Appendix 13A Flood Management

Historic Floods

Flood Parameters

Table 13A-1 (Flood parameters for principal streams) is based on US Geological Survey records. The stations were selected from all USGS gaging stations in the hydrologic region according to the following criteria.

- The watercourse must be a natural stream.
- The station must have a reasonably continuous record of discharge continuing to the present.
- The discharge record must begin no later than 1996.
- 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.

Eight of the stations, marked by footnote, represent outflow of the reservoirs at the downstream edge of the area, which provide flood control for valley areas to the west.

PLACEHOLDER Table 13A-1 Flood parameters for principal streams

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 the entire 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 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. The flood episodes of March 1907 and January 1909 in California 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 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. One-thousand-year rainfall events were recorded in the Sierra. Nearly 17 inches of rain fell at some locations during a 5-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 4 weeks, and a landslide destroyed a 30-foot section of Georgetown's canal, which supplies water to 9,000 customers in 6 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 Hydrologic Area and their activities are listed in Table 13A-2 (Flood management participants). Most listed activities are self-explanatory; descriptions of some are:

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.

PLACEHOLDER Table 13A-2 Flood management participants

Flood Risk Management

Structural Approaches

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 13A-3 (Reservoirs providing incidental flood control).

PLACEHOLDER Table 13A-3 Reservoirs providing incidental flood control

Disaster Preparation, Response, and Recovery

Management of flood emergencies is the responsibility of many organizations and individuals. Response is required by law to conform to the Standardized Emergency Management System, 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 13A-4 (Flood emergency responders) indicates the responsible entities at successive levels of response.

PLACEHOLDER Table 13A-4 Flood emergency responders, Mountain Counties Area

Relationship with Other Hydrologic 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 85,000 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. (Figure 13A-1 American River below Folsom historical runoff pattern)

PLACEHOLDER Figure 13A-1 American River below Folsom historical runoff pattern

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 between Yuba County Water Agency, the US Corps of Engineers, the Department of Water Resources (DWR), 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 regional chapters Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions.

Tables

Table 13A-1 Flood parameters for principal streams, Mountain Counties Hydrologic Area

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
North Fork Feather R.	near Prattville	392	16.2	10,000
Spanish Cr.	above Blackhawk Creek, at Keddie	195	15.6	22,100
North Fork Feather R.	at Pulga	1,269	41.7	105,400
South Fork Feather R.	below Forbestown Dam	54	17.6	21,800
Feather R.	at Oroville	4,4402	25.51	230,000
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]	53,600
Yuba R.	near Marysville[5]	1,746[2]	91.6[1]	180,000
Bear R.	below Rollins Dam, near Colfax	293[2]	21.4[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, nr Meeks Bay	28	n/a	28,800
South Fork American R.	near Kyburz	230	14.3	25,000
Silver Cr.	below Camino Diversion Dam	69	15.7[3]	47,700
South Fork American R.	near Placerville	1,060[2]	17.4[1]	71,000
American R.	at Fair Oaks[5]	2,719[2]	31.9	180,000
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.	at West Point	46	9.3	5,040
South Fork Mokelumne R.	near West Point	61	12.7	7,610
Mokelumne R.	below Camanche Dam[5]	565[2]	24.4	28,800
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	23.0[4]	26,600[4]

Table 13A-1 continued on next page

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

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

Table 13A-1 continued from previous page

Table 13A-1 Flood parameters for principal streams, Mountain Counties Area

Stream	Location	Mean annual runoff (taf)	Peak stage of record (ft)	Peak discharge of record (cfs)
Middle Fork Stanislaus R.	below Beardsley Dam	295[2]	19.3	28,200
South Fork Stanislaus R.	near Long Barn	62	13.0	12,900
Stanislaus R.	below Goodwin Dam, near Knights Ferry[5]	564	37.7[4]	62,900[4]
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]	23.3	47,700
South Fork San Joaquin R.	below Hooper Creek, near Florence Lake	58[2]	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[2]	10.3	7,400
Willow Cr.	at mouth, near Auberry	50	31.7[1,3]	15,700
San Joaquin R.	below Friant[5]	663	23.8	77,200

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

Table 13A-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										●		●											●		●
Natural Resources Conservation Service	●	●	●															●							
US Geological Service															●	●	●								
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	●	●	●	●	●	●			●	●		●			●	●	●	●	●	●	●		●	●	
Office of Emergency Services																			●	●	●	●	●		●
Local agencies																									
County emergency services units																			●	●	●				
County planning departments														●											
County building departments													●												
Local conservation corps																				●	●				
Local initial response agencies																			●	●	●				
Calaveras County Department of 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		●		●		●										●									

Table 13A-3 Reservoirs providing incidental flood control, Mountain Counties Area

Reservoir	Stream	Owner	Capacity (taf)
L. Almanor	North Fork Feather R.	Pacific Gas & Electric Co.	1308
Bucks L.	Bucks Cr.	Pacific Gas & Electric Co.	103
Little Grass Valley Res.	South Fork Feather R.	South Feather Water and Power Agency	93
New Bullards Bar Res.	North Yuba R.	Yuba County Water Agency	970
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 13A-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, all counties of the area, by request of county (operational area)
U. S. 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
Office of Emergency Services Headquarters	4	All emergencies, entire hydrologic region, by request of OES Region

Figure

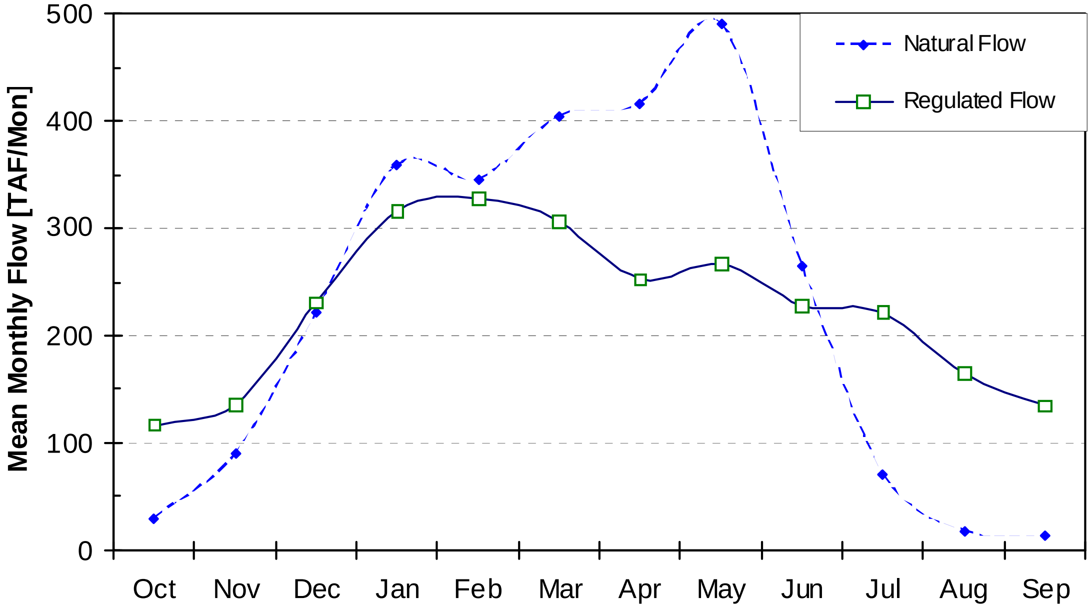

Figure 13A-1 American River below Folsom historical runoff pattern

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Appendix 13B More Information

Setting

Watersheds

A large proportion of the watershed area in the southern Sierra is snow-covered in winter, and most of this high elevation area is not vulnerable to a small increase in snow level during warmer storms. In contrast, the lower elevation Feather River basin is particularly vulnerable to small increases in the snow level, as shown in Table 13B-1 (Major watershed areas in Mountain Counties Area).

PLACEHOLDER Table 13B-1 Major watershed areas in Mountain Counties Area

Climate

Most of the precipitation in this region is the result of weather patterns originating in the Pacific Ocean, primarily mid-latitude cyclonic storms in winter. 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 13B-1 (Sierra annual precipitation variability, 1895-2007).

PLACEHOLDER Figure 13B-1 Sierra annual precipitation variability, 1895–2007

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 13B-2 Sierra mean annual temperature trend, 1895–2007). 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.

PLACEHOLDER Figure 13B-2 Sierra mean annual temperature trend, 1895–2007

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.

Demographics

PLACEHOLDER Table 13B-2 Demographic characteristics of selected Mountain Counties

Regional Water Conditions

The California Data Exchange Center provides a wealth of discharge and river stage information on streams and reservoirs in the region (http://cdec.water.ca.gov/). El Dorado Irrigation District's website contains hydrologic data for its major facilities (such as releases from Jenkinson Reservoir).

Water Supplies

Of California's developed water supply, about 40 percent originates within the Mountain Counties, more than 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 are 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 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 Sacramento-San Joaquin River Delta. (Table 13B-3 Reservoirs in the Mountain Counties Area (expanded list)

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 preexisting obligations. Calaveras County Water District and Union Public Utility District receive water from New Hogan Reservoir, operated by the US Army Corps of Engineers. The Sierra Valley Water Company and El Dorado Irrigation District import a small portion of their supplies from the North Lahontan Hydrologic Region as shown in Figure 13B-3 (Mountain Counties Area).

PLACEHOLDER Figure 13B-3 Mountain Counties Area

PLACEHOLDER Table 13B-3 Reservoirs in the Mountain Counties (expanded list)

Groundwater

Groundwater quantity, quality, and usage varies considerably due to the small and unpredictable yields of the fractured granite formations that constitute much of the Sierra Nevada foothills and the western slopes of the mountains. In general, groundwater is an inadequate and unreliable supply for large-scale usage in this area. Groundwater monitoring wells are located almost exclusively within the various alluvial deposits found within the region. Groundwater level trends are varied throughout the area, with some wells experiencing relatively constant water levels but others experiencing decreasing water levels. Seasonal water level variations are common and can exceed 10 feet. Higher in the watersheds, gradual snowmelt and retention time in mountain meadows enhances recharge of the groundwater levels. In dry years, as groundwater levels drop, many smaller streams are dry by the end of summer.

Regional Water and Flood Planning and Management

Additional Accomplishments

- North Fork Feather River at Chester Flood Control Project, completed in 1976
- Plumas County Flood Control and Water Conservation District, established in 1959
- Madera County Flood Control and Water Conservation Agency, established in 1969

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Tables

Table 13B-1 Major watershed areas in Mountain Counties

Watershed	Area (sq. miles)	Maximum elevation (ft)	Snowpack level* (ft)	Percent of basin above snow level*	Percent of basin in first 500-ft 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
Mokelumne River	575	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. It varies annually and seasonally, and has gradually increased in recent decades.

EDITOR'S NOTE: In the public review draft, this table also appears in main body (Table 13-1). Location for final document to be determined.

Table 13B-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

Table 13B-3 Reservoirs in the Mountain Counties (expanded list)

Reservoir	Stream	Operator	Capacity (taf)
Lake Almanor	North Fork Feather R.	Pacific Gas & Electric Co.	1308
Bucks L.	Bucks Cr.	Pacific Gas & Electric Co.	103
L. Davis	Big Grizzly Cr.	State Water Project	83
Frenchman L.	Little Last Chance Cr.	State Water Project	55
Little Grass Valley Res.	South Fork Feather R.	South Feather Water and Power Agency	93
Sly Creek Res.	Lost Cr.	South Feather Water and Power Agency	65
New Bullards Bar Res.	North Yuba R.	Yuba County Water Agency	970
Jackson Meadows Res.	Middle Fork Yuba R.	Nevada Irrigation District	69
Englebright Res.	Yuba R.	U.S. Army Corps of Engineers	70
Bowman L.	Canyon Cr.	Nevada Irrigation District	64
Lake Spaulding	South Fork Yuba R.	Pacific Gas & Electric Co.	75
Scotts Flat Res.	Deer Cr.	Nevada Irrigation District	49
Rollins Res.	Bear R.	Nevada Irrigation District	66
French Meadows Res.	Middle Fork American R.	Placer County Water Agency	136
Hell Hole Res.	Rubicon R.	Placer County Water Agency	208
Loon L.	Gerle Cr.	Sacramento Municipal Utility District	69
Union Valley Res.	Silver Cr.	Sacramento Municipal Utility District	267
Jenkinson Res.	Sly Park Cr.	El Dorado Irrigation District	44
Salt Springs Res.	North Fork Mokelumne R.	Pacific Gas & Electric Co.	142
New Spicer Meadows Res.	Highland Cr.	Calaveras County Water District	189
Donnell Res.	Middle Fork Stanislaus R.	Oakdale & South San Joaquin irrigation districts	57
Beardsley Res.	Middle Fork Stanislaus R.	Oakdale & South San Joaquin irrigation districts	98
Cherry L.	Cherry Cr.	City and County of San Francisco	273
L. Eleanor	Eleanor Cr.	City and County of San Francisco	29
Hetch Hetchy Res.	Tuolumne R.	City and County of San Francisco	360
Bass L.	Willow Cr.	Pacific Gas & Electric Co.	45

L. Thomas A. Edison	Mono Cr.	Southern California Edison Co.	125
Florence L.	South Fork San Joaquin R.	Southern California Edison Co.	64
Mammoth Pool	San Joaquin R.	Southern California Edison Co.	123
Huntington L.	Big Cr.	Southern California Edison Co.	89
Shaver L.	Stevenson Cr.	Southern California Edison Co.	135
Redinger L.	San Joaquin R.	Southern California Edison Co.	35

Reservoir capacity in thousand acre-feet (taf)

Figures

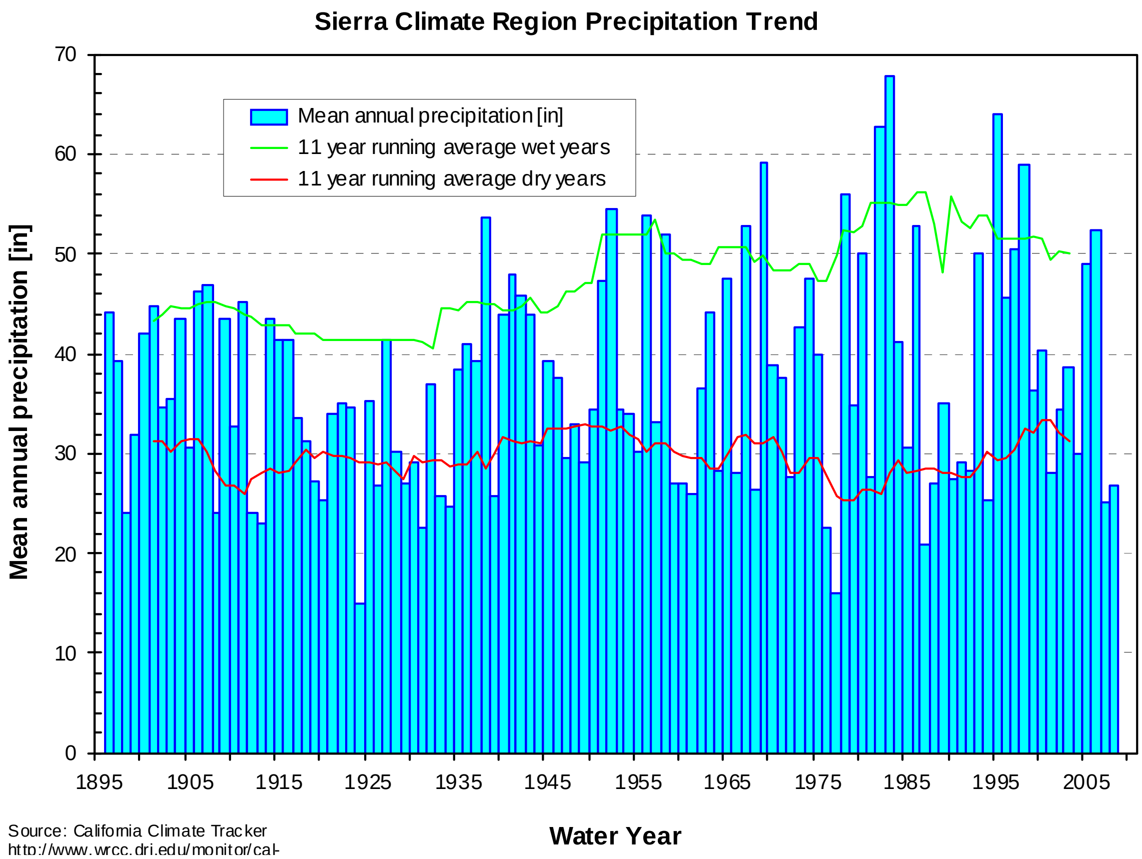

Figure 13B-1 Sierra annual precipitation variability, 1895–2007

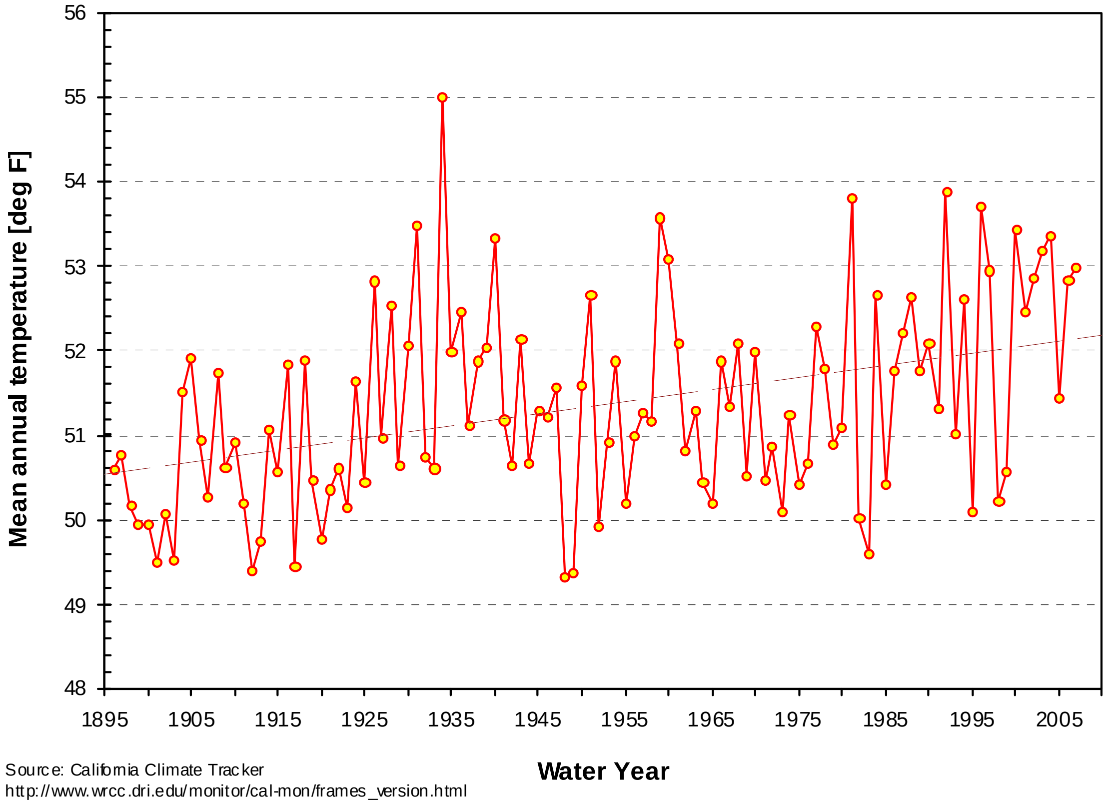

Figure 13B-2 Sierra mean annual temperature trend, 1895–2007