jurisdictions covered under the agreement. Under California's MMAA, each level of government seeks aid within its own level before calling for assistance from the next highest level within SEMS (CalEMA, 2009a).

Table 2-22. Emergency Plans and Statewide Mutual Aid Coverage

	Counties	Cities	Total
Emergency Plan	58	468	526
No Emergency Plan	0	11	11
Total	**58**	**479**	**537**
MMAA Signatory	58	472	530
Nonsignatory to MMAA	0	7	7
Total	**58**	**479**	**537**

Key:
MMAA = Master Mutual Aid Agreement

Cost Reimbursement

If mutual aid is used, reimbursement will be governed by the applicable mutual aid agreement. If State resources are obtained under California's MMAA, local jurisdictions are not expected to reimburse the State (CalEMA, 2009a). After a flood occurs, local governments can request State reimbursement for emergency response and repair costs under the California Disaster Assistance Act, and both State and local governments can request emergency response and recovery cost reimbursement from FEMA under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended) (Stafford Act). However, both these assistance programs require documented use of State and federal emergency management approaches during an event (CalEMA, 2009a).

Responsible Agencies

The following subsections describe public agencies charged with emergency management responsibilities primarily, and with flood-related emergency response roles in particular (see Table 2-23).

Table 2-23. Key Emergency Powers and Roles

Type	Statute/Regulation	Summary
Emergency Response Definition	California Code of Regulations Title 19, Section 2402	• Defines emergency response agencies.
Governor's Emergency Authority	California Government Code Section 8550 et seq.	• Gives Governor authority for the following: - Make and rescind orders and regulations. - Expend any appropriation. - Suspend provisions of any regulatory statue. - Commandeer private property (except media) or personnel. - Enlist DWR and other agencies for emergency purposes.
DWR Emergency Authority	California Water Code Section 128(a)	• Gives DWR authority to take remedial actions to avert, alleviate, repair, or restore damage or destruction to property having a public or State interest. • Places overall authority in emergency response with CalEMA.
	California Water Code Sections 6110-6113	• Allows DWR to take remedial measures to protect life and property if a dam is about to fail.
SEMS	California Government Code Section 8607(d)	• Requires all State agencies to use a standard emergency response system.
	California Code of Regulations Title 19, Section 2403	• Describes how State agencies should incorporate SEMS.
	California Code of Regulations Title 19, Section 2405	• Models SEMS on the ICS.
	California Code of Regulations Title 19, Section 2407	• Establishes communications and coordination procedures during an emergency.
Emergency Plans and Mutual Aid Agreements	California Government Code Section 8610	• Allows local governments to develop emergency plans and mutual aid agreements.
	California Government Code Section 8616	• Requires DWR aid given to local agencies to follow existing local plans.
	California Government Code Section 8617	• Allows DWR to provide mutual aid in periods other than emergencies. •
	California Government Code Section 8618	• States that local agency remains in charge of incident, unless aid-giving agency states otherwise.

Table 2-23. Key Emergency Powers and Roles (Contd.)

Type	Statute/Regulation	Summary
Responsibility for Sacramento and San Joaquin Flood Control Projects	California Water Code Sections 8370, 12642	• Assigns responsibility for Sacramento and San Joaquin Flood Control Projects to local levee maintaining districts, counties, cities, and other public agencies.
	California Water Code Sections 8361, 12878.1 Water Code Section 8715	• Authorizes DWR to maintain and operate portions of flood control projects in the Sacramento and San Joaquin river basins. Gives general authority to DWR to protect or strengthen any levee between Chico and Fresno.
Federal Cooperation	California Water Code Section 12642 Public Law 84-99	• Gives authority to maintain and operate federally authorized projects to DWR and public districts if the federal government is inactive. • Authorizes USACE to conduct emergency flood fight after Governor's request to aid DWR.
Debris Disposal	Government Code Section 8596	• Allows State agencies and employees to assist in disposal of debris on private property.
CEQA Exemptions	Public Resources Code Section 21080	• Authorizes emergency repair to public facilities. Exempts actions to prevent/mitigate an emergency.
Emergency Contracting Provisions	Public Contract Code Section 10122	• Permits DWR to use contracts on informal bids to effect emergency repairs.
Stream Bed Alteration Agreements	Fish and Game Code Section 1601(f)	• Allows DWR to perform emergency work with a notice to DFG within 14 days of work.
California Endangered Species Act	Fish and Game Code Section 2090(c)	• Allows DWR to perform emergency work with a notice to DFG within 14 days of work.
Wetlands Regulation	Clean Water Act Section 404	• States regional permit guidelines.
Emergency Volunteers/Good Samaritan Laws	California Government Code Section 820.2, 825, 8655, 8657, 8659, 8660	• Provides immunity from liability to good-faith volunteers pressed into emergency response service.

Source: DWR, 2007.

Key:
CalEMA = California Emergency Management Agency
CEQA = California Environmental Quality Act
DFG = California Department of Fish and Game
DWR = California Department of Water Resources
ICS = Incident Command System
SEMS = Standardized Emergency Management System
USACE = U.S. Army Corps of Engineers

Emergency Planning and Management Agencies At every level of government, at least one official, department, or agency is charged with leading preparations for natural disasters or other emergencies and managing the response when events such as flooding occur.

Local Government
All cities, counties, and special districts are responsible for public safety and for responding to emergencies within their jurisdictions (CalEMA, 2009a). Local ordinances describe emergency plans and identify emergency managers and officials authorized to issue "Local Emergency" declarations. All but 11 of the State's jurisdictions have local "Disaster Councils" charged with maintaining the jurisdiction's emergency plan and directing certain aspects of emergency response (CalEMA, 2009b).

Once the jurisdiction activates its emergency operations center or officials declare a local emergency, the local government must use SEMS to be eligible for state reimbursement of costs related to the response (CalEMA, 2009a).

California Emergency Management Agency
CalEMA, established in 2009 through the merger of the State's OES and Office of Homeland Security, is California's lead agency for emergency planning and response (CalEMA, 2009a). The agency maintains the state's emergency plan, which describes resources, roles, and procedures in all levels of government and within the State's broader emergency community for responding to a range of emergencies and natural or man-made disasters.

CalEMA considers local government requests for cost reimbursement following a Local Emergency declaration, and makes recommendations to the Governor on whether to grant local requests for State of Emergency declarations. When it is apparent that responding to an emergency will outstrip available State resources, CalEMA coordinates the Governor's requests for a Presidential Declaration of Emergency to release Stafford Act funds. The agency is the conduit through which DWR and all other State or local agencies must request federal assistance following an incident (CalEMA, 2009a). CalEMA may allocate funds for investigation, estimates, reports, and repairs regarding disaster recovery financial assistance for flood management works that do not come under the provisions of another authority.

Under its former identity as Governor's Office of Emergency Services (OES), CalEMA developed the following sets of guidelines for emergency planning in compliance with the Flood Emergency Action Team initiatives:

- Guidelines for Coordinating Flood Emergency Operations
- Legal Guidelines for Flood Evacuation
- Flood Preparedness Guide for Levee Maintaining Agencies

- Emergency Plans for Mobile Home Parks
- Memorandum of Understanding for Animal Care During Disasters
- Protocol for Closure of Delta Waterways
- Public Assistance Eligibility Guidelines for Floods Disaster Assistance Funding Guidance

Federal Emergency Management Agency
Through FEMA, the federal government provides assistance during presidentially declared emergencies and other major disasters under the Stafford Act. FEMA is responsible for coordinating assistance with and through CalEMA to State and local governments under the Stafford Act. FEMA is also responsible for coordinating direct federal assistance under the National Response Plan. Under the National Response Plan, federal agencies such as USACE may provide assistance with measures to reduce immediate threats to lives and property.

Flood fight and Flood Operations Assistance In addition to the above emergency management agencies, a number of local, State, and federal entities either have statutory flood fight responsibilities or may offer their assistance during a flood fight.

Levee Maintaining Agencies
Local agencies have primary authority for both levee maintenance and flood fighting within their jurisdictions. Levee maintenance is provided by LMAs: entities with the responsibility to maintain the flood works of the SRFCP, San Joaquin River Flood Control Systems, or other parts of the flood works of the Central Valley. This includes public LDs or RDs, local governments, private levee owners and, in some cases, DWR (DWR, 2007). LMAs are responsible for natural disaster emergency preparations, such as training and stockpiling flood fight supplies. CalEMA provides a flood preparedness guide for LMAs that contains an emergency plan checklist and identifies local government agencies with which LMAs should work before and during emergencies (OES, 1997g).

Department of Water Resources
Although CalEMA is the State's lead on overall emergency response, DWR is the lead State agency for flood fight assistance and flood emergency response. Section 128(a) of the CWC authorizes DWR in times of storms or floods to take any remedial measures necessary to avert, alleviate, repair, or restore damage or destruction to property having a general public or State interest. During flood events, DWR's divisions with emergency response capabilities organize in an ICS-based command

structure consistent with SEMS and directed at the FOC by the Division of Flood Management, and coordinate with other local, State, and federal agencies (DWR, 2007). During non-flood conditions, DWR's Division of Operations and Maintenance and Reclamation coordinate their day-to-day water operations and also participate in event-specific weather briefings presented by the FOC.

Division of Flood Management leads DWR's response to floods and directs sections of its Flood Operations Branch that provide key resources during flood emergencies (DWR, 2007). The DWR Division of Operations and Maintenance is responsible for coordinating activities at each flood incident in the field with the FOC. The Division of Planning and Local Assistance Central District Office, located in Sacramento, manages water resources in cooperation with State, federal, and local agencies and all public interests. The Central District Office has personnel trained in SEMS and provides expertise in floodplain management, geology, streamflow measurement, high-water surveying, and flood fighting (DWR, 2007).

California Department of Forestry and Fire Protection

During a flood emergency, or when storm activity, high river stages, high tides, or large reservoir releases may pose potential flood threats, CAL FIRE may supply personnel to support flood fighting and levee patrols. DWR must request CAL FIRE resources through CalEMA; DWR may not order crews directly from CAL FIRE unless there is an agreement between the two agencies. (DWR, 2007)

California Conservation Corps

Like CAL FIRE, the California Conservation Corps also may provide personnel for flood fighting and levee patrols during emergency situations. Standby crews are frequently stationed near sites where problems are anticipated because of storm activity, high river stages, high tides, or heavy reservoir releases (DWR, 2007).

U.S. Army Corps of Engineers

USACE has emergency authority under Public Law 84-99, enacted in June 1955, to fight any flood to protect life and property and to rehabilitate federal flood management facilities that are maintained by state and local entities (USACE, 1999).

U.S. Coast Guard

The U.S. Coast Guard has jurisdiction in coastal waterways and has the authority to restrict commercial vessel traffic. The U.S. Coast Guard will coordinate advisories and restrictions through CalEMA during proclaimed emergencies, and is also the lead federal agency responsible for hazardous materials incidents (DWR, 2007).

U.S. Department of the Interior, Bureau of Reclamation
Reclamation operates the CVP, which provides flood control benefits along with water throughout California for irrigation, supply, hydropower, recreation, and environmental needs. DWR and Reclamation will coordinate SWP and CVP operations during catastrophic events. Reclamation projects may require changes in operations during an emergency as long as the change does not jeopardize or interrupt lawful function of infrastructure.

U.S. Geologic Survey
USGS coordinates with NWS and DWR by providing streamflow data collected from telemetered stream gages throughout California. During a flood emergency, USGS will collect flow measurements and make repairs to damaged equipment at its gaging stations.

Flood Recovery Assistance

Natural Resources Conservation Service
The USDA NRCS provides technical and financial assistance to communities for restoring watersheds impaired by natural disasters. Through the Emergency Watershed Protection, NRCS helps safeguard people and property after natural disasters, such as floods, fires, windstorms, earthquakes, and drought. NRCS helps repair overtopped levees, dikes, and other flood-retarding structures. To prevent future flooding, NRCS provides assistance to help clear watercourses clogged by sediment and debris.

Flood Event Emergency Response

Flood emergency operations include not only flood fighting and emergency response, but also monitoring and notification activities that trigger mobilization of personnel and resources when a flood may occur. This section describes the sequence of events that could occur during a flood emergency and how DWR and other agencies would be involved in the response at various SEMS levels. It also includes general guidelines required to “integrate local agencies that maintain levees and flood control structures into the overall emergency response organization,” as the Governor’s Executive Order W-156-97. The guidelines were completed in compliance with Flood Emergency Action Team and approved by the SEMS Advisory Board on November 21, 1997.

Flood Emergency Preparedness and Warning Throughout California’s traditional wet season, DWR joins a number of federal agencies in monitoring potential flood threats and alerting local communities when floods occur.

River Forecasting
From mid-October through April, a joint State-federal forecast team continuously monitors river stages and weather conditions to maintain awareness of any high water potential. As major storm systems approach California, forecasters from NOAA, the NWS RFC, and DWR forecast the location, amount, and timing of expected precipitation and make initial river forecasts.

Once a major storm arrives and runoff begins, river forecasts are updated and issued, as necessary. Reservoir operators adjust flood control releases as inflows increase or downstream channels swell with runoff. If runoff is sufficient to raise streams to threatening levels, NWS and DWR issue forecasts as official public bulletins. Gage information, forecasts, and warnings are disseminated through the CDEC computer system. CDEC provides flood forecasts for all major tributaries influencing the Central Valley (DWR, 2007).

Flood Alert and High Water Notifications
Forecasts of sustained storm patterns and flood potential, the need for coordinated field operations during a flood fight, and requests for technical support from local agencies may require the DWR Flood Operations Branch Chief to declare a Flood Alert to officially activate the FOC under SEMS (DWR, 2007).

When streams are forecast to rise above certain predetermined stages (water surface elevations) or flow rates, FOC personnel make high water notification calls to appropriate local flood system maintaining and emergency response agencies (DWR, 2007).

Flood fight and Response The necessity to initiate a flood fight may result from overflow of a natural waterway, overflow of a waterway confined by levees, rising lake waters, dam overtopping, failure of a levee, or other circumstances. Flood fighting is initiated when a threat to life and property exists (FEAT, 1997b).

Field Command
At the field level, an agency responsible for responding in a particular type of emergency will provide or direct personnel who will establish an Incident Command Post and manage the emergency hands-on. In a flood fight, the agency that establishes the Incident Command and begins the flood fight may be an LMA, or DWR where the department has levee maintenance responsibilities (OES, 1997a). As the statewide lead for responding to floods, DWR may also send Division of Operations and Maintenance teams to assist the field response. If the agency responding in

the field has mutual aid agreements, participating organizations may provide personnel and equipment.

After receiving a flood alert or high water notification from the FOC, LMAs are required to patrol their levees on a 24-hour basis as long as the water level is at or above the high-level monitoring stage, and until no levee threat remains (DWR, 2007).

Local
If a flood fight exceeds the capability of an LMA or if communities are threatened, cities or counties will lend their resources to the flood fight, and local officials may activate the jurisdiction's EOC (OES, 1997a).

Operational Area
SEMS requires the activation of an operational area if one or more local jurisdictions have activated their EOCs and have proclaimed a local emergency. If the operational area EOC is activated during a flood, CalEMA and DWR will provide operational area EOC staff liaisons to the greatest extent possible to coordinate emergency operations and flood fight operations, respectively (OES, 1997a).

At this level, flood emergency response activities could include a host of cross-jurisdictional and cross-functional agency involvement. For example, if a flood is isolated to one operational area only, response activities might include RD staff assisted by county and DWR personnel working to shore up a levee, and a police department coordinating evacuations with sheriff's department and county emergency services staff.

Once an operational area's EOC is activated, it prompts involvement of CalEMA and the appropriate regional and State emergency management authorities, as well. In general, a flood emergency would need to be elevated to at least this operational level before State resources outside DWR would be used to respond.

Regional
When emergency management personnel activate an operational area's EOC, this also activates the appropriate CalEMA Regional EOC to coordinate information-sharing and the flow of resources among operational areas within a mutual aid region, and between the local and State levels (CalEMA, 2009a).

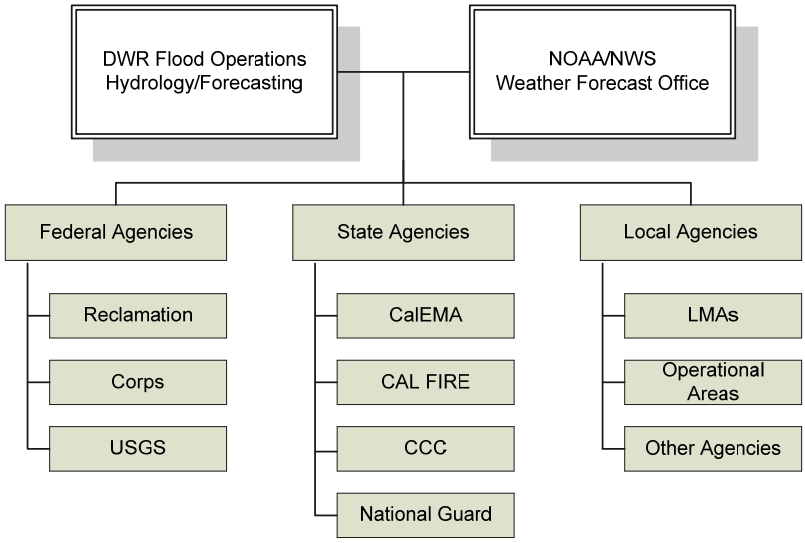
All State resources for flood-related emergency response in the Central Valley, outside those provided by DWR, must be coordinated and released to local efforts through the Inland or Central CalEMA regions.

State

When a CalEMA Regional EOC is activated, the State also activates the State Operations Center to support the regional level with State resources. The State agency with functional or legal emergency management duties creates its own operations center to direct its response in the field. Through CalEMA, the State level also integrates State and federal emergency response systems and interstate aid agreements, as directed by the Governor (CalEMA, 2009a).

In case of a flood fight, DWR activates its FOC. The FOC is the primary center for 24-hour coordination of DWR's overall flood fight assistance and the State's requests to USACE for assistance (DWR, 2007). During a flood event, many other State and federal agencies send special representatives to the FOC, where they coordinate their respective agencies' flood fight activities with DWR. Some of these representatives, such as USACE and the Board have their own dedicated resources within the FOC and work directly with FOC management. These representatives not only work to coordinate larger efforts between groups, but also serve as advisors to DWR's flood response.

Other agencies, such as USGS, CalEMA, CAL FIRE, local government representatives, and representatives from other DWR divisions work directly with the FOC Operations and Planning/Intelligence sections. Additional DWR staff can be assigned to aid any of these representatives, as needed. Figure 2-27 shows the flood emergency structure and different agencies that coordinate with DWR (DWR, 2007).



Source: DWR, 2007

Figure 2-27. Agencies that Cooperate with DWR and Each Other During Typical Flood Emergencies

Federal
In general, emergency response assistance from federal agencies must be requested by the Governor or through CalEMA. The Governor must issue a request to the federal government to assist DWR before USACE can join a flood fight (DWR, 2007).

Flood Evacuation The Flood Emergency Action Team flood evacuation guidelines focus on issues local government officials may face when evaluating the potential evacuation of their populations in the event of a flood emergency or disaster (OES, 1997h). The guidelines provide background regarding a local government's authority to issue an evacuation order and associated liabilities. The following section provides excerpts from CalEMA's flood evacuation guidelines and a description of the duties and responsibilities that arise during a flood emergency.

Evacuation Authority and Responsibility
The city, county, or State, or city and county entities are responsible for protecting the lives and property of their inhabitants. The local governing body, certain statutorily designated law enforcement officers, and the Governor, have the authority to order an evacuation.

Four entities may exercise authority for evacuation in the event of a flood emergency or disaster and are discussed below:

- Local governing body of cities, or whomever is authorized to act on their behalf
- Local governing body of counties, or whomever is authorized to act on their behalf
- Statutorily designated law enforcement officers
- Governor

The local governing body, or whomever the local governing body has authorized to issue the evacuation order, is primarily responsible for ordering an evacuation. This authorization can be in the form of an ordinance, resolution, or order that the local governing body has enacted. Many local jurisdictions have prepared flood-specific evacuation plans that identify egress routes and procedures based on the height of floodwaters and are organized for each law enforcement "beat" in the area (City of Sacramento, 2008).

Recovery

Once necessary response actions have been taken to minimize loss of life, damage to property, and adverse effects to water supply and water quality, agencies and jurisdictions involved will transition to the recovery phase. Post-flood recovery includes programs and actions that restore public facilities and services, provide aid to individuals, and facilitate other forms of assistance to individuals, businesses, and communities.

Infrastructure Repair and Debris Removal Activities such as repairing damaged infrastructure and debris removal are the responsibilities of affected local jurisdictions, which may also receive State or federal assistance in these efforts. In terms of infrastructure, DWR has the authority to finance or perform any activity intended to return flood-impacted facilities or persons to normal status. Recovery after a moderate flood event may also involve the funding and construction services of USACE if damaged facilities are parts of federal projects.

A number of State and federal agencies, including FEMA, CalEMA, DWR, USACE, and NRCS, share many damage assessment or repair responsibilities. Teams from these agencies complete damage survey reports or levee inspections, which are used to prioritize funding and assistance for debris removal and levee repairs (OES, 1997c).

Cooperating agencies may also assist one another in repairing damages to habitat and infrastructure on public or State-managed lands; many wildlife areas, for instance, are part of or adjacent to bypass systems that will handle floodwaters.

Disaster Recovery Assistance Immediately after a flood, individual residents and business owners may require aid to protect lives and property. Various forms of assistance can also expedite recovery; assistance may be in the form of temporary shelter, grants or loans, or other forms of financial assistance. Typically, the issuance of a disaster declaration (by the Governor and/or President) expands the forms of assistance that can be offered. Some grants and loans may be conditioned on reducing future flood risks by reducing or eliminating development in flood-prone areas, or minimizing future flood exposure through reconstruction techniques. Overall finance administration and responsibility for accounting, time-keeping, recovery, and FEMA claims are carried out using SEMS (OES, 1997c).

Rehabilitation and Restoration Rehabilitation and restoration refers to the longer term effort to restore normal operations and conditions following a flood.

Availability of resources to repair local and private facilities, remove floodwaters, and restore housing, business, and infrastructure often depends on the severity of the event and the allocation of event-specific State or federal funds (DWR, 2007). For example, both the U.S. Small Business Association and USDA provide low-interest loans to individuals, households, and businesses and organizations in declared disaster areas (CalEMA, 2009a). CalEMA coordinates the integration of federal resources into local and State response and recovery operations, including FEMA's predisaster and postdisaster mitigation grants (DWR, 2008b).

Federal funding for postflood repairs to State-federal facilities is also provided through Public Law 84-99, under which an eligible flood protection system can be rehabilitated and restored to its predisaster status at no cost to the federal system owner, and at a 20-percent cost to the eligible nonfederal system owner (OES, 1997c).

Flood Insurance Flood insurance is provided by the federal government via the NFIP, which was established by Congress in 1968. The NFIP enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between each community and the federal government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance and to reduce the escalating costs of repairing damage to buildings and their contents caused by floods (DWR, 2009e).

2.2 Likely Future Conditions

Defining existing conditions and how these conditions may change in the future is critical to the planning process. The magnitude of change influences not only the scope of problems and opportunities, but the extent of related conditions that could be affected by possible actions taken to address them. This section includes brief descriptions of the period of analysis for the 2012 CVFPP, key drivers and influencers for integrated flood management, and a brief description of likely future conditions.

2.2.1 Period of Analysis

For the 2012 CVFPP, the period of analysis is through 2050. The period of analysis is the time frame for which plan effects are evaluated and likely changes in conditions are considered. All plan elements are analyzed using this period of analysis. It should be noted that project life for many plan elements may be longer than the period of analysis. Further, it may not be possible to project or anticipate all changes over the period of analysis.

2.2.2 Key Drivers and Influencing Factors

Key drivers and influencers associated with integrated flood management are discussed in this section to better define likely future conditions and challenges, and to evaluate the relationships and relative sensitivity of the drivers and influencers to these conditions and challenges. Drivers are trends and external forces outside the control of flood managers that impact integrated flood management. Drivers are typically associated with a trend and direction of increasing or decreasing intensity or magnitude. Major drivers and influencers for integrated flood management in the Central Valley include the following:

- Change in population, and type and location of development in floodplains
- Water supply reliability and conveyance needs
- Climate change
- Environmental regulations
- Water quality
- Availability of public funding for flood management system improvements

Change in State Population, and Type and Location of Development in Floodplains

California's population is projected to grow from its current level of about 37 million people to 60 million people by 2050 (DOF, 2007). Much of this additional population will be accommodated in the crowded metropolitan coastal areas and in Southern California's Inland Empire. But these areas are finding it increasingly difficult to accommodate new development. Despite economic pressures to grow, the combination of rising costs and local opposition to growth is likely to push many people to seek homes and employment in the Central Valley (Teitz et al., 2005). The conversion of agricultural lands to other uses is expected to continue as urban areas grow and prospective homeowners move farther away in search of lower housing costs and a more rural lifestyle (USACE, 2001).

Much of this population increase in the current and planned urban areas of the Central Valley is expected to take place within floodplains (USACE, 2001). In many areas throughout the Central Valley, higher elevation locations have already been developed, pushing new development into historic floodplains. In some cases, land-use decisions are based on outdated information regarding the seriousness of the flood threat. For example, many flood maps used by public agencies and the general public are decades old and do not reflect the most accurate information regarding potential flooding, especially as it relates to the presumed level of protection provided by flood protection facilities (DWR, 2005). Furthermore, there is a lack of updated watershed and floodplain analysis and mapping information necessary to adequately manage floodplains and to evaluate impacts of land use and grading on floodplains and existing flood management infrastructure.

Population increase will likely result in profound changes in land-use patterns, increasing the population at risk from flooding and further reducing existing agricultural land and wildlife habitat. These changes will most likely occur as an encroachment of present urban/suburban areas into adjoining farmland. Also, this type of urbanization affects the flood management system by altering flow pathways, water storage, pollutant levels, rates of evaporation and transpiration, groundwater recharge, surface runoff, timing and extent of flooding, sediment yield of rivers, and suitability and viability of aquatic habitats (DWR, 2009e).

This will, in turn, impact the function and management of flood infrastructure, operations, and maintenance. Continued urban development within the floodplain will also make future changes to the "footprint" of the flood management system increasingly costly, increasing potential damages should the flood management system fail. In several flood-prone

areas, development has already occurred at the levee toe, which greatly increases the cost to raise existing levees or construct setback levees.

Low-density exurban development is having a much greater effect on the Central Valley landscape. This type of growth is also predominating in other parts of the country where land is inexpensive. Not only are people generally seeking larger houses and lots, but the entire apparatus of urban settlement – streets, commercial and industrial properties, public facilities, and other land uses – has become increasingly extensive. This means that for areas now on the urban frontier of growth, the footprint of development is much larger for a given population size. Such growth patterns are rare in coastal California. But this development pattern could occur over the next 40 years in the thousands of square miles of flat, privately owned, relatively inexpensive farmland in the Sacramento and San Joaquin river basins (Teitz et al., 2005).

Regional Population Changes and Floodplain Development Trends
The population of the Sacramento River Basin was about 2.6 million in 2000, but this is expected to increase to more than 4.5 million by 2030 (DWR, 2005c). The southern portion of this river basin is experiencing rapid population growth and urbanization. While the State experienced a statewide population growth approaching 15 percent from 1990 to 2000, growth rates in the Sacramento Metropolitan Area have exceeded this trend. Similarly, the adjoining urban areas in Placer, Yolo, and Sutter counties are also experiencing extensive growth and urban expansion. Much of this urbanization is occurring in areas protected by SPFC facilities.

Historically, most of the growth in the San Joaquin River Basin has occurred adjacent to agricultural towns that emerged along Highway 99 in the late nineteenth and early twentieth centuries (Teitz et al., 2005). While growth has slowed considerably because of the current economic conditions, significant residential and industrial growth is expected when the economy recovers. Of the estimated 4 million new people in the San Joaquin River Basin expected by 2050, fewer will be employed in agriculture, and they will live in urban areas that are largely yet to be built (Teitz et al., 2005). As with the Sacramento River Basin, much of this urbanization will be protected by SPFC facilities.

In the Delta, there is a formal process for urban development restrictions under the Delta Protection Act. The Delta Protection Commission (DPC) has designated primary and secondary zones within the legal Delta to respond to the threat of urban encroachment and promote orderly, balanced conservation and development of Delta land resources and improved flood protection. Figure 2-28 shows a map of the primary and secondary zones.

The Primary Zone of the Delta was delineated to eliminate incorporated cities (DPC, 1995). Many areas are currently being used for agricultural purposes and have value as agricultural lands (DPC, 1995).The Secondary Zone is all the Delta land outside the Primary Zone and is subject to the land-use authority of local government. These areas have a high likelihood of being developed for residential or other urban uses in the future (DPC, 1995).

Senate Bill (SB) 1 of the 2009 California Water Package would enact the Sacramento-San Joaquin Delta Reform Act of 2009. This act would establish the Delta Stewardship Council. The Delta Stewardship Council, an independent agency of the State, would have seven members (six appointed and one the chairperson of the DPC). The council's purpose would be to develop, adopt, and implement the Delta Plan, the long-term management plan to improve the Delta, by January 1, 2012.

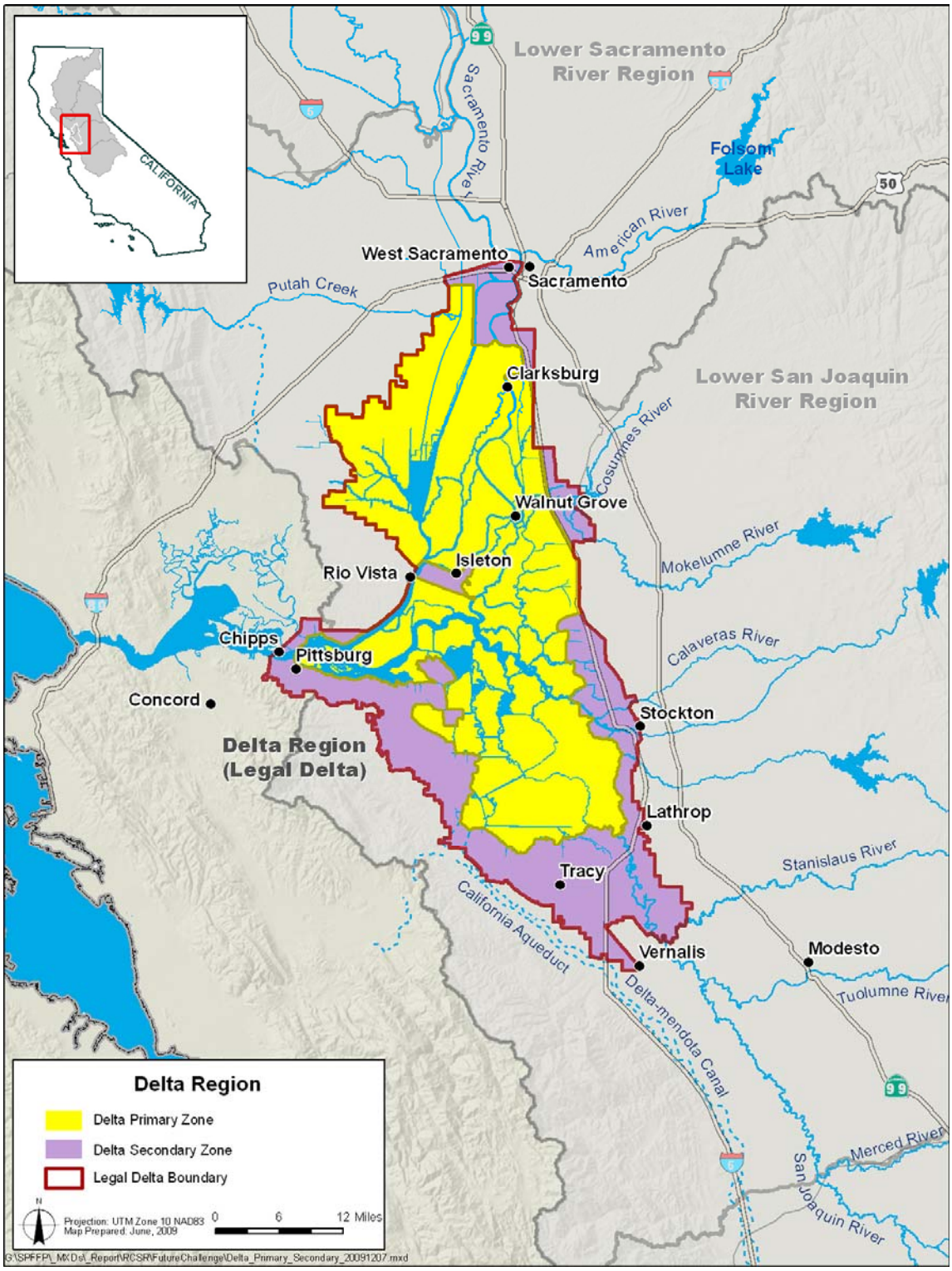


Figure 2-28. Delta Primary and Secondary Zones

2.2.2

Growth indicators include the number of residential housing development and related commercial/infrastructure facilities proposed, regional population forecasts, and city and county general plan update movements underway. These indicators demonstrate that urban development in the Primary Zone has been moderate, but activities in the Secondary Zone have continued to increase at a significant rate. Thus, the potential for development activities in the Secondary Zone to impact the Primary Zone continues to be of increasing concern and challenge for the Delta Protection Commission.

Water Supply Reliability and Conveyance Needs

Providing reliable water supply for residential, agricultural, and industrial users throughout the State is a current challenge that will likely increase in intensity in the future. Currently, water from the Sacramento River and San Joaquin River enters the Delta where it is exported to Southern California, the San Joaquin River Basin, and Central Coast areas through facilities of the CVP and SWP. Other local and regional water users also divert water from the Delta. Demand for water supply will likely increase as California's projected population grows to 60 million people by 2050 (DOF, 2007). Increasingly stringent environmental regulations, such as recent Delta export restrictions to protect delta smelt, have constrained already-limited rights to water from the Delta through additional diversions restriction based on conditions like, the reverse flow rate in Old and Middle rivers, San Joaquin River flow rate at Vernalis, and the locations of the 2 parts per thousand (ppt) isohaline (measured as 2.64 milliSiemens per centimeter (mS/cm) surface salinity) from the Golden Gate Bridge.. Sea level rise and reductions in snowpack from climate change will alter Central Valley hydrology and bring new water supply challenges. All of these factors will further impact availability and reliability of water supplies, and the ability to convey water supplies to major demand centers south of the Delta.

It is the opinion of some partners that the State will need to turn to localized, self-sufficient water solutions, rather than statewide water delivery systems, to ensure the demand for safe, clean, affordable water is met for all Californians.

These water supply reliability and conveyance challenges affect flood management. Primary areas of dependence and conflict between flood management and water supply include competition for limited storage space in multipurpose reservoirs, groundwater overdraft-induced subsidence affecting performance of flood protection facilities, and reliance of the State water conveyance system on levees in the Delta. These water supply reliability and conveyance challenges affect flood management. Primary areas of dependence and conflict between flood management and

water supply include competition for limited storage space in multipurpose reservoirs, groundwater overdraft-induced subsidence affecting performance of flood protection facilities, and reliance of the State water conveyance system on levees in the Delta. There are many ongoing efforts in Delta water management. The major efforts are:

- Legislation (SB 1 of the 2009-2010 Seventh Extraordinary Session) mandating the State Water Resources Control Board to develop flow criteria for the Delta ecosystem necessary to protect public trust resources.

- The same legislature also enacts the Sacramento-San Joaquin Delta Reform Act to establish the Delta Stewardship Council to develop, adopt, and implement the Delta Plan that will provide a more reliable water supply for California and protect, restore, and enhance the Delta ecosystem.

- At the same time, the State, Federal, and local water agencies are collaborating to develop the Bay-Delta Conservation Plan to identify a set of water flow and habitat restoration actions that will contribute to the recovery of endangered and sensitive species and their habitats in the Delta.

Reservoir Operations Management Multipurpose reservoirs are required to perform a wide variety of objectives, including water supply, flood control, recreation, hydropower, ecosystem resources, and water quality. Water supply and flood management are closely related because both objectives compete for limited reservoir storage space. To achieve flood control objectives, reservoirs decrease water storage to create flood conservation space in preparation for winter flooding. To achieve water supply objectives, flood conservation space decreases in late spring to allow additional storage for water supply. Reservoir operators must constantly make this tradeoff between storing additional water for future water supply needs and releasing water to increase flood control storage space. Many multipurpose reservoirs are already constrained by actions that promote instream habitat, water temperature management, and hydropower generation. As the demand for water continues to increase, there will be more pressure to maximize reservoir storage, which will severely reduce the flexibility of future flood control actions.

Land Subsidence Due to Groundwater Overdraft The statewide water supply system in California is so interdependent that decreased water availability through the Delta might lead to accelerated subsidence from increased groundwater pumping, in areas that have developed a reliance on imported water from the Delta. Subsidence from groundwater pumping

impacts flood control management because it damages flood control structures, increases costs for levee maintenance, and changes channel hydraulics and capacity. Subsidence also causes saltwater intrusion into the San Joaquin River Basin aquifer, which causes irreversible damage to groundwater supplies and increases water scarcity (USGS, 2000). Subsidence also damages highway and railway infrastructure. Increased groundwater pumping also degrades soil conditions because groundwater generally contains higher levels of boron, selenium, iron, and manganese than surface water.

Historically, over-pumping in the San Joaquin and Santa Clara valleys has compacted critically stressed aquifer systems, resulting in land subsidence. Before imported Delta water became available in the mid-1970s, nearly 30 feet of subsidence had been measured in the San Joaquin River Basin and up to 14 feet in the city of San Jose in the Santa Clara Valley. Estimated damages were in the hundreds of millions of dollars, largely due to costs associated with construction of flood control structures and well damage (Galloway et al., 1999).

Both the Santa Clara and San Joaquin valleys now rely, in part, on imported water from the Delta to augment local supplies. The imported water reduces local groundwater pumping and arrests, or slows, subsidence. Recent groundwater pumping increases in the San Joaquin River Basin has raised concerns that land subsidence could lead to damages in the concrete channel of the California Aqueduct. Without repair, damages to the California Aqueduct would impair water exports to major demand centers south of the Delta by causing cracks in the structure or creating low spots that reduce canal capacity. Increased groundwater banking during wet years will likely be needed to reduce land subsidence and improve water supply reliability for the San Joaquin River Basin.

Reliance on Delta Flood Protection Facilities The Delta, as the heart of California's statewide water supply system, is strongly dependent on flood protection facilities. The Delta's maze of waterways serves as an outlet for flood flows and provides water supply for more than 60 percent of the State. These waterways are surrounded by more than 1,100 miles of levees that protect 57 islands or tracts from flooding while at the same time protecting critical transportation, energy, and communications infrastructure. If levees from multiple islands were to fail because of an earthquake, sea level rise, or increased hydrostatic pressure from Delta land subsidence, seawater would be pushed into the Delta and cause a water supply emergency that is estimated to cost more than $10 billion (Lund et. al, 2008). Delta levee stability is therefore critical to water supply exports from the Delta.

Recent environmental restrictions on water supply exports from the Delta and the risk of a catastrophic levee failure have renewed interest in alternative conveyance that would reduce reliance on through-Delta conveyance and southern Delta export diversions with upstream diversions. The Bay Delta Conservation Plan is an ongoing planning effort to support restoration of habitat for Delta fisheries in a way that reliably delivers water supplies to water users south of the Delta. The Bay Delta Conservation Plan is considering a range of alternatives that would combine a Delta conveyance option with compatible restoration opportunities, actions to address other stressors, and corresponding adaptive management strategies.

Climate Change

While the exact conditions of future climate change remain uncertain, there is no doubt about physical changes that have already happened. The average early spring snowpack in the Sierra Nevada decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage (California Natural Resources Agency, 2009a). During the same period, sea level rose 7 inches along California's coast. California's average temperature has risen 1 degree Fahrenheit (°F), mostly at night and during the winter, with higher elevations experiencing the highest increase (DWR, 2008b). A disturbing pattern has also emerged in flood patterns; peak natural flows have increased in many of the State's rivers during the last 50 years (DWR, 2008b).

As California's hydrology evolves, both naturally and with climate change, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Moreover, as peak flows and precipitation change over time, climate change calls into question assumptions of "stationarity,"[16] which are used in flood-related statistical analyses like the 100-year flood. Planners will need to factor new levels of robustness and resiliency into design, operation, and regulation of flood protection facilities such as dams, floodways, bypasses, and levees, as well as design of local sewers and storm drains.

Increased temperatures directly impact the health of California's environment and water systems. In addition, increased temperatures are altering runoff patterns and sea levels, which will challenge the State's water infrastructure and flood management policies.

The State has acknowledged the importance of climate change, as demonstrated by the passage of Assembly Bill (AB) 32 – the California Global Warming Solutions Act, which states, "Global warming poses a

[16] Stationarity is an assumption that the mean and variance of historical data do not change over time.

serious threat to the economic well-being, public health, natural resources, and the environment of California."

Increasing Temperature The average temperature in California is expected to increase by 2 to 5°F by 2050 because of climate change (California Natural Resources Agency, 2009b). Higher temperatures – especially in the summer and over a longer growing season – cause small increases in evapotranspiration rates from plants, soils, and open water surfaces, including reservoirs. Higher temperatures overall will also increase water temperatures throughout the system, including inflows into reservoirs, water stored within reservoirs, and water flowing downstream. Such increases will significantly affect ecosystem and human uses of the water system (Hanak and Lund, 2008).

Changes in seasonality, quantity and temperature of water, as well as sea level rise, may affect establishment of riparian vegetation, and the quality, quantity, and connectivity of terrestrial and aquatic habitat. Most species have a range of temperatures in which they thrive. Chinook salmon, in particular, generally prefer temperatures of less than 68 °F (Hanak and Lund, 2008). In many streams, cold-water habitat is provided at unnaturally low elevations for some salmon runs by releasing cold water stored in reservoirs from winter and early spring flows. Rising water temperatures will make it increasingly difficult to mitigate for upstream storage by providing habitat downstream. Delta smelt require temperatures below 68 °F to spawn and rising temperatures would likely decrease the spawning season (Bennett, 2005). Impacts on terrestrial ecosystems have also been observed in North America, including changes in the timing and length of growing season, timing of species life cycles, primary production, and species distributions and diversity (CEC, 2009).

To date, little research has been done on other impacts of water temperature increases, although such changes are likely to significantly affect drinking water quality, habitats for native species, and agricultural practices. In general, higher temperatures are likely to increase chemical reaction rates in water, leading to increased rates of algal growth and decay, perhaps adding problems and instability to water quality throughout the State. For human uses, several water treatment processes are affected by water temperature (Hanak and Lund, 2008). Cropping patterns, planting and harvest timing, and other agricultural practices may need to be changed to adjust to the effects of higher temperatures and increased evapotranspiration.

Runoff Patterns Rising temperatures will reduce snowpack in California's mountains because more precipitation will fall as rain, and snowmelt will occur earlier (Knowles et al., 2006). If overall precipitation

patterns do not change, these effects of warming will increase winter runoff and decrease spring runoff (Lettenmaier and Gan, 1990). Knowles and Cayan (2002) found that the combination of warmer storms and earlier snowmelt caused April watershed total-snow accumulation to drop to 95 percent of present levels by 2030, 64 percent by 2060, and 48 percent by 2090.

California's current water systems are designed and operated to strike a balance between water storage for the dry months and flood protection during the winter and spring, when heavy rainstorms, runoff, and snowmelt can cause downstream flooding. Historically, the snowpack produces about 15 million acre-feet of runoff slowly over the warming spring and summer months (DWR, 2008b). California's water storage and conveyance infrastructure gathers this melting snow in the spring and delivers it for use during the drier summer and fall months. This same infrastructure is also used for flood control in the winter and early spring by keeping reservoir levels lower. With earlier snowmelt and heavy winter/spring rains possibly coinciding, difficult tradeoffs may need to be made between water storage and flood protection (California Natural Resources Agency, 2009b). Warmer conditions are very likely to result in new juxtapositions of more intense flood seasons paired (often in the same year) with much-depleted runoff in warm seasons. Increased coordination among water supply, hydropower, fish protection, and flood management agencies will likely be required.

Reductions in snowpack and shifts from snowfall to rainfall seem likely to increase flood peak flows and flood volumes and shift the timing of peak runoff due to snowmelt (Miller et al., 2003; Fissekis, 2008). A greater proportion of annual runoff has already been occurring earlier in the water year (Aguado et al., 1992; Dettinger and Cayan, 1995). For reservoirs that lie downstream from significant mountain snowpacks, the resulting shift in reservoir inflows could pose major risks for flood control and water supply, particularly if reservoir operations are not modified to accommodate the new conditions (DWR, 2006; Medellin et al., 2008; Fissekis, 2008).

Increased intensity and frequency of major storms, another anticipated effect of climate change, would further augment flood problems in California (Knox, 1993; Florsheim and Dettinger, 2007). Flood peaks can increase erosion rates that result in greater sediment loads and turbidity, altering channel shapes and depths, possibly increasing sedimentation behind dams and affecting habitat and water quality (DWR, 2008b). Increasing temperatures would also increase the frequency and severity of wildfires due to drier fuel conditions (California Natural Resources Agency, 2009b), which, in turn, result in further increased runoff, erosion, and sedimentation. Prolonged droughts interrupted by intensified flooding

events may result in increased water quality impacts from pollutants (naturally occurring and anthropogenic) in the watershed being carried by the runoff.

Sea Level Rise Sea levels are rising, and it is generally accepted that this trend will continue. However, the exact rate of rise is unknown, because of ongoing scientific uncertainty about the melting of ice sheets in western Antarctica and Greenland and the potential for abrupt changes in ocean conditions. Recent peer-reviewed studies estimate a sea level rise of from 7 to 55 inches by 2100 along California's coast (DWR, 2008b).

The implications of a 7-inch rise are dramatically different than a rate of rise toward the upper end of the range. However, even a rise at the lower end of this range poses an increased risk of storm surge and flooding for California's coastal residents and infrastructure, including many of the State's wastewater treatment plants (DWR, 2008b). Historical coastal and Bay-Delta structure design criteria may be exceeded by rising sea levels (Cayan et al. 2006). New flood control facilities or improvements to existing facilities will need to be designed more robustly to account for expected sea level rise.

Moreover, sea level rise can contribute to levee failures in the Delta inundating communities, damaging infrastructure, and interrupting water supplies throughout the State (Hanak and Lund, 2008). Roos (2005) reports that a 1-foot rise in sea level would increase the frequency of the 100-year peak high tide to a 10-year event. Impacts associated with a rise in sea level would likely be most significant in the Delta, where a rise in sea level would increase pressure on levees currently protecting low-lying land, much of which is already below sea level. However, many believe that because sea level rise occurs gradually, a consistent long-term maintenance program would enable levee systems to keep pace.

Even without levee failures, Delta water supplies and aquatic habitat will be affected because of saltwater intrusion. An increase in the penetration of seawater into the Delta will further degrade drinking and agricultural water quality and alter ecosystem conditions. More freshwater releases from upstream reservoirs will be required to repel the sea to maintain salinity levels for M&I, and agricultural uses (DWR, 2008b).

Regional Impacts from Climate Change In the Upper Sacramento River Region, reduced snowpack and more rainfall will impact Shasta Dam operations because the reservoir is primarily operated for rainfall runoff. The multiple unregulated tributaries in the region without reservoirs will be influenced by changes in the timing of inflow.

In the Lower Sacramento River Region, multipurpose reservoirs will struggle to balance demands for water supply reservation and flood control storage. Folsom Dam is the only reservoir in the region currently designed to deal with increased water supply and flood control competition. Climate change will also require greater coordination among single-purpose reservoirs to share information and integrate operations. Refuge management will also be impacted by changes in flow timing and volume. Sea level rise will move the Delta further upstream, inundating channels and requiring higher, more robust levees.

In the San Joaquin River Basin, climate change would cause a longer drought season due to higher temperatures and would increase the occurrence of forest fires, which would, in turn, increase runoff, erosion and sedimentation in the basin. Also, reduced snow pack and more rainfall would impact Friant Dam operations.

In the Delta region, sea level rise would require higher levees because of increased flood risk. Increased velocity from runoff patterns and sea level rise will increase sediment transport and change the location of sediment deposition. Tidal energy would decrease because of more flooded areas. The combination of increased temperature and sea level rise would likely alter existing Delta habitats, threatening several Delta species and possibly increasing the infestation of invasive species. The location of marsh habitat, in particular, would likely move upstream or disappear.

State and Federal Environmental Regulations

As societal values for ecosystem sustainability have grown, State and federal environmental regulations have also increased in size and scope. These regulations have served a critical role in attempts to prevent the loss of native habitat and species and promote natural physical and biological processes.

Compliance with environmental regulations poses significant challenges for the construction, operation and maintenance of the flood management system, especially since most of the system was not designed or built to readily accommodate multiple objectives. Multiple State and federal permits from multiple agencies are often required for construction of new flood control facilities and some routine levee maintenance, such as debris and brush removal, levee crack repair, and rodent control. Mitigation is often required to offset the take from each flood maintenance activity or newly constructed facility on a project by project basis. The numerous plans and studies required for compliance can take more than a year to obtain, which can constrain the limited budgets and staff of locally funded LMAs responsible for maintaining and operating flood control facilities.

Recent trends in the permitting and mitigation process have sought to both improve regulatory effectiveness and reduce the costs of compliance. The trend among Habitat Conservation Plans has been towards programmatic and regional approaches to the permitting and mitigation process in place of a project by project approach. Programmatic mitigation approaches allow fulfillment of mitigation requirements in advance of proposed projects. This provides higher biological value from larger, contiguous habitat areas, reduces monitoring and management costs, and speeds up project approval. USACE has begun adopting Regional General Permits which streamline the regulatory process for activities within a region that are similar in nature and cause only minimal individual and cumulative adverse impacts. Also, under development is regional advance mitigation planning (RAMP), a new approach to addressing mitigation required by infrastructure projects in the State. RAMP incorporates both a "regional" geographic component and an "advance" time frame. The "regional" component will allow State and federal agencies to consider regional conservation priorities and evaluate the environmental impacts of several planned infrastructure projects at once. The "advance" time frame will identify regional mitigation opportunities that will satisfy anticipated mitigation requirements early in the project planning and environmental review process. Several agencies, including DWR, are participating in the RAMP Work Group formed in 2008.

Flood management construction, operation and maintenance practices will need to continue to adapt to current and new environmental regulations using a variety of structural and nonstructural solutions that provide comprehensive, multi-objective benefits. Trends will likely lead to flood management practices that increasingly combine an understanding of ecosystem functions with opportunities to increase flood protection.

Several drivers suggest that environmental regulations will increase, and that more sensitive species will require Federal and California ESA protections. Sea level rise, increased temperature, and changes in runoff patterns from climate change will impact surface water quality and may affect establishment of riparian vegetation. Climate change may also impact the quality, quantity and connectivity of terrestrial and aquatic habitat. The water supply needs of future urban development may also conflicts with the need for environmental in-stream uses. Assuming continued statewide reliance on non-local water sources, water will become more scarce and water quality will continue to worsen. The introduction and establishment of invasive species could also increase the need for more environmental regulations by altering ecosystem habitats and displacing sensitive species on the brink of becoming threatened or endangered. These factors will increase the stress on habitat and species, and more environmental regulation will be required to protect them.

Regional Trends in Environmental Regulations The Upper Sacramento River Region contains multiple mitigation banks that serve other regions. Environmental mitigation requirements will likely increase demand for mitigation banks in this area. A recent safe harbor agreement program has been created to cover 222 miles of the Sacramento River from Red Bluff Diversion Dam to Verona which will encourage landowners to restore and enhance wildlife habitat on their property without fear of being burdened with new ESA restrictions.

In the Lower Sacramento River Region, pressure on anadromous fish populations may require restored access to the upper watersheds of the American and Yuba rivers, which may result in dam removal. Flood managers will need to use floodwater to provide beneficial use for both habitat and flood management, such as using flood releases for groundwater replenishment and storage. Development of additional HCPs will also increasingly drive future land-use decisions, resulting in more open space for mitigation, habitat, and flood storage.

With the large number of flood control and multipurpose reservoirs in the Upper San Joaquin River Region, tensions between flood operations and their potential impacts to endangered species will likely increase. Water rights for Section 215 water[17] may require permitting. The spread of invasive species such as quagga and zebra mussels could clog pipelines and impair the ability of reservoirs to provide adequate flood control.

In the Lower San Joaquin River Region, environmental regulations could both benefit and hinder flood management. Increased regulations to control invasive species and support environmental restoration could increase channel capacity and floodplain habitat. But environmental regulations also increase the complexity and cost of flood system improvements.

In the Delta, regulations requiring the creation of brackish marsh would have significant effects, including increased wave fetch, the “domino effect” of Delta levee collapse, decreases in Delta agricultural production, and threats to critical infrastructure (Lower San Joaquin Work Group, 2009). The importance of the Delta as a diverse ecological habitat, a water supply source for the entire State, and the drainage basin for flood flows from the Sacramento and San Joaquin rivers, create a complex regulatory environment.

[17] Section 215 water refers to temporary water supply made available via Section 215 of the Reclamation Reform Act of October 12, 1982 (Public Law 97-293, Title II), as amended (43 United States Code Section 39000).

Water Quality

The following sections describe factors (temperature, salinity, and mercury) that affect water quality and are expected to change in the future.

Temperature There are several State and federal water temperature requirements in the Sacramento River Basin downstream from existing reservoirs. River temperatures are influenced by water temperature from reservoir releases, flow volume, natural instream warming, and riverine shading. Low flows and higher temperature water released from reservoirs can cause river water temperatures to approach critically high levels for sustaining juvenile salmon populations (Vermeyen, 1997).

Temperature requirements impact flood management because they influence the timing and amount of upstream reservoir releases. Climate change and its impacts on air temperature and runoff patterns will likely require reservoir operators to revise operations to meet existing water temperature requirements. Higher temperatures overall will likely increase water temperatures throughout the system, including inflows into reservoirs, water stored within reservoirs, and water flowing downstream. Such increases will significantly affect ecosystem and human uses of the water system (Hanak and Lund, 2008). Management operations may include revised carryover storage requirements for upstream reservoirs, enforceable water temperature requirements in downstream reaches, and flexible short- and long-term flow management strategies.

While riverine vegetation provides ecosystem benefits of riverine habitat and shading, vegetation on and around levees can obscure visibility, impede access for maintenance and inspection, and hinder emergency flood fighting operations. Vegetation also increases the roughness of the land surface and could impede flood flows. In California, USACE has granted a temporary exclusion from enforcing the national levee maintenance policy, which allows only grass on levees, but not trees or shrubs. But if USACE enforces its levee maintenance policy and vegetation is removed, temperature requirements will have a greater impact on reservoir operations because of the need for more cold water storage to compensate for increased water temperature due to tree and shrub removal.

Salinity Before construction of today's water supply and flood control facilities, salinity levels in the Delta were lower in the winter and spring and higher in the summer and fall (URS, 2007). Today, Delta salinity levels are mandated by water quality control regulations that maintain a more constant low level of salinity in the south and central Delta for agricultural and urban uses (MWH, 2008). Salinity in the Delta is managed by a mix of releases from upstream reservoirs, Cross Channel Gate operations, Delta outflow, and exports from the Delta (URS, 2007). Similar to temperature

requirements, salinity objectives impact flood management because they influence the timing and amount of upstream reservoir releases.

While salinity in the Sacramento River is generally low, salinity continues to increase in the San Joaquin River Basin. The accumulation of salts in the San Joaquin River Basin is due to a combination of the regional geology, high water table, irrigation and drainage practices, importation of water from the Delta that is high in salinity, and hydrology. Salinization caused by naturally occurring soil salts is exacerbated by the use of more saline Delta water, imported via the Delta-Mendota Canal and California Aqueduct. Salts become concentrated in the root zone by evaporation through the soil. Farmers actively leach these salts from the soil, and drainage water is discharged to San Joaquin River tributaries. A preliminary evaluation of salt migration to groundwater in the San Joaquin River Basin estimated that more than 400 thousand tons of salt per year were being added to the confined aquifer in the San Joaquin River Basin (RWQCB, 2006). If current practices for discharging waters containing elevated levels of salt continue unabated, a large portion of San Joaquin River Basin groundwater could be severely degraded within a few decades (RWQCB, 2007). A Total Maximum Daily Load (TMDL) has been adopted for salt and boron in the San Joaquin River and the Basin Plan for the San Joaquin and Sacramento river basins has been amended to include the TMDL.

Delta salinity is influenced by tidal exchanges with San Francisco Bay, river inflows, diversions, and return flows from agricultural and urbanized lands. The north Delta tends to have better water quality primarily because of inflow from the Sacramento River. West Delta water quality is strongly influenced by tidal exchange with San Francisco Bay. In the south Delta, water quality tends to be poorer because of the combination of inflows of poorer water quality from the San Joaquin River, discharges from Delta islands, and effects of diversions that can sometimes increase seawater intrusion from the San Francisco Bay. Because actual flow from the San Joaquin River is lower than from the Sacramento River, total dissolved solids concentrations in San Joaquin River water average approximately 7 times those in the Sacramento River (MWH, 2008).

Sea level rise from climate change will increase salinities in the Delta, unless additional freshwater inflows to the Delta are provided to prevent this. In response to expected sea level rise from climate change, Delta outflow requirements will likely increase to maintain Delta salinity conditions. Natural summer flows will likely be lower, adding to dry season water supply and quality problems (DWR, 2009f). Changes in reservoir operations and reduced annual snowpack from climate change

could result in less water being available in the summer and fall to meet Delta outflow and salinity control requirements.

Mercury Most of the inorganic mercury entering the Delta comes from historic mercury and gold mining operations in the Coast Ranges and Sierra Nevada Mountains. Hard rock, placer, and hydraulic mining all used mercury to extract gold. Mercury forms an amalgam with gold and is later burned off, or volatilized, by a retort process, leaving the gold behind.

An estimated 26 million pounds of mercury were used to extract gold from ore in California (Alpers, 2005). Of this, an estimated 13 million pounds were lost to the environment in mining operations (Churchill, 2000). In the Sacramento and, San Joaquin river basins and Delta, the transport of mercury-contaminated water and sediment from historic mercury and gold mining areas has contaminated aquatic environments and floodplains far downstream (Domagalski, 1998, 2001; Ganguli et al., 2000; Rytuba, 2000). Elemental mercury and gold-mercury amalgam are often visible in streams draining hydraulically mined areas of the Sierra Nevada and in dredged goldfields downstream, such as those on the Yuba and American rivers (Michael Hunerlach, USGS, Sacramento, California, unpublished data; Rick Humphreys, SWRCB, Sacramento, California, unpublished data (Wiener et al., 2003)). The Sacramento River Basin, in particular, was a site of intensive historic mining for gold and mercury and is a significant source of mercury and methylmercury in the Delta today (Domagalski, 2001; Choe and Gill, 2003; Choe et al., 2003). Methylmercury is formed from inorganic mercury by anaerobic organisms in natural aquatic environments. Restoration projects in the Delta and floodplains have the potential to cause mercury methylation. Cache Creek is cited as the largest single contributor of mercury into the Delta and this is reflected in the proposed Delta mercury TMDLs (Foe and Croyle, 1998; Domagalski, 2001).

Dredging reintroduces mercury to a stream through fine sediment and clay particles (Humphreys, 2005) and the mercury can reenter streams as runoff when dredge spoils are disposed of on land. Sediments in their natural reduced state bind mercury much more effectively than after they have become oxidized when exposed to air. Thus, when mercury-contaminated sediments are exposed to air and to oxygen-rich surface waters, the bound mercury is released to the environment as a solution in the runoff water. The present distribution of contaminated sediments extends from small streams below mine sites, to extensive alluvial areas in floodplains where gold was dredged, downgradient through the Delta and San Francisco Bay (Wiener et al., 2003). Mercury-contaminated sediments impact flood control because they limit dredging operations. Dredging projects are ongoing, continuing activities necessary to remove sediment and improve

flood control, keep ship channels open, and control riverbank erosion. The average annual sediment load from the Sacramento and San Joaquin rivers to San Francisco Bay is estimated to be 8 million cubic yards (Porterfield, 1980). The Delta, with more than 700 miles of waterways, is a major area of dredging activity.

Availability of Public Funding for Flood Management System Improvements

Funding for the major capital improvement and routine maintenance of the flood management system is dependent on public funding generated by local, State, and federal sources. There has been a growing recognition that funding for flood management in recent years was woefully inadequate (DWR, 2005b). Total local and State capital spending for flood management from 2001 to 2003 has been in the range of $40 million to $55 million. A preliminary assessment by DWR (2005b) put investment needs at 3 to 4 times that amount during the same period. The Governor's Strategic Growth Plan, coming in the wake of Hurricane Katrina flooding, increased spending on flood management, calling for $6 billion in spending over 10 years. While the State increased funding for flood control through Propositions 84 and 1E in 2006, the recent economic crisis and limitations in local government funding have made financing critical flood control infrastructure a major challenge.

Local Government The need for increased funding at the local level to deal with a deteriorating flood control infrastructure is particularly great (DWR, 2005b). A series of initiatives and laws enacted over the last 3 decades make it difficult to meet this need. Proposition 13, passed in 1978, capped property tax increases at 2 percent per annum for existing homeowners, limited assessments to 1 percent of assessed value, and authorized reassessments only on resale. It also mandated supermajority (two-thirds) voter approval for the passage of special taxes. In 1986, state voters passed Proposition 62, a statutory law that mandated that a majority of voters within a locality approve any new general local taxes. In 1996, the courts declared Proposition 62 constitutional and applicable to all localities (Hanak and Reuben, 2006). In that same year, voters passed Proposition 218, a constitutional amendment that mandated majority votes for general taxes, and extended Proposition 13's supermajority requirement to local assessments and nonspecific fees[18] (Hanak and Reuben, 2006).

Flood control charges have been interpreted to fall under Proposition 218's strict voter approval requirements (DWR, 2005b). These supermajority requirements put a significant constraint on the ability of local agencies to raise flood control funding. Without new revenue sources, cities will either

[18] An alternative is passage by a simple majority of property owners.

need to cut back on existing services or fall into noncompliance because of a lack of funds[19] (Hanak and Reuben, 2006).

Although some at-risk areas, such as the cities of Sacramento and West Sacramento, have been successful in raising funds, California is dotted with examples of local bonds that have failed despite high voter approval (Hanak, 2009). Cities for which flood-control bonds have recently failed include Burlingame (64 percent) and Orinda (62 percent) in November 2006 (Hanak, 2009). California is one of only eight states with supermajority voter requirements on the passage of local bonds[20] (Hanak and Reuben, 2006). These restrictions on availability of local funding for flood management improvements are likely to continue into the foreseeable near future.

State and Federal Government Given these constraints on local funding, it is not surprising that State bonds – which require a simple majority approval – seem like a sound funding alternative. Of the seven state infrastructure bonds that passed in the November 2006 and 2008 elections, only one – for education – would have passed under local voter rules. This is because local school bonds are held to a lower voter approval threshold – 55 percent rather than two-thirds. Flood risk concerns have stimulated an increase in State funding since 2006, through special budget appropriations and about $5 billion in new bond funds. As a result, State spending on flood works has overtaken federal funding from its traditional source, USACE (Hanak, 2009).

State and federal funding have a profound effect on the ability of local agencies to operate, manage, and improve their flood protection systems. But responsibility for flood control funding is now shifting away from State and federal governments and toward local agencies. Per the WRDA of 1996, the federal government reduced the maximum that it would pay for the cost of new flood control projects, from 75 percent to 65 percent of the total project cost. It is expected that flood control projects will require an increasingly greater cost share from local agencies. This financial strategy is intended to distribute the costs of flood control measures among those that benefit from them, thus relieving the general taxpayer of the burden.

Furthermore, both the State and federal government are in worse financial shape than they were a few years ago. The State's recent fiscal crisis has decreased the general fund's allocations for flood maintenance, improvements, and management activities (DWR, 2005b). It seems unlikely that the State government will have, at any time in the near future,

[19] See Hanak and Barbour (2005) for some cost estimates.
[20] Missouri and North Dakota also require a two-thirds majority to pass local debt, and Idaho, Iowa, Oklahoma, Washington, and West Virginia require a three-fifths vote.

a ready supply of general fund money to invest in new flood control ventures (Misczynski, 2009).

Even when State and federal funding is available, local agencies must undergo a rigorous process to apply for eligibility. Local agencies cannot access State or federal cost-sharing funds unless they apply for a Section 104 federal credit. Under Section 104, Public Law 99-662, nonfederal sponsors constructing a flood control project must prove that the project is compatible with a future federal project. Local agencies must also comply with Section 14 of the Rivers and Harbors Act of 1899 (33 United States Code (USC) 408), which grants permission for the temporary occupation or use of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States.

Delta Region Public Funding Issues More than 700 miles of Delta levees are now maintained by local special districts, including RDs, LDs, and flood control and drainage districts. About 385 miles of these levees are part of the SRFCP overseen by USACE and are eligible for financial assistance from USACE. The State has provided grants to help local agencies maintain and improve their levees since 1973, and recent State general obligation bond acts have substantially increased the money available in the past few years (Propositions 84 and 1E in 2006). But the existing financing structure will likely struggle to bring Delta levees to minimally reasonable standards of protection. Furthermore, costs of reasonable protection will almost certainly increase with the expectations of a rising sea level, and could rise considerably should a large earthquake occur in or near the Delta.

The Delta Levees Maintenance Subventions Program provides financial assistance to local LMAs for the maintenance and rehabilitation of non-project levees in the Delta since 1973. It is authorized in the California Water Code, Sections 12980 thru 12995. The intent of Legislature, as stated in the Water Code, is to preserve the Delta as much as it exists at the present time. The program is under the authority of the Board and is managed by DWR. Water Code Section 12987 calls on DWR to prioritize the islands for receipt of grant funds through the program and recommend the prioritization to the Board. The Board reviews and approves the Department's recommendation and enters into an agreement with RDs to reimburse eligible costs.

The amount of money available remains modest relative to “need,” and many local levee maintenance agencies are unable to raise the local matching funds required by the propositions (Misczynski, 2009). The problem is compounded because in many cases, the cost of levee improvements exceeds the value of the land and assets protected (Lund et

al., 2008). Because of restrictions on development in the Delta Primary Zone, development fees to support flood management improvements are also unavailable.

The trend in declining available public funding for flood management improvements is likely to continue, especially with regard to locally generated funding.

2.2.3 Likely Changes in Conditions Through 2050

Predicting future changes to the physical, biological, social, and economic environments is complicated by various flood management, ecosystem restoration, water supply reliability, and water quality efforts that are anticipated to be implemented over the period of analysis, through 2050. It is difficult to estimate how these individual projects may influence future conditions because they are not part of a well-defined, integrated, or regional plan. Furthermore, these efforts may not meet the conditions generally required for projects to be considered reasonably foreseeable (i.e., authorized, funded, and permitted, or under construction). The following is a brief description of the likely changes future conditions.

Physical Conditions

Basic physical conditions are expected to remain relatively unchanged in the future. No major changes to area topography, geology, or soils are foreseen. Continued development in urban and suburban areas is expected. Current agricultural-to-urban land conversion trends in the Central Valley and around existing Delta communities will likely continue.

Ongoing restoration efforts along rivers are expected to marginally improve natural riverine processes and rivers' abilities to meander. Restoring floodplain processes will also provide some flood protection. Without major levee realignments, the geomorphology of the Sacramento and San Joaquin river basins would remain similar to present conditions. In areas where the rivers are not confined by geological or man-made formations and are given space to meander, more natural river channel meander and migration patterns would occur as a result of geomorphic processes.

Without major physical changes to the river systems, hydrologic conditions will probably remain unchanged. The region's hydrology could be altered should there be significant changes in global climatic conditions. A trend of decline in the portion of annual precipitation stored as snowpack would likely occur. A potential increase in the variability of precipitation and runoff could have an effect on flood hydrology and on water supply within the Sacramento and San Joaquin river basins and the State. Without major changes in hydrology, topography, or geology, sedimentation and erosion patterns are also likely to remain unchanged.

Increased population is one factor that could degrade water quality, but existing regulations require mitigation for that effect. Increased ecosystem restoration (i.e., restored wetlands) would provide some improvement in water quality. In addition, efforts are underway to better manage the quality of runoff from urban environments to major stream systems, and to control the levels and types of herbicides, fungicides, and pesticides that can be

used in the environment. Sea level rise would increase saltwater intrusion into the Delta degrading water quality and affecting water management in the Delta.

As the population continues to grow and agricultural lands are converted to urban and industrial uses, a general degradation of air quality conditions could occur. However, because of technological innovation and stringent regulations, air quality could improve over time.

Similar types and sources of hazardous materials and waste are likely to be present in the future. However, an increasing population will likely increase the potential for hazardous waste storage, disposing, and handling issues.

Infrastructure

Urban development within floodplains will increase the need for flood management infrastructure. Urban development that is near existing flood management facilities will limit opportunities for infrastructure improvements. The cost and time necessary to conduct routine levee maintenance will remain high. Compliance with environmental regulations will continue to drive where and when construction of new flood control facilities can occur.

Biological Conditions

Efforts are underway by numerous agencies and groups to restore various biological conditions throughout the Sacramento and San Joaquin river basins. Accordingly, major areas of wildlife habitat, including wetlands and riparian vegetation areas, are expected to be protected and restored. While regional habitat planning initiatives exist, such as the Central Valley Joint Venture, most habitat improvement will be based on separate opportunities that are not integrated in a single plan. While many have visions for an integrated ecosystem plan, they lack authority to significantly alter the river system because of its flood management function. Therefore, ongoing restoration will likely provide localized benefits. In addition, as population and urban growth continues and land uses are converted to urban centers, many wildlife and plant species especially dependent on woodland, oak woodland, and grassland habitats may be adversely affected.

Through ongoing efforts of various agencies and groups, populations of special-status species in the riverine and nearby areas are estimated to generally remain as under existing conditions. Although increases in anadromous and resident fish populations could occur through implementation of various ongoing restoration projects, some degradation will likely occur through actions that reduce flows or elevate water temperatures.

Social and Economic Conditions

The population of California is estimated to increase from about 37 million to more than 60 million by 2050 (DOF, 2007). Growth in population and increased global competition in the agricultural sector will contribute to the conversion of agricultural and other rural land to urban uses, particularly in the Central Valley. This will increase flood risk and further reduce land available for maintaining and restoring ecosystem values.

Anticipated increases in population growth in the Central Valley will also increase demands on water resources systems for additional and reliable water and energy supplies; water-related, recreational and flood management facilities; water and wastewater utilities; public services such as fire, police protection, and emergency services; and communication infrastructure. Further, the increasing population will increase the potential for hazardous, toxic, and radiologic waste issues in the future. Modification of existing traffic corridors and construction of new transportation routes likely will occur, further connecting anticipated population growth centers in the Central Valley.

Anticipated increases in population also will have impacts on visual resources, as areas of open space are converted to urban uses.

Cultural Resources

Paleontological, historic, archaeological, or ethnographic resources currently being affected by flooding, erosion, urban and agricultural development, and rodent intrusion would continue to be impacted. However, no changes in Native American groups or Indian Trust Assets are anticipated.

2.3 Pending Projects and Programs

Present and reasonably foreseeable (probable) projects are those projects that are currently under construction, approved for construction, or in final stages of formal planning and environmental compliance and will be completed before the succeeding CVFPP update in 2017.

Based on this review, the effects of the following actions were qualitatively considered in the assessment of the existing conditions. This list includes major flood protection facilities, resource management and restoration, water supply and quality, transportation, development, and emergency response.

2.3.1 Early Implementation Program

DWR has been given authority under Proposition 1E to make funds available for flood protection work to local agencies (State, 2007b). Projects that are funded by the Early Implementation Program (EIP)[21] are:

- American River Watershed, Folsom Dam Raise Project
- Feather River Levee Improvement Project
- Lower Feather River Setback Levee at Star Bend Modification
- Mid-Valley Levee Reconstruction Project
- Natomas Cross Canal South Levee Improvement Project, Phases 1, 1B and 2
- Sutter Bypass East Borrow Canal Water Control Structures
- Sutter Bypass Pumping Plants Control Systems Upgrade Project
- The Bear River North Levee Rehabilitation Project
- Tisdale Bypass Channel Rehabilitation
- West Sacramento Project

[21] Descriptions of each of these projects may be found at http://bondaccountability.resources.ca.gov/plevel1.aspx?id=88

Sacramento River Basin Projects

Sacramento Area Flood Control Agency Projects The City of Sacramento, the County of Sacramento, the County of Sutter, the American River Flood Control District, and RD 1000 created Sacramento Area Flood Control Agency (SAFCA) through a Joint Exercise of Powers Agreement to provide the Sacramento region with increased flood protection along the American and Sacramento rivers (SAFCA, 2008). SAFCA projects that are under construction, or will be constructed by 2015 include:

- **Folsom Dam Joint Federal Project** – This USACE project consists of a six-gated control structure, a 2,100-foot spillway with a stilling basin, and an approach channel in the reservoir leading to the control structure. Phase 2 is expected to be completed in fall 2010 and consists of excavating the spillway downstream of the proposed gated structure. The gated control structure, Phase 3, should be completed in 2015 (SAFCA, 2008).

- **American River Common Features Project** – This project is designed to strengthen American River levees so they can safely pass a flow of 160,000 cfs. The project has installed approximately 23 miles of slurry wall, raised levees to provide adequate freeboard, addressed slope stability issues, and corrected some erosion problems (SAFCA, 2008). Most phases of the projects are completed, but construction of the remaining project phases should be completed by summer 2010.

- **Natomas Levee Improvement Program** – This project consists of early implementation (2008 through 2010) improvements to the perimeter levee system of the Natomas Basin in Sutter and Sacramento counties and modification of associated landscaping and irrigation/drainage infrastructure (SAFCA, 2008). The remaining improvements are expected to be completed by 2015.

- **South Sacramento Streams Project** – This project consists of levee improvements starting south of the town of Freeport and running easterly along the southern edge of the urbanized area (SAFCA, 2008). Construction is in progress and is expected to be completed by 2012.

- **Mayhew Levee Improvement Project** – USACE, along with the Board and SAFCA, is constructing flood improvements for the Mayhew Levee and Drain. Construction involving raising and widening the existing levee is complete and the Mayhew Drain Closure Structure is near completion (SAFCA, 2008).

- **Sacramento Bank Protection Project** – This program addresses long-term erosion protection along the Sacramento River and its tributaries.

The proposed project consists of implementing bank protection measures at up to 15,646 linear feet of levees along the Sacramento River and tributaries during 2009 and 2010. (SAFCA, 2008).

Yolo County/West Sacramento City Flood Projection Projects The following are flood control projects in Yolo County and the City of West Sacramento:

- **Sacramento River West Bank Integrated Project** – The Sacramento River West Bank Integrated Project is designed to improve the management of public safety infrastructure and public benefits of water resources on the west side of the Sacramento River in Yolo County. The project aims to reduce the risk of flooding by collaborating on levee rehabilitation, levee maintenance, and storm drainage improvements, while enhancing water quality, habitat, and water-based recreation. The actions incorporated in the integrated project apply to the geographic sub-area that includes the portion of the west bank and levee of the Sacramento River in Yolo County, the City of West Sacramento, Knights Landing, and Clarksburg, and the basin surrounded by levees between the Deep Water Ship Channel and the Sacramento River.

- **Knights Landing Levee Improvement Project** – Levee improvements to address through seepage and underseepage problems are needed, as well as repair of a critical erosion site. Through seepage can be addressed through construction of the Mid-Valley Project, a multiple-phase USACE project. Underseepage can only be addressed once levee integrity studies are completed that will identify needed improvements. Originally planned actions have been completed, but possible new sites are being considered with contracts expecting to go out in fall 2009 (WRA, 2005).

- **Deep Water Ship Canal Navigation Levee Repair** – USACE will correct deficiencies, protect against underseepage, and maintain the Deep Water Ship Channel levees to current standards for FEMA 100-year and urban levee 200-year levels of flood protection. This will also include completing the deepening and widening of the navigation channel to authorized depth and improving navigation. Currently the project is in the design phase, but should be built by 2015 (WRA, 2005).

- **Sacramento Bypass-Yolo Bypass Levee Repair** – Physical improvements may include restoration and armoring of waterside levee slopes, increased levee height through crown raising or crown top walls, slurry cutoff walls in the levee prism, seepage blankets on the

levee landside, or levee setbacks. The project is expected to be ready for implementation by 2010 (WRA, 2005).

- **West Sacramento South Cross Levee Repair** – This USACE project aims to construct levee improvements as soon as possible to reduce flood risk and provide recreational and open space elements for the city that are compatible with flood improvement actions. An Environmental Impact Statement/Environmental Impact Report is being prepared for the alteration of an existing flood control structure. Construction should take place in spring 2010 (Federal Register, 2009).

- **Ongoing Levee Maintenance and Critical Repair Program** – This annual program of levee maintenance and repair at critical erosion sites is implementing Public Law 84-99. Identified sites have been undergoing repairs (WRA, 2005).

- **Sacramento River Levee Rehabilitation Project** – In West Sacramento, improvements include emergency repairs at two critical erosion sites at RM 56.0 and RM 56.7, and non-emergency repairs at RM 57, RM 55.8, and RM 53.5. In Merritt Island, this project addresses erosion control and levee improvements on the Sacramento River levee, as identified by RD 150. Funding is being requested for implementation of improvements identified during 2006 analyses of seepage problems. The project should be ready for implementation by 2010 (WRA, 2005, 2007).

- **Lower Cache Creek Feasibility Study –** The City of Woodland, County of Yolo, and the Yolo County Flood Control & Water Conservation District, through their FloodSAFE Yolo Pilot Program, are working with the USACE and DWR to continue the feasibility investigation to reduce the flood risk to Woodland and local and State highway infrastructure. The flooding in the area has been exacerbated by construction of improvements to the Cache Creek Settling Basin to maintain the flood conveyance integrity of the Yolo Bypass to minimize the risk of flooding in Sacramento. Local interests envision a project involving the relocation and strengthening of levees and creating a floodway to recover flood conveyance directly to the Yolo Bypass.

Three Rivers Levee Improvement Authority Projects Yuba County and RD 784 created Three Rivers Levee Improvement Authority (TRLIA) to achieve 200-year flood protection for southern Yuba County. More than 11 miles of levees have already been constructed and are certified to meet FEMA by requirements by the USACE. Funding for the improvements is provided by the State (Proposition 13 and Proposition 1E), local

developers/landowners, local development fees, RD 784, Yuba County, and the YCWA (TRLIA, 2009). The following are projects that are under construction, or will be constructed by 2015:

- **Feather River Levee Improvements –** These will improve local and regional flood protection by widening the floodway. Construction on Segments 1 (Bear River to Star Bend) and 3 (Shanghai Bend to Yuba River) have been completed. Segment 2 (Star Bend to Shanghai Bend) is expected to be completed by late 2009 (TRLIA, 2009). There may be opportunities to create habitat with the addition of a setback levee.

- **Upper Yuba River Levee Improvement Project –** This Project will address recently identified through and underseepage deficiencies, levee geometry correction and waterside slope protection of the Yuba River south levee system. Construction is planned for 2010 (Board, 2009a).

Yuba River Basin Project YCWA and USACE are heading this project that includes construction of 6.7 miles of slurry walls, deepening of 9 miles of interior toe drains, and construction/modification of 9.5 miles of berms along sections of the Yuba and Feather rivers and construction of 5 miles of slurry walls and berms along the ring levee around Marysville (Board, 2009b). This will provide a 300-year level of flood protection for Marysville and 200-year level of protection to Linda, Olivehurst, and Arboga. Because of the imminent flood risk, the State and local interests have begun advance construction repairs and improvements, excluding the Marysville Ring Levee. All of the repairs and improvements by the non-federal interests have been or will be reviewed, inspected, and certified by USACE (Board, 2009b). Construction of the Marysville levee improvements is scheduled to start in 2010. An Engineering Documentation Report and Post-Authorization Decision Document are being prepared to document updates in design, costs, benefits, and environmental effects.

Yuba-Feather Supplemental Flood Protection Project YCWA and DWR are responsible for this project, which includes the New Colgate Powerhouse Tailwater Depression, Forecast-Coordinated Operations of Lake Oroville and New Bullards Bar Reservoir for Major Storms, New Bullards Bar Reservoir Outlet Capacity Increase, Feather River Levee Setback, and the Feather-Bear Rivers Levee Setback Project. The following are projects that are under construction, or will be constructed by 2015:

- **New Bullards Bar Reservoir Outlet Capacity Increase** – This will add a new upper-level outlet works at New Bullards Bar Reservoir to increase flood-release capability. This will provide the ability to reduce

peak flood flows downstream during major storms by providing for the early release of more water than can be released with the existing outlet (DWR, 2005a). Due to lack of funding, this project has not progressed beyond the preliminary design phase.

- **Colgate Powerhouse Tailwater Depression** – This project will allow the powerhouse to operate at high water levels to provide operational flexibility in releasing additional flows from New Bullards Bar Reservoir (DWR, 2005a). Due to lack of funding, this project has not progressed beyond the preliminary design phase.

- **Forecast-coordinated Operations of Lake Oroville and New Bullards Bar Reservoir program** – USACE, DWR, YCWA, and NOAA are leading this program. It will improve flood protection and better protect life and property for communities along and downstream from the Yuba and Feather rivers without impacting upstream reservoirs via improved river flow forecasting and coordination between Lake Oroville and New Bullards Bar Reservoir flood operations (DWR, 2005a). Work on this multi-year program began in 2005. During the first 2 years of implementation, 19 remote gauging stations were installed with telemetry systems that transmit data to the CDEC. The third-year effort focuses primarily on developing a robust reservoir operations model and integrating the model with the National Weather Service River Forecasting Center system (YCWA, 2008).

- **Feather River Levee Setback** – The Feather River Levee Setback element will entail setting back the east Feather River levee for 8.6 miles in two segments between Shanghai Bend and the Bear River (above Star Bend and below Star Bend) and removing most of the existing levee in those segments. This levee setback would increase flood protection by lowering the flood stages near Marysville, Linda, Olivehurst, and Yuba City and would provide greater security because the levees would be well designed and constructed using modern analyses and construction methods. For portions of the setback areas, particularly areas where continued farming would not be practical, riparian habitat restoration/enhancement would take place (DWR, 2005a).

- **Feather-Bear Rivers Levee Setback Project** – The Feather-Bear Rivers Levee Setback Project will entail setting back the right (north) levee of the Bear River between SR 70 and the Feather/Bear River confluence, removing an orchard from the Bear River floodway, and restoring habitat in the expanded floodway area between the existing and setback levee alignments. The project would enhance flood protection for Yuba and Sutter counties by addressing identified

deficiencies of the lower Bear River levee and lowering upstream water surface elevations. It would also enhance fish and wildlife habitat in the project area. The western end of the proposed setback levee overlaps the project area considered for the segment of the Feather River Levee Setback element below Star Bend (see description above). If the project is implemented, the Feather River Levee Setback segment below Star Bend is unlikely to be pursued in the future (DWR, 2005a).

Feather River Improvements at Abbott Lake Unit and Nelson Slough Unit Wildlife Conservation Board, Ducks Unlimited, and DFG are leading the project to restore and enhance the riparian habitat at the Abbott Lake Unit and Nelson Slough Unit of the Feather River State Wildlife Area. The proposed habitat restoration project will improve the long-term management of the floodway by developing a planting plan that enhances water flow and reduces long-term maintenance costs. It is currently scheduled to be completed in 2010 (River Partners, 2009).

West Bank Feather River Restoration As part of the Feather River Levees Early Implementation Project, Sutter-Butte Flood Control Agency is leading the effort to explore the feasibility of repairing and improving the west bank of the Feather River to its original design from the Thermalito to Yuba City. It is possible that construction will take place by 2015 (Butte County, 2008).

Lower Deer Creek Restoration and Flood Management Project Deer Creek Watershed Conservancy, with the support of Tehama County, is the lead on this project. The project will reduce flooding by setting back two 600-foot sections on each side of the Deer Creek Levee System project levee to greatly widen and enhance the floodplain, reduce channel degradation, and improve aquatic and terrestrial habitat. This levee has failed repeatedly and had a 1,200-foot breach in 1997. The project has the support of State and federal agencies, land owners, and local government. The feasibility study and preliminary design have been completed and a preferred alternative has been selected.

Middle Creek Flood Damage Reduction and Ecosystem Restoration Project This project, led by USACE and Lake County, will eliminate flood risk to 18 residential structures, numerous outbuildings and approximately 1,650 acres of agricultural land, and will restore damaged habitat and the water quality of the Clear Lake watershed. Restoring this area to a functional wetland is expected to improve basin health and the water quality of Clear Lake (County of Lake, 2007). The project was authorized on the State level with AB 74 and signed by Governor Schwarzenegger on October 11, 2009. Some property has been purchased, and flood risk to seven structures has been reduced to zero. Funds have

been on hold since December 2008 due to State budget issues and the inability to sell sufficient bonds. Construction is expected to begin in 2015.

Hamilton City Flood Damage Reduction and Ecosystem Restoration USACE and Reclamation are leading this effort that includes constructing a setback levee, removing most of the existing private ”J” levee, and actively restoring more than 1,000 acres of native vegetation. Construction should tentatively begin in 2009 (Board 2007, USACE 2004).

Woodson Bridge/Kopta Slough Restoration Project DWR, along with project partners (Tehama County, Sacramento River Conservation Area Forum, State Parks, the Nature Conservancy, City of Corning, and USACE), is responsible for this project that could include the removal of 5,600 feet of rock revetment along the Kopta Slough property and placement of rock to protect the west abutment of Woodson Bridge and the City of Corning Sewer Outfall (Sacramento River, 2008). The hydraulic analysis, conceptual design, and preliminary cost estimate report is currently being completed. DWR will use this report to complete the geomorphic analysis and the remainder of the feasibility study. DWR will need to seek further funding from its flood programs and work with the other funding partners to solidify other sources of funding for this phase of work.

Mace Boulevard Bridge Improvement Project Lower Putah Creek Coordinating Committee is leading the project to increase capacity under the Mace Boulevard Bridge over Putah Creek east of Davis. Hydrologic studies would be required to determine the appropriate capacity (WRA, 2005). Construction is expected to be complete by 2010.

The Sutter Basin Feasibility Study The Sutter Basin Feasibility Study, jointly sponsored by DWR, the Board, and USACE, is evaluating alternatives to lessen the risk of flooding in Yuba City, Live Oak, Gridley, and Biggs in Sutter and Butte counties. DWR and Sutter Butte Flood Control Agency are the joint non-federal sponsors for the study. The Sutter Butte Flood Control Agency is a joint exercise of powers agency formed in December 2007 to plan, finance, and construct flood control improvements within the Sutter and Yuba City basins.

San Joaquin River Basin Projects

Mossdale (RD17) 100-Year Levee Seepage Project DWR, USACE and RD 17 will conduct levee improvements on levee reaches in RD 17 for underseepage control. Eight of the nine Phase II reaches consist of construction of seepage berms along the landside levee toe. The other reach would have various maintenance and site cleanup activities. The project has an approved negative declaration with an Environmental Impact Report

underway. Phase II construction will begin in August 2009 and be completed no later than December 2009 (EDAW, 2009).

Arroyo Pasajero Flood Control Project Westlands Water District, DWR, and USACE are heading the Arroyo Pasajero Flood Control Project. This project will modify existing features and construct new facilities to better control periodically inundating flows. Construction is expected to begin in 2010 (SLDMWA, 2006). It includes the following project features:

- Enlargement of the Westside Retention Basin
- Construction of a siphon under or a flume across the California Aqueduct to prevent flows from entering the aqueduct
- Construction of a diversion channel to convey water from the California Aqueduct to a detention basin
- Construction of an eastside detention basin on lands that Westlands Water District has acquired or will acquire in the future

Cosgrove Creek Flood Control Project Cosgrove Creek Flood Control Project is led by Calaveras County Water District and USACE. It would include construction of a 50-acre retention basin off Hogan Dam Road, which would capture and slowly dispose of floodwaters. Construction may begin in 2010 (Baptista, 2007; Lungren, 2009).

San Joaquin River Restoration Program The San Joaquin River Restoration is a joint effort by Reclamation, USFWS, NOAA National Marine Fisheries Services, DWR, and DFG. The goals are to restore and maintain fish populations in good condition in the main stem of the San Joaquin River and to reduce or avoid adverse water supply impacts to Friant Division long-term contractors. The San Joaquin River Restoration Settlement Act (Public Law 111-11) was signed into law on March 30, 2009, and authorized federal agencies to implement the Settlement. The Settlement identifies several projects to be completed by 2015, including the release of flows, which began in October 2009 (SJRRP, 2009).

Regional Transportation Plan (2007) San Joaquin County COG is the lead agency for the major planning document produced for the San Joaquin County region to guide the region's transportation development over a 20-year period. Short-range plans will be implemented between 2007 to 2019 and include work on Interstate 205 and SR 99, SR 120, SR 12, and SR 4 (San Joaquin Council of Governments, 2007).

Lower San Joaquin River Feasibility Study The San Joaquin Area Flood Control Agency and USACE have initiated the Lower San Joaquin River Feasibility Study, which will investigate flood damage reduction alternatives along existing levees on the lower San Joaquin River from Lathrop to White Slough, including levees along major tributary channels entering from the east. Study alternatives may include levee strengthening measures, setback levees, flood bypasses, and reservoir reoperation. The feasibility study is an extension of the Lower San Joaquin River Reconnaissance Study completed in 2004 (USACE, 2002).

Delta Projects

Delta Levee System Integrity Program The Delta Levee System Integrity Program manages risks associated with fragile levee reaches in the Delta via construction projects and other programs, such as emergency response planning. It quickly implements high-priority levee reconstruction projects to reduce risk of catastrophic levee failure, ecosystem restoration, water quality, water supply, conveyance, and beneficial reuse of dredged materials. This includes the Mayberry Slough Setback Levee Habitat Project on Sherman Island. Construction is expected to be completed by December 2009 and will increase levee stability while providing an intertidal and riparian habitat (State, 2007a).

Delta Levees Special Flood Control Projects and Delta Levees Maintenance Subventions Program DWR provides financial assistance to local LMAs for rehabilitation of levees in the Delta. The program presently focuses on flood control projects and related habitat projects for eight western Delta islands – Bethel, Bradford, Holland, Hotchkiss, Jersey, Sherman, Twitchell and Webb islands – and for the towns of Thornton and Walnut Grove (DWR, 2009a; DWR, 2009b).

Delta Risk Management Strategy The Delta Risk Management Strategy (DRMS) Project analyzes the risks and consequences of levee failure in the Delta Region under current management practices and regulatory requirements. The Phase 1 analysis considered current and future risks from earthquakes, high-water conditions, climate change, subsidence, dry weather events, and a combination of these factors. The analysis also estimated the consequences of levee failures to the local and State economy, public health and safety, and the environment. Various scenarios to reduce the risks and consequences of levee failure are considered in Phase 2 of the DRMS Project.

Delta Islands and Levees Feasibility Study The Delta Islands and Levees Feasibility Study will determine the federal interest in providing flood damage reduction, ecosystem restoration, and recreation improvements in the Delta, and will build upon the information and

strategies generated by the State's ongoing DRMS Project. The study will incorporate DRMS Project findings and build on the State's work to determine how USACE can contribute to flood management efforts in the region.

Cross Levee Between RD 2107 (Mossdale) and RD 2062 (Stewart Tract) Currently a railroad embankment separates the two reclamation districts on the Stewart Tract. A new non-federal levee will be constructed that will provide a 200-year barrier between the two districts. Because RD 2107 has previously flooded and caused the embankment to fail, a removable levee will be constructed along the RD 2107 levee on Paradise Cut, which will allow flood waters to flow into Paradise Cut in the event of a failure in RD 2107. This removable levee will mitigate against any increased flood water elevation or duration that could have occurred with the new barrier between the districts (Board, 2006).

Paradise Cut Expansion Reclamation is leading the Paradise Cut Expansion on the north bank. This is part of RD 2107 Floodway Protection, Eco-Restoration and Agricultural Preservation Project. Paradise Cut currently does not carry designed flood flows. To help correct this deficiency, a 40-acre silt bench downstream from the Paradise Weir will be lowered by 5 feet, which will allow more flow into Paradise Cut. The additional flood volume will be accommodated by widening the Paradise Cut bypass by setting back the levees on the north bank of the Cut approximately 900 to 1,200 feet. A total of 4 miles of levees will be set back (DWR, 1998).

North Delta Flood Control and Ecosystem Restoration Project DWR and The Nature Conservancy are leading a multiobjective restoration planning, design and monitoring program that covers 1,600 acres of land. Future planning and permitting for this project is proceeding as part of North Delta Improvements Project. Through the North Delta Flood Control and Ecosystem Restoration Project, DWR aims to control flood water through McCormack-Williamson Tract to minimize the surge, provide flood control benefits by achieving stage reductions, and reduce risk of catastrophic levees failures. Construction is expected to be completed by spring 2012 (Water Education Foundation, 2009).

Dutch Slough Tidal Restoration Project This project aims to provide large-scale tidal marsh restoration, reestablish natural ecological processes and habitats, and provide shoreline access and educational and recreational opportunities. It will additionally be designed and implemented to maximize opportunities to assess the development of those habitats and measure ecosystem responses to improve the success of future Delta restoration projects. This project is being implemented by DWR, CALFED,

the California State Coastal Conservancy (Conservancy), and the City of Oakley. A draft Environmental Impact Report was released in November 2008 (DWR, 200b).

Mayberry Farms, Farm Scale Tule Project This DWR-led project will create a permanent wetland for waterfowl on Sherman Island to reduce subsidence and sequester carbon. The land identified on Sherman Island is a 307-acre parcel currently owned by DWR. Full project construction is expected to being in 2009 (DWR, 2009c).

Meins Landing Habitat Enhancement/Mitigation This DWR-led restoration project is part of a comprehensive effort to achieve the tidal wetland restoration goals identified in the Habitat Preservation and Restoration Plan for the Suisun Marsh. Restoration activities are expected to begin in 2011 (DWR, 2009c).

Farm Scale Rice Pilot Project DWR is currently implementing a pilot project that will provide an opportunity to evaluate the effectiveness of subsidence reversal via growing rice while considering water quality, farming, and best management practices (BMP). The data analyzed during this project will help develop recommendations on how this method can be applied to reduce subsidence and sequester carbon. The project is expected to be completed by 2014 (DWR, 2009c).

Liberty Island Conservation Bank RD 2093 is the lead agency for this project. Formation of this conservation bank will preserve, enhance, and restore 165.7 acres of habitat for native fish species. The project is sponsored by Wildlands. Construction is expected to occur in 2009 (ICF Jones and Stokes, 2009).

Franks Tract Project The Franks Tract Project is designed to protect fish resources and reduce seawater salinity intrusion into the Delta. DWR and Reclamation are evaluating installing operable gates to control the flow of water at key locations (Threemile Slough and/or West False River) to limit the entry of certain fish species of concern and higher salinity water into Franks Tract. In addition to improving water quality, the gates would limit migration of fish species of concern into the central and south Delta where their survival rates are reduced. By protecting fish resources, this project also would improve operational reliability of the SWP and CVP because water export restrictions would be less frequent. Construction will begin in spring 2010 (DWR, 2008c).

South Delta Improvements Project DWR and Reclamation are responsible for implementing CALFED's South Delta Improvements Program in the Delta. This program includes a series of proposed actions

designed to improve water quality and protect salmon in the south Delta while allowing the SWP to operate more effectively. The South Delta Improvements Program includes channel dredging in Old River, Middle River, and West Canal and construction and operation of the head of Old River fish control gate and the Old River at Delta-Mendota Canal, Middle River, and Grant Line Canal flow control gates. Construction is expected to start in 2010 (DWR, 2009d).

2-Gates Fish Protection Demonstration Project Reclamation is leading the 2-Gates pilot demonstration project along with participation from DWR. The 5-year study project will look at ways to achieve better protection of at-risk fish species in the south Delta by installing temporary gates at two locations (DWR, 2009c).

Bubble Curtain Barrier Project Led by DWR and part of the Vernalis Adaptive Management Plan, this project is testing the use of bubble curtains instead of temporary rock barriers to keep migrating Chinook salmon and steelhead in San Joaquin River, rather than Old River. Experimental hatchery releases occurred in 2009 (DWR, 2009e).

Delta Water Supply Project City of Stockton's Department of Municipal Utilities is responsible for the Delta Water Supply Project (DWSP). This will develop a new supplemental water supply by taking in water from the Delta and pumping it to a new surface water treatment plant. Intake construction will take place from 2009 through 2011. The water treatment plant and pipeline construction will occur from 2009 to 2012 (City of Stockton, 2009).

North Bay Aqueduct Alternative Intake Project DWR and USACE have proposed to relocate the aqueduct intake as it connects to the existing North Bay Aqueduct, thus increasing capacity. This would also reduce impacts to listed fish species and increase water supply to North Bay cities. Planning and preliminary design will be completed by 2012 (City of Calistoga, 2009; Solano County Water Agency, 2007).

Ongoing Programs

There are many ongoing programs that have numerous environmental restoration implementation actions that will likely have some impact the flood management system.

Flood Emergency Preparedness and Hazard Classification Program Yolo County Flood Control and Water Conservation District, City of Woodland, and Yolo County, as part of the Yolo Integrated Regional Water Management Plan (IRWMP), are responsible for this program. This

program aims to improve the method of notifying at-risk residents of the need to take emergency action (evacuation) in Yolo County (WRA, 2005).

Delta Levee Emergency Management and Response Plan As part of the Delta Levee System Integrity Program, DWR and USACE are leading the effort to develop this plan. Its objectives are to enhance emergency response capabilities and resource allocation and develop a stable funding source for emergency response. This includes implementing a comprehensive reconstruction, repair, and maintenance program for Delta levees (CALFED, 1999).

Anadromous Fish Restoration Program FWS and Reclamation are leading the Anadromous Fish Restoration Program (AFRP). There are various projects being implemented and include:

- **Fish Passage Improvement at the Red Bluff Diversion Dam –** Tehama-Colusa Canal Authority and Reclamation are modifying Red Bluff Diversion Dam to reduce its impacts on upstream and downstream migration of juvenile and adult anadromous fish, while improving the reliability of agricultural water supply in the Tehama-Colusa and Corning Canal systems. The proposed action would include a new pumping plant that would be capable of operating throughout the year. The pumping plant will have a fish screen with an initial installed pumping capacity of 2,180 cfs and a footprint that will allow expansion to 2,500 cfs. The National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) documents have already been completed and the aggressive goal is to be operational by spring 2012 (EPA, 2008; TCCA, 2009).

- **Upper Sacramento River Gravel Replacement Program –** Under Central Valley Project Improvement Act, Reclamation and USFWS are leading the program to increase the availability of spawning gravel and rearing habitat for Sacramento River Basin Chinook salmon and steelhead trout. Some construction is currently ongoing (Reclamation, 2008).

- **Deer Creek Flow Enhancement Project –** DFG and Deer Creek Irrigation District are leading this project which addresses transport flows that are insufficient in some years to provide for adequate upstream and downstream migration. This project will drill, install, develop, and test wells. Construction should be underway by 2010 (American Rivers, 2009a).

Anadromous Fish Screen Program Projects Anadromous Fish Screen Program (AFSP) is led by FWS and Reclamation to protect juvenile

Chinook salmon, steelhead trout, and green and white sturgeon from entrainment at priority diversions throughout the Central Valley and Delta. Projects in 2008 include providing technical assistance for fish screen projects operated by Natomas Mutual Water Company, Meridian Farms Water Company, RD 2035, Patterson Irrigation District, and Pleasant Grove-Verona Mutual Water Company. Construction depends on funding (Reclamation, 2007). The 2009 work plan included increasing the availability of spawning gravel and rearing habitat for Sacramento and American River Basin Chinook salmon and steelhead trout and was completed in September 2009 (Reclamation, 2008).

California Waterfowl Projects The California Waterfowl Association is leading projects that preserve, protect, and enhance California's waterfowl resources, wetlands, and associated hunting heritage. The projects are located throughout Northeastern California, Sacramento River Basin, Yolo Bypass, Suisun Marsh, San Joaquin River Basin, and Southern California. Two of the projects are:

- **Upper Butte Water Basin Wildlife Area Project** – California Waterfowl will complete a 365-acre restoration project on part of Little Dry Creek Wildlife Area in 2009 which will change the water delivery system (California Waterfowl, 2009).

- **Yolo Bypass Wildlife Area Project** – The project will enhance over 500 acres, restore 90 acres, and improve water delivery to over 1,000 acres of wetlands and the adjacent private duck clubs. Construction will occur in 2009 (California Waterfowl, 2009).