California **Water Plan**
Update 2009

Mountain Counties

INTEGRATED WATER MANAGEMENT

Bulletin 160-09 • Department of Water Resources

Volume 3
Regional Reports

Northern Region Office

The Division of Integrated Regional Water Management assists public and private agencies and the general public with water issues throughout the state. Four regional offices are located throughout California to maintain close contact with local interests to facilitate communication and to work on water-related matters. The offices are:

- Northern Region in Red Bluff,
- North Central Region in West Sacramento,
- South Central Region in Fresno, and
- Southern Region in Glendale.

Each of the regional offices offers technical guidance and assistance in water resource engineering, project management, hydrology, groundwater, water quality, environmental analysis and restoration, surveying, mapping, water conservation, and other related areas within the boundaries of their offices. Because of the regional offices' close ties with local interests, DWR regional coordinators in each office facilitate overall communication between DWR divisions and local partners to ensure coordinated efforts throughout all DWR programs and projects.

For more information on DWR and DWR projects, please contact the Regional Coordinators at:
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http://www.water.ca.gov/

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Cover Photos:

1. 5. South Yuba River, which runs through Nevada County en route to the valley. This photo, with very high flows, is taken near Nevada City. Photo by Dave Carter, Nevada Irrigation District.

2. 3. 6. View of a small lake in the Grouse Ridge Lakes Basin. This serves as a high mountain watershed Scotts Flat Reservoir (owned and operated by Nevada Irrigation District). Photo by Dave Carter, Nevada Irrigation District.

4. Scotts Flat Reservoir (owned and operated by Nevada Irrigation District). Photo by Dave Carter, Nevada Irrigation District.

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Mountain Counties Area

Setting

The Mountain Counties Area of California includes the foothills and mountains of the western slope of the Sierra Nevada and a portion of the Cascade Range. The area extends from the southern tip of Lassen County to the northern part of Fresno County (Figure MC-1) and overlays the eastern portions of the Sacramento River and San Joaquin River hydrologic regions. The foothill and mountain areas of these two hydrologic regions are grouped together to present their common characteristics.

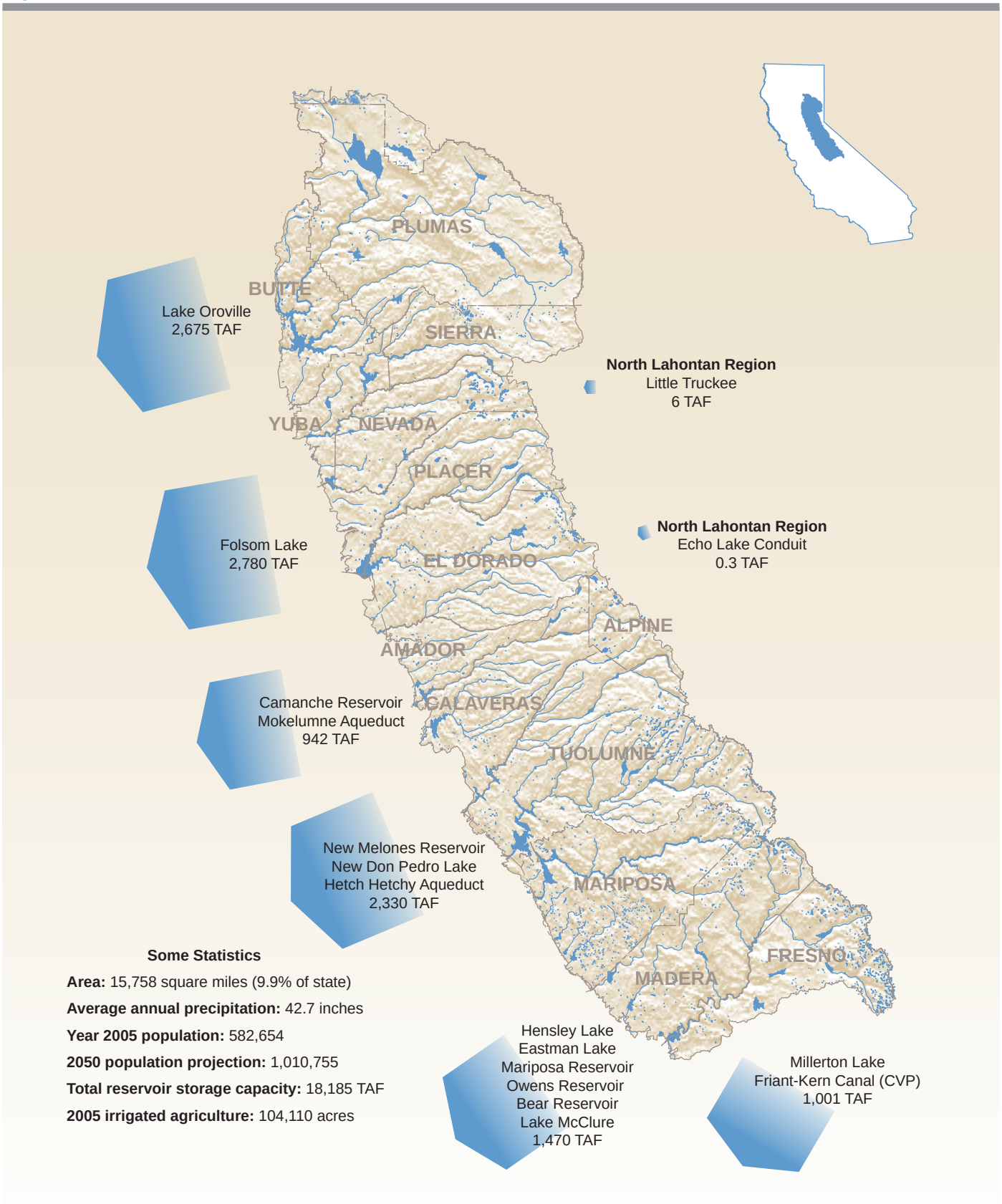
The area includes all or portions of 15 counties. Elevations vary from around 100 feet near the edge of the valley floor to nearly 14,000 feet at peaks along the crest of the southern Sierra Nevada. The major rivers in the area include the Feather, Yuba, Bear, and American rivers in the Sacramento River Hydrologic Region and the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, Fresno, and San Joaquin rivers in the San Joaquin River Hydrologic Region. These watersheds account for about a quarter of all natural river runoff in California and over half of all snowmelt runoff in the state. For more on these watersheds and rivers, see the Sacramento River and San Joaquin River regional reports.

The climate, ecosystems, and level of human activities in this area have varied greatly over the past 150 years. Since 1850, increasingly intense settlement and resource use has transformed portions of the Sierra, especially due to mining, grazing, timber harvest, and water development. About 2 percent of the state's population live in the area, and recreational use of the extensive public lands has increased in recent decades.

Watersheds

The northern part of the Mountain Counties Area borders with the volcanic Cascade Range and the Diamond Mountains of the Basin and Range Province. The foothills and mountains of the predominantly granite Sierra Nevada cover the remainder of the area, increasing in elevation from the edge of the Central Valley to the mountain crest along the eastern edge. The Sierra crest generally rises from the Feather River watershed in the north to peaks reaching nearly 14,000 feet in the headwaters of the San Joaquin River. South of the volcanic plateau around Lassen Peak, the soils become increasingly granitic, and the topography is dominated by multiple steep canyons. These canyons become extremely deep in the glacier-carved terrain of the southern Sierra, exemplified by the U-shaped valleys of Yosemite and Hetch Hetchy. Eight rivers originate along the crest of the Sierra in this area and drain in a southwesterly direction into the Central Valley and to the Sacramento and San Joaquin rivers and Sacramento-San Joaquin Delta (the Delta). Additional rivers and streams drain from the foothills into the Central Valley between the major rivers. These watersheds range from under 100 square miles

Figure MC-1 **Mountain Counties Area 2005 inflows and outflows**



Some Statistics

Area: 15,758 square miles (9.9% of state)

Average annual precipitation: 42.7 inches

Year 2005 population: 582,654

2050 population projection: 1,010,755

Total reservoir storage capacity: 18,185 TAF

2005 irrigated agriculture: 104,110 acres

Box MC-1 Acronyms and Abbreviations Used in This Report

CABY	Cosumnes-American-Bear-Yuba
Cal EMA	California Emergency Management Agency
CDEC	California Data Exchange Center
CRS	Community Rating System
CVP	Central Valley Project
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
Delta	Sacramento-San Joaquin River Delta and Suisun Marsh
DPH	Department of Public Health
DSOD	Division of Safety of Dams
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EID	El Dorado Irrigation District
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRMs	Flood Insurance Rate Maps
HHW&P	Hetch Hetchy Water and Power
ID	irrigation district
IRCUP	Inter-Regional Conjunctive Use Project
IRWM	Integrated Regional Water Management
MAC	Mokelumne-Amador-Calaveras
MCWRA	Mountain Counties Water Resources Association
NCPA	Northern California Power Agency
NFIP	National Flood Insurance Program
NIMS	National Incident Management System
NWS	National Weather Service
PCWA	Placer County Water Agency
PG&E	Pacific Gas and Electric Co.
RAP	regional acceptance process
Regional Water Board	Central Valley Regional Water Quality Control Board
SCE	Southern California Edison
SEMS	Standardized Emergency Management System
SMUD	Sacramento Municipal Utility District
SNEP	Sierra Nevada Ecosystem Project
SWP	State Water Project
State Water Board	State Water Resources Control Board
taf	thousand acre-feet
USACE	US Army Corps of Engineers
USBR	US Bureau of Reclamation
USFS	US Forest Service

to about 3,600 square miles in area. In winter, over half of the total watershed area is usually snow-covered, as shown in Table MC-1. Stream gradients are steep, often exceeding 100 feet per mile, and sediment loads are heavy during high flow events, especially following forest fires. Nearly all of the upper watershed area is public land administered by federal agencies.

Total natural river runoff from the area averages about 17 million acre-feet per water year, with a historical range of 3 million to 39 million acre-feet. About two-thirds of this runoff volume originates in the northern half of the Mountain Counties Area. The natural flow is very seasonal, with river runoff typically peaking during winter in the lower elevation northern watersheds, and in spring in the higher elevation southern watersheds where snowmelt predominates, as illustrated in Figure MC-2. Spring runoff from snowmelt usually contributes half of the total annual runoff from this area and is used to fill reservoirs after flood control restrictions ease. By late summer, natural river flow recedes to very low levels, especially in the watersheds with shallow granitic soils; and reservoir releases provide much of the downstream water supply. Many hundreds

Table MC-1 Major watershed areas in Mountain Counties Area

Watershed	Area (sq miles)	Maximum elevation (ft)	Snowpack level* (ft)	Percent of basin above snow level*	Percent of basin in first 500 feet above snow level*
Feather River	3,620	10,450	4,500	72	16
Yuba River	1,190	9,100	4,500	50	8
Bear River	286	5,800	4,500	4	2
American River	1,900	10,380	4,500	48	6
Cosumnes River	530	7,700	4,500	24	8
Mokelumne River	585	10,380	5,000	50	7
Stanislaus River	935	11,570	5,000	60	6
Tuolumne River	1,530	13,110	5,000	60	6
Merced River	1,020	13,110	5,500	47	4
San Joaquin River	1,640	13,990	5,500	72	5

* Winter snowpack level is approximate and based on data centering about 1980. The snowpack level varies annually and seasonally and has gradually increased in recent decades.

of natural lakes and constructed reservoirs provide fishery and recreation resources. Many of the natural lakes are less than a few square miles surface area in the glaciated terrain of the higher elevations. Reservoirs for water supply, power, and flood control are concentrated at middle and low elevations. In Appendix A Flood Management, Figure MCA-1 (American River below Folsom historical runoff pattern) shows the smoothing effect of regulation on the flow in the American River below Folsom.

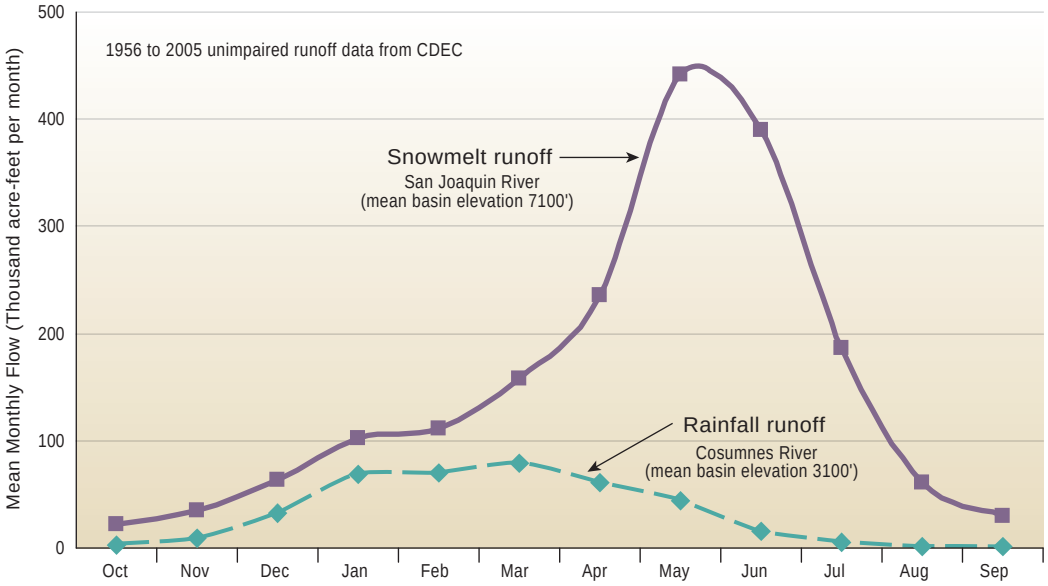
Groundwater Basins and Recharge Areas

Most of the Mountain Counties Area groundwater basins that are identified in the Department of Water Resources (DWR) California's Groundwater Update 2003 are found in the volcanic soils of the upper portion of the Feather River watershed. Groundwater availability is more limited in the fractured rock underlying the remainder of the Sierra. Melting of the upper watershed snowpack in spring provides an important source of groundwater recharge throughout the Sierra and into valley floor aquifers. The Relationship with Hydrologic Regions section in this report provides information on interregional relationships and cites as example the Inter-Regional Conjunctive Use Project (IRCUP) involving the Mokelumne River water resources.

Ecosystems

The watersheds and ecosystems of the Sierra Nevada provide extremely valuable "ecological services" for much of the state by providing natural storage, filtration, and conveyance of high-quality water and by attenuating peak flows. Watershed assessments by local watershed groups provide rich detail about the habitats in individual watersheds. Restoration efforts and Habitat Joint Ventures by these groups are supported by the

Figure MC-2 Seasonal runoff patterns, high vs. low elevation

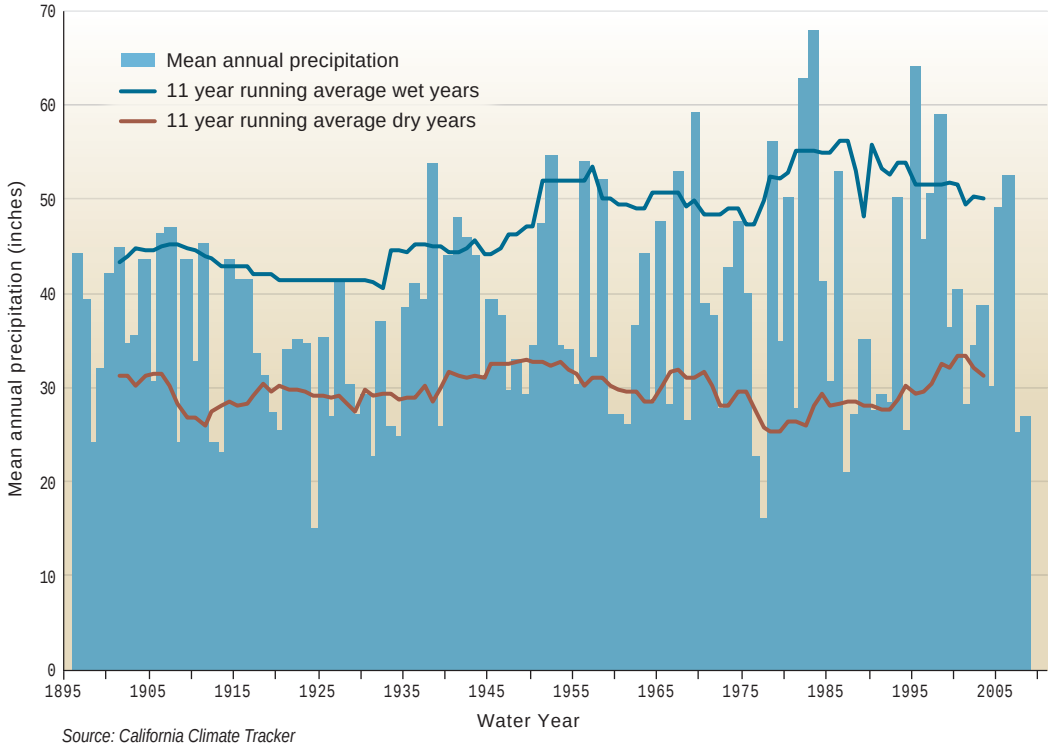


California Department of Conservation, Department of Fish and Game, and the Sierra Nevada Conservancy.

The 1996 Sierra Nevada Ecosystem Project (SNEP) reported that the Sierra Nevada is home to more than 3,500 native species of vascular plants and about 400 species of terrestrial vertebrates in a wide variety of elevation-dependent vegetation zones including riparian, meadow, savanna, chaparral, forest, and alpine. The Sierra Nevada provides habitat for about half of California's vascular plants and 60 percent of the state's vertebrate fauna. The Mountain Counties Area provides prime habitat for many of the state's largest migratory deer herds. Conversion of riparian, foothill, and late successional forest (forests that include mature and old-growth trees) habitat affects the viability of species dependent on those habitats as well as migratory species. About 200 of the Sierra's plant species are rare, and about half of the terrestrial vertebrates are considered "at risk" (endangered, threatened, of special concern, or sensitive) by State or federal agencies. Of about 40 native fish species in Sierra streams, less than half are deemed to have secure populations due to competition with non-native fish and loss of habitat. Amphibians and anadromous fish such as Chinook salmon have declined sharply in abundance and distribution over the last century.

Forest fires have a large impact on watersheds and ecosystems of the Sierra Nevada. In the 20th century, noticeable trends in fire and fuel show a reduction in the annual area burned, from 2 to 10 percent depending on the forest types. This can lead to a build-up of fuels for severe fires which are occurring more frequently. Three major fire-related problems have been identified in the Sierra-Nevada by the SNEP Report to Congress in 1996: (1) large number of high-severity fires, (2) too few moderate-severity fires, and (3) continued rural development in areas with extreme fire hazards.

Figure MC-3 Sierra annual precipitation variability, 1895–2007



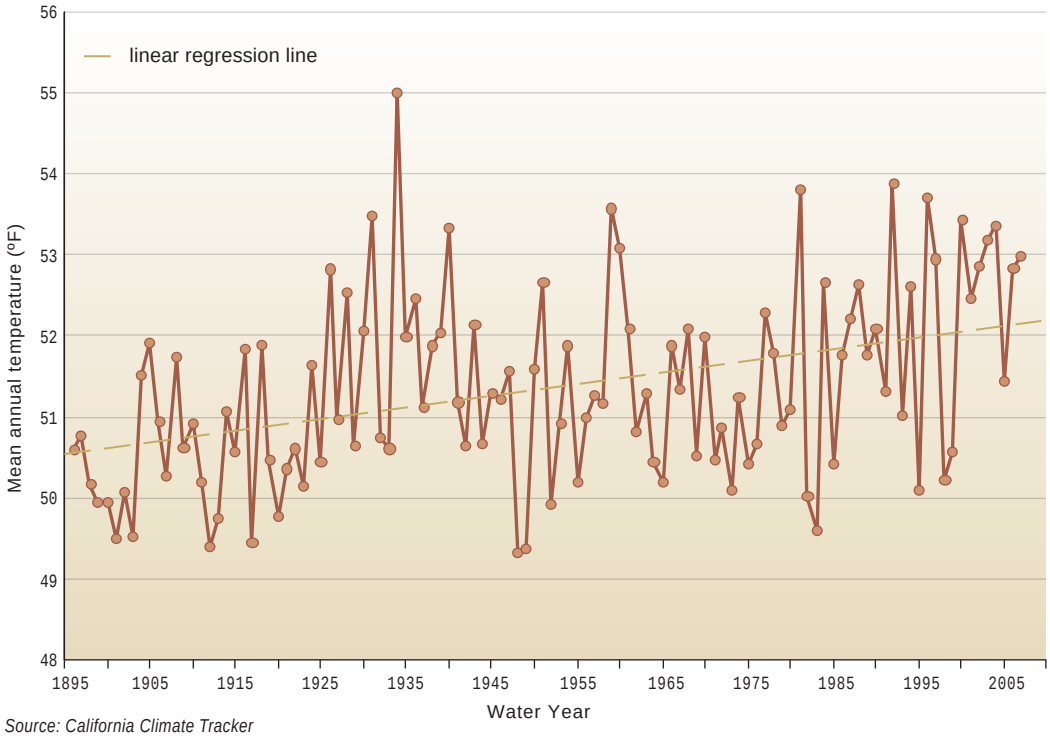
Source: California Climate Tracker
http://www.wrcc.dri.edu/monitor/cal

Climate

Climate varies dramatically with topography throughout the Mountain Counties Area, with mean annual precipitation ranging from more than 90 inches at Lassen Peak to about 14 inches below Friant Dam on the upper San Joaquin River. Annual precipitation is highest in the higher latitudes, especially the Yuba and Feather watersheds, downwind of where southwesterly winds during winter storms pass through the break in the Coast Range at the Carquinez Straits. Furthermore, due to orographic effects, high elevation slopes facing toward the southwest receive up to five times as much precipitation as the floor of the Central Valley. The rugged topography creates many local microclimates with rain shadowing downwind of mountain ridges. For example, the Sierra Valley, high in the mountains but downwind of the Sierra Buttes, averages less than 18 inches of annual precipitation.

The precipitation varies greatly from year to year as well as seasonally. About seven-eighths of the annual precipitation falls between November and April. Historical annual precipitation at Blue Canyon, near the center of this area, has ranged from about 23 to 131 inches since 1914, with an average of 64 inches. Both the seasonal and interannual variability is greater in watersheds of the San Joaquin tributaries than those in the Sacramento River tributaries. Interannual variability has increased over the last century as shown in Figure MC-3.

Figure MC-4 Sierra mean annual temperature trend, 1895–2007



Source: California Climate Tracker
http://www.wrcc.dri.edu/monitor/cal-mon/frames_version.html

Much of the precipitation accumulates as snow in the higher elevations in the winter, above about 4,500 feet in the north and above about 5,500 feet in the south. In the higher elevation watersheds of the southern Sierra, the majority of the annual precipitation contributes to the snowpack, which typically peaks about April 1. Total water content of the snowpack for the entire state averages near 15 million acre-feet of which over half accumulates in the Mountain Counties Area. This snowpack acts as the largest reservoir in the state during the winter months. Water managers throughout the area rely on this natural storage and capture or divert the subsequent spring snowmelt runoff.

Average temperatures in the area generally decrease from west to east with increasing elevation and from south to north with increasing latitude. Mean annual temperatures averaged over the Sierra region have increased 1.5 degrees Fahrenheit over the last 100 years, based on the Western Regional Climate Center's California Climate Tracker (Figure MC-4). Evapotranspiration rates in the Mountain Counties Area are influenced by the elevation, exposure, and vegetation, as well as other factors such as temperature and humidity. The reference evapotranspiration ranges from 53 to 57 inches per year.

In the summer months, mean daily temperatures usually range from 65 to 85 degrees Fahrenheit at 2,000-foot elevation and from 45 to 65 degrees Fahrenheit at 8,000-foot elevation. Typical mean daily temperatures during the winter months range from 35 to 55 degrees Fahrenheit at 2,000-foot elevation and from 15 to 35 degrees Fahrenheit at 8,000-foot elevations.

Population

The 2005 population of the Mountain Counties Area was about 596,000, approximately 2 percent of the state's total population. Development continues in most of the foothill areas and is associated with increased water needs. Population growth in the area from 2000 to 2005 was about 8 percent, less growth than in the previous five years, and similar to the state's growth rate of 8 percent for the same period. The California Department of Finance projects that the population of this foothill and mountain area will increase about 85 percent between 2000 and 2050, while the state's population is projected to increase 74 percent over the same period.

Population density is low at 37 people per square mile (including the public lands), compared to a statewide average of about 230 people per square mile. The majority of people reside in small communities and rural residential neighborhoods clustered around population centers. The largest cities entirely within the Mountain Counties Area are Auburn and Grass Valley, with about 13,000 people each. Much of the population and recent growth is located along this western portion of the foothills, particularly near the cities of Rocklin and Grass Valley. Median annual household income for these three communities currently averages $36,000 to $78,000. Many communities in the Mountain Counties Area are economically disadvantaged communities with income averages of $43,000, which is $10,000 less than the statewide average. The disparity in income between communities can be attributed to the Highway 50 and 80 corridors being home to numerous "high-tech" development companies that support higher incomes in the local communities. See Table MC-2 for demographic characteristics of selected mountain counties.

California government code section 65352.3 requires cities and counties to consult with Native American Indian Tribes during the adoption or amendment of local general plans or specific plans. A contact list of appropriate Tribes and representatives within a region is maintained by the Native American Heritage Commission. A Tribal Consultation Guideline, prepared by the Governor's Office of Planning and Research, is available online at http://www.opr.ca.gov/programs/docs/09_14_05%20Updated%20Guidelines%20(922).pdf. At California Water Plan Update regional workshops and Tribal water plenary sessions that supported the California Tribal Water Summit, information was gathered about regional tribal concerns. See reports of the hydrologic regions in Volume 3 for regional outlines of concerns. See also Tribal Summit proceedings in Volume 4.

Land Use Patterns

The economies of these mountain and foothill areas have historically been tied to the land. Today, tourism, ranching, timber harvesting, limited mining, and agriculture continue as an economic base for many communities. More recently, the high-tech industry has provided a significant contribution to the foothill economy and employment. Grass Valley, Nevada City, and Placer County have numerous companies that develop technical items for electronic media special units. The area's population growth is limited by the relatively higher costs of infrastructure in the rugged

Table MC-2 Demographic characteristics of selected mountain counties

County	1960 Population	2005 Population	2050 Population (projected)	2005 median annual household income
Plumas	11,620	21,130	28,480	$40,980
Sierra	2,250	3,510	3,550	$39,380
Nevada	20,910	98,700	136,110	$51,580
Placer	57,000	307,650	751,210	$62,780
El Dorado	29,390	173,670	314,130	$62,200
Amador	9,990	37,640	68,490	$52,080
Calaveras	10,290	44,760	80,420	$47,640
Tuolumne	14,400	56,950	73,290	$42,380
Mariposa	5,060	17,920	28,090	$39,890
Madera	40,470	141,200	413,570	$44,655

Note: Population data from California Department of Finance

Additional note: Portions of the Mountain Counties population lie outside of the Mountain Counties Area.

topography and the relatively small amount of land in private ownership. Urban land use and irrigated agriculture are each just 1 percent of the total land use. The total size of the Mountain Counties Area is 15,758 square miles, of which 60 percent is contained in eight National Forest units and three National Parks. Approximately 30 Tribes in the Mountain Counties Area are federally recognized with land areas covering less than 0.1 percent of the total area.

The federal government is the dominant landowner in the area with almost all of the higher elevation lands in the watersheds under the management of the US Forest Service (USFS) or National Park Service. These public lands provide recreational opportunities for people throughout the state. Large private land holdings for timber production of softwood forests exist in areas designated as Timberland Preservation Zones; management of National Forest land for multiple uses is addressed in Forest Plans. Forest management practices such as fuels reduction and logging methods affecting the risk of forest fires have a large impact on water quality and supply in these watersheds. Every year, numerous forest fires occur in the Sierra Nevada and expose the watershed to erosion—increasing the speed at which water runs off the bare soil; reducing percolation; and damaging water conveyance infrastructure, homes, and roads. Sediment from subsequent debris flows and landslides can obstruct waterflow in the open ditch systems, reduce reservoir capacity, cause local flooding, and impact riparian habitat.

Three-fourths of the irrigated land area is pasture in the northern Sierra, but the growing-season length is suitable for a variety of crops at lower elevations, including grain, wine grapes, apples, and other deciduous fruit. The shift to viticulture continues, especially in the central Sierra, where it is the major crop. Open space provides recharge areas, filtration, and flood attenuation that benefits downstream interests. The shift continues from historical land uses (such as timber harvesting, livestock grazing, and irrigated agriculture) to residential, commercial, and recreational developments. Cities along the western edge of the area are among the fastest growing in the state. Population growth

doubled in the Sierra Nevada between 1970 and 1990; 40 percent of the population growth occurred in the foothill portion of just three counties: Nevada, Placer, and El Dorado. Many of these small developments are dependent on individual wells and septic systems.

Regional Water Conditions

Environmental Water Use

Dedicated environmental water use in the area includes instream flows required below most major dams and diversions by State Water Resources Control Board (State Water Board) licenses, Federal Energy Regulatory Commission (FERC) licenses, and agreements with other agencies and Wild and Scenic River designations.

Wild and Scenic Rivers under federal and California law in this area include the following:

- 78 miles of the North and Middle forks of the Feather River above Lake Oroville (federal)
- 39 miles of the South Yuba River above Englebright Lake (State)
- 38 miles of the North Fork American River east of Colfax (federal and State)
- 23 miles of the lower American River below Nimbus Dam (federal and State)
- 83 miles of the Tuolumne River above Don Pedro Reservoir (federal)
- 122 miles of the Merced River and its South Fork above Lake McClure (federal)

These river reaches are managed by a combination of the National Park Service, US Bureau of Land Management, and USFS. An additional 15 miles of the North Fork Merced River was authorized for study in 1995 for potential designation under federal law.

Instream flow releases at designated dams are designed to meet beneficial uses of all stakeholders downstream including environmental, agricultural and urban users. Current issues regarding storage, allocation, distribution, and use of water in California involve environmental laws. Much of the dedicated environmental water use in the Mountain Counties Area is subsequently diverted and used by downstream users. In addition, the major foothill reservoirs at the western edge of the Mountain Counties Area are managed to meet downstream water quality and flow objectives, including Delta outflow requirements. Another environmental use is managed wetlands, marshy lands set aside for environmental or waterfowl purposes, with an augmented water supply. One managed wetland is in the lower Bear watershed, and several large natural wetlands are in the upper Feather watershed.

Water Supplies

Of California's developed water supply, about 40 percent originates within the Mountain Counties Area, more than from any other source. Local use of the water originating in this area comprises only 1 percent of the total statewide consumption, but local use is

growing. However, much of the water supplies is unavailable locally due to prior water rights appropriations for downstream or out-of-basin users. In the early 1900s, Bay Area water agencies began developing large water projects to export supplies from the Mokelumne and Tuolumne rivers to meet anticipated demands. Later, the State and federal water projects, Central Valley water agencies, and the US Corps of Engineers (USACE) built the major foothill multipurpose reservoirs from Lake Oroville to Millerton Lake, which enabled delivery of water to other regions of the state through canals, aqueducts, and via the Delta (Table MC-3).

Stockton East Water District and Central San Joaquin Water Conservation District have contracted for Central Valley Project water from New Melones Reservoir, but deliveries have been limited due to the Central Valley Project Improvement Act and pre-existing obligations. Calaveras County Water District and Union Public Utility District receive water from New Hogan Reservoir, operated by USACE. The Sierra Valley Water Company and El Dorado Irrigation District (EID) import a small portion of their supplies from the North Lahontan Hydrologic Region as shown in Figure MC-1.

The Gold Rush era marked the beginning of much of the water supply development to the foothill and mountain areas: mining operations, especially hydraulic mining. Subsequently, Pacific Gas and Electric Co. (PG&E) and several water agencies developed an extensive hydroelectric power and consumptive water use delivery system throughout the Sierra Nevada, often incorporating old mining ditches. Most of the early water conveyance facilities were later purchased or transferred to local water agencies for consumptive water deliveries. Some of these water agencies still use the ditch systems as a primary means of water delivery to both their water treatment plants and to some individual water users along the route to the treatment plants. Many of these old and unimproved conveyance systems, including ditches, flumes, and pipes, have been in use for more than 100 years. The open ditches and flumes are prone to seepage and to damage from forest fires and subsequent sedimentation and debris flows. As a result, some communities dependent on these conveyance systems have been left without water for various periods of time. Repairs on some systems have been opposed by groups and landowners concerned with the loss of the aesthetics of the flowing canal and loss of vegetation, wildlife, and groundwater recharge created by leakage and percolation. Some see the water saved as growth inducing. A few areas still use untreated water diverted directly from raw-water ditch delivery systems supplemented by bottled water deliveries; and some of the residents in the unincorporated areas are dependent on small, independent municipal or private water systems.

After years of studies, the Amador Water Agency in 2006 committed to replacing its old Amador Canal with a new Amador Transmission Pipeline. The old canal lost 40 to 50 percent of the water along the 23-mile canal through leakage and seepage. It also faced serious water quality degradation along its route and was susceptible to outages and landslides. The agency built an 8-mile pipeline and will eventually abandon the canal. The project has been operational for two years and has met or exceeded its objectives of increased water delivery efficiency, conservation, water quality preservation, and improved reliability.

Table MC-3 Reservoirs in the Mountain Counties Area

Reservoir (Dam)	Stream	Operator	Capacity (taf)
Antelope Lk	Upper Indian Creek	California Department of Water Resources	22.6
Beardsley Lk	Middle Fork Stanislaus River	Oakdale & South San Joaquin Irrigation District	70.6
Belden (Caribou Afterbay)	North Fork Feather River	Pacific Gas & Electric Co.	2.4
Bowman Lk	Canyon Creek	Nevada Irrigation District	64.0
Buchanan (Eastman Lk)	Chowchilla River	US Army Corps of Engineers	150.0
Butt Valley	Butt Creek	Pacific Gas & Electric Co.	49.9
Camanche	Mokelumne River	East Bay Municipal Utility District	417.1
Camino	Silver Creek	Sacramento Municipal Utility District	0.8
Camp Far West	Bear River	South Sutter Water District	104.5
Caples Lk	Trib Silver Fork	El Dorado Irrigation District	21.6
Cascade Lk (Lwr.Peak)	Trib South Fork Yuba River	Pacific Gas & Electric Co.	0.5
Cherry Lk (Lake Lloyd)	Cherry Creek	City and County of San Francisco	273.5
Concow	Concow Creek	Thermalito Irrigation District	6.4
Crane Valley (Bass Lk)	North Fork Willow Creek	Pacific Gas & Electric Co.	45.4
Don Pedro	Tuolumne River	Turlock Irrigation District	2,030.0
Donnells Res	Middle Fork Stanislaus River	Oakdale & South San Joaquin Irrigation District	56.9
Englebright	Yuba River	US Corps of Engineers	70.0
Faucherie	Canyon Creek	Nevada Irrigation District	5.5
Florence Lk	South Fork San Joaquin River	Southern California Edison Company	64.6
Folsom Lk	American River	US Corps of Engineers	975.0
French Lk	Canyon Creek	Nevada Irrigation District	12.5
French Meadows Res	Middle Fork American River	Placer County Water Agency	111.3
Frenchman	Lit Last Chance Creek	California Department of Water Resources	55.5
Gerle	Gerle Creek	Sacramento Municipal Utility District	1.2
Grizzly Forebay	Grizzle Creek	Pacific Gas & Electric Co.	1.1
Hensley Lk (Hidden)	Fresno River	US Corps of Engineers	90.0
Hetch Hetchy Res	Tuolumne River	City and County of San Francisco	360.0
Huntington Lk	Big Creek	Southern California Edison Company	89.2
Ice House	South Fork Silver Creek	Sacramento Municipal Utility District	37.1
Jackson Lk	Jackson Creek	Nevada Irrigation District	1.0
Jackson Meadows	Middle Fork Yuba River	Nevada Irrigation District	52.5
Junction	Silver Creek	Sacramento Municipal Utility District	3.2
Kelly Lk	Trib North Fork American River	Pacific Gas & Electric Co.	0.3
Kerckhoff	San Joaquin River	Pacific Gas & Electric Co.	4.2
Kidd Lk	Trib South Fork Yuba River	Pacific Gas & Electric Co.	1.9
Kunkle	Trib W Br Feather River	Pacific Gas & Electric Co.	0.3
Lake Almanor	North Fork Feather River	Pacific Gas & Electric Co.	1,308.0
Lake Davis (Grizzly Valley)	Big Grizzly Creek	California Department of Water Resources	83.0
Lake Eleanor	Eleanor Creek	San Francisco Public Utility Commission	28.6
Lake Fordyce	Fordyce Creek	Pacific Gas & Electric Co.	48.9
Lake McClure	Merced River	Merced Irrigation District	1,032.0
Lake Spaulding	South Fork Yuba River	Pacific Gas & Electric Co.	74.8
Lake Thomas A. Edison/Vermilion Valley	Mono Creek	Southern California Edison Company	125.0
Lake Valley	Trib North Fork American River	Pacific Gas & Electric Co.	8.1
Little Grass Valley	South Fork Feather River	Oroville-Wyandotte Irrigation District	93.0

Table MC-3 Reservoirs in the Mountain Counties Area (continued)

Reservoir (Dam)	Stream	Operator	Capacity (taf)
Loon Lk	Gerle Creek	Sacramento Municipal Utility District	76.5
Lost Cr	Lost Creek	South Feather Water and Power Agency	5.7
Lower Bear River	Lower Bear River	Pacific Gas & Electric Co.	48.8
Lower Hell Hole	Rubicon River	Placer County Water Agency	208.4
Lyons	South Fork Stanislaus River	Pacific Gas & Electric Co.	6.2
Main Strawberry	South Fork Stanislaus River	Pacific Gas & Electric Co.	18.3
Mammoth Pool	San Joaquin River	Southern California Edison Company	123.0
Millerton Lk (Friant)	San Joaquin River	US Bureau of Reclamation	520.5
Miners Ranch	Trib North Honcut Creek	South Feather Water and Power Agency	0.9
Mountain Meadows (Indian Ole)	Hamilton Creek	Pacific Gas & Electric Co.	24.8
New Bullards Bar Res	North Fork Yuba River	Yuba County Water Agency	969.6
New Hogan	Calaveras River	US Corps of Engineers	317.1
New Melones	Stanislaus River	US Bureau of Reclamation	2,400.0
New Spicer Meadow Res	Highland Creek	Calaveras County Water District	189.0
Oroville	Feather River	California Department of Water Resources	3,537.6
Pardee	Mokelumne River	East Bay Municipal Utility District	180.0
Philbrook	Philbrook Creek	Pacific Gas & Electric Co.	5.2
Ponderosa Div.	South Fork Stanislaus River	South Feather Water and Power Agency	4.8
Relief	Summit Creek	Pacific Gas & Electric Co.	15.1
Rock Cr	North Fork Feather River	Pacific Gas & Electric Co.	4.7
Rollins Res	Bear River	Nevada Irrigation District	66.0
Round Valley	West Br Feather River	Pacific Gas & Electric Co.	1.1
Salt Springs Res	North Forth Mokelumne River	Pacific Gas & Electric Co.	141.9
Sawmill Lk	Canyon Creek	Nevada Irrigation District	3.0
Scotts Flat	Deer Creek	Nevada Irrigation District	49.0
Slab Cr	South Fork American River	Sacramento Municipal Utility District	16.6
Sly Cr	Sly Park Creek	Oroville-Wyandotte Irrigation District	65.1
Tulloch	Stanislaus River	Oakdale & South San Joaquin Irrigation District	68.4
Union	North Fork Stanislaus River	Northern California Power Agency	2.0
Union Valley Res	Silver Creek	Sacramento Municipal Utility District	230.0
Utica	North Fork Stanislaus River	Northern California Power Agency	2.4

Note: Reservoirs listed in table represent 95% of the total storage in the Mountain Counties Area.

The Tuolumne Utilities District is developing a Tuolumne County Ditch System Sustainability Plan by 2010 with support from the Sierra Nevada Conservancy. This plan will include surveying and mapping the county's ditch systems and preparing both a capital improvement program and an operation and maintenance strategy. The goal is to protect and preserve the ditches, address pollution sources, reduce flood- and fire-related ditch failures, research the benefits of easements, reduce water losses, and enhance the sustainability of the systems. The project is intended to be a model for other communities facing similar issues.

Many hundreds of public and private water systems supply water within the Mountain Counties Area, and locally developed surface water accounts for approximately 90 percent of the local public consumptive water supply. The remainder of the water

is provided from federal water facilities, groundwater, locally developed imports from adjacent hydrologic regions, and reclaimed wastewater. In 2005, EID reported using 3,010 acre-feet of recycled water for landscape irrigation, meeting 6 percent of its overall demands. Many individual water users throughout the area have developed their own supplies, typically groundwater and small surface storage. However, much of the surface water is unavailable locally due to prior water rights appropriations for downstream or out-of-basin users.

Local water supplies vary seasonally and year to year, depending on the amount and timing of precipitation and the corresponding large fluctuations in runoff.

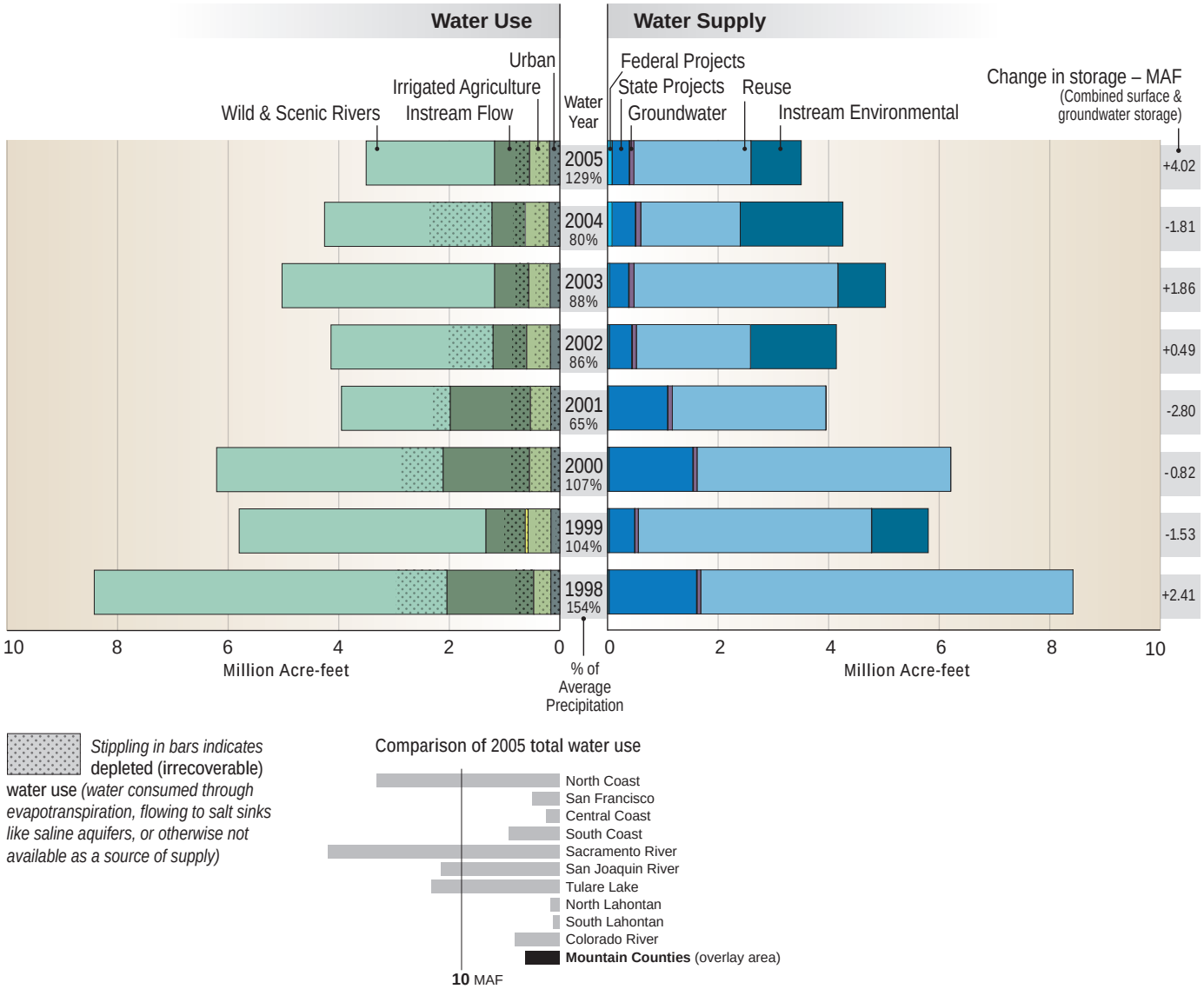
Groundwater

Groundwater constitutes approximately 5 percent of the area's overall water supply and is used as a supply for single-family homes as well as public and private water supply systems. Groundwater availability is often limited to fractured rock and small alluvial deposits immediately adjacent to the area's many streams. In the rural areas, many individual residences are not connected to a municipal water system and are wholly dependent upon individual wells for domestic use, which are often unreliable during drought periods. Some farms and many of the vineyards have developed wells with enough production to irrigate their lands in all but the driest of years. Larger groundwater basins occur in the high valleys of the upper Feather River. Sierra Valley, the largest valley in the watershed, contains a large aquifer that has suffered from overuse in recent decades. For more information, see DWR's California's Groundwater Update 2003.

Water Use and Efficiency

Total consumptive use of water in the Mountain Counties Area is less than 2 percent of the 17 million acre-feet of natural river runoff from the area in an average year, and about 1 percent of total statewide consumption. The overall consumptive water use is about 75 percent agricultural, with the remainder urban; but it varies widely between counties. Agricultural use, especially drip irrigation of vineyards, is increasing. Increasing urban water use is driven by the growth in population, housing, employment, and tourism. Shifts in land use are affecting water use and quality. Development of second homes and vacation rentals is a growing trend in many of the foothill and mountain areas, resulting in higher water use on most weekends during the popular summer and winter vacation periods. For example, Groveland Community Services District, near Yosemite National Park, estimates that the service area population doubles during peak vacation periods. Tourism water use, which is most significant in the central Sierra, tends to inflate the area's per capita urban water use because the volume of water consumed is large compared to the permanent residential population. Overall per capita urban water use is approximately 240 gallons per day. This water usage rate is within the range of communities located in the Central Valley regions that range from 200 to 300 gallons per day.

Figure MC-5 Mountain Counties Area water balance summary, 1998-2005



Water Balance Summary

Figure MC-5 summarizes the total developed water supplies and distribution of the dedicated water uses within this overlay region for the eight years from 1998 through 2005. As indicated by the variation in the horizontal bars for wet (1998) and dry (2001) years, the distribution of the dedicated supply to various uses can change significantly based on the wetness or dryness of the water year. The more detailed numerical information about the developed water supplies and uses is presented in Volume 5 Technical Guide, which provides a breakdown of the components of developed supplies used for agricultural, urban, and environmental purposes and Water Portfolio data.

For the Mountain Counties Area, dedicated environmental water for instream fishery flows dominate the developed water use; urban and agricultural water uses are much

Table MC-4 Mountain Counties water balance for 1998-2005 (thousand acre-feet)

Mountain Counties	Water Year (Percent of Normal Precipitation)							
	1998 (154%)	1999 (104%)	2000 (107%)	2001 (65%)	2002 (86%)	2003 (88%)	2004 (80%)	2005 (129%)
Water Entering the Region								
Precipitation*	55,206	38,289	38,412	23,445	31,886	32,462	29,605	47,543
Inflow from Oregon/Mexico	0	0	0	0	0	0	0	0
Inflow from Colorado River	0	0	0	0	0	0	0	0
Imports from Other Regions	10	29	10	9	35	30	10	6
Total	**55,216**	**38,318**	**38,422**	**23,454**	**31,921**	**32,492**	**29,615**	**47,549**
Water Leaving the Region								
Consumptive Use of Applied Water ** (Ag, M&I, Wetlands)	237	335	279	264	305	275	333	275
Outflow to Oregon/Nevada/Mexico	0	0	0	0	0	0	0	0
Exports to Other Regions	19,983	12,776	13,548	7,376	7,143	8,742	8,941	11,670
Statutory Required Outflow to Salt Sink	1,227	1,024	1,090	654	1,565	862	1,882	3,466
Additional Outflow to Salt Sink	81	1	174	180	0	0	0	0
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	31,274	25,707	24,153	17,781	22,422	20,754	20,273	28,120
Total	**52,802**	**39,843**	**39,244**	**26,255**	**31,435**	**30,632**	**31,429**	**43,531**
Storage Changes in the Region								
[+] Water added to storage [-] Water removed from storage Change in Surface Reservoir Storage	2,420	-1,511	-802	-2,721	422	1,811	-1,859	3,983
Change in Groundwater Storage ***	-6	-14	-20	-80	64	49	45	35
Total	**2,414**	**-1,525**	**-822**	**-2,801**	**486**	**1,860**	**-1,814**	**4,018**
Applied Water ** (compare with Consumptive Use)	402	544	472	452	539	506	563	483

* The percent precipitation is based upon a running 30-year average of precipitation for the region; discrepancies can occur between information calculated for Update 2009 and earlier published data.

** Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.

*** Change in Groundwater Storage is based upon best available information. Basins in the north part of the state (North Coast, San Francisco, Sacramento River and North Lahontan regions and parts of Central Coast and San Joaquin River Regions) were modeled - spring 1997 to spring 1998 for the 1998 water year and spring 1999 to spring 2000 for the 2000 water year. All other regions and years were calculated using the following equation:

GW change in storage = intentional recharge + deep percolation of applied water + conveyance deep percolation and seepage - withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow.

smaller portion of the total. The water supply portion of Figure MC-5 also indicates that most of the water supply in this region is from surface water flows from the Sierra Nevada, with significant amounts of water reuse by downstream users. Groundwater usage is very minor in this region because the Mountain Counties Area does not overlay or have access to any significant large groundwater aquifers.

Table MC-4 presents information about the total water supply available to this region for the eight years from 1998 through 2005, and the estimated distribution of these water supplies to all uses. The annual change in the region's surface and groundwater storage is also estimated as part of the balance between supplies and uses. In wetter years, water will usually be added to storage; and during drier water years, storage volumes may be reduced. Of the total water supply to the region, more than half is either used by native vegetation; evaporates to the atmosphere; provides some of the water for agricultural crops and managed wetlands (effective precipitation); or flows to other states, the Pacific Ocean, and salt sinks like saline groundwater aquifers. The remaining portion, identified as consumptive use of applied water, is distributed among urban and agricultural uses and for diversions to managed wetlands. For some of the data values presented in Table MC-4, the numerical values were developed by estimation techniques because actual measured data are not available for all categories of water supply and use.

Water Quality

Salinity

The water in the Mountain Counties Area is the source water for many of the other hydrologic regions. Other than localized naturally occurring problems, the water in the Mountain Counties Area is excellent quality. Protecting high-quality source waters is important part of the solution to the Central Valley salinity problem. Protection must focus on both the quality and quantity of water from the Mountain Counties watersheds as a reduction in the quantity of flow will have a negative impact on the Salinity concentration in the lower watersheds. The Central Valley Regional Water Quality Control Board (Regional Water Board) has formed a salinity policy group to work on solutions and this effort does include the lower portions of the Mountain Counties Area. The goal of the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) effort is to maintain a healthy environment and protect the state's water. Its solutions will cross regional boundaries, go beyond the board's jurisdiction, and require cooperation by a number of local, State, and federal agencies. For information on salt and salinity management, see the resource management strategy in Volume 2.

Nitrates

Groundwater is a primary water supply in many instances. But in many places, groundwater is impaired or threatened because of elevated levels of nitrates and salts that are derived principally from irrigated agriculture, discharges of wastewater to land, and from disposal of sewage from both community wastewater systems and septic tanks. As noted in California's Groundwater Update 2003, nitrate is one of the most frequently

exceeded constituents in public supply wells. See State Water Board report to the State Legislature on Nitrate in Drinking Water (1988).

Groundwater in crop production areas can become contaminated with nitrate when nitrogen fertilizers are applied at rates in excess of crop utilization and inefficient irrigation or high rainfall leach the nitrate to groundwater. Other factors that put groundwater at risk are a shallow aquifer, the absence of a restricting layer to vertical migration of nitrate, permeable soils, and poor well construction. The Regional Water Board's Irrigated Lands Regulatory Program may address some of these issues by starting the process of identifying impacts and requiring development and implementation of practices to reduce and/or eliminate the impacts.

In the foothills, discharges from septic tanks are a significant water quality concern (Central Valley Water Board 2004). The Regional Water Board has approximately 600,000 individual onsite systems within its boundaries (equivalent dwelling units). Collectively, these systems discharge approximately 120 million gallons per day to the subsurface, a portion of which may cause water quality issues. Pollutants of concern in these discharges consist primarily of nutrients and pathogens, but metals, salts, and personal care products (e.g., pharmaceuticals) are also a concern. The Regional Water Board developed "Guidelines for Waste Disposal from Land Developments" in 1976 to protect drinking water beneficial uses and human health concerns from contact. Since then, many changes have been made in onsite wastewater disposal techniques that regulatory agencies have not had adequate opportunity to evaluate, especially in foothill areas that have shallow soil cover and sloping surfaces.

Legacy Mine Impacts

Historical use of mercury to amalgamate gold in the Sierra has resulted in substantial mercury loads discharged to Central Valley waterways. Methylmercury is the most toxic form of mercury and accumulates in successive levels of the food chain. It is a neurotoxicant that adversely affects reproductive and immune systems in humans and wildlife that consume contaminated fish and shellfish. Drainage from abandoned gold mines in the Mother Lode District of the Sierra Nevada foothills may contain arsenic in concentrations that affect domestic drinking water supplies and, if precipitated into the stream sediments, may pose a threat to human health via dermal contact or inhalation of dried precipitates or tailings. The California Office of Environmental Health Hazard Assessment has issued fish advisories for the Lower Feather River, lakes on the Bear and Yuba rivers, Lake Natomas and the Lower American River, the Cosumnes River, and the Mokelumne River due to the mercury levels in the fish.

Legacy copper mining in the Upper Feather River watershed has caused copper, cadmium and zinc impairments in several of the tributaries in this watershed. Copper and zinc impacts from copper mining have also been identified in Camanche Reservoir. Drainage from abandoned mines contributes metals and other water quality problems downstream. The 1999 remediation of Penn Mine, a copper mine in the Mokelumne River watershed, is an example of how acid mine drainage can be corrected.

Sedimentation and Erosion

In the Sacramento and San Joaquin River watersheds, erosion is occurring from the headwaters down to the valley floor. Although naturally occurring, erosion can be accelerated by commercial timber harvest activities, land use conversion, rural development, grazing, recreational use, and forest fires. Excessive soil erosion and sediment delivery can impact the beneficial uses of water by (1) silting over fish spawning habitats and increasing turbidity; (2) clogging drinking water intakes; (3) filling in pools creating shallower, wider, and warmer streams, and increasing downstream flooding; (4) creating unstable stream channels; and (5) losing riparian habitat. Timber harvesting in the riparian zone can adversely affect stream temperatures by removing stream shading, which is especially a concern for spawning and rearing habitat for salmonids. Thousands of miles of streams are potentially impacted, and the lack of resources has prevented a systematic evaluation of these impacts.

During the past five years, timberland owners have submitted 1,473 timber harvest plans that allow harvesting on over 500,000 acres, or 5 percent of the total land surface of the Mountain Counties Area. Another major source of erosion is construction activities that expose or loosen soils. In the past five years, the Regional Water Board has documented 11 incidents of water quality impacts that resulted in formal enforcement action and 84 incidents that could result in water quality impacts if not corrected.

Linkages between water quality and water supply are addressed in several of the resource management strategies in Volume 2.

Project Operations

Overall, the water projects in this area provide about 45 percent of the reservoir storage capacity and 55 percent of the hydroelectric power capacity in the state. The major water projects in the area are listed in Table MC-5. Several projects were built with partnerships between PG&E and local water suppliers under contracts that will expire between 2009 and 2016. For information about specific projects, see links in Appendix B Selected References.

Most of the major foothill reservoirs at the western edge of the Mountain Counties Area are operated to provide flood control and water supply benefits to downstream interests. Figure MC-6 shows the historical average combined storage in these reservoirs compared to the flood control reservations mandated in their USACE Flood Control Manuals. Most of the upstream reservoirs provide seasonal storage, and the largest reservoirs at the edge of the foothills provide multi-year carryover storage. For more information about the reservoirs operated by the State Water Project, Central Valley Project, and Central Valley irrigation districts, see Volume 3 reports for Sacramento River and San Joaquin River hydrologic regions. Changes in runoff timing due to climate change, as well as modified operations for fishery and recreation needs that result from FERC hydro-relicensing, will affect future reservoir operations.

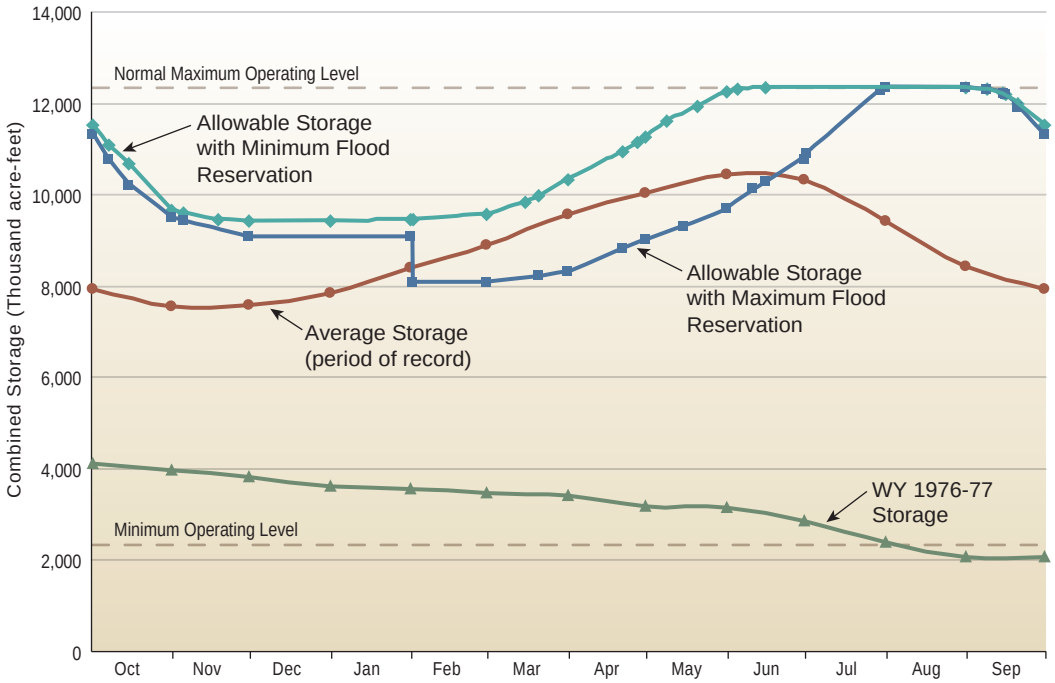
Table MC-5 Large upstream water projects in the Mountain Counties Area

Project name	Operator(s)	Project type	Mean basin outflow (taf/year)	Reservoir capacity (taf)	Generating capacity (MW)
Feather River projects	Pacific Gas & Electric (PG&E)	hydroelectric	2,400	1,322	794
Upper Feather reservoirs	State Water Project	water storage, local supply	120	162	0
South Feather Project	South Feather Water and Power Agency and PG&E	local supply and hydroelectric	290	171	104
Yuba River Project	Yuba County Water Agency and PG&E	local supply and hydroelectric	1,300	966	364
Drum-Spaulding Project	PG&E	hydroelectric	650	154	181
Yuba-Bear Project	Nevada ID and PG&E	local supply and hydroelectric	400	280	80
Middle Fork American Project	Placer County WA and PG&E	local supply and hydroelectric	840	347	211
Upper American River Project	Sacramento MUD	hydroelectric	1,000	406	641
Lower Mokelumne River Project	East Bay MUD	export and hydroelectric	770	615	33
North Fork Stanislaus Project	Northern California PA and Calaveras County WD	local supply and hydroelectric	310	201	253
Tri-Dam project (Stanislaus)	Tri-Dam Power Authority and PG&E	local supply and hydroelectric	1,200	229	162
Hetch Hetchy Project	San Francisco PUC	export and hydroelectric	1,250	661	385
Big Creek Project	Southern California Edison	hydroelectric	1,660	573	950

Water Governance

More than 100 local governmental agencies and districts—most serving from 1,000 to more than 100,000 customers—deliver water and treat wastewater for water users in the Mountain Counties Area. In addition, the many city and county governments manage land use zoning, building permitting, and other activities related to water resources development and utilization such as treated and raw water management plans and drought plans. County General Plans provide direction for these activities; and Sierra, Nevada, Mariposa, and Madera counties include a water resources element in their plans. East Bay Municipal Utility District (EBMUD) and Hetch Hetchy Water & Power export water from the Mokelumne and Tuolumne rivers to the San Francisco Bay Area. These agencies are managed by governing bodies elected by their customers,

Figure MC-6 Operation of major foothill reservoirs in Mountain Counties Area



Sum of storage at Lake Oroville, Bullards Bar Reservoir, Folsom Lake, Camanche and Pardee Reservoirs, New Hogan Lake, New Melones Reservoirs, New Don Pedro Lake, New Exchequer Reservoir, and Millerton Lake. Data from CDEC and USACE.

who live outside the Mountain Counties Area. The State Water Project and the federal Central Valley Project also export water from the area, and numerous Central Valley water agencies manage additional reservoirs to divert water from the western edge of the area. Finally, several State and federal agencies exercise regulatory control over water management activities. Table MC-6 lists some of the major types of organizations involved in the governance and planning of water resources in this area.

In addition to the government and public agencies with responsibility for managing water resources, the Mountain Counties Area is home to several regional planning organizations seeking to identify future trends such as climate change and their challenges. These groups are working on issues of land use, housing, environmental quality, and economic development, wetlands, water reliability, watershed management, groundwater management, water quality, fisheries, and ecosystem restoration. The Mountain Counties Water Resources Association assists water agencies and local governments in coordinating water resource matters important to the area and interfaces with applicable State officials and departments on these matters. Formed in 1950s, its members include 17 water agencies and local governments who meet bimonthly. Existing and forming integrated regional water management (IRWM) planning groups are discussed later in this report.

Table MC-6 Water governance and planning in Mountain Counties Area

Organization	Legal status	Purpose
Local water and wastewater agencies and districts	Local government	Water storage and delivery, wastewater treatment, water resources planning and management at the local, regional and state level
Downstream or exporting water agencies (EBMUD, HHW&P, SWP, CVP, numerous others)	Local government, State, and federal projects	Water storage and delivery, wastewater treatment, flood management
City and county governments	Local government	Water delivery, wastewater treatment, flood management, land use zoning
Hydroelectric utilities (PG&E, SCE, SMUD, NCPA)	Private and public utilities	Power production, water storage
Regulating agencies (State and Regional Water Boards, DPH, DSOD, FERC)	State and federal government	Regulation of water diversions, water quality, hydroelectric projects, dam safety
Mountain Counties Water Resources Association	Nonprofit association	Regional water planning, advocacy
IRWM planning groups (Upper Feather, CABY, MAC, Madera, Tuolumne-Stanislaus)	Varies	Regional water plan development and implementation
Watershed forums, resource management groups	Varies	Resource protection planning, advocacy
Sierra Nevada Conservancy	State government	Resource protection planning, grant administration
Sierra Nevada Alliance	Nonprofit organization	Resource protection planning, advocacy

Flood Management

Flood Hazards

Floodwaters in the Mountain Counties Area originate from rainfall or melting of the Sierra snowpack. Floods are often of short duration, but due to the steep stream gradients, they can be destructive. Standing high water is generally rare as a result of the steep relief of the area; but exceptions occur in broader mountain valleys. Towns and roads located along major streams at the bottom of steep canyons are especially vulnerable. Flood hazards in the region include these representative situations (for specific instances, see Challenges):

- Highways and roads are vulnerable to the 1 percent event in many locations.
- Some existing culverts and channels do not have sufficient capacity to carry flow resulting from the 1 percent event.
- Population growth and the ensuing development increase the area of impervious surface without sufficient mitigation, increasing peak runoff.
- Development occurs in the floodplain of the 1 percent event without sufficient mitigation, causing increased flood damage risk.
- Development has resulted in poorly placed, flood-vulnerable structures.
- Mapping of the 1 percent event floodplain is incomplete in some areas.
- Inadequate topographic information limits the accuracy of floodplain mapping.
- Unmanaged vegetation has reduced floodflow capacity at some locations.
- Some dams do not meet current State seismic, spillway, or other structural requirements.

Box MC-2 Flood Management Agencies

Federal

- Federal Emergency Management Agency
- National Weather Service
- Natural Resources Conservation Service
- US Geological Survey
- US Army Corps of Engineers

Tribal

- Tribal governments of the Mountain Counties Area

State

- California Conservation Corps
- California Emergency Management Agency
- Central Valley Flood Control Board
- Department of Corrections
- Department of Forestry and Fire Protection
- Department of Water Resources

Local

- Calaveras County Public Works
- Madera County Engineering and General Services Department
- Placer County Flood Control and Water Conservation District
- Plumas County Flood Control and Water Conservation District
- County and city emergency services units
- County and city planning departments
- County and city building departments
- Local conservation corps
- Local emergency response agencies
- Local initial responders to emergencies

- Uncontrolled runoff from minor watersheds and other areas often causes significant damage.
- Wildfires may denude steep slopes, which are then vulnerable to increased runoff and debris flow during ensuing storms.
- Public education about flood hazards is insufficient at some locations.

Historic Floods

Notable events occurred in 1861-62, 1906, 1909, 1955, 1964, 1986, 1997, and 2005. For more information on these floods see Appendix A Flood Management.

Flood records for selected flood-producing streams are listed in Appendix A in Table MCA-1 Record floods for selected streams, which also includes for most rivers a downstream station, usually outside the region, that approximates the total regional outflow for that stream.

Flood Governance

Flood management is a cooperative effort in which federal, Tribal, State, and local governments all play significant parts. The principal participants are listed in Box MC-2. For more information on the agencies' roles, see Table MCA-2, Flood management participants, in Appendix A.

Flood Risk Management

Flood risk management includes a wide variety of projects and programs, which may be grouped as Structural Approaches (constructed facilities, coordination and reservoir operations, maintenance), Land Use Management (regulation, flood insurance), and Disaster Preparedness, Response, and Recovery (information and education, event management).

Structural Approaches

Constructed Facilities. Mirroring the relatively sparse development in the region, infrastructure dedicated to flood management is comparatively rare. Eight large reservoirs on eight of the region's major streams, all with USACE-managed flood reservations, provide flood control in the valley areas below but not for the Mountain Counties. These reservoirs are Lake Millerton, Hensley Lake, Eastman Lake, Lake McClure, New Don Pedro Reservoir, New Melones Lake, New Hogan Lake, and Camanche Reservoir. For more information on these reservoirs, see Sacramento River and San Joaquin River regional reports' appendices A on Flood Management.

Although many other reservoirs have been constructed throughout the region, they were built primarily for water supply and hydroelectric generation but may provide incidental flood management. These facilities are listed in Appendix A, Table MCA-3 Reservoirs providing incidental flood control.

A federal project on the North Fork Feather River provides protection to Chester by diverting excess flows via a leveed floodway into Lake Almanor.

Coordination and Reservoir Operations. There are no forecast-based operations agreements for operation of flood protection facilities in the region. No reservoirs in the Mountain Counties Area incorporate formal flood control reservations benefiting the area. However, storage space in certain upstream Mountain Counties Area reservoirs is considered to contribute to available flood management space in some of the large multi-purpose foothill reservoirs, to the benefit of downstream areas. See "Relationships with Other Regions" as well as Volume 3 reports on the Sacramento River and San Joaquin River hydrologic regions for more information. During high water periods, reservoir operators coordinate with DWR and USACE in daily operations conferences at the State-Federal Flood Operations Center in Sacramento. These conferences often lead to voluntary modifications of individual schedules to improve overall system operation for the Central Valley.

Maintenance. Maintenance of flood control works is a critical activity that preserves the integrity of the facilities, ensuring continued protection for the public. This effort is made more difficult by two factors: (1) Lack of adequate financing for many installations is the result of tax-management efforts of the late 20th century, which have placed controls on former sources of revenue; and (2) heightened public awareness of the environment has resulted in new regulations making the permitting process lengthy and

expensive. Compounding the problem, deferred maintenance can cause establishment of new habitat which then must be protected.

Maintenance of flood control facilities in the Mountain Counties Area is described in the regional reports of the Sacramento River and the San Joaquin River hydrologic regions.

Land Use Management

Regulation. Counties are the main agencies responsible for designating and regulating floodways. All counties in the region regulate development on floodplains via ordinances and building codes. However, sparse information on recurring flooding issues in rural lands may encourage inappropriate development within high-risk floodplains. All local land use jurisdictions must adopt a floodplain management ordinance identifying 1 percent floodplains and floodways, in order to qualify for Federal Emergency Management Agency (FEMA) flood insurance.

Adopting designated floodways facilitates enforcement of floodplain building ordinances. In the Mountain Counties Area, the Feather River and its tributaries in Plumas County, Angels Creek in the vicinity of Angels Camp, and floodplains of Sonora and Woods creeks within the city limits of Sonora have been identified as floodways by appropriate entities.

Flood Insurance. The National Flood Insurance Program (NFIP) is administered by FEMA. It enables property owners in participating communities to purchase insurance as protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. About 97 percent of California communities participate in the NFIP. Of those, approximately 12 percent participate in the Community Rating System (CRS) Program, which encourages communities to go beyond minimum program requirements in return for reduced insurance rates. Quality mapping is critical to administering an effective flood insurance program, developing hydrologic and hydraulic information for determining floodplain boundaries and allocating flood protection project funds.

FEMA has provided Flood Insurance Rate Maps (FIRMs) for most areas within the region. As of June 2009, maps in five of the region's 16 counties are new since 2008, and seven more are scheduled to be updated by 2010. One county had a partial update in 2008, and three are not scheduled for update.

CRS rates communities from 1 to 10 on the effectiveness of flood protection activities. The lower ratings bring larger discounts on flood insurance. Of the 16 counties and 16 cities in the hydrologic region, four counties participate in CRS. As of May 2009, Sacramento County and Placer County are in CRS Class 5; Yuba County, Class 7; and Fresno County, Class 8. See http://www.fema.gov/business/nfip/crs.shtm for more information on the CRS system.

Disaster Preparedness, Response, and Recovery

Information and Education. The California Data Exchange Center (CDEC) provides real-time and historical hydrometeorological data for hundreds of stations statewide, as well as real-time data on releases, spill rates, and elevations of many reservoirs. For listings of real-time stream and reservoir data stations, see Volume 3 reports for the Sacramento River and the San Joaquin River hydrological regions, including their appendices on Flood Management. For access to CDEC data, see http://cdec.water.ca.gov.

The USGS maintains and publishes statistics for stream gages nationwide. USGS gages are the source of data for the Appendix A, Table MCA-1, Record floods for selected streams, Mountain Counties Area. For access to USGS gage data, see http://waterdata.usgs.gov/nwis.

Accurate forecasting of precipitation and river flows is necessary to determine reservoir releases that reduce flooding risks and to alert citizens of upcoming floods. The National Weather Service's (NWS) California Nevada River Forecast Center, in conjunction with the US Bureau of Reclamation (USBR) and DWR, provides real-time hydrologic data and short- and longer term river stage forecasts for selected stations in the Feather, American, Tuolumne, and Merced River basins. Additionally, housing staff with expertise in flooding from USBR, DWR, NWS river forecasting, and NWS weather forecasting under one roof in the Flood Operations Center in Sacramento has increased the efficacy of flood management operations and resulted in dissemination of consistent multi-agency bulletins updating the public about flooding issues. Many models describing the hydrology of the area's major streams have applicability to flood forecasting in the Mountain Counties Area. See the following Volume 3 regional reports for more details: Sacramento River, San Joaquin River, and Tulare Lake.

DWR's Awareness Floodplain Mapping program provides an easy-to-use computer interface for viewing areas vulnerable to flooding by the flood having a 1 percent probability of occurrence. The program applies to areas not already covered by FEMA FIRMs. For this region, maps have been drawn for all counties, but coverage of some areas may have been deferred. By 2015, all areas expected to develop over the next 25 years will have mapped floodplains.

Accurate hydrologic and hydraulic models inform the design of effective flood control structures and emergency actions before, during, and after floods. NWS's Advanced Hydrologic Prediction Service uses historical hydrologic data, current river and watershed conditions, and near-term meteorological outlooks to forecast river flows. The service is publicly available for certain streams of the Mountain Counties Area. Locations are given in Appendix A, Table MCA-5, Advanced Hydrological Prediction Service stream forecast points.

Event Management. Under the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS), initial flood emergency response is made by the responsible party at the site. When its resources are exhausted,

the county emergency management organization (Operational Area) provides support. If necessary, additional support is coordinated by the Inland Region of the California Emergency Management Agency (Cal EMA). Through the Cal EMA region and Cal EMA headquarters, help can be obtained from any State agency. Cal EMA coordinates with federal agencies and private organizations as well. The State-federal Flood Operations Center (a joint facility of DWR and the Sacramento Weather Office and California-Nevada River Forecast Center, both units of NWS) is normally called early in the event to provide weather and river forecasts, facilitate information flow, provide field situation analysis, and give flood fight expertise. Severe situations that require Cal EMA involvement may also require emergency response by USACE, which is obtained by request of DWR. Table MCA-4, Flood emergency response organizations, in Appendix A, is a listing of specific response organizations.

Recovery after a flood may involve the funding and construction services of USACE if the facilities are parts of federal projects. Availability of resources to repair local and private facilities, remove floodwater, and restore housing, businesses, and infrastructure often depends on the severity of the event and the allocation of event-specific federal or State funds.

Flood preparedness and mitigation efforts are promoted and funded by many organizations, including city and county governments, Cal EMA, DWR, NWS, and USACE.

Relationship with Hydrologic Regions

About 40 percent of the state's developed water supply originates from the Mountain Counties Area. This percentage represents the fraction of statewide agricultural, urban, and managed wetland net water use that is supplied by river runoff from the Mountain Counties Area. Many surface storage and diversion facilities capture and export water, including several Central Valley Project and State Water Project reservoirs, and local facilities operated by Yuba County Water Agency, EBMUD, the city of San Francisco, Modesto and Turlock Irrigation districts, Merced Irrigation District, and others. Combined, these watersheds produce an average of about 18 million acre-feet per year of water supplies for agricultural, urban, and managed wetlands uses in the Central Valley, Bay Area, and South Coast; and contribute a majority of the water flowing through the San Francisco Bay and the Delta, helping with environmental needs, salinity concerns, and water quality issues. Figure MC-1 provides information about the volume of water flowing from the Mountain Counties Area in 2005.

Many counties and water districts meet regularly to discuss regional and interregional water issues at Mountain Counties Water Resources Association meetings. The Association of California Water Agencies Region 3 holds its meetings in conjunction with the mountain counties meetings. Other groups of upland and neighboring downstream counties and water districts meet regularly to discuss interregional use of water from particular rivers. A prime example of this commitment to regularly

Box MC-3 Mokelumne River Forum

The upper Mokelumne River and its tributaries, vital to meeting water resource needs in Amador, Alpine and Calaveras counties, flows westward into northern San Joaquin County, where the lower Mokelumne River is an important water resource for valley farms and communities. The Mokelumne River Forum (forum) includes agencies and non-governmental entities with interests in the upper and lower Mokelumne River water resources. The forum was developed in the early 2000s to foster an interregional approach.

A memorandum of understanding bridges forum member agencies with support from DWR, which provides support by helping regional collaboration. Facilitation has been useful in resolving complex interregional water resource issues facing adjoining regions: the upper Mokelumne participants and the San Joaquin participants.

From this collaborative forum effort, the concept of an Inter-Regional Conjunctive Use Project was proposed. The IRCUP concept integrates existing infrastructure on the Mokelumne River with potential new projects undertaken by one or more forum agencies in an effort to improve the conjunctive management of a portion of the Mokelumne River's water supplies for member benefit. In 2007, the forum utilized the technical assistance as provided by DWR to perform initial review of the feasibility of the IRCUP. A joint chapter was developed and is included in the Mokelumne-Amador-Calaveras Integrated Regional Water Management Plan (developed by upper Mokelumne stakeholders) and the Northeast San Joaquin County Groundwater Banking Authority Integrated Regional Water Management plan (developed by lower Mokelumne stakeholders). Discussion of upper and lower Mokelumne River water resource matters continues to take place at the forum. Attendees are evaluating a potential interregional conjunctive use project that could benefit both Mokelumne-Amador-Calaveras and the Groundwater Banking According planning regions.

communicate can be found in the Mokelumne River Forum (Box MC-3). Further north, DWR and the State Water Contractors are partners in the Plumas Watershed Forum, which invests in watershed restoration and management in the Upper Feather River region for the mutual benefit of the State Water Project and the residents of the region. All users benefit from such collaborative actions taken to maintain the health of the watersheds and meet multiple objectives using an integrated approach. Because water rights administered by the State Water Board are often at the heart of many interregional challenges and opportunities, these efforts rely on the on-going commitment of regional working groups.

Throughout California, 129 existing hydroelectric projects hold FERC licenses, of which 37 will be up for license renewal within the next 10 years or are already engaged in renewing. Twenty-five of the projects are on river systems within the Mountain Counties Area and are operated by private and public utilities such as PG&E and the Sacramento Municipal Utility District and water agencies. As part of the FERC renewal process, project owners must evaluate the future use, impacts, and alternatives for each hydroelectric project. For local water agencies this process provides key opportunities to develop and improve integrated resource planning so that the proposed reoperation and federal relicensing of hydroelectric projects can also consider improved benefits to local water supplies, instream flows, and recreation uses. As most of these are multi-use projects, balancing the operational objectives requires the cooperation of all stakeholders.

Many mountain reservoirs contribute to reducing flood risks to communities in the Central Valley, through crediting flood reservation space in foothill reservoirs to upstream reservoirs, forecast-coordinated agreements, voluntary collaboration, and effective communication between operators of upstream and downstream dams. For further information about this coordination during floods, see Appendix A.

Many factors in the headwater areas affect downstream water supply, water use, water quality, and flood management, and highlight the need for further coordination between upstream and downstream interests. Fire management, USFS Forest Management and timber harvest plans, and watershed and conservancy plans have major effects on upper watershed health and downstream river runoff. Regional transportation blueprints and county general plans influence growth and water use across regional boundaries. Other connections between regions include habitat and species protection across bio-regions, the indirect consequences of regulatory actions, and interregional economic and recreation linkages.

Regional Water and Flood Planning and Management

Some of the major water-related challenges facing the Mountain Counties Area include

- meeting future water needs in the region;
- improving water supply reliability to sustain water supplies in drought periods and other emergency outages;
- maintaining and improving drinking water quality across the area by continuing to meet and exceed current and anticipated drinking water quality standards and protecting drinking water sources; and
- improving the ecosystem health.

Other challenges include linking local land use planning with water system planning, developing mutually beneficial water management strategies with downstream interests, and improving linkages with other regional plans, including watershed management plans, habitat joint ventures, urban water management plans, Regional Water Board basin plans, etc.

Many projects and programs are already under way to address these needs. USFS is updating 14 Forest Management Plans for Region 5. Additionally, through the efforts of the Mountain Counties Water Resources Association (MCWRA) and IRWM planning groups, various parties are collaborating to develop regional and subregional solutions. These planning efforts are described in this section, including projects to improve water supply reliability, water quality, and ecosystem restoration through regional partnerships.

Integrated Regional Water Management

The IRWM Planning Act, signed by the Governor as part of SB1 in 2008 (California Water Code Sec. 10530 et seq.), provides a general definition of an IRWM plan as well

as guidance to DWR as to what IRWM program guidelines must contain. The Act states that the guidelines shall include standards for identifying a region for the purposes of developing or modifying an IRWM plan. The first regional acceptance process (RAP) spanned 2008-2009. Final decisions were released in fall 2009. The region acceptance process is used to evaluate and accept an IRWM region into the IRWM grant program. See Figure MC-7 for regions approved or conditionally approved in the Mountain Counties Area. See Table MC-5 for earlier IRWM efforts that within the area.

The main water issues identified by IRWM regions are water supply, water quality, and environmental restoration. Several IRWM plans in this region also consider flooding issues. See Appendix A for more information.

Recent Accomplishments

Water Management and Environmental Health

- MCWRA is acting as "voice" and forum for the area, with a newsletter, website, and meetings, and has created an associated non-profit organization.
- IRWM groups in the area are participating in regional and inter-regional forums, including in the Feather and Mokelumne watersheds and statewide.
- Sierra Nevada Conservancy awarded over 100 grants in 2007 and 2008 to watershed groups and local government agencies for watershed management projects.
- Plumas County and partners are engaged in multiple meadow restoration projects in the Upper Feather River watershed.
- Nevada Irrigation District completed a Strategic Plan in 2006 and a Capital Improvement Plan in 2007.
- Amador Water Agency completed a $22 million pipeline project to replace the old 23-mile Amador Canal with an 8-mile 30-inch pipeline project that provides water to the western portion of Amador County.
- Amador Water Agency is constructing a 6-mile pipeline to bring a reliable surface water supply to the city of Plymouth and end a water moratorium that has lasted over ten years.
- USBR and Placer County Water Agency completed the 100 cubic-feet-per-second-capacity American River Pumping Station in 2008, replacing a temporary diversion near the Auburn Dam site.
- EID has invested over $6 million in their energy efficiency initiative and several million dollars in water conservation over the last five years, including installation of a large photovoltaic array, low-flow home appliance rebates, agricultural water efficiency programs saving about 2,400 acre-feet per year, and a strong home and business water survey program.
- EID developed watershed hydrology and water demand models of their system in 2007 using the WEAP modeling framework to evaluate its Drought Plan and the readiness of the district for possible climate change effects on water supply reliability and regional economies.

Figure MC-7 Regional acceptance process IRWM regions, Mountain Counties Area

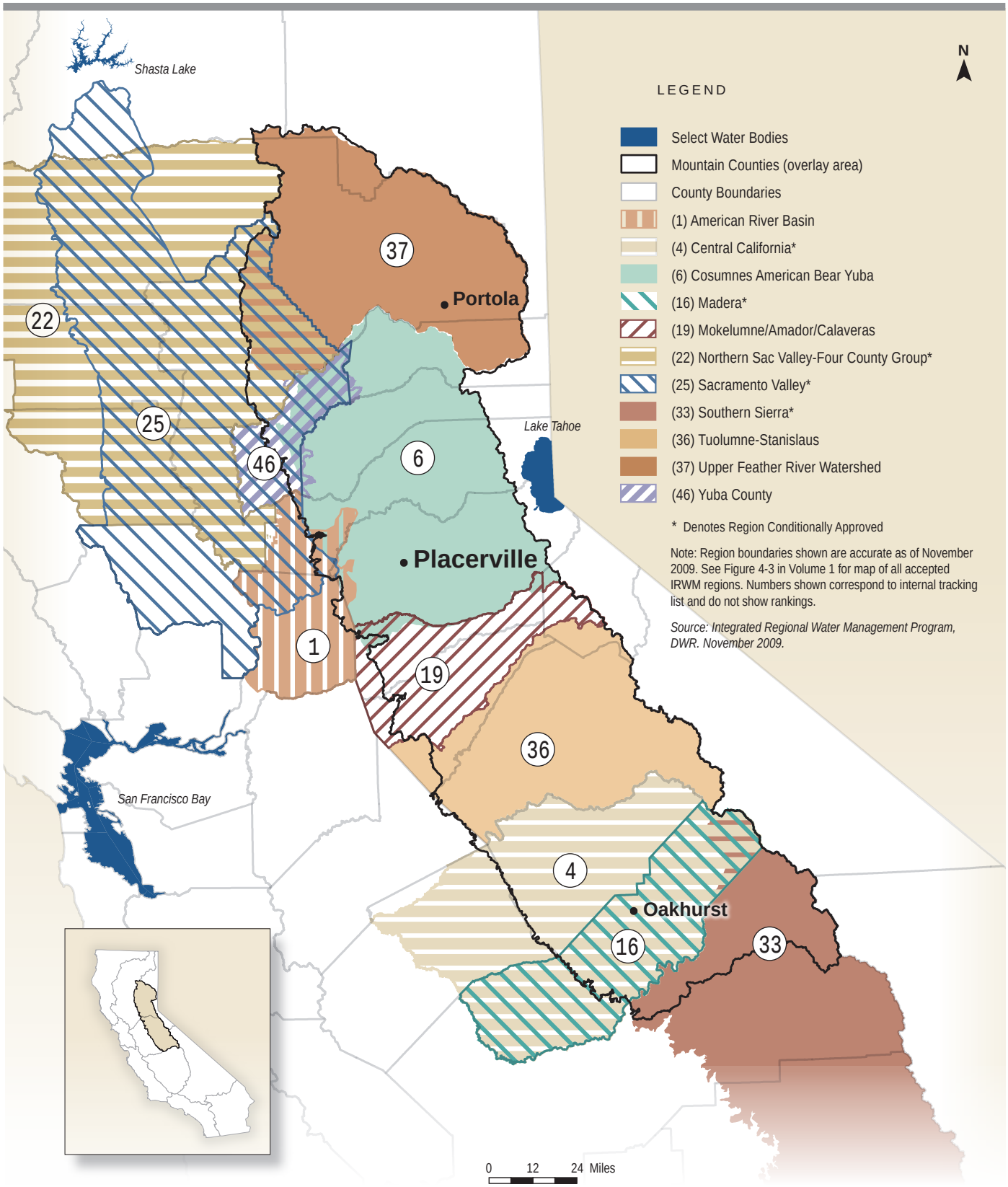


Table MC-7 Strategies of integrated regional water management efforts, Mountain Counties Area

Strategy	American River Basin IRWM Plan June 2006	Upper Feather River Watershed and Water Quality Improvement Project [1] June 2005	Cosumnes, American, Bear, and Yuba IRWM Plan[1, 2] December 2006	Mokelumne/ Amador/ Calaveras IRWM Plan[2] November 2006
Agriculture			✓	
Climate change			✓	
Conjunctive use management	✓	✓		✓
Conservation				✓
Ecosystem restoration	✓	✓		
Environmental and habitat protection and improvement	✓	✓	✓	✓
Flood management	✓	✓	✓	✓
Groundwater management	✓	✓	✓	✓
Imported water				✓
Land use coordination			✓	✓
Land use planning	✓	✓		
Monitoring mercury and other contamination			✓	
Nonpoint source pollution	✓	✓		✓
Recreation	✓	✓	✓	
Public access	✓	✓		
Resource mapping			✓	
Storm water management	✓	✓		✓
Streamflow			✓	
Surface storage		✓		✓
Water and wastewater treatment	✓			✓
Water conservation	✓	✓	✓	
Water conveyance			✓	
Water quality	✓	✓	✓	✓
Water recycling	✓		✓	✓
Water supply reliability	✓	✓	✓	✓
Watershed planning	✓	✓		✓
Wetland enhancement and creation	✓	✓	✓	

Note: The summary information contained in these tables was obtained from various IRWM plans. For additional details or information related to a specific plan, please consult the current version of the plan or its authors.

1 The regional boundaries of this plan overlaps multiple hydrologic regions. This plan can also be found in the Sacramento River Hydrologic Region report of Volume 3.

2 The regional boundaries of this plan overlaps multiple hydrologic regions. This plan can also be found in the San Joaquin River Hydrologic Region report of Volume 3.

- Calaveras County has begun the process of adding a water element to its General Plan.
- Tuolumne Utilities District completed a strategic plan in 2008 with goals for the next five years including management policies, infrastructure master planning, and partnerships.
- Groveland Community Service District and Tuolumne Utilities District developed a mobile water treatment plant for use during a 2008 tunnel outage. It is now available for emergency use.
- Sierra Nevada Alliance developed a Sierra Nevada Yard and Garden Guide to assist Sierra homeowners in creating gardens and implementing best management practices that conserve water, protect water quality, reduce fire risks, and use native plants.
- The Upper Mokelumne River Water Authority, a joint power agreement established in 2000 to address watershed issues of mutual interest, has completed an Upper Mokelumne River Watershed Assessment and Planning Project with funding support from CALFED.
- The Mokelumne River Forum, a 13-agency stakeholders group, has developed IRCUP.
- The National Fish and Wildlife Foundation developed a business plan for a 10-year program to restore and conserve meadow habitat in the Sierra Nevada.

Flood Management

- The federal Disaster Mitigation Act of 2000 amended existing law regarding hazard mitigation planning. The Act emphasizes pre-disaster mitigation and mitigation planning. In order to receive federal hazard mitigation funds in the future, all local jurisdictions must adopt a hazard mitigation plan identifying hazards, risks, mitigation actions, and priority and providing technical support for those efforts. Between 2004 and 2007, Alpine, Amador, Butte, El Dorado, Nevada, Placer, Plumas, Sacramento, and Tuolumne counties adopted hazard mitigation plans and subsequently received Cal EMA approval.

Challenges

The existing water storage, delivery, and treatment infrastructure in the Mountain Counties Area will require improvements and retrofitting to address its increasing need for water supply, water quality, environmental, and flood management. If recent climate trends continue, the historical relationships will change between river runoff timing and magnitude, for which much of the infrastructure was designed.

For the most effective response to these challenges, multiple agencies must carefully plan and coordinate their land use, forest management, water supply, water quality, and environmental policies and actions. Furthermore, although the Mountain Counties Area shares many of the same challenges, specific subregional solutions require watershed-scale planning involving upstream and downstream interests. A significant obstacle in

this planning is the need for more coordination between the "communities of place" (those interests that have residents and customers located in the watershed) and the "communities of interest" (those interests that may have residents and customers located outside the watershed). These communities of interest include downstream urban, agricultural, and environmental groups, which often represent large populations with greater economic resources and political representation than the upstream communities. The communities within the watershed are relatively small and have limited economic resources to implement projects to meet their own needs. Increased coordination is needed between upstream and downstream interests as they work to preserve water quality, manage water supplies and floods, and comply with federal and State policies.

Funding is needed to address the following challenges that have been identified in the area's IRWM plans and in comments received from stakeholders during regional workshops.

Water Supply and Sustainability

- Improve the water supply reliability of the water delivery systems throughout the area to meet current and future needs, as identified in the 1999 Borcalli study. Preserve local water supplies for local growth and address the cumulative consequences of growth on the ability to export additional water to meet statewide demand.
- Address complex water rights concerns and preserve Area of Origin/County of Origin water right provisions (California Water Code sections 10505-10505.5, 11460-11463). Address impacts on upstream supplies of downstream initiatives and related legal challenges for San Joaquin River restoration, Delta improvements, and FERC hydropower license renewals.
- Investigate the hydrogeologic processes of the fractured rock aquifers that make up a majority of the groundwater resources in the Mountain Counties Area. Preserve adequate recharge of these fractured rock aquifers, and address the effect of land-use and water transfer decisions on groundwater levels.

Water Quality

- Protect high quality source water and provide support for mandated water quality requirements.
- Protect groundwater from pollutants such as nitrates, pathogens, and pharmaceuticals. Expand capacity of wastewater treatment infrastructure.
- Address pollution from abandoned mine drainage and impervious surfaces in urban areas.

Watershed Management

- Control excessive soil erosion and sediment delivery from forestry practices, fires, grazing practices, recreational uses, and land development to avoid impacting beneficial water uses.

- Address concerns about open ditch delivery systems within the Mountain Counties Area (refer to the forthcoming Tuolumne County Ditch System Sustainability Plan).
- Manage riparian and upland vegetation to delay runoff and increase groundwater recharge, as addressed in the Upper Feather IRWM plan.
- Control spread of exotic (non-native) plant, fish, and animal species such as arundo, quagga mussels, and northern pike.
- Preserve habitat and in-stream flows for special status species.

Flood Management

- Recurrent flooding is a problem in many places in the Mountain Counties Area. Lives, homes, business, farm lands, and infrastructure are frequently at risk in many locations. Providing better protection for lives and property remains the definitive flood management challenge. Lack of a discharge-based flood standard, such as protection from the flood having an 0.5 percent, 1 percent, or 2 percent probability of occurrence (or such a standard in conjunction with land use type or other pertinent factor) makes equitable distribution of State and federal support funding more difficult. Some considerations in the region are potential runoff rate and flood frequency increases due to climate change; coordinating upper watershed programs to maintain ecosystems and minimize harmful sedimentation and flooding; developing means of flood protection or regulation of occupancy for lands subject to occasional flooding of minor streams, and providing better protection for agricultural lands subject to frequent flooding. Some floodways lacking sufficient capacity in the region are Squirrel Creek at Penn Valley, Cosgrove Creek at Valley Springs, South Fork Jackson Creek at Jackson, and flood channels in Cameron Park. Flash floods threaten lives in Alpine County.
- Urbanization brings greater runoff due to increases of impervious area, making retention of flood protection levels a challenging issue. Urbanization often causes increases in erosion and sedimentation. Construction of flood infrastructure or changes in land use may cause subsequent undesirable vegetation growth, whether of native or invasive species. Regulation of occupancy and land use is critical for reducing the number and severity of flood damage occurrences in an era of population growth.
- Effective preparedness for floods depends on accurate evaluation of the risk, adequate measures for mitigation of flood damage, sufficient preparation for response and recovery activities and coordination among local, State and federal agencies. Incomplete floodplain mapping, both the FEMA FIRMs and the State's complementary Awareness Floodplain Mapping, make evaluating flood risk more difficult. In the Mountain Counties Area, some current needs are better topographic mapping for use in determining floodplain boundaries; stream gage data from more streams; improved public awareness of flood issues in rural areas, and protection of emergency routes from flooding, particularly on Concow Creek in Butte County.
- Local funding for flood maintenance and construction projects has become less effective in recent years because of several factors: Heightened public awareness of the need to protect the environment has increased the cost of upkeep and improvement; concern for endangered species has made scheduling more complex;

both environmental and endangered species conditions have made permits more difficult to obtain; measures to reduce taxation, especially on property, have rendered revenue increases difficult to achieve, and inflation has increased costs. Meeting the requirements of these new restraints has become a high-profile local challenge. Other funding-related concerns in the region are seismic issues at Magalia Reservoir; vegetation in the channel of Hangtown Creek; sediment removal after increased erosion following forest fires, and invasive vegetation in several places.

- Wildfires may denude steep erodible slopes in canyons and upland areas above urban development below. Ensuing winter rains may threaten these areas not only with high water, but also with debris flows. In these situations, flooding may cause greatly increased damages to structures and other installations and may leave large amounts of sediment and other detritus.

Drought and Flood Planning

Drought is a serious concern, especially for the area's smaller water systems dependent on groundwater from fractured rock or small surface streams in the foothills. Because many of these small systems are relatively isolated in rough terrain where it is impractical to build interties with other systems; their options are limited in a water shortage emergency. Furthermore, drought exacerbates the risk of wildfire in the surrounding forests and grasslands and increases the need to reserve water for firefighting. Drought preparedness planning is addressed in various city and county Urban Water Management Plans, IRWM Plans, water agency plans, and county General Plan safety elements throughout the Mountain Counties Area. For example, the Nevada Irrigation District adopted a revised Drought Contingency Plan in 2007 and the EID adopted a Drought Preparedness Plan in 2008. EID has made tanker trucks and fire hydrants available to smaller systems in the region and shares their expertise in regards to conservation, which can significantly help during drought situations.

Placer County Flood Control and Water Conservation District manages flooding in the county by developing master plans for watersheds, evaluating construction for compliance with district standards, implementing flood control projects, and operating the county's flood warning system. The district has published a storm water management manual that provides guidance for all flood control activities within the county. The Madera County Flood Control and Water Conservation Agency is charged with maintaining channel capacities in cooperation with the USACE, the State of California, water supply agencies, and irrigation districts. The agency also manages the NFIP for the county and regulates development in flood hazard areas.

Nine of the 16 counties in this region have adopted hazard mitigation plans. For more information, see "Challenges" in this chapter.

FloodSAFE is a strategic initiative of DWR that seeks a sustainable integrated flood management and emergency response system throughout California that improves public safety, protects and enhances environmental and cultural resources, and supports

economic growth by reducing the probability of destructive floods, promoting beneficial floodplain processes, and lowering the damages caused by flooding. FloodSAFE is guiding development of regional flood management plans. These plans will encourage regional cooperation in identifying and addressing flood hazards and will include flood-hazard identification, risk analyses, review of existing measures, and identification of potential projects and funding strategies. The plans will emphasize multiple objectives, system resiliency, and compatibility with State goals and IRWM plans.

FloodSAFE is responsible for the Central Valley Flood Management Planning Program, the purpose of which is to improve integrated flood management in the Sacramento and San Joaquin Valleys. The program study area includes the watersheds of the Sacramento and San Joaquin rivers and so could possibly affect flood management in the Mountain Counties Area. For more information on the Central Valley Flood Management Planning Program, see Sacramento River regional report.

Looking to the Future

Climate Change

Climate change is projected to present major water resource management challenges to the Mountain Counties Area. Many climate models predict warming and increased precipitation variability over the entire Sierra Nevada, which would result in reduced snow accumulation, earlier and quicker snowmelt, more frequent rain on snow events, more frequent and higher peak flows, an overall shifting of runoff to earlier in the season, and lower summer streamflows and groundwater levels. These potential changes in runoff patterns would not only affect the upstream ecosystems and water supplies, but would have dramatic effects on the operation of the major multi-purpose dams and on downstream water supplies. Many of these trends have already been observed in temperature, precipitation, snowpack, and runoff records (DWR 2008; CalClim 2008). In addition, climate change is projected to indirectly affect water supply and quality due to predicted effects on increased water temperature, changes to species habitat, ecosystems and forest fire frequency.

More frequent rain on snow events and higher and more frequent peak flows would increase the occurrence of localized flooding. Although not currently a high priority issue in the Mountain Counties Area, flooding is associated with landslides, debris flows, and bridge damage and often contributes to overflows from wastewater treatment plant effluent ponds. These events can be locally catastrophic. Reservoirs that provide flood protection and water supply reliability would need larger winter flood reservations to maintain past levels of protection. Decreased spring runoff would make it more difficult to fill this flood control space with water supplies for summer, and higher peak flows would increase the rate at which sediment accumulates in reservoirs. These combined effects highlight the need for forecast coordinated reservoir operations to respond quickly to storm events and balance flood protection with water supply reliability. Long-term adaptation measures to consider include increasing storage capacity in reservoirs and groundwater basins (where available), downstream works such as levees and

bypasses, changes in floodplain use, upstream meadow restoration, and the full suite of other resource management strategies discussed in Volume 2.

Planning for climate change is a priority issue addressed in the Cosumnes-American-Bear-Yuba (CABY), Feather River, and Mokelumne-Amador-Calaveras (MAC) IRWM plans. These regional groups are modeling future challenges, such as climate change and worst-case droughts, to better prepare for potential changes in resource supply and management, economic effects, and general social welfare. For example, CABY has completed modeling that will improve project priorities and land-use planning to better meet future needs. To implement these future projects that affect both upstream and downstream interests, the Mountain Counties Area will need to look to both regional stakeholders and the State and federal governments for expertise and funding.

Response Strategies

Urban and agricultural water users in most of the Mountain Counties Area have limited water supply options to meet future needs because of the mountainous topography, lack of significant groundwater aquifers, limited financial resources for water development, and the fact that most water originating in the area was previously allocated to downstream users and exports through the water rights process. However, most water agencies are actively pursuing a wide variety of supply augmentation and demand reduction actions to secure water for future needs. Ongoing cooperation between organizations in the IRWM process has enabled various agencies to implement various water resources strategies that benefit the needs of multiple stakeholders both within and outside of their region.

Many of the resource management strategies discussed in Volume 2 can improve the management of Sierra water for use within the Mountain Counties Area and downstream. Many of these strategies rely on capital improvements for water infrastructure, facilities, and equipment in the Mountain Counties Area including reservoirs, conveyance systems, groundwater recharge and extraction facilities, and water and wastewater treatment facilities.

Storage

Some agencies are looking for new supplies from expansion of existing storage, reoperation of hydroelectric storage, or construction of new storage. For example, Tuolumne Utilities District is considering the expansion of Lyons Reservoir from 5,800 to 50,000 acre-feet, and EID has requested funding for a feasibility study for development of 31,000 acre-feet Alder Reservoir, which would provide drought storage, enhanced environmental flows, and hydropower generation benefits. Amador Water Agency entered into a partnership with Calaveras County Water Agency, San Joaquin County, and EBMUD, to study the feasibility of enlarging Lower Bear River Reservoir. At the southern end of the Mountain Counties Area in the upper San Joaquin River basin, development of additional surface storage has been proposed at Temperance Flat. If it is determined to be feasible, such storage could help contribute to restoration and

improvement of waterflow and quality in the lower San Joaquin River and facilitate conjunctive water management and water exchanges among downstream water agencies.

Although large quantities of groundwater are not generally available in the Sierra-Cascade area, a number of local agencies are implementing groundwater management strategies to help ensure the reliability of local groundwater supplies. On a larger scale, for the Mokelumne River region IRCUP is being considered as a means for addressing water resource issues in Amador and Calaveras counties and EBMUD (all participants in the MAC IRWM Plan and northern San Joaquin County. Brought together by the Mokelumne Forum process, the IRCUP represents a unique interregional water management strategy involving upper Mokelumne River surface water supply, storage and regulation and lower Mokelumne River groundwater basin management (see Box MC-3).

Water Recycling

Several local agencies and governments are developing recycled water projects, including:

- EID is investigating construction of up to 5,000 acre-feet of seasonal storage to more efficiently use recycled water produced by the district. The project would allow for storing winter production of recycled water (when the production is at its peak) for use in the spring and summer (when demand is at its peak).
- The city of Auburn is developing a proposal to sell up to 5,000 acre-feet of recycled water to agricultural users by 2020. The water is expected to be delivered near Lincoln.
- Smaller projects are proposed by the city of Angels Camp (300 acre-feet), Calaveras County (470 acre-feet), Groveland Community Services District (425 acre-feet), and Sierra Conservation Center in Tuolumne County (300 acre-feet).
- Amador Water Agency is developing a Regional Recycling Master Plan that involves coordination with the cities of Amador City, Jackson, Sutter Creek, Ione, Plymouth, and the county to provide reuse of 20 percent of their water supply by 2020.

Water Use Efficiency

Urban growth, with an average of 1,800 new homes each year in the city of Lincoln, has created a need for new drinking water in an area that has been served by agricultural water since 1926. An association consisting of the Nevada Irrigation District, Placer County Water Agency, and the city of Lincoln, is investigating how to accommodate this growth in the most efficient manner possible, using existing supplies.

Multiple Responses

South Sutter Water District, Camp Far West Irrigation District, and DWR have implemented the 2000 agreement to meet the State Water Board's water quality

objectives - Phase 8 of the Water Quality Control Plan for the San Francisco/ Sacramento-San Joaquin Delta Estuary (4,400 acre-feet of water from Camp Far West Reservoir was provided under this agreement in 2007).

Key resource management strategies identified in Mountain Counties Area workshops include the following.

- Increase regional self-sufficiency, protect area of origin water rights.
- Develop upstream/downstream inter-regional conjunctive use/water transfer programs to meet future water needs in Sierra Nevada and meet critical overdraft needs of the valley.
- Build or enlarge reservoirs to catch earlier snowmelt runoff due to projected climate change for use later in the year when it is needed for irrigation and urban use.
- Re-operate reservoirs to optimize benefits and add stream and rain gages.
- Address infrastructure needs for replacing aging systems and for new development.
- Conserve water, reuse stormwater and graywater.
- Protect and assign value to watersheds and wetlands, protect waterways from risk of contamination from interstate highway and railroad fuel or chemical spills.
- Protect groundwater quality, properly plug abandoned wells.
- Monitor groundwater levels and recharge with winter flood releases from reservoirs.
- Integrate land use and water planning, develop land use strategies to cluster development to economically serve water/wastewater needs instead of wells and septic systems.
- Partner with USFS, state and federal land managers to reduce fuels.
- Restore meadows as discussed in the Upper Feather IRWM Plan.

Implementation Next Steps

These response strategies need support and funding that will be dedicated specifically to local development and implementation of IRWM projects in the Mountain Counties Area watersheds. Potential steps include designation as a funding area, specific wastewater repair bond funding, prioritization of water bond funding to improve areas that have been neglected in the past, and focusing IRWM funding on implementation measures to improve quantity and quality of water supplies and lasting environmental health.

Key project implementation steps identified in Mountain Counties Area workshops include the following.

- Prioritize regional, multi-objective projects.
- Quantify goals with flexibility in how to achieve; help regions identify best strategies.
- Identify costs and benefits for projects and actions; include risk analysis; quantify value of watershed on water quantity and quality and community values (recreation, economic, environmental benefits); consider multiple beneficiaries.
- Develop mechanisms for funding support from downstream water users who share in benefits for projects in mountain watersheds; increase funding of demonstration projects.

- Quantify success with indicators to track regional goals and how they interrelate.
- Outreach to local agencies on key challenges and strategies in State Water Plan; include functional, transferable data that local agencies can use; provide education programs.
- Integrate with comprehensive regional plans and General Plan updates.
- Support IRWM Plan implementation and regional integration and coordination; establish priorities for fair representation and funding of subwatershed groups.
- Expedite infrastructure construction and repair, support flood project maintenance.

Appendix A. Flood Management

Historic Floods

Flood Parameters

Table MCA-1, Record floods for selected streams, is based on US Geological Survey records. Eight of the stations, marked by footnote 5, represent outflow of the reservoirs at the downstream edge of the area, which provide flood control for valley areas to the west. The stations were selected from all USGS gaging stations in the hydrologic region according to the criteria in Box MCA-1.

Box MCA-1 Selection Criteria

- The watercourse must be a natural stream with a watershed of at least 100 square miles.
- The station must have a reasonably continuous record of discharge from 1996 to the present.
- The station must be far enough from other stations on the same river to reasonably represent a separate condition.
- Stations in well defined watercourse locations such as deep canyons are omitted, unless particularly important to the overall flood situation.

Flood Descriptions

Early Floods. Floods have been recorded in the Mountain Counties Area since the discovery of gold along the Mother Lode Belt in 1849. The worst flooding in California history occurred during the winter of 1861-62, which reached its apex in mid-January when large areas of the Sacramento and San Joaquin valleys were under water. Undoubtedly, many of the recently erected mining camps and town sites were severely impacted or entirely swept away.

Beginning in the mid-1850s, hydraulic mining become increasingly common, exacerbating flooding along waterways below mines. The especially heavy rains of 1861-62 brought the first severe flooding influenced by hydraulic mining to the Sacramento Valley, as the streams dumped mining debris onto the valley's farmlands and growing communities. Hydraulic mining was rendered impractical in 1884 by a decision of the US Circuit Court in San Francisco. Nonetheless, it has taken many decades for the mountain streams to sluice out the hydraulic mining debris.

Floods from a storm in late 1906 inundated more than 300,000 acres in the Sacramento Valley. In 1909, a storm extended from Fort Ross on the coast to the Feather River Basin. La Porte, in the Feather River Basin, had 57.41 inches of rain in 20 days, an event with a return period of 12,000 years. California's flood episodes of March 1907 and January 1909 resulted in an overhaul of planned statewide flood control designs. In December 1955, major flooding occurred along the North Coast, in the Central Valley, and on the western slopes of the Sierra Nevada. Most of the catastrophic flooding occurred in the Central Valley and Coast Range, but downtown portions of Chester and Portola in Plumas County also were flooded.

December 1964. Flooding occurred in the northern Sierra counties. A large portion of Chester was flooded and a bridge washed out on Highway 36. Farms and residences along tributaries of the North Fork Feather River were flooded in the Indian Valley and Quincy areas. Flooding in other areas above Oroville was confined to minor streams such as Gray Eagle, Lights, Red Clover, and Thompson creeks, which

Table MCA-1 Record floods for selected streams, Mountain Counties Area

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
North Fork Feather R.	near Prattville	143	7.0	2,710
Spanish Cr.	above Blackhawk Creek, at Keddie	195	15.7	22,100
North Fork Feather R.	at Pulga	1,269	41.7	105,400
South Fork Feather R.[7]	below Forbestown Dam	54	17.6	21,800
Feather R.	at Oroville	4,491[2]	25.5	161,000
North Yuba R.	below Goodyears Bar	548	25.7	45,500
Middle Yuba R.	below Our House Dam, near Camptonville	100	30.7	27,500
South Yuba R.	at Langs Crossing, near Emigrant Gap	79	23.6	34,200
South Yuba R.	at Jones Bar, near Grass Valley	335	30.7[1, 4]	53,600
Yuba R.	near Marysville[5]	1,746[2]	91.6	161,000
Bear R.	below Rollins Dam, near Colfax	293[2]	20.6[1]	34,300
Bear R.	near Wheatland[5]	299[2]	24.3[1]	48,000
North Fork American R.	at North Fork Dam	599	11.9	65,400
Middle Fork American R.	near Foresthill	822	69.0	310,000
Rubicon R.	below Hell Hole Dam near Meeks Bay	28	n/a	28,800
South Fork American R.	near Kyburz	230	14.3	25,000
Silver Cr.	below Camino Diversion Dam	68	15.7[3]	47,700
South Fork American R.	near Placerville	1,060	17.4[1]	71,000
American R.	at Fair Oaks[5]	2,719[2]	28.0	134,000
Cosumnes R.	at Michigan Bar	362	18.5	93,000
North Fork Mokelumne R.	below Salt Springs Dam	162	17.7	17,000
Middle Fork Mokelumne R.[7]	at West Point	47	9.3	5,040
South Fork Mokelumne R.[7]	near West Point	61	12.7	7,610
Mokelumne R.	below Camanche Dam[5]	565[2]	11.2	6,060
Mokelumne R.	near Mokelumne Hill	722[2]	25.6	41,300
North Fork Stanislaus R.	below Beaver Creek, near Hathaway Pines	56	n/a	25,200[6]
Middle Fork Stanislaus R.	at Hells Half Acre Bridge, near Pinecrest	193	18.0	24,600
Middle Fork Stanislaus R.	below Beardsley Dam	201[2]	19.3	28,200
South Fork Stanislaus R.[7]	near Long Barn	62	13.0	12,900
Stanislaus R.	below Goodwin Dam, near Knights Ferry[5]	564[2]	28.9	40,200
Tuolumne R.	below Early Intake, near Mather	401	12.3	18,200
Cherry Cr.	below Cherry Valley Dam, near Hetch Hetchy	29[2]	11.6	6,460
Cherry Cr.	near Early Intake	117[2]	18.5	33,200
Tuolumne R.	below La Grange Dam, near La Grange[5]	751	28.4	58,900
Merced R.	at Pohono Bridge, near Yosemite	454	23.4	24,600
Merced R.	below Merced Falls Dam, near Snelling[5]	1,003[2]	12.4	9,360
South Fork San Joaquin R.	below Hooper Creek, near Florence Lake	57	n/a	10,400
San Joaquin R.	above Shakeflat Creek, near Big Creek	308	32.0	80,000
Big Cr.	near mouth, near Big Creek	24	10.3	7,400
Willow Cr.	at mouth, near Auberry	50	31.7 [1, 3]	15,700
San Joaquin R.	below Friant[5]	663[3]	23.0	60,300

1-Different date than peak discharge; 2-Most recent but less than period of record; 3-Due to backwater; 4-Outside period of record
5-Downstream of region; 6-Computed daily mean; 7-Regionally significant site with less than 100 sq mi tributary watershed area.

Note: taf = thousand acre-feet; ft = feet; cfs = cubic feet per second

flooded about 120 acres of agricultural land. Along the Yuba River, flooding occurred in the town of Downieville and damaged campgrounds, highways, and a portion of Interstate 80. Extremely high discharges were recorded in the American River Basin and were exacerbated when the partially constructed Hell Hole Dam on the Rubicon River failed, sending a surge down the American River. A bridge on Highway 49 was destroyed, and many summer homes were damaged. Minor flooding occurred along the Stanislaus River above Melones Dam, causing damage to public facilities in Calaveras Big Trees State Park and Stanislaus National Forest. Above Don Pedro Dam, flooding along the Tuolumne River and its upper tributaries was limited to the Stanislaus National Forest, with damages to public facilities estimated at $84,000. Heavy runoff from headwaters of the Merced River caused flooding in Yosemite Valley, which inundated about 1,100 acres of the valley floor, flooded campsites and recreational facilities, and damaged roads and bridges.

February 1986. A vigorous low pressure system drifted east out of the Pacific, creating a string of storms that lasted from February 11 through February 24 and unleashed unprecedented amounts of rain on Northern California. In the Sierra, 1,000-year rainfall events were recorded. Nearly 17 inches of rain fell at some locations during a five-day period. Many mountain communities were stranded by slides; floodwaters blocked several roads. Union Pacific railroad tracks were washed out, and Highway 70 in the Feather River Canyon was closed until July. High water damaged several portions of Highway 50 along the South Fork American River.

January 1997. The New Year's Day Flood was probably the largest in the 90-year Northern California measured record. Many stream gages (including those in the Feather, Yuba, American, Stanislaus, and Tuolumne river basins upstream of major foothill reservoirs) recorded their highest discharge levels since record keeping began. Severe flooding occurred along the Feather River Canyon, closing down Highway 70 for lengthy periods of time. Landslides from water-saturated slopes closed Highway 50 for four weeks, and a landslide destroyed a 30-foot section of Georgetown's canal, which supplies water to 9,000 customers in six towns in rural El Dorado County. Nearby, El Dorado Irrigation District lost use of its flume from the forebay on the American River due to a separate landslide. In Yosemite National Park, over half of the valley campsites, 200 employee housing units, and 33 backcountry bridges were destroyed. Roads entering the valley were severely damaged, with some remaining closed for several months. The National Park Service estimated the cost of damages at more than $178 million.

May 2005. Snowmelt runoff caused the Merced River in Yosemite Valley to rise to its highest level ever. However, only minor damages were suffered since most facilities were relocated or not rebuilt after the 1997 event.

Flood Governance

Many federal, State, and local agencies have responsibilities in the overall effort to manage floods. The principal participants in the Mountain Counties Area and their

Table MCA-2 Flood management participants, Mountain Counties Area

	Structural approaches						Land use management								Preparedness, response, and recovery										
	Flood projects						Floodplains			Flood insurance			Regulation		Data management				Event management						
	Financing	Development	Construction	Operation	Encroachment control	Maintenance	Conservation	Restoration	Delineation	Administration	Participation	FIRM mapping	Building permits	Designated floodways	Data collection	Hydrologic analysis	Data station maintenance	Flood education	Preparedness	Response management	Response personnel	System administration	Recovery funding	Recovery operations	Mitigation
Federal agencies																									
Federal Emergency Management Agency										●		●											●		●
National Weather Service															●	●	●	●	●	●					
Natural Resources Conservation Service	●	●	●															●							
US Geological Survey															●	●	●								
US Army Corps of Engineers	●	●	●	●	●	●									●	●	●	●	●	●	●		●	●	●
State agencies																									
California Conservation Corps																				●	●				
Central Valley Flood Protection Board					●	●								●											
Department of Corrections																					●				
Department of Forestry and Fire Protection																				●					
Department of Water Resources	●	●	●	●	●	●			●	●		●			●	●	●	●	●	●	●		●	●	
California Emergency Management Agency																			●	●	●	●	●		●
Local agencies																									
County emergency services units																			●	●	●				
County planning departments														●											
County building departments													●												
Local flood maintenance organizations				●	●	●																			
Local conservation corps																				●	●				
Local initial responders to emergencies																			●	●	●				
Calaveras County Department of Public Works						●	●																		
Madera County Engineering and General Services Department										●	●														
Placer County FCWCD		●		●		●										●									
Plumas County FCWCD		●		●		●										●									

Note: FCWD = Flood Control and Water Conservation District

activities are listed in Table MCA-2. Most listed activities are self-explanatory. Descriptions of some follow.

- **Flood project development.** Performing feasibility studies, planning, and design of constructed facilities.
- **Encroachment control.** Establishing, financing, and operating a system of permitting and enforcing permits to encroach on constructed facilities.
- **Floodplain conservation or restoration.** Any overt activity causing part of a floodplain to remain in effect or to be reinstated as a watercourse overflow area.
- **Flood insurance administration or participation.** Contribution to the management of or acting as a sponsor and cooperator in the National Flood Insurance Program including the Community Rating System.
- **Hydrologic analysis.** Hydrologic or statistical analysis of collected hydrometeorological data.
- **Flood education.** Informing the general public about any aspect of flood management; publishing or broadcasting collected hydrometeorological data or other flood-related material.
- **Recovery operations.** Financing or performing any activity intended to return flood-impacted facilities or persons to normal status.
- **Event management system administration.** Oversight of the National Incident Management System/Standardized Emergency Management System (NIMS/SEMS) as applied to California.

Flood Risk Management

Structural Approaches

With one exception, the only reservoirs having flood control space reservations in the Mountain Counties are those located on the major streams leaving the area, and the reservations protect lower lands outside the area. Nevertheless, many small reservoirs offer incidental flood control benefits, insofar as they have not been filled at the time of the high water. These reservoirs are listed in Table MCA-3.

New Bullards Bar Reservoir, with a capacity of 970 thousand acre-feet, is located well within the Mountain Counties Area, but its 170 taf flood control space is reserved to protect the valley cities of Marysville and Yuba City and areas downstream.

Disaster Preparedness, Response, and Recovery

Management of flood emergencies is the responsibility of many organizations and individuals. Response is required by law to conform to SEMS, under which action is taken by levels of organization. It is begun by the person or organization on the site. That entity resists personal injury and property damage to the best of its ability, only calling on the next level when its resources become insufficient, and succeeding levels follow the same procedure. Table MCA-4 indicates the responsible entities at successive levels of response.

Table MCA-3 Reservoirs providing incidental flood control, Mountain Counties Area

Reservoir	Stream	Owner	Capacity (taf)
L. Almanor	North Fork Feather R.	Pacific Gas & Electric Co.	1,308
Bucks L.	Bucks Cr.	Pacific Gas & Electric Co.	103
Little Grass Valley Res.	South Fork Feather R.	South Feather Water and Power Agency	93
French Meadows Res.	Middle Fork American R.	Placer County Water Agency	136
Hell Hole Res.	Rubicon R.	Placer County Water Agency	208
Union Valley Res.	Silver Ck.	Sacramento Municipal Utility District	267
Salt Springs Res.	North Fork Mokelumne R.	Pacific Gas & Electric Co.	142
New Spicer Meadows Res.	Highland Ck.	Calaveras County Water District	189
Beardsley Res.	Middle Fork Stanislaus R.	Oakdale & South San Joaquin Irrigation Districts	98
Cherry L.	Cherry Ck.	City and County of San Francisco	273
Hetch Hetchy Res.	Tuolumne R.	City and County of San Francisco	360
L. Thomas A. Edison	Mono Ck.	Southern California Edison Co.	125
Mammoth Pool	San Joaquin R.	Southern California Edison Co.	123
Huntington L.	Big Ck.	Southern California Edison Co.	89
Shaver L.	Stevenson Ck.	Southern California Edison Co.	135

Table MCA-5 is a list of forecast points that can be used in the Advanced Hydrologic Prediction Service of NWS.

Relationship with Other Regions

Although no dams are operated to provide flood control to communities in the Mountain Counties Area, many mountain reservoirs can contribute to reducing flood risks to communities in the Central Valley. Because such benefits offer additional flood control system flexibility, regulators have allowed crediting flood reservation spaces in foothill reservoirs to upstream facilities, contingent on available space. For example, up to 200 thousand acre-feet of flood reservation space in Folsom Lake can be credited to Union Valley, French Meadows, or Hell Hole reservoirs from the beginning of October to the end of April. On the San Joaquin River, rain-flood reservation space in Millerton Lake exceeding 85 thousand acre-feet may be transferred to Mammoth Pool Reservoir; similarly, seven power-generating reservoirs can be credited for snowmelt flood reservation space from February 1 until the end of June. The operating rules that influence these downstream risks and benefits are subject to change if the trend toward increasing temperatures continues and changes the timing and intensity of runoff (see Figure MCA-1).

New Bullards Bar Reservoir on the North Fork Yuba River in Tahoe National Forest provides significant protection to the valley cities of Marysville and Yuba City. Additionally, forecast-coordinated agreements being developed between Yuba County Water Agency, the US Corps of Engineers, the Department of Water Resources (DWR),

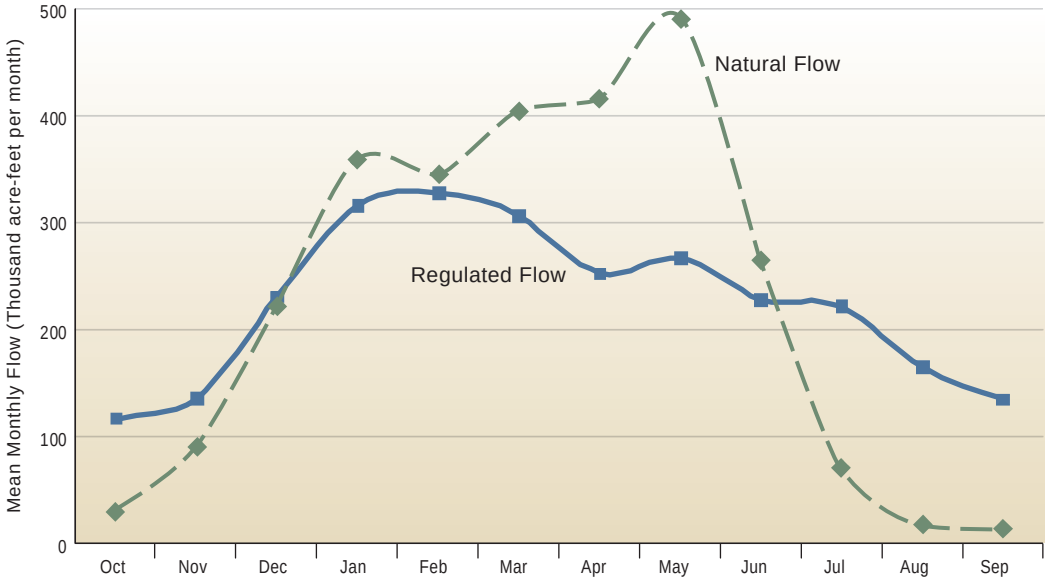
Table MCA-4 Flood emergency responders, Mountain Counties Area

Responder	Level	Comment
Person(s) or organization(s) on the site	0	Any emergency
Emergency services units of the 16 cities in the area	1	Any emergency
Emergency services units of the 16 counties in the area	1 or 2	Any emergency, and by request from Level 1 responders
Department of Water Resources	2	Flood Operations Center, flood fight and Corps liaison
Office of Emergency Services, Inland Region	3	Any emergency, entire area, by request of county (operational area)
US Army Corps of Engineers	3	Specified water-related emergencies, by request of DWR
California Conservation Corps	3	Personnel and equipment for flood fight
Department of Forestry and Fire Protection	3	Personnel and equipment for flood fight
California Emergency Management Agency Headquarters	4	All emergencies, entire hydrologic region, by request of Cal EMA Region

Table MCA-5 Advanced Hydrologic Prediction Service stream forecast points, Mountain Counties Area

River basin	Stream	Location
Sacramento River	American River	Folsom Lake
Sacramento River	Feather River	Lake Oroville
Sacramento River	Middle Fork American River	Foresthill
Sacramento River	Middle Fork American River	French Meadows Reservoir
Sacramento River	North Fork American River	North Fork Dam
Sacramento River	North Fork Feather River	Lake Almanor
Sacramento River	North Yuba River	New Bullards Bar Reservoir
Sacramento River	Rubicon River	Hell Hole Reservoir
Sacramento River	Sacramento River	Delta
Sacramento River	Silver Creek	Union Valley Reservoir
Sacramento River	South Fork American River	Chili Bar Reservoir
Sacramento River	Yuba River	Englebright Reservoir
San Joaquin River	Cherry Creek	Cherry Lake
San Joaquin River	Eleanor Creek	Lake Eleanor
San Joaquin River	Merced River	Exchequer Reservoir
San Joaquin River	Merced River	Yosemite at Pohono Bridge
San Joaquin River	Mokelumne River	Pardee Reservoir
San Joaquin River	San Joaquin River	Millerton Reservoir
San Joaquin River	Stanislaus River	New Melones Reservoir
San Joaquin River	Tuolumne River	Hetch Hetchy Reservoir
San Joaquin River	Tuolumne River	New Don Pedro Reservoir

Figure MCA-1 American River below Folsom historical runoff pattern



and the National Weather Service for New Bullards Bar and Oroville reservoirs promise to decrease flooding risks to communities and agricultural lands along the lower Feather and Yuba rivers. Voluntary collaboration between Pacific Gas and Electric, DWR, and Kings River Water Association has led to improved flood control operations in the San Joaquin Valley. Correspondingly, effective communication between Sacramento Municipal Utility District and the US Bureau of Reclamation has led to more efficient flood control operations in the American River Basin. For further information about coordination of foothill reservoir operations during floods, flood management benefits provided to Central Valley by upstream reservoirs, and downstream impacts of regulatory changes, see reports for Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions.

Regional Water and Flood Planning and Management

Integrated Regional Water Management

There are seven Integrated Regional Water Management (IRWM) plans in this region, and six of them consider flooding issues. The American River Basin IRWM Plan identifies 17 flood or stormwater management projects and highlights five as flood control projects of the Sacramento Area Flood Control Agency. It also contains general language that calls for 200-year floodflow protection throughout the planning region. The Cosumnes, American, Bear, Yuba Region IRWM Plan recommends projects that reduce flood damages to existing water resource infrastructure and also notes the

connection between flood control and ecosystem benefits. The Upper Feather River IRWM Plan seeks to minimize flood damages by promoting projects that increase floodwater retention via higher interception and infiltration rates, and projects that maintain/restore channel capacities by retarding high sediment yields resulting from poor land use practices. The Mokelumne/Amador/Calaveras IRWM Plan suggests 14 projects that have direct flood control benefits and uses diverse flood control strategies, such as reservoirs, channel modifications, and wastewater treatment facility, drainage, and culvert improvements. Though the Madera County IRWM Plan does not identify specific flood control projects to be implemented, it discusses a suite of strategies such as *Arundo donax* eradication for lessening flood risks. The Yuba County IRWM Plan also addresses flood control issues.

Appendix B. Selected References

Editor's Note: The author used some bibliographic references for several topics listed here, but in the interest of space, those references are listed only once in this appendix.

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The California Water Plan provides a framework for resource managers, legislators, Tribes, other decision-makers, and the public to consider options and make decisions regarding California's water future. Our goal is that this document meet Water Code requirements, receive broad support among those participating in California's water planning, and be a useful document. With its partners, DWR completed the final Update 2009 volumes and Highlights in December 2009.

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