FLOOD CONTROL

The Sacramento River has always been both a blessing and a curse to the City of Sacramento and surrounding area. Throughout geological ages the river annually overflowed its banks creating an inland sea up to 30 miles in width, and in the process, forming the rich farmland enjoyed in the Central Valley today. As a transportation link to the gold fields, it was the lifeblood to the young city growing on its banks. From the start, however, the inhabitants have also had to fight to keep the river out of the city. One effort was to raise the city.

HILLS IN SACRAMENTO

Observing visitors to downtown Sacramento are often curious about the sagging alleys and the sunken parking lots, often with brick cubicles under the street sidewalks, in a town that is otherwise as flat as a miner's flapjack. The answer to their queries is the tale of how Sacramento raised itself out of the mud over a twenty-year period that began during the Gold Rush days and ended more than a hundred years ago.

Sacramento was born at the beginning of the Gold Rush in 1848 and, because of its location on rivers extending from San Francisco Bay into the mountains where the gold was found, soon became an important supply point for both the northern and southern mines. Except for the advantage offered by ready access to the river, the site of the budding city was a most unlikely one. The land was below the level of high water in the river and the area was laced with many sloughs.

Flooding in the 1850's, dramatized the need for flood control measures.

Raising of the first State Capitol and Court House located at 7th and I Streets.

In 1852, after several years of flooding and while the City was still under water, a plan was proposed to lift Sacramento out of the mud and above the flood waters. The proposal was to raise the level of Sacramento by filling in the main streets with sand and gravel as far as the Public Square at Tenth Street, which was above high water. A short levee would close the gap to create a high and dry business district. The property owners would then fill in their property at their own expense and raise their business establishments to the level of the new street grades.

Eventually approval was obtained and the work was started. The main streets were raised one to five feet extending from the river to as far as Eighth Street and the cross streets were raised to match. Most of the fill was brought in by carts from the American River sandbars. One contractor built a railroad consisting of 2500 feet of track, but the rail operation proved to be too expensive and eventually carts took over the job.

After more devastating floods, further improvements to the downtown streets were begun in 1863. Two special trains of ten cars, each car carrying ten tons of gravel, ran daily between Folsom and Sacramento. As the work of raising the streets progressed, the property owners turned to the business of raising their buildings to the high grade. Most of the work of raising the buildings was done with screw jacks. Hydraulic jacks were also used, but most contractors favored the former. One of the largest buildings was the St. George Hotel, which was raised eight feet using 250 jacks. The building measured 76 by 160 feet and weighed 1900 tons. The work took from August until October and cost $4,700. The largest job was Toll's Hotel at Seventh and K Streets. It was raised seven feet using 430 jacks, 8000 blocks, and required seventy-four men.

During 1867 Sacramento was again flooded, resulting in a flurry of street raising which totaled thirteen blocks in 1868, the year which marked the beginning of the end of the street raising program. In 1872 most of the essential work had been done. Even by present day standards the City of Sacramento undertook a tremendous job in raising the business district out of the mud and above the flood waters. By the standards of a hundred years ago and with the equipment then available, the project was a phenomenal demonstration of the dedication of the business community to survive and to bring prosperity to itself and to the city as a whole.

Much of the evidence of the grade raising program has been obliterated by later improvements. Some entire blocks have been raised even with the surrounding streets, thus hiding the fact that the streets had been raised above the original ground. In the last 25 years a redevelopment program has drastically altered much of the old business section. Old buildings have been removed and replaced with modern buildings after recontouring the area. Such changes will no doubt continue with the passage of time until the entire project will be buried in the past and known only to those familiar with the early history of Sacramento.

LEVEES, WEIRS, FLOODWAYS

Raising the city improved conditions; however, as is usually the case, a variety of efforts has been required to keep the valley cities dry. A major factor is the storing of large quantities of floodwater temporarily in the relatively recent large reservoirs — Shasta (1945), Folsom (1956), and Oroville (1968), to list a few.

Of far more historic interest is the line of defense along the river itself — the levee. Levee construction began in Sacramento about 1850 with a levee running from the sand hills at Sutterville to the Sacramento River, along the river and around South Slough to the American River and up the river to high ground. In front of the city the levee was five feet high, twenty feet wide at the base, and ten feet wide at the top. Many levees followed, and in the course of time the face of the earth was greatly altered. Some features, like China Slough, disappeared altogether. Far too modest, these early levees were frequently breeched.

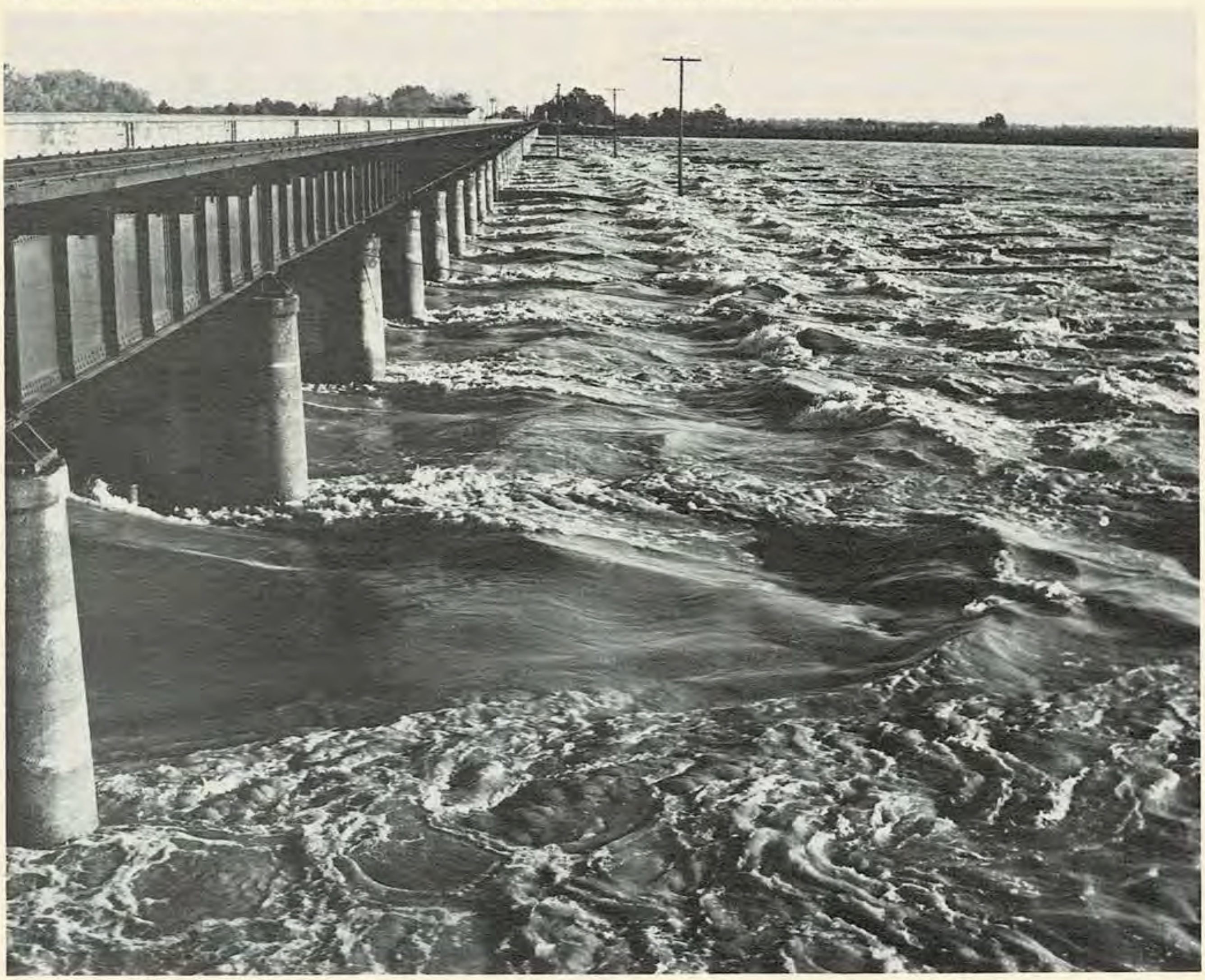
The Sacramento Weir during the 1950 flood. Flow directions in both the river and bypass are shown.

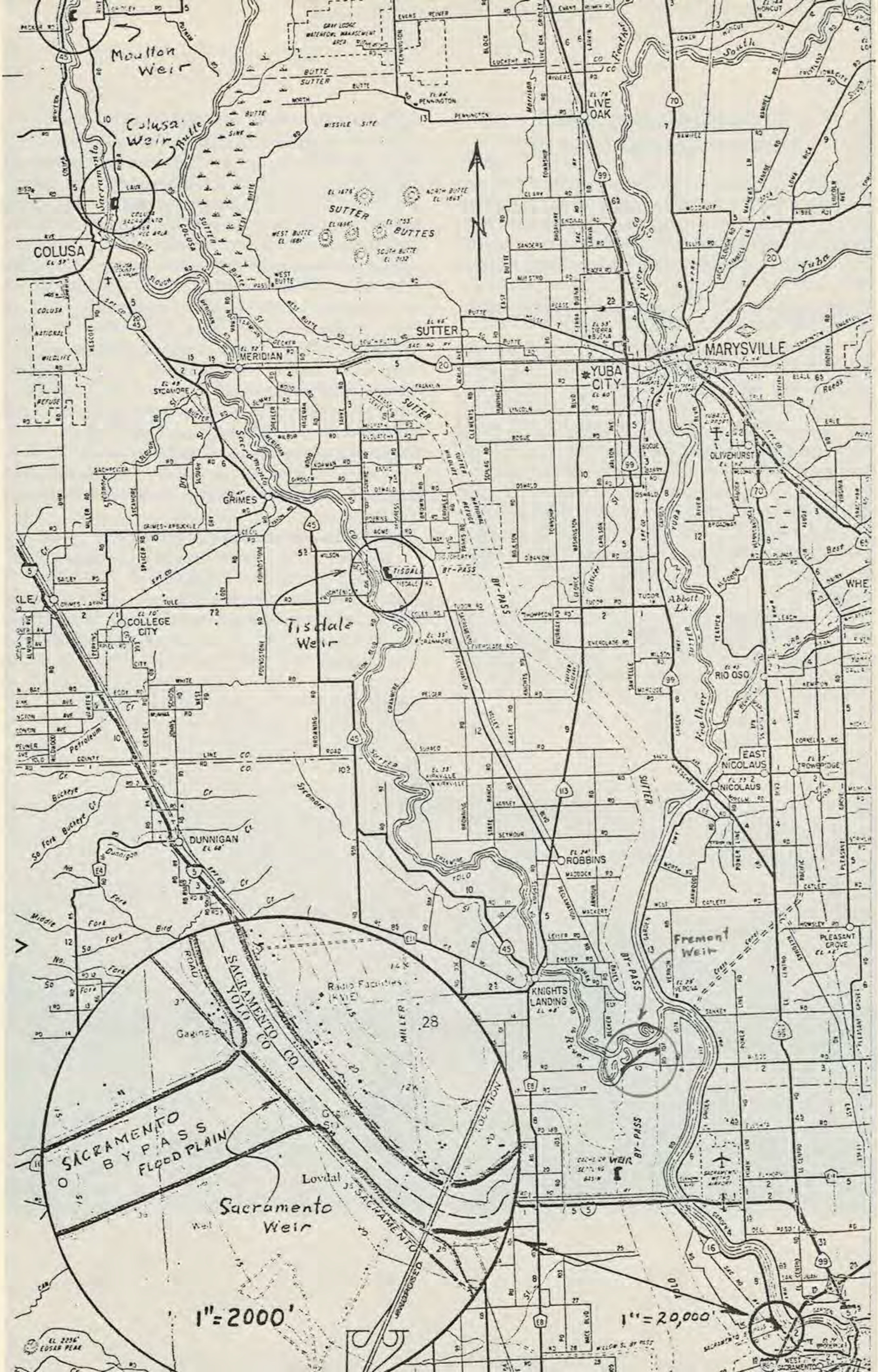
The United States Army Corps of Engineers has played a major role in the control of the Sacramento River. Activity first began in the San Francisco Harbor in 1868, and along the Sacramento River in 1888. The latter was initially a program of snag removal to improve navigation. After years of study, a comprehensive flood control plan was proposed in 1910 and subsequently approved. This called for federal, state and local cooperation to enlarge existing levees as well as to construct new levees along the river. Since the flood flows are far in excess of what can be carried even between the levees, relief channels such as the Yolo bypass were included in the plan. The bypasses required their own levees as well as headwork structures to divert the river water into them. For this latter purpose five weirs were included in the plans.

The second of these weirs, the Sacramento Weir, with a crest length of 1830 feet, was built by the City of Sacramento in 1917. The other weirs were completed as follows: Tisdale (1908) length 1155 feet; Fremont (1924) length 9120 feet; Moulton (1932) length 500 feet; and Colusa (1933) length 1650 feet. The entire layout of the flood control plan is shown on the accompanying map.

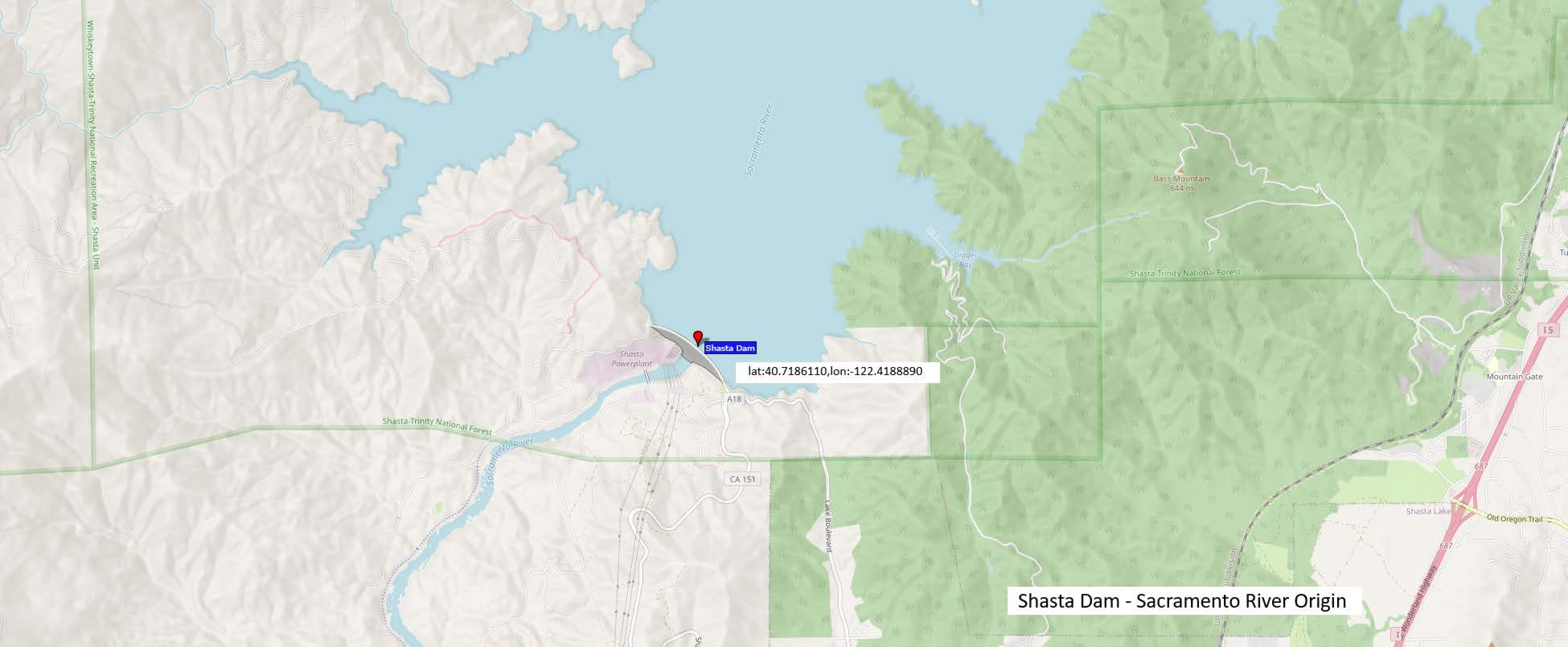
Map of Sacramento Valley showing the weir and bypass system. (Adjoining page)

Sacramento Weir in operation. The Sacramento Northern tracks to Woodland cross over the weir.





Moulton Weir
Colusa Weir
Tisdale Weir
Fremont Weir
Sacramento Weir
SACRAMENTO BYPASS FLOOD PLAIN
1"=2000'
1"=20,000'
COLUSA
SUTTER BUTTES
LIVE OAK
SUTTER
MERIDIAN
YUBA CITY
MARYSVILLE
OLIVEHURST
GRIMES
TISDALE
COLLEGE CITY
RIO OSO
EAST NICOLAUS
NICOLAUS
DUNNIGAN
ROBBINS
KNIGHTS LANDING
SACRAMENTO YOLO CO
Radio Facilities
Lovdal
BY-PASS


Whiskeytown-Shasta-Trinity National Recreation Area - Shasta Unit
Sacramento River
Bass Mountain
844 m
Digger Bay
Shasta-Trinity National Forest
Shasta Dam
Shasta Powerplant
lat:40.7186110,lon:-122.4188890
A18
Shasta-Trinity National Forest
Sacramento River
CA 151
Lake Boulevard
I 5
Mountain Gate
Shasta Lake
Old Oregon Trail
Wonderland Highway
687
Shasta Dam - Sacramento River Origin


OREGON
CALIFORNIA
NEVADA
Medford
KLAMATH
Upper Klamath Lake
Klamath Falls
LAKE
Klamath
Crescent City
Clear Lake Res.
Goose Lake
SISKIYOU
MODOC
Alturas
Mount Shasta
McCloud
Pit
Trinity Lake
Trinity
Eureka
Hat Cr.
SHASTA
LASSEN
TRINITY
Shasta Lake
Whiskeytown Lake
Redding
Eagle Lake
Cottonwood Cr.
Battle Cr.
Eel
Lake Almanor
Pyramid Lake
South Fork
Mill Cr.
Red Bluff
TEHAMA
North Fork
Indian Cr.
East Br.
PLUMAS
Thomes Cr.
Middle Fork
Black Butte Lake
Chico
Orland
BUTTE
Butte Cr.
MENDOCINO
Stony Cr.
GLENN
Sacramento
Feather
Oroville
SIERRA
Reno
Fort Bragg
N. Yuba
Mid. Yuba
South Yuba
NEVADA
Yuba
COLUSA
Colusa
Carson City
LAKE
Yuba City
Grass Valley
North Fork
Clear Lake
SUTTER
YUBA
Bear
Mid. Fork
Lake Tahoe
Cache Cr.
PLACER
Russian
YOLO
South Fork
American
Folsom Lake
SONOMA
Lake Berryessa
Putah Cr.
Davis
EL DORADO
ALPINE
Santa Rosa
Sacramento
SACRA-MENTO
AMADOR
NAPA
Napa
Mokelumne
Pacific Ocean
SAN JOAQUIN
CALAVERAS
Stockton
Tuolumne
Oakland
San Francisco
San Joaquin
0
20
40
60
80 miles


OREGON
CALIFORNIA
Goose Lake
Alturas
Rush
Pit
Sacramento
McCloud
Clear
Shasta Lake
Burney
Hat
Redding
Anderson
Battle
Cottonwood
Lake Almanor
Red Bluff
Deer
North Feather
Middle Feather
Black Butte Reservoir
Grindstone
Chico
Stony
Butte
Oroville
Lake Oroville
New Bullards Bar Res.
Feather
Colusa
Yuba
North Fork American
Sacramento
Yuba City
Indian Valley Res.
Clear Lake
Cache
South Fork American
American
Folsom Lake
Woodland
Davis
Putah
Sacramento
Lake Berryessa
Pacific Ocean
Sacramento-San Joaquin Delta
Sacramento River Watershed
About 300 miles (483 km) across


Moulton Weir
Butte Sink
Colusa Weir
Feather River
Sutter Bypass
Tisdale Weir
Sacramento River
Fremont Weir
Sacramento Weir
Yolo Bypass
Sacramento

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DIVISION OF FLOOD MANAGEMENT

Fact Sheet

Sacramento River Flood Control Project Weirs and Flood Relief Structures

December 2010
Flood Operations Branch

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Overview

Sacramento Valley has a history of floods and management of floods that goes back as long as people have populated the region. Prior to flood management, the valley floor would be blanketed by seasonal runoff nearly every year; the Sacramento Valley was once nicknamed the "inland sea." This tendency to flood results from the geography of the region as well as the weather. The occasionally large amounts of rain that fall in the surrounding Coastal ranges and the relatively steep Sierra Nevada mountain ranges produce rapid surface water runoff to the Sacramento River. The amount of this surface water runoff can be quite large, depending on the amount of rainfall, snow melt, and soil moisture of the watershed. Fast water flowing from the mountains is blunted by the relatively shallow grade of the Sacramento River south of the city of Red Bluff, and would often overtop the river banks. In addition, The Sacramento River would begin depositing sediment in the more shallow grades that would often alter its direction of flow. In order to control these storm flows that would otherwise flood farmland and cities, the Sacramento River Flood Control Project (the Project) was created.

The Project was designed with the understanding that runoff from many of the storm events experienced in the Sacramento River watershed cannot be contained within the banks of the river. Nor could this flow be fully contained within a levee system without periodically flooding adjacent property. Thus, the Project was designed to occasionally spill through a system of weirs and flood relief structures into adjacent basins. These basins are designed to contain flood waters and channel them downstream, to eventually be conveyed back into the Sacramento River near Knights Landing and Rio Vista. Dry weather flows are contained within levees near the river banks and land within the flood basins is then used for agricultural purposes.

There are ten overflow structures in the Project (six weirs, three flood relief structures, and an emergency overflow roadway) that serve a similar function as pressure relief valves in a water supply system. Weirs are lowered sections of levees that allow flood flows in excess of the downstream channel capacity to escape into a bypass channel or basin.

All six weirs of the Project (Moulton, Colusa, Tisdale, Fremont, Sacramento, and Cache Creek) consist of the following: (1) a fixed-level, concrete overflow section; followed by (2) a concrete, energy-dissipating stilling basin; with (3) a rock and/or concrete erosion blanket across the channel beyond the stilling basin; and (4) a pair of training levees that define the weir-flow escape channel.

All overflow structures except the Sacramento Weir pass floodwaters by gravity once the river reaches the overflow water surface elevation. The Sacramento Weir has gates on top of the overflow section that hold back floodwaters until opened manually by the Department of Water Resources' Division of Flood Management.

Four other relief structures are concentrated along 18 river miles between Big Chico Creek (River Mile 194) and the upstream end of the left (east) bank levee of the Sacramento River Flood Control Project (near River Mile 176). These structures function like weirs but are not called weirs because they do not have all four structural characteristics previously described. All of these relief structures convey water into the Butte Basin (a natural trough east of the river) upstream of the levee system designed to guide the flood waters.

Three of the structures are designated as flood relief structures (M&T, 3B's, and Goose Lake). If these three fail as designed a raised 6,000-foot roadway near the south end of Parrott Ranch allows excess floodwaters to escape the Sacramento River to the Butte Basin before being confined by the downstream project levees.

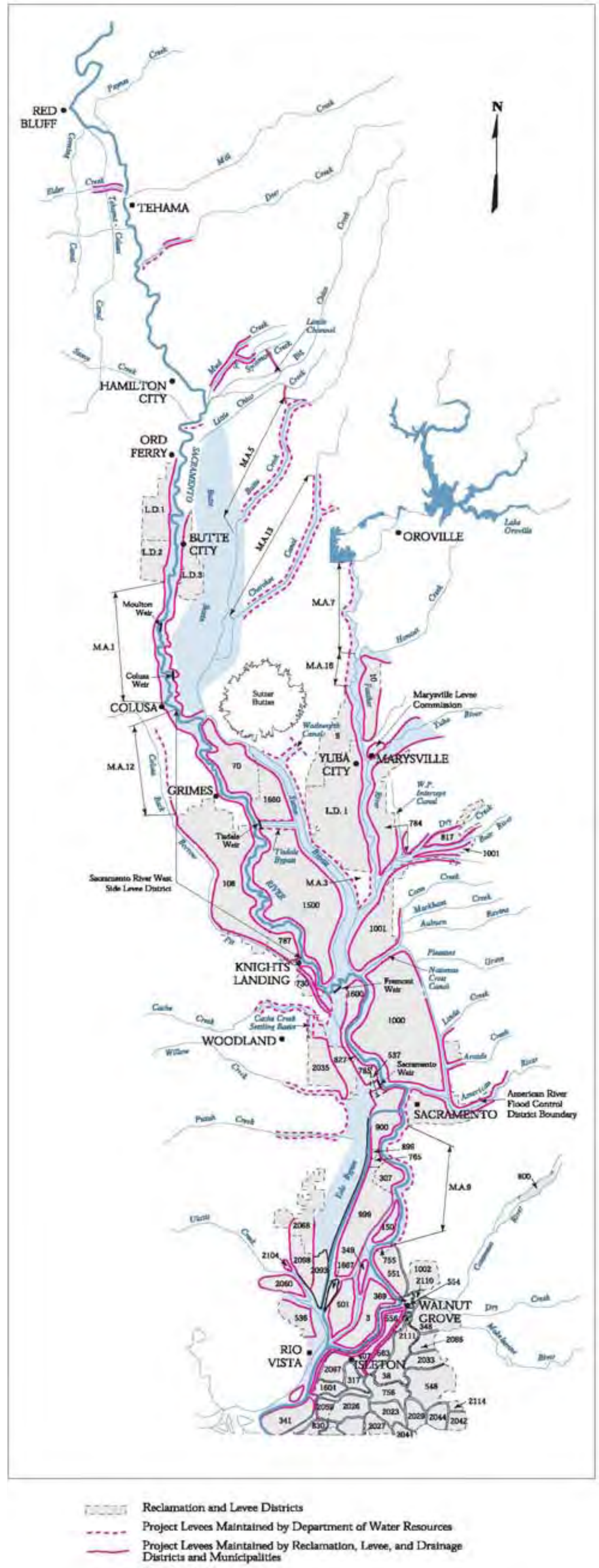

Figure 1 (above), Location Map for Weirs and Relief Structures in the Sacramento River Flood Control Project

Figure 2 (right), Sacramento River Flood Control Project Overview, showing project levees and basins

Moulton Weir


Figure 3, Moulton Weir, January 1997

Moulton Weir was completed in 1932. It is located along the easterly side (left bank looking downstream) of the Sacramento River approximately eight miles north of the town of Colusa and about 100 miles north of Sacramento. Its primary function is to release overflow waters of the Sacramento River into the Butte Basin at such times when floods exceed the safe carrying capacity of the main channel of the Sacramento River downstream from the weir. The fixed crest reinforced concrete weir is 500 feet long with concrete abutments at each end. The outlet channel is flanked by training levees and is approximately 3,000 feet long. The crest elevation is 76.75 feet and the project design capacity of the weir is 25,000 cubic feet per second (cfs). The Moulton Weir is typically the last of the non-gated weirs to overtop, and spills for the shortest duration.

Colusa Weir and Bypass


Figure 4, Colusa Weir, January 1997

Colusa Weir was completed in 1933. It is located along the left bank of the Sacramento River one mile north of the town of Colusa. Its primary function is to release overflow waters of the Sacramento River into the Butte Basin. The fixed crest reinforced concrete weir is 1,650 feet long and is flanked by training levees that connect the river to the basin. The crest elevation is 61.80 feet and the project design capacity of the weir is 70,000 cfs. Normally, the Colusa Weir does not overtop until the Tisdale Weir is also spilling, except for flood events that are characterized by rapid rise in Sacramento River stage.

Tisdale Weir and Bypass

Tisdale weir was completed in 1932. It is located along the left bank of the Sacramento River about ten miles southeast of the town of Meridian and about 56 miles north of Sacramento. Its primary purpose is to release overflow waters of the Sacramento River into the Sutter Bypass via the Tisdale Bypass. The fixed crest reinforced concrete weir is 1,150 long. The four-mile leveed bypass channel (Tisdale Bypass) connects the river to the Sutter Bypass. The crest elevation is 45.45 feet and the project design capacity of the weir is 38,000 cfs. Typically, the Tisdale Weir is the first of the five weirs in the Sacramento River Flood Control System to overtop, and continues to spill for the longest duration.

Figure 5, Tisdale Weir and Tisdale Bypass (Sutter Bypass in background, January 1997

Fremont Weir

Fremont Weir was completed in 1924. It is the first overflow structure on the river's right bank and its two-mile overall length marks the beginning of the Yolo Bypass. It is located about 15 miles northwest of Sacramento and eight miles northeast of Woodland. South of this latitude the Yolo Bypass conveys 80 percent of the system's floodwaters through Yolo and Solano Counties until it connects to the Sacramento River a few miles upstream of Rio Vista. The weir's primary purpose is to release overflow waters of the Sacramento River, Sutter Bypass, and the Feather River into the Yolo Bypass. The crest elevation is 33.50 feet and the project design capacity of the weir is 343,000 cfs.

Figure 6, Fremont Weir (Sutter Bypass on left, and Yolo Bypass on right)

Sacramento Weir and Bypass

The Sacramento Weir was completed in 1916. It is the only weir that is manually operated – all others overflow by gravity on their own. It is located along the right bank of the Sacramento River approximately 4 miles upstream of the Tower Bridge, and about 2 miles upstream from the mouth of the American River. Its primary purpose is to protect the City of Sacramento from excessive flood stages in the Sacramento River channel downstream of the American River. The weir limits flood stages (water surface elevations) in the Sacramento River to project design levels through the Sacramento/West Sacramento area. The project design capacity of the weir is 112,000 cfs.

It is 1,920 feet long and consists of 48 gates that divert Sacramento and American River floodwaters to the west down the mile-long Sacramento Bypass to the Yolo Bypass. Each gate has 38 vertical wooden plank "needles" (4 inches thick by 1 foot wide by 6 feet long), hinged at the bottom and retained at the top by a hollow metal beam. The beam is manually released using a latch. Flood forecasters provide the necessary predictive information to weir operators who manage the number of opened gates in order to control the river's water surface elevation. Closing the hinged gates is a more laborious process than opening them. While opening a gate takes only a matter of minutes, closing it can take up to an hour. Long, hooked poles are used to raise each gate from its free open position to the vertical upright position. The hollow metal beam is then replaced, and the gate is released and allowed to rest against it.

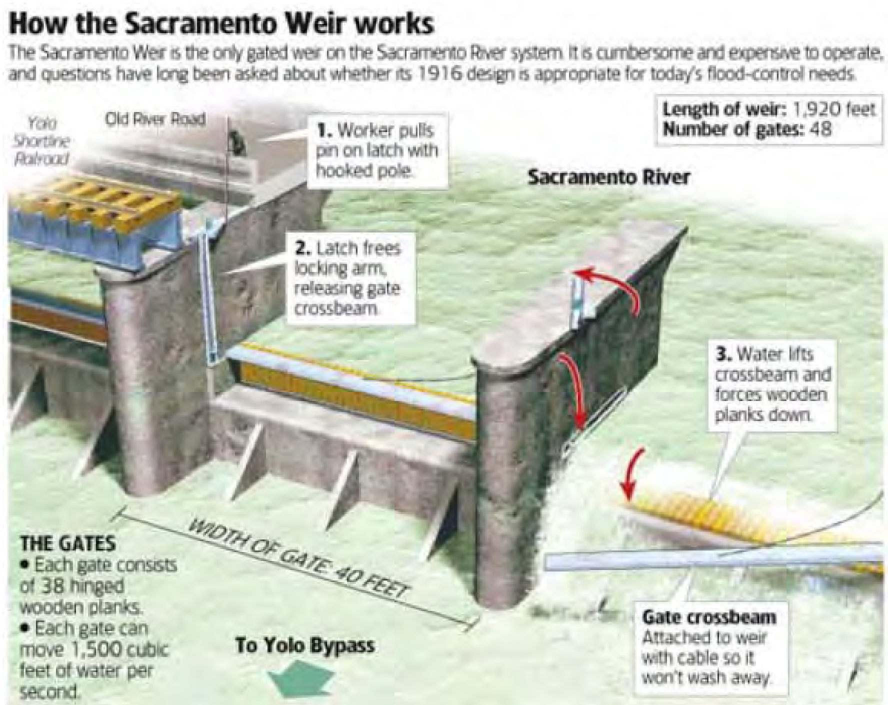

Figure 7. Diagram Depicting the Opening of the Sacramento Weir.
Appeared in the Sacramento Bee on January 5, 2006.

The Department of Water Resources operates the weir according to regulations established by the U.S. Army Corps of Engineers. The opening and closing criteria have been optimized to balance two goals: (1) minimize sediment deposition due to decreased flow velocities downstream from the weir to the mouth of American River; and (2) limit the flooding of agricultural lands in the Yolo Bypass until after they have been inundated by floodwaters over Fremont Weir.

Though the weir crest elevation is 24.75 feet, the weir gates are not opened until the river reaches 27.5 feet at the I Street gage with a forecast to continue rising. This gage is about 1,000 feet upstream from the I Street Bridge and about 3,500 feet downstream from the mouth of the American River. The number of gates to be opened is determined by the NWS/DWR river forecasting team to meet either of two criteria: (1) to prevent the stage at the I Street gage from exceeding 29 feet, or (2) to hold the stage at the downstream end of the weir to 27.5 feet. Once all 48 gates are open, Sacramento River stages from Verona to Freeport may continue to rise during a major flood event. Project design stages are 41.3 feet at Verona, 31.5 feet at the south end of the Sacramento Weir, and 31 feet at the I Street gage.

Figure 8, Sacramento Weir with Yolo Bypass in foreground, January 1997

Figure 9, Sacramento Weir with American River in background, March 1995 (30,000 cfs)

During a major flood, opening the weir gates at river stages below 27.5 feet does not reduce ultimate peak flood stages in the Sacramento River from Verona to Freeport. Diversion of the majority of upstream floodwaters to the Yolo Bypass from Fremont Weir controls Sacramento River flood stages at Verona.

Downstream of the Sacramento Weir, the design flood capacity of the American River is 5,000 cfs higher than that of the Sacramento River. Flows from the American River channel during a major flood event often exceed the capacity of the Sacramento River downstream of the confluence. When this occurs, floodwaters flow upstream from the mouth of the American River to the Sacramento Weir.

The weir gates are closed as rapidly as practicable once the stage at the weir drops below 25 feet. This provides "flushing" flows to re-suspend sediment deposited in the Sacramento River between the Sacramento Weir and the American River during the low flow periods when the weir is open during the peak of the flood event.

A rating table has been developed to estimate flow over the Sacramento Weir into the Yolo Bypass (Table 1). This table can be used to calculate both the approximate discharge per open gate and, for higher stages, the approximate discharge over closed gates as well. All stages are listed with respect to USGS mean sea level datum.

Table 1. Rating Table for the Sacramento Weir.

Sacramento River Stage at Gage Opposite of Weir - ft (USGS)	Discharge over Weir Crest per Open Gate (cfs)									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
22	0	3	8	14	22	30	40	50	61	73
23	86	100	114	130	146	163	181	199	218	238
24	258	279	301	323	346	370	394	419	445	471
25	498	525	552	581	610	639	669	699	730	762
26	794	826	859	893	927	961	996	1031	1067	1103
27	1140	1177	1215	1253	1291	1330	1370	1410	1450	1490
28	1531	1573	1615	1657	1700	1743	1786	1830	1874	1918
29	1963	2008	2054	2100	2146	2193	2240	2288	2336	2384
30	2432	2481	2530	2580	2630	2680	2730	2781	2832	2884
31	2936	2988	3041	3094	3147	3200	3254	3308	3362	3417
	Discharge over each Closed Gate (cfs)									
28	0	4	11	20	30	41	54	68	82	98
29	115	132	151	171	191	212	234	256	280	304
30	329	355	381	408	436	465	494	524	554	585
31	617	650	683	717	752	787	823	860	897	935

Cache Creek Settling Basin and Weir

The Cache Creek Settling Basin and Weir were originally completed between the late 1930's through the early 1950's. The basin was expanded and the new weir was completed in 1991. It is located in Yolo County about two miles east of the City of Woodland. Its primary purpose is to preserve the floodway capacity of the Yolo Bypass by entrapping the heavy sediment load carried by Cache Creek before its waters pour into the bypass. The basin is bound by levees on all sides and covers approximately 3,600 acres. The roller compacted concrete weir is 1,740 feet long along the east levee of the basin and controls discharge to the bypass. The project design capacity of the weir is 30,000 cfs, which is also the maximum capacity of the upstream Cache Creek channel system.

Figure 10, Cache Creek Settling Basin Weir, March 1995

Overflow records for Moulton, Colusa, Tisdale, Fremont, and Sacramento Weirs from 1934 through 2007 are found on the following pages. Subsequent years will be added as the charts are updated.

Sacramento Valley Flood Control Historical Timeline

(Based on *Battling the Inland Sea*, by Robert Kelley)

1849	U.S. Congress passes Swamp Land Act of 1849
1850	Swamp Land Act of 1850
January 7, 1850	City of Sacramento floods
March, 1850	Another storm hits Sacramento. Hardin Bigelow organizes flood fighting party and successfully dams most low points along American and Sacramento Rivers (Bigelow soon becomes Mayor of Sacramento)
1851	First levees built in Sacramento (3-feet high)
December, 1852	First levees built in Sacramento failed
March, 1853	Second flood of season (larger than first) inundates Sacramento
May 31, 1861	AB 54 (State Reclamation Act) passed – Swamplands Commission created, tasked with statewide flood control program development
1861	Andrew Humphreys of the U.S. Army Corps of Engineers (USACE) submits Mississippi River flood study to U.S. Congress – Advocates levees only, main channel flood control approach (All storm flow to remain within levees, and assumption that river will scour out material from the bed to accommodate additional flow)
1862	City of Sacramento Levee District created
March 22, 1866	AB 591 passes – State-wide Swampland Commission dissolved (Reclamation authority delegated to county boards of supervisors)
1867 – 1880	Reclamation districts upstream and downstream of Colusa race each other to construct levees on each bank of Sacramento River
April 13, 1868	Sacramento Valley Levee District 1 (Sutter County) created
May 30, 1868	Green Act (named for *Colusa Sun* editor William S. Green, who authored the bill) passes – Greatly reduces County authority to block reclamation projects. William Green is also the earliest known figure to call for a system of flood overflow basins for the Sacramento River
December 6, 1871	Colusa-area swampland owner, William Parks completes construction of earthen dam across Butte Slough, the effect of which will inundate the property of others upstream

December 27, 1871	Parks Dam is cut by parties unknown; releasing pooled floodwaters downstream – Dam is rebuilt in following year
January 19, 1874	Parks Dam fails
December 28, 1874	L.F. Moulton proxy and Parks Dam flood victim, Justin Laux v. William Parks: Suit is dismissed when Parks purchases Laux's farm
January, 1875	Marysville inundated by water and mining sediment via Yuba River – Mining sediment from hydraulic mining operations had for several years been polluting rivers and settling in river beds, thus raising the bed elevation, and causing more frequent flooding and more extensive damage to adjacent properties
January 25, 1875	Parks Dam fails again
May 7, 1875	William Parks petitions for creation of swampland district
June 3, 1875	County Supervisors deny Parks' request to rebuild dam
June 16, 1875	William Parks' Swampland District (SLD) 226 created – Construction of dam recommences
January 5, 1876	Floodwaters impounded by Parks Dam breach Reclamation District (RD) 70 levee; flooding farm properties downstream
January 8, 1876	Thirty to Forty armed men from RD 70 form naval party to successfully destroy Parks Dam
March 4, 1876	Judge Phil. Keyser issues injunction against Parks' and SLD 226 dam constuction
March, 1878	Drainage Bill enacted – Independent public commission would establish drainage districts; State Engineer would plan projects (based on levees only); Districts would raise and expend taxes, construct and operate projects
March, 1879	Judge Phil. Keyser issues injunction against Bear River mining operations, citing Equity Clause
November, 1879	State Supreme Court overturns Keyser's injunction
January 21, 1880	California's first State Engineer, William Hammond Hall, submits Irrigation/Flood Control Report to State Legislature – A damning report on the mining operations' environmental destruction that advocated State control of drainage
September 26, 1881	Drainage Act declared unconstitutional – Act was not created by State Legislature

January, 1884	Edwards Woodruff v. North Bloomfield Gravel Mining Company-- Prohibited the discharge of mining waste in surface waters
February, 1891	USACE's Biggs Commission Report asserts mining operations may continue, with mining companies construction of debris dams, and Federal restoration of natural river channels downstream
March, 1893	Caminetti Bill (based on Biggs Commission Report findings) signed by President Benjamin Harrison – Establishes California Debris Commission
December, 1894	Marsden Manson & C.E. Grunsky, (consulting engineers working foe State Commissioner of Public Works, A.H. Rose,) issue *Marsden & Grunsky Report for Sacramento Valley Flood Control*, and present it to California Governor – First comprehensive report that advocated bypass channels (William Green had asserted this need three decades earlier)
January, 1896	Flood of '96 – Many mining debris dams (products of Biggs Commission recommendations) fail, sending waste downstream
March, 1896	Rivers and Harbors Act enacted in Congress -- $250K appropriated (none of which was for mining assistance)
May, 1902	River Improvement and Drainage Association of California created
May 11, 1904	San Francisco Chronicle editor and Commonwealth Club founder, Edward Adams' public presentation on statewide flood control and reclamation – A retelling of California reclamation history to date, and a call for State and Federal governments to assert control of future planning
1904	U.S. Army Corps of Engineers' Dabney Commission issues report that rejects the Manson & Grunsky Report's findings of the need for bypass channels and a design flood of 300,000 cfs. Advocates levees only main channel approach and a design flood of 250,000 cfs
March 19, 1907	Flood of '07 – First flood event to occur with USGS staff gages in place to measure river levels – Observed flow calculated to be 600,000 cfs (more than *double* the Dabney design flood) Feather River dumps into Butte Sink, Yuba City & Shanghai Bend Sacramento River jumps banks both north and south of Colusa
1907	USACE's California Debris Commission expands navigation assurance role to include flood control
1909	Flood of '09 – Nearly as large as the Flood of '07
1910	Thomas H. Jackson of the USACE produces the "Jackson Report"; the foundational plan for the Sacramento Flood Control Project – employing the Manson & Grunsky Report's bypass channels, only with a design flood of 600,000 cfs
1911	State Flood Control Act enacted

1913	State Reclamation Board given greater authority
1913	Dredging of the mouth of the Sacramento River begins – Continues through the 1920s
1917	Congress enacts Flood Control Act – Includes funding for the Sacramento Flood Control Project, but largely limited to navigation related tasks
1928	Flood Control Act of ’28 – Enacted as a response to the Mississippi Flood of ’27, and adds flood control to USACE directives
1936	Flood Control Act of ’36 – Promotion of multi-purpose water resource projects for USACE purview
February 11, 1986	Flood of ’86 – 600,000 cfs (maximum design flow) pours into Sacramento-San Joaquin Delta via Sacramento River and Yolo Bypass. Only upstream flood control reservoirs prevent approximately *one million cfs* from severely testing the Sacramento Flood Control Project. As a result, the system largely works as designed
January 3, 1997	Flood of ’97 – nearly 600,000 cfs again pours into Sacramento-San Joaquin Delta via Sacramento River and Yolo Bypass. Only upstream reservoirs prevent approximately one million cfs from inundating the Sacramento Flood Control Project.

1997

Record Flood: The fifth record flood in 46 years occurs over the New Year's holiday. Unprecedented flows from rain and melted snow surge into the Feather and the San Joaquin. Sacramento is spared when the fury of the storm hits 40 miles north in the Feather River. Levee failures flood Olivehurst, Arboga, Wilton, Manteca, and Modesto. Sacramento experiences significant levee problems in the Sacramento area.