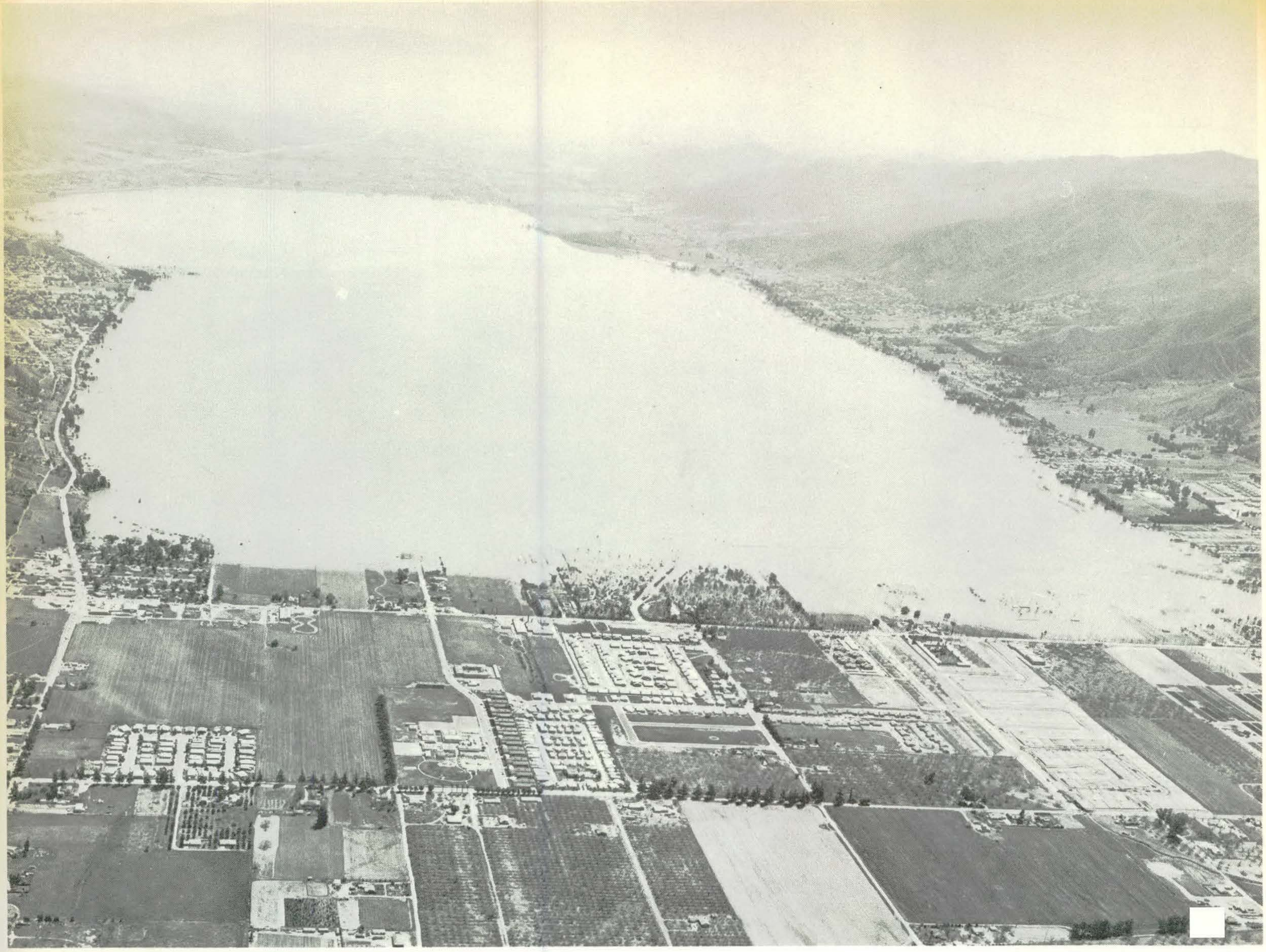
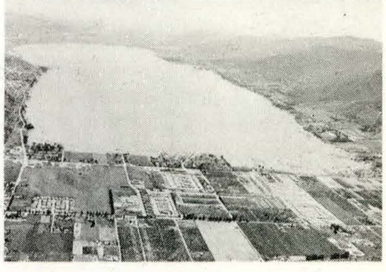


State of California
The Resources Agency

Department of
Water Resources

# California High Water 1979-80

Bulletin 69-80
November 1981



ON THE COVER: Lake Elsinore in Riverside County as it appeared in March 1980 after 80 days of heavy inflow swelled the lake to 1.75 metres (5.7 feet) above flood stage, causing some 2,000 lakefront residents to flee to higher ground.

# ERRATA

Due to a printing error, the photographs on page 18 and that on page 26 were interchanged. The photograph on page 26 illustrates a flood event in the Tulare Lake Basin, whereas those on page 18 show flooding in San Bernardino County.

Department of
Water Resources

Bulletin 69-80

# California High Water 1979-80

November 1981


Huey D. Johnson
Secretary for Resources

Edmund G. Brown Jr.
Governor

Ronald B. Robie
Director

The Resources Agency

State of California

Department of Water Resources

## FOREWORD

An extended dry spell, reminiscent of the 1976 and 1977 drought years, dominated the early 1979-80 water year, but in mid-December a series of storms began and eventually caused the Sacramento River to rise to 10-year highs in both January and February. The influx of high water from the Sacramento and San Joaquin River Systems, combined with strong winds and high tides, contributed to the failure of four levees in the Delta, flooding four islands.

Southern California fared even worse. Almost a score of people lost their lives, and property damage soared as a result of mudslides and flooding triggered by frequent, and sometimes torrential, rains.

Bulletin 69-80, the fourteenth in a series of reports on high-water in California, presents information on storms, flooded areas, and damage during the 1979-80 water year (October 1, 1979 through September 30, 1980). Included are weir overflow graphs, and hydrographs of selected stream gages and reservoir operations.

Information for this bulletin was provided by the Department of Water Resources, National Weather Service, U. S. Geological Survey, U. S. Army Corps of Engineers, U. S. Bureau of Reclamation, and other public and private sources whose assistance is gratefully acknowledged.

Ronald B. Robie, Director
Department of Water Resources
The Resources Agency
State of California

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2—82445

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HUEY D. JOHNSON, Secretary for Resources

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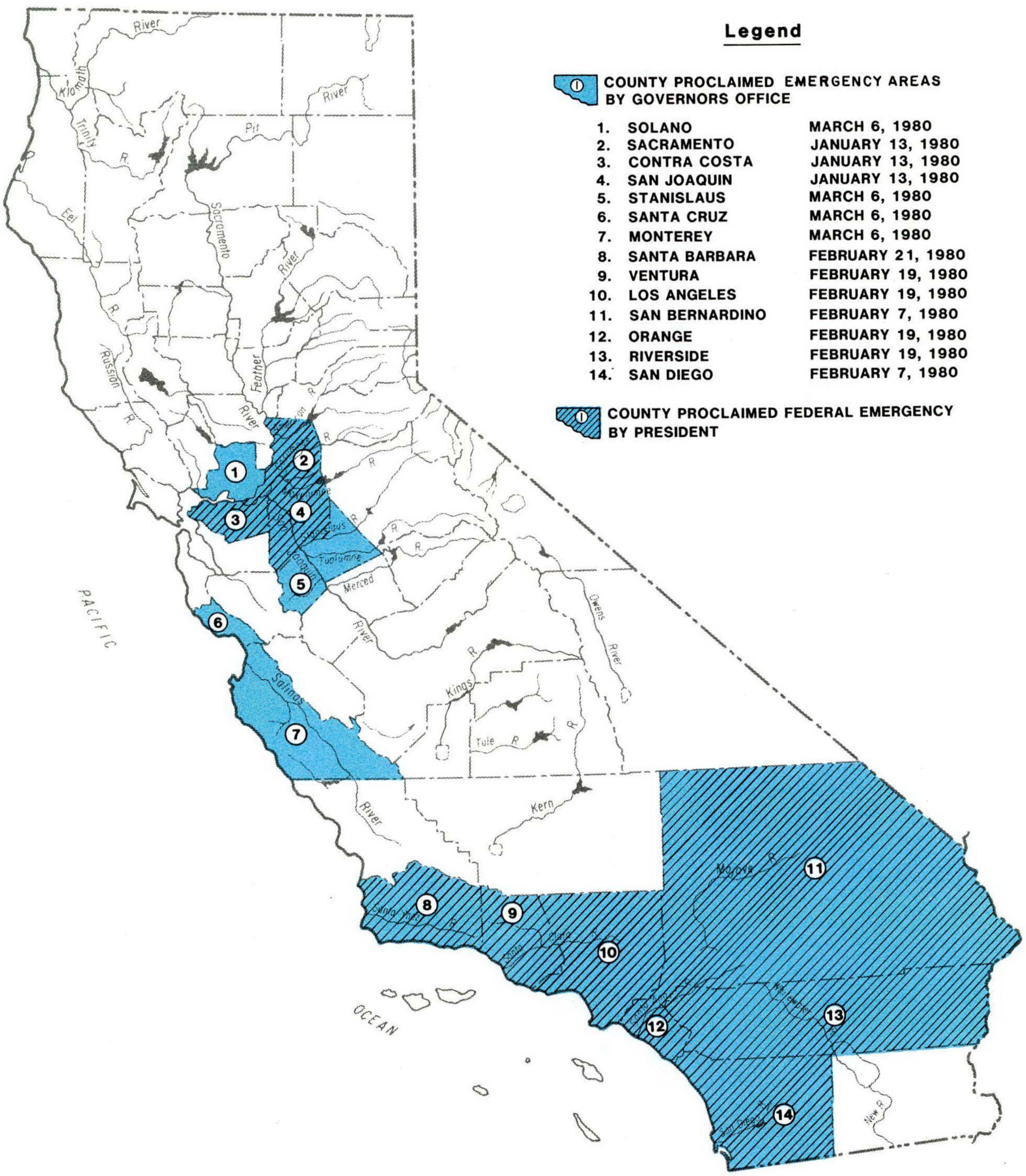
State of California
Department of Water Resources
CALIFORNIA WATER COMMISSION



The California Water Commission serves as a policy advisory body to the Director of Water Resources on all California water resources matters. The nine-member citizen Commission provides a water resources forum for the people of the State, acts as a liaison between the legislative and executive branches of State Government and coordinates Federal, State, and local water resources efforts.

## Figure 1. COUNTIES PROCLAIMED EMERGENCY AREAS DURING WATER YEAR 1979-80



## FLOOD EVENTS OF 1979-80 WATER YEAR

On December 19, 1979, following an extended dry spell, a series of strong weather fronts dislodged a blocking high-pressure system off the coast of California and began tracking across Northern and Central California. Although not suspected at the time, the change in weather pattern heralded the coming of subsequent intense and widespread storms that brought flooding and destruction to much of the State and adversely affected the lives of thousands of Californians. Counties proclaimed emergency areas are shown in Figure 1.

Most of the storm damage during the winter 1979-80 can be attributed directly to an intense storm beginning in mid-January and to another series of weather fronts during the last two weeks of February. The two weather patterns were comparable in intensity, but characteristically different in source and nature.

The first three weeks of the 1979-80 winter quarter (December, January, February) were virtually rainless. With the bitter drought experience of 1976-77 still lingering in the minds of many Californians, it was not surprising that expressions of concern began to surface about mid-December. Thus, the late December storms, in addition to bringing much needed rainfall to Northern and Central valleys and foothills and abundant snow to higher elevations, relieved some drought anxieties and brightened an otherwise questionable water supply outlook for 1980.

A shifting of the storm track in mid-January to a more southerly latitude resulted in an unusually persistent and intense series of storms that left their mark on much of the State. The weather fronts were formed chiefly of warm air masses bringing rain to the 2 100-2 700 metre elevations (7,000-9,000 feet) and melting much of the snow deposited by the late December storm. Major releases from Central Valley reservoirs became necessary to accommodate fast runoff from melting snow and heavy rainfall. The unscheduled releases and substantial local runoff generated the highest river stages along the Sacramento and San Joaquin River system in nearly a decade. The effectiveness and capability of the Sacramento-San Joaquin River Flood Control Project was thoroughly tested. The high river flows, coupled with strong winds, were contributing factors to the failure of nonproject levees in the Delta and the inundation of nearly 4 050 hectares (10,000 acres) of agricultural land.

The mid-January onslaught spanned the length of the State but centered mainly from the Feather River Basin southward. During a ten-day period beginning January 10, the Feather and American River Basins received as much as 558 mm (22 inches) of precipitation, but the upper Sacramento River drainage area above Shasta Dam received only about one-third of that amount. The San Joaquin River Basin was also the recipient of generous precipitation averaging about 380 mm (15 inches) for the same period. South of the Tehachapis, total rainfall was less, but the rain, torrential at times, severely eroded the steep hillsides, denuded of protective vegetation by summer wildfires, and massive mudslides and flows resulted.

The next series of major storms, beginning on February 15 was from a more northerly quarter, colder, and extended the force of impact to include the North State. During the assault (February 15-28), Shasta Dam (upper Sacramento River drainage area) recorded 550 mm (22 inches) of precipitation, DeSabla (Feather River) 430 mm (17 inches), and Blue Canyon (American River) nearly 500 mm (20 inches). Abundant precipitation, mostly in the form of snow, also fell in the San Joaquin River Basin. Snow measurements on March 1 indicated the water content was about 145 percent of average and the threat of additional flooding persisted during and following the storms for an extended period. In Southern California, a total of seven storms during an 11-day period tracked through the south coastal area and desert regions. The death toll and property damage mounted as the renewed attack triggered additional mud flows, raised some lake elevations to destructive levels, and forced thousands of citizens to flee their homes for prolonged periods. Seasonal precipitation for the period through April 30, 1980 is shown in Figure 2.

The flood events of 1979-80 fell short of record proportions on a statewide basis, but some noteworthy events described elsewhere in this report occurred in specific areas. Total damage, however, might have been significantly higher had the spring snowmelt potential, particularly in the San Joaquin River drainage basin, followed the expected pattern. Fortunately, exceptionally mild temperatures and lack of significant precipitation during the early spring months deterred rapid melting of the threatening snowpack and averted what might have been disaster in the lower San Joaquin Valley.

Further evidence of the inconsistency of California weather is noted as key precipitation stations (Crescent City and Eureka) on the North Coast, normally the wettest portion of the State, were the only stations reporting less than normal precipitation for the first seven months of the 1979-80 water year.

A weather review and a summary of flood events follow:

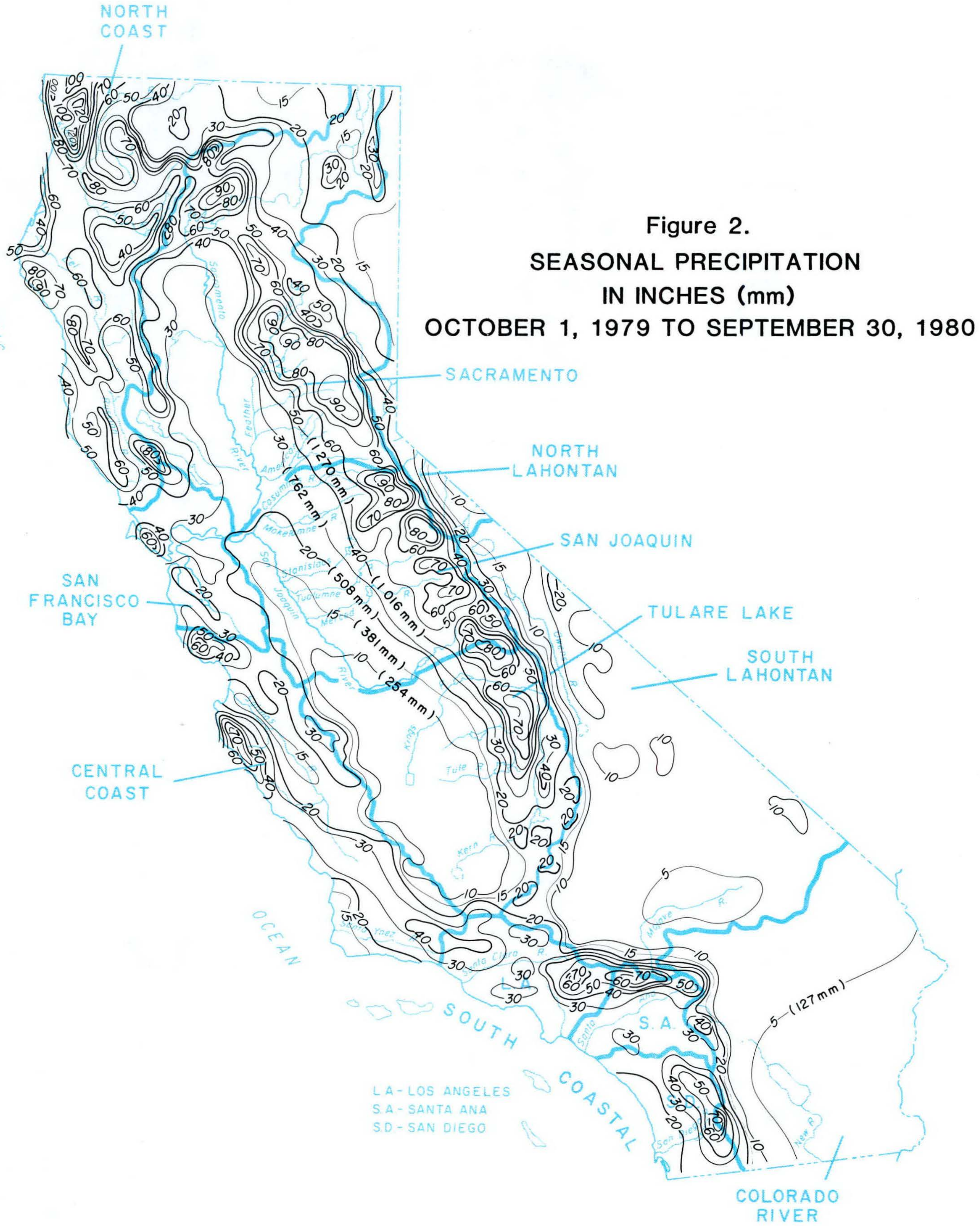



**Figure 2.**
**SEASONAL PRECIPITATION IN INCHES (mm)**
**OCTOBER 1, 1979 TO SEPTEMBER 30, 1980**

## Weather Review

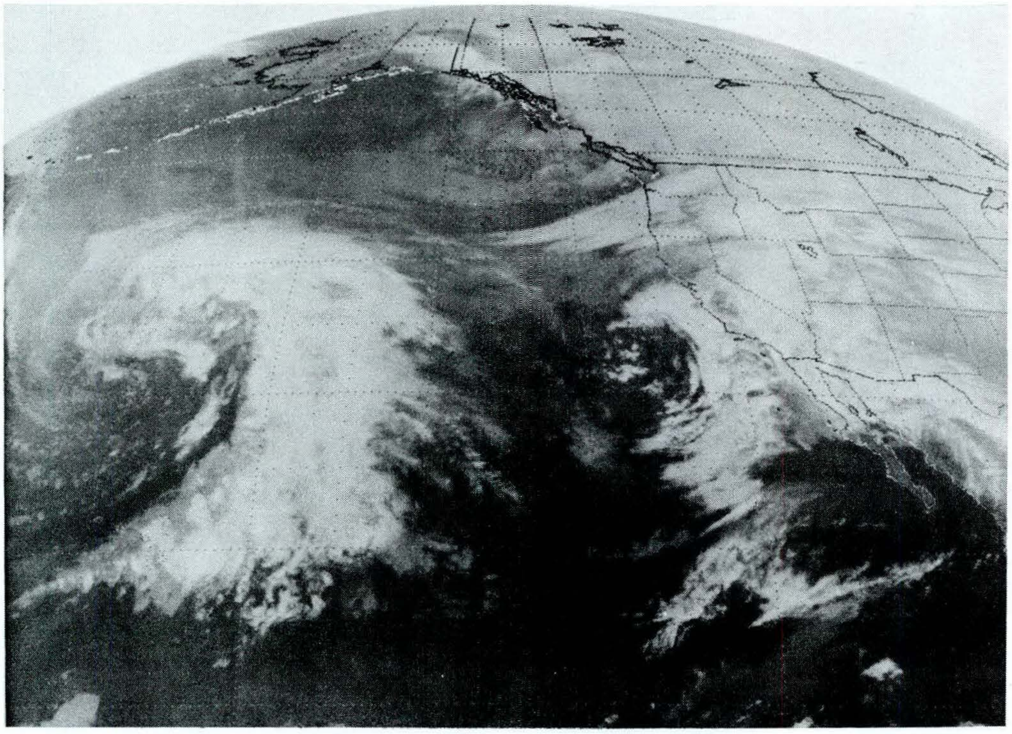
During the fall months (September, October, November), as a result of radiational processes, the temperature contrast in the atmosphere increases between the polar and tropical regions. Upper level winds increase in response to this temperature contrast and stimulate the midlatitude storminess.

In the fall of 1979 stronger than normal westerly winds set the stage for a vigorous storm pattern over the Pacific in the fall and continued into the winter quarter (December, January, February). The storm tracking over the Pacific in the fall brought above-normal precipitation to the northern half of California. The Sierra Nevada basins in the San Joaquin drainage area were near 100 percent of normal precipitation for the fall quarter, but the rest of the southern half of the State was below normal. The beginning outlook for the water year 1980 was a favorable one.

In the winter period (December, January, February) the upper-level westerlies over the Pacific were displaced well south of normal, resulting in a favorable storm tracking in the latitude band directed toward California. Many strong fronts were forced to traverse California and deposit abundant precipitation on the State. The Pacific Northwest experienced near normal precipitation, while most of California was well above normal. (See Table on Page 7.) Southern California, especially, received an onslaught of a storm series both in January and February.

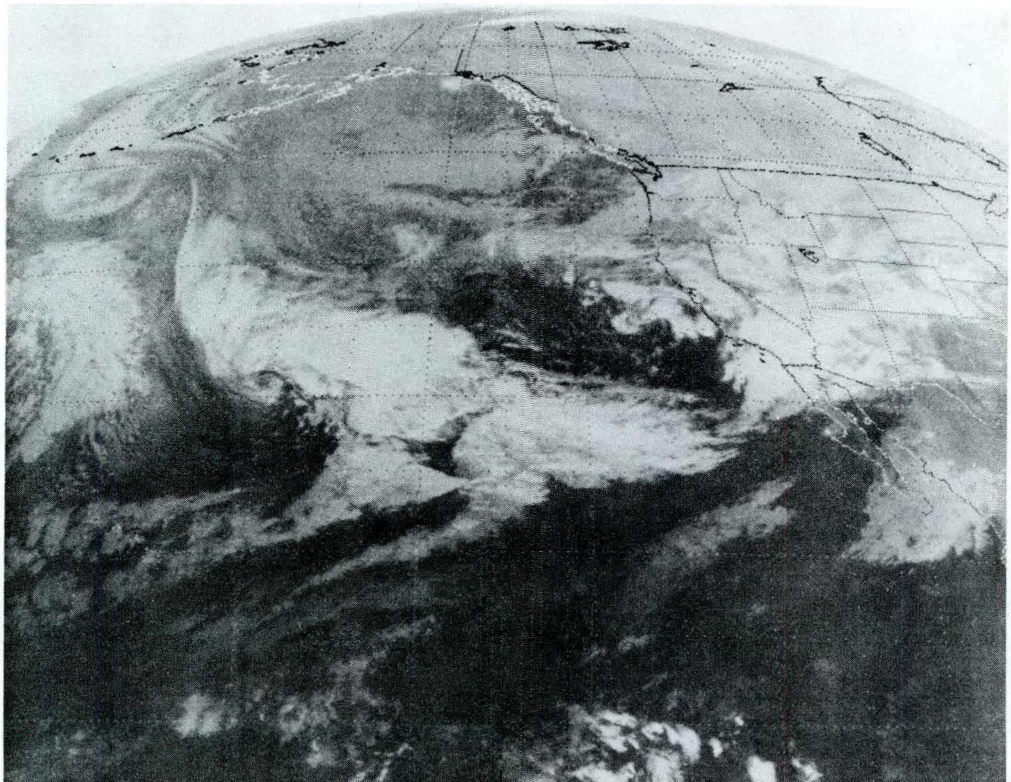
The significant winter storm periods occurred in January and February. The January storm series occurred between the 9th and 18th with moderate to heavy rain occurring to high elevations in the mountains through January 13, but with lower snow levels after that date. A satellite picture showing the cloud pattern over the eastern Pacific on January 9 is shown in Figure 3. The cloud mass off the Central and Southern California coast is the initial storm of the series, and the large cloud mass between 140° and 150° W longitudes (northeast of the Hawaiian Islands) is the next storm, which reached the California coast on the following day.

Satellite imagery for January 9 and February 15, 1980 at 1215 GMT (0415 PST) from the geostationary NOAA satellite GOES-West located over the equator at 135°W longitude at an altitude of approximately 23,000 miles (36,800 km). This depiction is from infrared sensing of a radiometer aboard the satellite. See text for interpretation of the cloud patterns.



**JANUARY 9, 1980**

*Figure 3. Satellite Imagery for January 9 and February 15, 1980*



**FEBRUARY 15, 1980**



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Precipitation totals for January were less than 100 percent of normal in the North Coast basins, but the combined drainage above Shasta and Oroville Dams was slightly over 100 percent. Southward from the Feather River Basin the percentages increased to the 200 to 300 percent range. A large area of Southern California had totals exceeding 300 percent of normal.

February was another wet month -- a repeat of the January pattern. Strong westerlies in the upper levels of the atmosphere over the Pacific, displaced south of their normal location, brought a storm track headed toward the California coast. The principal wet spell occurred in the period February 13-22, and Southern California was hit especially hard with the loss of life and extensive property damage. The heavy precipitation was combined with wind, hail, and lightning.

Precipitation over the State during February was above normal, with the Sierra Nevada basins receiving over 200 percent of normal and parts of Southern California over 500 percent of normal. The precipitation station at the Civic Center in Los Angeles received 324 millimetres in nine consecutive days, as compared with the normal value of 70 millimetres for the entire month. At other locations, many of the higher elevation stations in Southern California reported storm totals from 380 to 790 millimetres.

A representative satellite picture for the February storm period is shown in Figure 3. The picture shows the succession of storms moving across the Pacific and headed for the California coast.

PRECIPITATION AT SELECTED STATIONS
OCTOBER 1, 1979 THROUGH MAY 31, 1980

| Station North to South: | Elevation m | Oct. - Nov. 1979 mm | Oct. - Nov. 1979 % | Winter 1980 mm | Winter 1980 % | Spring 1980 mm | Spring 1980 % |
|---|---|---|---|---|---|---|---|
| | | | Mountain Stations | | | | |
| Shasta Dam | 328 | 391 | 125 | 961 | 119 | 321 | 88 |
| De Sabla | 829 | 406 | 116 | 1267 | 147 | 291 | 71 |
| Blue Canyon | 1610 | 367 | 105 | 1394 | 160 | 353 | 79 |
| Calaveras Big Trees | 1431 | 280 | 115 | 1309 | 192 | 268 | 71 |
| Yosemite Park | 1209 | 225 | 137 | 934 | 209 | 207 | 82 |
| Huntington Lake | 2140 | 213 | 133 | 1001 | 214 | 295 | 105 |
| Grant Grove | 2012 | 137 | 81 | 1188 | 217 | 264 | 84 |
| Glennville | 957 | 86 | 129 | 405 | 181 | 140 | 97 |
| North to South: | | | Coastal Stations | | | | |
| Eureka | 18 | 313 | 137 | 295 | 61 | 305 | 122 |
| San Francisco (City) | 40 | 118 | 127 | 297 | 100 | 62 | 50 |
| Santa Maria | 77 | 22 | 47 | 268 | 157 | 72 | 81 |
| Los Angeles (City) | 78 | 25 | 43 | 527 | 262 | 133 | 146 |
| San Diego | 4 | 25 | 63 | 256 | 198 | 115 | 181 |

Metric Equivalents

1 millimetre (mm) = 0.039 inch
1 metre (m) = 3.28 feet

Winter Quarter = December, January, February
Spring Quarter = March, April, May

The columns headed with the percent sign (%) are the precipitation amounts expressed in terms of percent-of-normal for the respective periods.

## SUMMARY OF FLOOD EVENTS

### North Coast

Normally the wettest portion of the State, the North Coast was probably the least affected by the January and February storms. Precipitation, though continuous for long periods, was generally below 25 millimetres (1 inch) during any 24-hour period; thus, no damaging flows occurred. Although warning stages were reached on several of the North Coast streams, only the Eel River at Fernbridge reached flood stage when it crested on January 14 at 6.2 metres (20.4 feet). Flood stage at Fernbridge is 6.1 metres (20.0 feet).

Possibly the most significant incident resulting from this season's rains in the North Coast was the mudslide occurring in mid-March which dumped an estimated 76,500 cubic metres (100,000 cubic yards) of rain-saturated earth and boulders down on U. S. 101 six kilometres (four miles) north of Leggett. The slide buried a 550-metre (600-yard) stretch of highway and temporarily dammed the Eel River's south fork.

The road remained closed for weeks, and the four-hour-long detour route around the slide was considerably inconvenient for local business interests and residents.

### North Bay Area

In the early hours of January 14, a stage of 11.4 metres (37.4 feet) occurred at Guerneville on the Russian River. The flood stage at Guerneville Bridge is 9.8 metres (32 feet). Flooding occurred on both sides of the stream from Healdsburg to the mouth of the river at Jenner. Dozens of stranded residents were evacuated by canoes and boats, and many vacation cabins, characteristic of the area, suffered flood damage. Highway 116 was closed for a brief period but no serious damage was reported; this community floods frequently, and residents have learned to deal with the high waters.

During mid-February the river again rose to above flood stage but no serious damage was reported. The Napa river at Napa fluctuated near the warning level at various times, but no damage was reported.

### South Bay Area

Heavy rains in the Salinas River basin caused a sharp rise on the Salinas River at Bradley in the Monterey Bay area. The rise exceeded the flood stage of 3.4 metres (11.0 feet) between February 17-22. On February 19, the river peaked 0.8 metres (2.5 feet) above flood stage. Fortunately, high river stages in the valley are not particularly destructive at that time of the year.

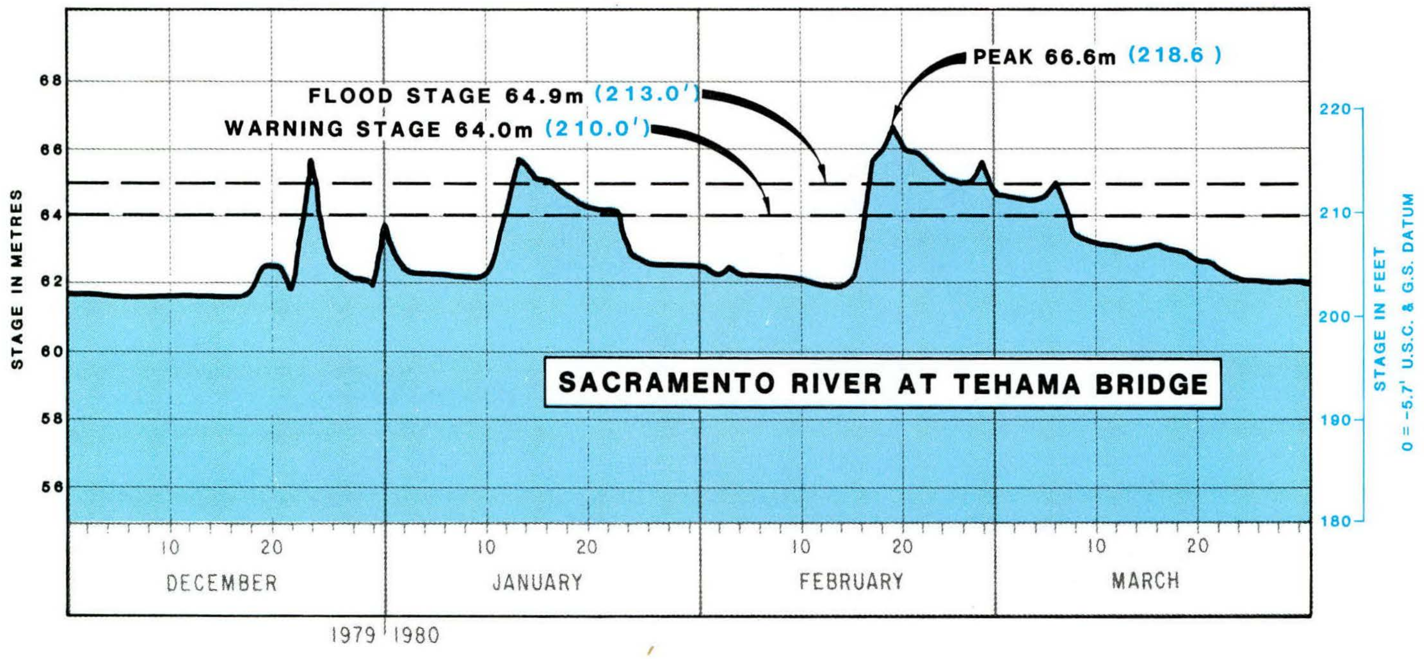
## Sacramento River System

The highest streamflows in nearly a decade occurred on the Sacramento River system during mid-January and the last week of February 1980 (see Figure 4).

The warm storms that brought rain to elevations as high as 2 750 metres (9,000 feet) in the Central Sierra instigated high volumes of runoff and prompted unscheduled releases from major flood storage reservoirs. Releases as high as 1 400 $m^3$/sec (50,000 cfs) at Shasta Dam through Keswick; 2 400 $m^3$/sec (85,000 cfs) at the Oroville complex; and 2 100 $m^3$/sec (75,000 cfs) at Folsom Dam through Nimbus activated the Sacramento-San Joaquin Flood Control Project, resulting in overflow at all fixed weirs into the Sutter and Yolo Bypasses. In mid-January, 26 of the 48 gates of the Sacramento weir were opened, releasing 710 $m^3$/sec (25,000 cfs) into the Sacramento Bypass, thus reducing the threat of danger to levees in the vicinity of Sacramento. Subsequent storms in February reactivated the weir system, and inundation of the three flood project by-passes was repeated. Overflow of the Tisdale Weir into the Sutter Bypass continued through March 19. Prolonged flooding occurred in areas near Tehama Bridge and Vina Woodson Bridge on unleveed portions of the Sacramento River. Damage was primarily limited to trailer and recreational parks at low lying areas and within the flood plain. Similar conditions occurred on the lower reaches of Feather and Yuba River areas and within the confines of levees on the American River.

Stages at Clear Lake in Lake County reached the flood stage of 2.3 metres (7.6 feet) on February 17, and on February 24, a stage of 3 metres (9.7 feet) was recorded. The high stages, coupled with strong winds, battered lake shore resort facilities, including some older residences, and eroded public and private thoroughfares.

**Figure 4. HYDROGRAPH OF THE SACRAMENTO RIVER**



The Sacramento-San Joaquin River Delta was particularly hard hit by the warm and intense series of mid-January storms, which brought rain to the 2 100 to 2 700 metre (7,000-9,000 feet) elevations of the Central Sierra and melted much of the snow deposited in late December. The resulting runoff quickly encroached flood reservation space and prompted major releases from central valley flood control reservoirs. These releases, combined with heavy local runoff, resulted in some of the highest river stages in nearly a decade.

The impact of the high streamflows began to hit the Sacramento-San Joaquin Delta about January 13. It was not surprising that at about this same time, the Flood Operations Center began receiving telephone calls from worried Reclamation District officials in the Delta, expressing concern about the safety of their levees. Seventy-five percent of the Delta levees are not part of the Sacramento-San Joaquin Flood Control Project and are not maintained to State standards. Consequently, their stability is questionable. Some of the levees, originally constructed to protect reclaimed agricultural land from ocean tides and high river stages, are more than 100 years old.

## History of Delta Problems

Many of these nonproject levees, comprised mostly of "peat" soil with unstable foundations and substandard dimensions, have had a history of failures. Between 1930 and 1979, there have been thirty-four incidents of flooding in the islands due to excessive seepage or levee breaks. Prior to this winter, the most recent occurrence was on June 21, 1972, when a levee on the right bank of the San Joaquin River breached, flooding nearly 6 000 hectares (15,000 acres) of the Andrus and Brannan Islands. Reclaiming flooded islands is a time-consuming and costly operation. In some instances, when cost-benefit ratios are weighed, these islands are abandoned, at least for agricultural purposes. Big Break, Lower Sherman Island, and Franks Tract are examples where costs of closing the breach and dewatering outweighed foreseen benefits.

The Delta islands are primarily an agricultural area comprising nearly 300 000 hectares (750,000 acres) divided into more than 60 islands and tracts. About 1 800 kilometres (1,100 miles) of levees enclose the islands. The rich soils produce crops of sugar beets, asparagus, potatoes, alfalfa, corn and other crops valued in access of $375 million annually. The peat soil of the islands, while highly productive, is susceptible to oxidation and shrinkage and has contributed to the gradual subsidence of the islands. The current subsidence rate, about 7 centimetres (2.8 inches) per year, has reduced the surface elevation to as much as 6 metres (20 feet) below sea level. Additional causes of subsidence are dust storms, water erosion, soil removal, burning, and the withdrawal of gas. It is estimated that the present subsidence rates might be reduced by about 30 percent, but implementation of known decelerating methods would necessarily limit types of crops and acres farmed. Economic income from the land would be substantially reduced.

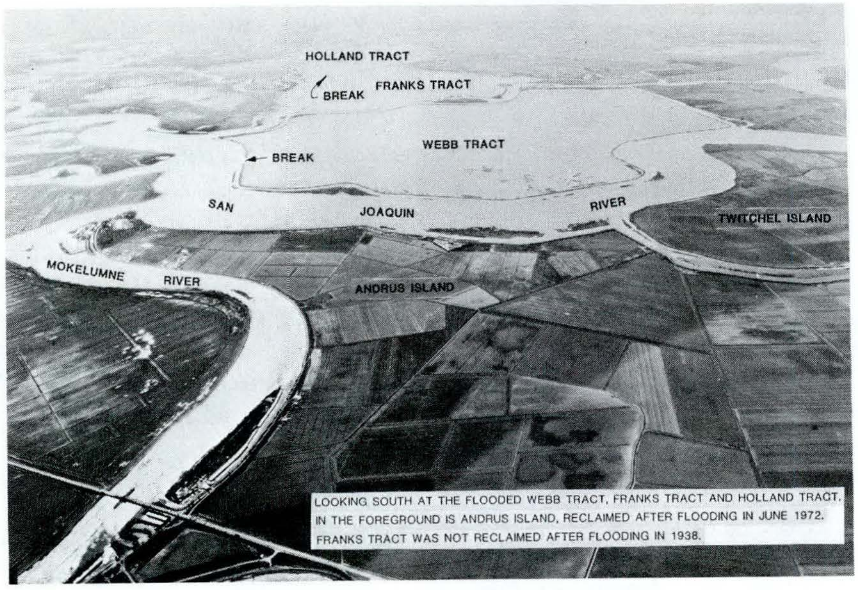
In addition to agriculture, a fast growing industry of the Delta is water-oriented recreation. Some of the finest fishing in the State can be found in the Delta. Many vacationers find the 1 100 kilometres (700 miles) of waterway that meander through sometimes remote and jungle-like surroundings, aesthetically pleasing. The increasing popularity of this vast, but fragile, recreation area, however, is contributing to the deterioration and eventual demise of this unique area as we know it today. Man-caused wild fires, which destroy wildlife habitat and protective vegetation on levees, are difficult to control and actually burn the peat soil. Vehicular travel on unpaved levee roads during dry periods agitates the dirt surface, which is blown away by the wind in the form of dust, gradually lowering the elevation of levee crowns. Incessant wind wave-wash action on levees, further agitated by the wake of industrial craft as well as fast moving pleasure boats, adds significantly to levee erosion problems. During the recent high flows of mid-January and February, the U. S. Corps of Engineers imposed stringent controls on the use of Delta waterways by deep-draft, as well as shallow-draft, vessels.

The Delta Flooding

As the inflow from January storms increased in the Delta, levee deterioration accelerated and tensions mounted. To add to the woes of harried flood fighters, a forecast of tides ranging from 2.7 to 2.95 metres (9 to 9.7 feet) at Rio Vista, accompanied by gale force winds, was the outlook for the next several days. Reclamation District officials and volunteer workers were working long hours to save the levees. All rock barges and dredges in the area were requisitioned to shore up levees at the numerous heavily eroded and low points of levees at widely scattered sites. Webb Tract, located directly north of the previously inundated and forfeited Franks Tract, appeared to be the chief area of concern.

In response to an influx of telephone inquiries and increasing damage reports, the Flood Center extended its operating hours and expanded its staff to provide a 24-hour communication and flood fight coordination base. During this pre-flood alert period, the Center also dispatched area teams to investigate trouble spots and assigned Department of Water Resources (DWR) vessels, normally used to test water quality in the Delta, to survey levees and report trouble spots. It was from one of these vessels, the Beowulf (Bay-wof) that the inevitable report of a levee failure came.

At approximately 1645 hours on January 18, 1980, the "feared" occurred. The "Beowulf," cruising in the vicinity of Webb Tract, witnessed the breaching of its east levee opposite the confluence of Potato Slough and the San Joaquin River. The initial break was reported to be about 60 metres (200 feet) long, but extended rapidly as the current accelerated through the gap. About an hour later, a break in the north levee of Holland Tract near the junction of the east levee was reported. The flooding



LOOKING SOUTH AT THE FLOODED WEBB TRACT, FRANKS TRACT AND HOLLAND TRACT. IN THE FOREGROUND IS ANDRUS ISLAND, RECLAIMED AFTER FLOODING IN JUNE 1972. FRANKS TRACT WAS NOT RECLAIMED AFTER FLOODING IN 1938.

of Webb Tract was destructive in that approximately 2 100 hectares (5,200 acres) were inundated, but not comparable to the immediate trauma experienced at the 1 700 hectare (4,100 acre) Holland Tract. One hunter was reported missing by a companion and presumed drowned when swept away by the rushing waters. Numerous structures, including resort facilities and dwellings, were lost or damaged and approximately 1,500 head of cattle were trapped by rising waters. Less than one-third of the animals were rescued or escaped.

Shortly after this event a "flood alert" condition was declared, and authorization was given to the State to release manpower and materials to assist Reclamation District officials in the flood fight. The Flood Operations Center responded by implementing an agreement with the California Department of Forestry (CDF) and the California Conservation Corps (CCC) to provide trained flood fighters during emergency conditions. In addition, the center dispatched experienced personnel from the Sacramento Maintenance Yard and Central District to supervise crews and provide technical "know how." The U. S. Corps of Engineers and the Office of Emergency Services (OES) participated by arranging for equipment and materials to reinforce battered levees and prevent further widening of the breeches in the levees. The OES also coordinated the cattle rescue and carcass-removal efforts at Holland Tract.

The problems in the Delta were now magnified. The filling of the tracts exposed the unprotected land side of the levees to the same wave-action battering that was continuing on the waterward side. The high tide regime continued; winds to 100 kilometres per hour (60 mph) were prevalent and inflow from the major rivers was close to 8,500 cubic metres per second (300,000 cfs).



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The situation appeared hopeless at times as 1-metre (3-foot) high waves battered the deteriorating levees and tired crews gave their best. The strategy was to deter further erosion of threatened levees by placing sandbags and canvas at badly eroded portions of the levees until more permanent reinforcements could be made. In the meantime, rock barges and trucks delivered rock to accessible problem areas and sand dredges worked around the clock to raise levee crowns and replace material lost through erosion. Working conditions, particularly for hand crews, were extremely hazardous and limited to daylight hours. The gusty and persistent winds slowed the handling of canvas, and, when the winds were coupled with torrential rain, the capabilities of equipment and work crews were severely limited. In addition, dense fog and washed-out or soggy roads made transporting personnel and materials to trouble spots difficult and, at times, impossible.

The morale of the flood fighters was dealt another blow on January 23 when an earthquake of 5.5 magnitude shook the already battered levees. Department engineers feared that the quake and aftershock might trigger a series of levee breaks. However, a thorough inspection of the area failed to reveal any damage directly related to the earthquake.

About 200 State-sponsored workers were involved in the flood fight; the crews consisted of men and women, some experienced and some novices. That only one additional island (Little Mandeville) was lost during the January onslaught, when it was feared many more might go under, is a testimony to their efforts.

As the end of January neared, the sun came out, the winds subsided, and the high tides receded to below-warning stages of 2.4 metres (8 feet) at Rio Vista. River inflows continued to be high, but since the extended weather and tide forecasts were favorable, the weary flood fighters were released by January 29. However, levee-reinforcement work, performed by rock barges and dredges continued.

The cost to the State to conduct the levee protection fight during late January amounted to about $375,000. Most of this money went to pay overtime salaries for workers and for the cost of expended materials (canvas, wire, lumber and sacks).

The next ten days were relatively uneventful. The break in the weather pattern was a short, but welcome, reprieve.

At the end of the first week of February, strong north winds up to 100 kilometres (60 miles) per hour began creating high waves in the flooded Webb and Holland Tracts, and the levees were once again in jeopardy. Following a recommendation from area teams on the morning of February 7, CDF and CCC crews with DWR supervisors were rushed to the Holland Tract to canvas and sandbag the battered levees. The fight continued well into the night and was resumed the next day. Early in the afternoon of February 8 the winds subsided, and shortly afterwards temporary emergency repairs were discontinued.

The second series of destructive storms beginning on February 13 was from a more northerly quarter, and the force of the impact spanned the length and breadth of the State. The impact of the February 13-22 storm in the Delta was a repeat of conditions surrounding the events of the January storm. High winds, high tides, and high river inflows forced the return of the emergency levee repair crews on February 16, where they remained through February 18. The canvas and sandbags placed by these crews were quickly ripped away by the wind and waves; therefore, on February 19, the U. S. Corps of Engineers began speeding up the rock revetment work. By this time, the levees had deteriorated to the extent that rocking the interior levee slopes seemed the only way to save the levees.

The Delta flood fight was not limited to protecting levees of the inundated Webb and Holland Tracts. Levees of numerous islands and tracts in the central Delta were subjected to the same battering from the storms as were the two stricken tracts and required constant surveillance. At times, an all-out effort was necessary to shore up critically eroded levee sections and prevent flooding of additional agricultural acreage. The efforts were generally successful except for the failure of two additional levees located outside the area of concentration. About mid-day on February 21, levees of the 80-hectare (200-acre) Dead Horse Island and the 450-hectare (1,100-acre) Prospect Island failed. The two islands are located approximately 16-25 kilometres (10-12 miles) north of Webb Tract.

Further cause for concern in the Delta occurred when the National Weather Service forecast tide levels of 3 metres (9.9 feet) at Rio Vista, slightly above the record of 2.99 metres (9.8 feet) established December 26, 1955. The Department advised local Delta flood control agencies whose areas lie below sea level to review the dependability of their levee systems, and to determine if they should arrange the evacuation of people, livestock, and equipment from threatened areas during the Friday-Monday critical period. Fortunately, a sudden meteorological change resulted in a weakening of weather fronts and tide influence that may have averted disaster in the Delta. This timely event signaled the end of critical conditions in the Delta for the spring of 1980.

Restoration work in the Delta, including closing the breaks, dewatering the flooded tracts, and restoring damaged levees on about 25 tracts, will exceed $15 million. The Department's participation in the combined January and February flood fight amounted to about $560,000. The Office of Emergency Services expects to expend about $8.5 million and the Federal Emergency Management Agency about $6.6 million.

NOTE: At approximately 5:30 p.m., September 26, 1980, a levee failure occurred at Old River on the northwest portion of the 2 100-hectare (5,200-acre) Lower Jones Tract, which lies 16 kilometres (10 miles) west of Stockton. This event and subsequent ramifications will be reported in a subsequent memorandum.

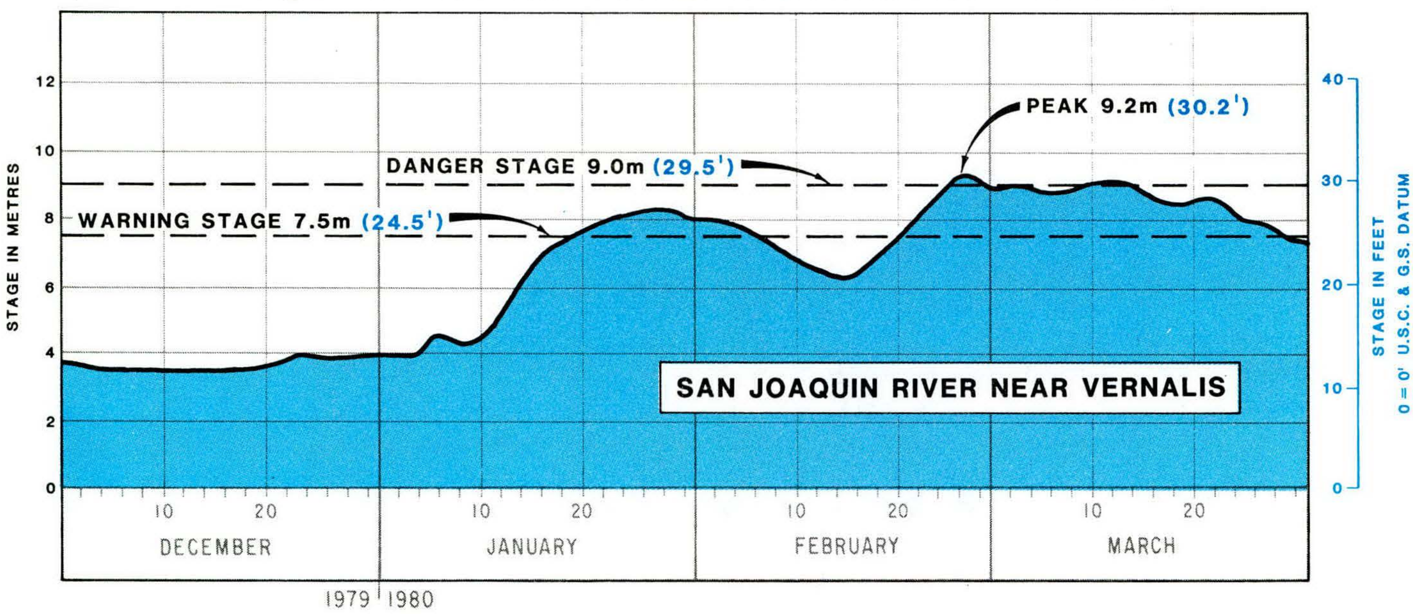
San Joaquin Valley

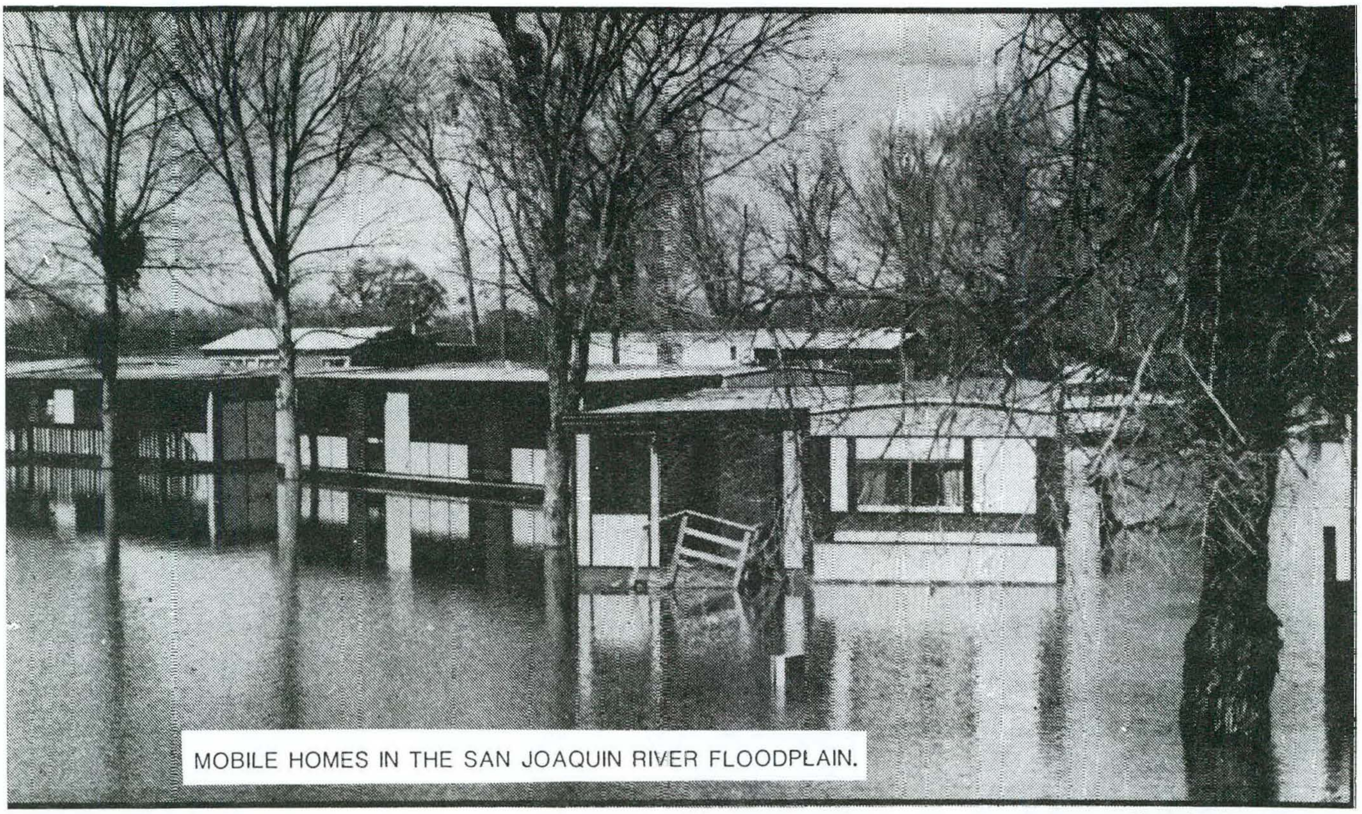
The Federal-State River Forecast Center began issuing flood and warning-stage forecasts for streams in the San Joaquin River System on January 13. By January 15, a warning stage of 7.5 metres (24.5 feet) was reached at Vernalis on the San Joaquin River, and the waters remained above that level through February 6 (see Figure 5).

During this period, flows on the Stanislaus River below New Melones Reservoir generated considerable controversy, when 142 $m^3$/sec (5,000 cfs) releases from the reservoir flooded most of the industrial waste ponds in Ripon and more than 600 hectares (1,500 acres) of farmland. The Corps of Engineers had known since 1962 that federal law (PL 87-874) requires a flood channel downstream from the New Melones Dam with a capacity of 226 $m^3$. The Corps had also been aware that under normal flood operations such flows would be required at times. In the years between 1962 and 1979, some progress was made in channel maintenance and purchase of easements, but final acquisition of easements needed for the 226 $m^3$ floodway was not completed until mid 1981.

On February 21, the San Joaquin River again rose above warning levels at most stations and was followed quickly by significant rises on the Tuolumne River and the Mokelumne River. Warning stages were exceeded on the San Joaquin River at Vernalis through March 28. During this period, the flood reservations at all the flood control reservoirs in the Central Valley became encroached, except New Melones Reservoir.

Figure 5. HYDROGRAPH OF THE SAN JOAQUIN RIVER





MOBILE HOMES IN THE SAN JOAQUIN RIVER FLOODPLAIN.

Photo by Marilyn Odello

At noon on March 10, with a river stage of 9 m (29.7 ft.) at Vernalis, an alert levee patrolman detected river water surging through an animal burrow in the east levee of the San Joaquin River upstream from the Durham Ferry Road. As the patrolman radioed the warning to his District office, the hole enlarged, washing a deep gully in the adjacent vineyard. Fortunately, the levee eventually caved in on top of the hole, temporarily sealing off the break. Trucks carrying rock, sand, and earth rushed to the site and quickly restored the damaged levee. Thousands of acres of agricultural land were saved from flooding by this quick action.

Many farmers and mobile home park residents were affected by high San Joaquin River flows in the vicinity of the City of Stockton and southward. The Designated Floodway between the San Joaquin River levees is heavily farmed and is also a popular area for mobile home parks. The high waters destroyed or harmed most of these crops, and while most mobile home residents heeded river stage warnings and evacuated in time, a few waited too long and their homes were flooded. Since the flooding, several mobile home park managers in the Designated Floodway have developed more realistic evacuation plans keyed to upstream river stages.

## Tulare Lake Basin

Runoff resulting from much above-normal precipitation in the Tulare Lake Basin was heavy following the January and February storms, but the impact was limited to road washouts and minor structural damage.

The flood-control reservation space of Pine Flat, Success, and Isabella Reservoirs, became encroached in February and remained in this state for several months. Fortunately, cool weather during late spring prevented a fast snowmelt runoff, which could have forced flood-producing releases from the brimfull reservoirs. During the January downpour, several residents of the foothill community of Three Rivers evacuated their homes as the Kaweah River overflowed its banks. No significant damage was reported because many citizens used sandbags to protect their homes from the invading waters.

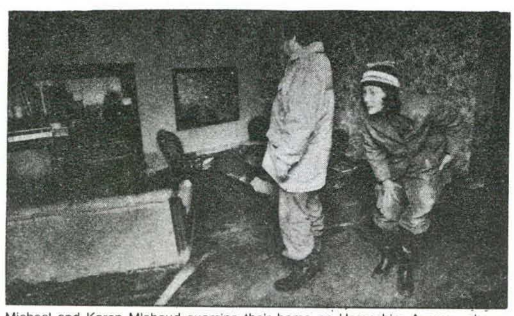
Another factor that reduced the impact of flooding of some prime agricultural land was use of the Kern River - California Aqueduct Intertie. For the second time since its construction, the Intertie was used to divert excess water away from Tulare Lake and into the aqueduct for delivery to Southern California. The Intertie was used from March 7 until June 9 and again between July 1 and July 17, 1980 -- a total of 112 days -- and diverted 171,000 $DAM^3$ (138,800 acre-feet) of water. Much of this water was delivered to the Mojave Desert for storage in ground water basins and will be available during times of scarcity.

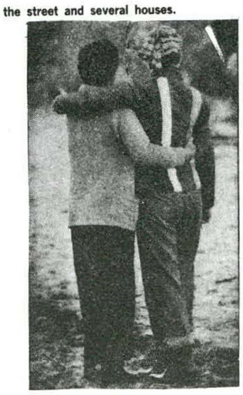
Staff photo by Tom Kasser

This is Hampshire Avenue as seen from a helicopter

Staff photo by Bob Ringquist

A San Bernardino police officer walks toward a house on Hampshire Road, where mud filled the street and several houses.





Michael and Karen Michaud examine their home on Hampshire Avenue, above. Right, two area residents console each other.

**HARRISON CANYON**

## Southern California

Generally, the area south of the Tehachapi Mountains is the driest part of the State, but by March 1980 some Southern California precipitation stations were recording rainfall totals more than 200 percent of normal for that time of year.

Steep hillsides, stripped of vegetation by summer wildfires, offered little resistance to erosion, and the resulting torrents of mud and debris jeopardized everything in their path as they swept down the canyons. Reservoirs and debris dams, which were not designed to handle rainfall in such proportions, soon were brimfull and spilling dangerous flows into downstream communities. Property damage soared and nearly a score of lives were lost as hapless victims were swept away by raging currents or buried under tons of oozing mud. Six Southern California counties were declared federal disaster areas, and one other was proclaimed a state of emergency by the Governor's Office.

A summary of flood events in these seven counties follows:

### Los Angeles County

The most severe flood-related damage in Los Angeles County from the January - February storms was caused by landslides and mudflows. The foundation bases of many hillside homes became supersaturated by the persistent rains and could not support the structures. Numerous homes and roads abutting steep hillsides were damaged when slopes above eroded and shifted.

Erosion and mud damage of note occurred in Mandeville Canyon, Monterey Park, Laurel Canyon, and Altadena. In Mandeville Canyon, 200 persons were evacuated when mudflows ripped through the canyon, destroying one home and damaging 20 others. One life was lost. In Laurel Canyon more than 30 homes were evacuated, two homes were completely destroyed, and several were damaged by mud flows. In Monterey Park, 4 homes collapsed and 2 homes were pushed from their foundations by mud and debris. Mud oozed into 20 residences at Altadena when the Gooseberry Inlet to the Rubio Diversion Channel became clogged and overflowed. Water backup due to clogged drains also caused some localized flooding at Trousdale Estates, Kagel Canyon, Beverly Hills, and West Hollywood.

Numerous roads throughout the County were closed when sections were washed out or blocked by mud and debris. The Pacific Coast Highway, located at the base of steep, unstable cliffs, is highly vulnerable to slides, particularly between Point Dume and the Santa Monica Freeway. This section of the road was closed for an extended period, resulting in mammoth traffic jams. Other major roads closed because of slides and erosion were in Topanga and Malibu Canyons. Several motorists lost their lives, and numerous others were rescued while attempting to cross submerged sections of the roads. In the Malibu area, sea walls were battered and eroded away by a combination of a high surf and debris, which was washed into the area by flooding streams. The tempest was further aggravated as the sun and moon were aligned at the time of the moon's closest approach to earth, and the combined gravitational fields created higher than normal tides during intense periods of the storm.

The Los Angeles County drainage area is an example of an urban area that suffered heavily during the January and February storms even though it had an extensive flood control program. A brochure entitled "Reducing Flood Damage", dated September 1980, was produced by the Department of Water Resources. It offers ways to mitigate future storm damage in the Los Angeles County drainage area.

## Orange County

During a nine-day period beginning February 13, six major storms passed through Southern California, dropping more than 230 millimetres (9 inches) of rain on Orange County. The resulting high runoff caused at least 13 road closures, along with local flooding and mudslides throughout the County.

In San Clemente, 50 residents were forced to evacuate their homes. Also, an earthslide into the water supply reservoir north of San Clemente raised the turbidity of the city's water for several days, during which imported drinking water was made available.

When flood flows in Trabuco Creek washed out Live Oaks Canyon Road, the residents of Cota de Caza, a small resort community of about 300 people, were stranded. Road access to Cota de Caza was cut off for over a week until a prefabricated Bailey bridge could be erected over the flood-swollen creek. During the isolation period, private and National Guard helicopters air lifted food and supplies to the community. Residents wishing to leave Cota de Caza before the bridge was erected were forced to rely on chartered helicopters.

## Riverside County

Flood damage in Riverside County was primarily attributable to torrential and persistent rainfall in the San Jacinto Mountains. Waters flowing down the easterly side of the mountains severed roads, flooded a portion of Palm Springs, and then continued down the Whitewater River to feed the fast rising Salton Sea. Residents of beach front homes and resort owners on this vast inland sea frantically constructed dikes and barricaded structures to combat the rising water. On the west side of the mountain, runoff into the San Jacinto River flooded the City of San Jacinto and was a major contribution to the record-breaking and destructive surface rise of Lake Elsinore.

A summary of these flood events follows.

### Palm Springs

City Police of Palm Springs began an emergency evacuation of residents at about 2 a.m. on February 16. The evacuation project, carried out under adverse conditions, eventually included 1,300 people. Swiftly flowing flood waters from Palm Canyon Wash and Tahquity Wash washed out portions of virtually every road in their path to the resort community.

Shortly before 6 a.m., the Palm Canyon Wash levee collapsed and water rushed into the low-lying Smoke Tree and Araby Drive areas, which are dotted with older, single-family homes and condominiums. No casualties were reported, although the breach remained open for 3 hours as County flood-control workers struggled to plug the break.

State Highway 111 was virtually the only access road to the area following the torrential runoff; then this road also had to be closed, when erosion weakened the four-lane Araby bridge. Two of the lanes, however, were opened to traffic following emergency repairs.

Flood waters receded quickly the following day and many evacuees managed to return to their homes. Residents of Andres Hills and Los Pueblos Condominiums, however, remained evacuated because of the impassible condition of the access roads. National Guardsmen were dispatched to the isolated areas to prevent looting and to keep sightseers from interfering with cleanup operations.

Early estimates of damages to roads and bridges, where the greatest losses occurred, were about $3.3 million.

San Jacinto

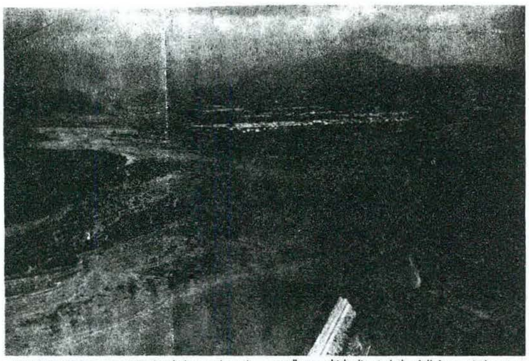
At approximately 7 a.m., February 21, a section of levee on the San Jacinto River failed, and muddy water as deep as 1.2 metres (4-feet) flooded the town of San Jacinto. Police with loudspeakers sounded the alarm, and local emergency agencies and volunteers searched for stranded residents and pets. Helicopters hovered above the inundated areas and rescued people from rooftops National Guard personnel assisted in the rescue work and took steps to prevent looting.

Most of the town's 6,500 residents were successfully evacuated -- some by boat or helicopter. Many of the evacuees were elderly and disabled and escaped with little more than the clothes they were wearing. A Red Cross shelter was set up at Hemet Fair-grounds, and about 3,000 displaced people were taken there. Some evacuees went to homes of friends and relatives. Others went to Hemet area churches, the recreational hall at Seven Hills, or to the 50 private homes offered for shelter.

About half of the city's water mains were put out of service, and most other utility services were suspended or in partial operation. Residents were warned to boil all drinking water.

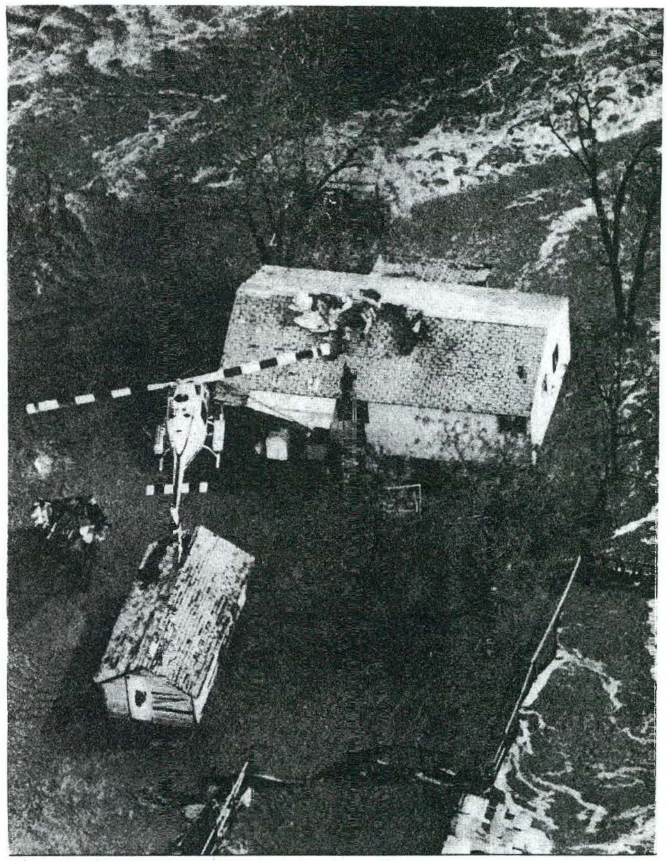
As early as the following day, most residents were permitted to return to their homes, but water remained 1-meter (3-feet) deep in some neighborhoods. Utility services were slowly restored and a diversionary dike, constructed by the Army Corps of Engineers to divert the flood waters back to the river, was nearly completed. Although the crisis was over for San Jacinto, the flood waters continued downstream to create flooding problems at Lake Elsinore.

# Over 6,000 flee Riverside County homes



BREAKING POINT — An 1,800-foot hole tore through the San Jacinto River levee at the east end of Commonwealth avenue near Mountain avenue. Riverside Flood Control District blamed the failure on shifting sandbars, which directed the full force of the river straight into the levee. Crews are now attempting to build a rock dike around the break.

(Hemet News photo)



Staff photo by Fred Bauman

A helicopter descends yesterday to rescue people from the roof of a house surrounded by floodwaters in San Jacinto.

Staff Photo by Jim Edwards

Staff photo by Fred Bauman

The city of San Jacinto was flooded yesterday when a levee on the San Jacinto River broke. Thousands of residents fled their homes.

After helping save a teenage girl from being swept away by fast moving floodwaters, A1C Mark Strong (carrying girl) and A1C Dave Gorman attempt to get the victim to safety. They were among many March people who helped residents of San Jacinto during last week's flooding. (U.S. Air Force photo by SSgt. T. C. Perkins)

## Lake Elsinore

Near the end of February, following a series of torrential storms, officials of the City of Lake Elsinore realized that the lakefront community was in serious trouble. Lake Elsinore, which had risen and fallen many times in past years without any serious problems, was filling at a rate of 25 mm (one inch) per hour. Engineers were predicting the lake would crest at an elevation of 386 metres (1,265 feet) above sea level -- 1½ metres (5 feet) above flood stage.

By February 22, 30 homes were flooded as heavy inflow from the San Jacinto River, as well as runoff from the Elsinore Mountains, raised the lake surface to flood stage, or about 384 metres (1,260 feet). Despite the urgings of city officials and the Army Corps of Engineers, residents of the area surrounding the fast rising lake were reluctant to evacuate their homes.

Lake Elsinore had not reached flood stage (384 metres) since 1916 and the channel, which once drained the lake down Alberhill Creek into Temescal Wash, was blocked with sand and debris. The culverts through the roads crossing the drain were inadequate to carry large volumes of water from the lake. In desperation, the Army Corps of Engineers, using backhoes and mud dozers, reopened the drainage channel for a length of 3.2 kilometres (2 miles) and lowered the channel bottom to elevation 384 metres (1,260 feet). Reopening the channel provided some relief, but the low 5.7 $m^3$/sec (200 cfs) capacity of the new channel could not keep pace with the inflow from the San Jacinto River, which had been measured at over 145 $m^3$/sec (5,000 cfs) at its peak.

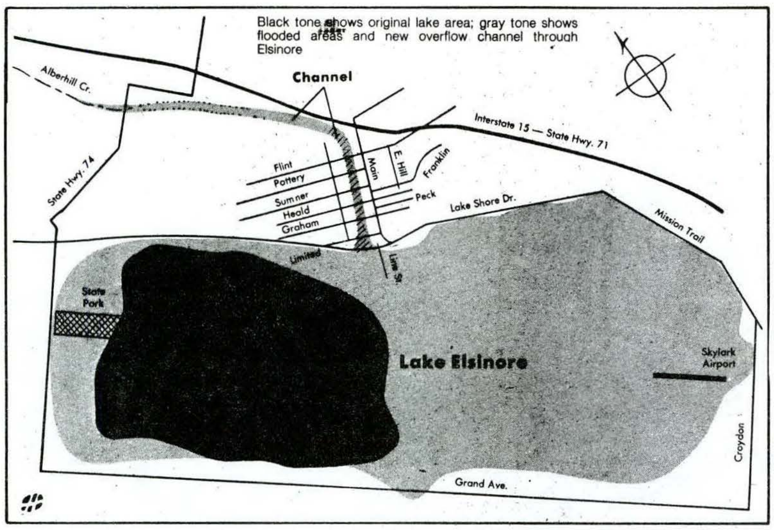
The new channel completely cut the town of Lake Elsinore in half until the Department of Transportation hurriedly constructed a temporary bridge across the channel. During excavation of the channel, a 25.4 cm (10 inch) waterpipe from the City's storage reservoir was severed and water service was interrupted to about 200 homes.

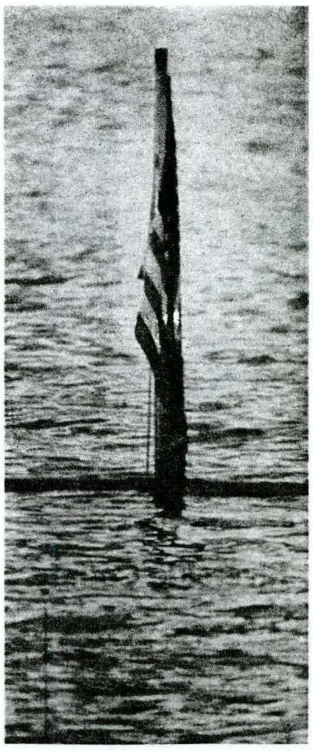
In an effort to combat the rising waters and save another 200 homes from flooding, the Army Corps of Engineers constructed dikes at four locations on the perimeter of the lake. The Department of Water Resources Flood Operations Center dispatched Sacramento Maintenance Yard personnel to the area to supervise California Conservation Corps (CCC) emergency flood crews. The crews placed sheets of heavy plastic, held in place by sandbags, along the waterward side of the dikes to prevent wave wash erosion to the newly placed earth. Residents and CCC workers also stacked sandbags to protect homes at the lake's edge from wave damage. More than 400,000 sacks and at least 50 rolls of plastic sheeting were used in the flood fight.

Leakage from flooded septic tanks soon began polluting the lake waters, creating a health hazard. Also, many septic systems outside the flooded area began to malfunction as ground water levels rose, saturating their leaching systems. For awhile it was feared this development would require an additional 500 evacuations. Residents using private wells were advised to drink bottled water until their wells could be tested by the County Health Department.

On March 21, after 80 days of heavy inflow, the lake crested at a record 305.79 metres (1,265.72 feet). Approximately 2,000 lakefront residents were displaced, and 250 permanent homes were damaged by the rising water. In addition, about 500 mobile homes had to be moved to high ground. Some mobile units were not moved in time and consequently were either damaged or destroyed. Total damage to private property was an estimated $25 million and public losses were about $8.7 million.

The flood waters eventually receded to near the elevation of the discharge channel bottom but this was still a dangerously high level. Large inflows could quickly repeat the flooding disaster. To provide some margin of safety, an emergency pumping station was set up at the channel inlet to lower the lake an additional 1.5 metres (5 feet). In addition, the U. S. Army Corps of Engineers, in cooperation with the State Department of Parks and Recreation, and the Elsinore Valley Water District, began development of a short- and long-term flood control and water use program for the Lake Elsinore area.





An American flag flew from a submerged flagpole at Lake Elsinore — the 30-foot flagpole was all but swallowed by the rising lake.


Only the roof of this Lake Elsinore home could be seen above the water.

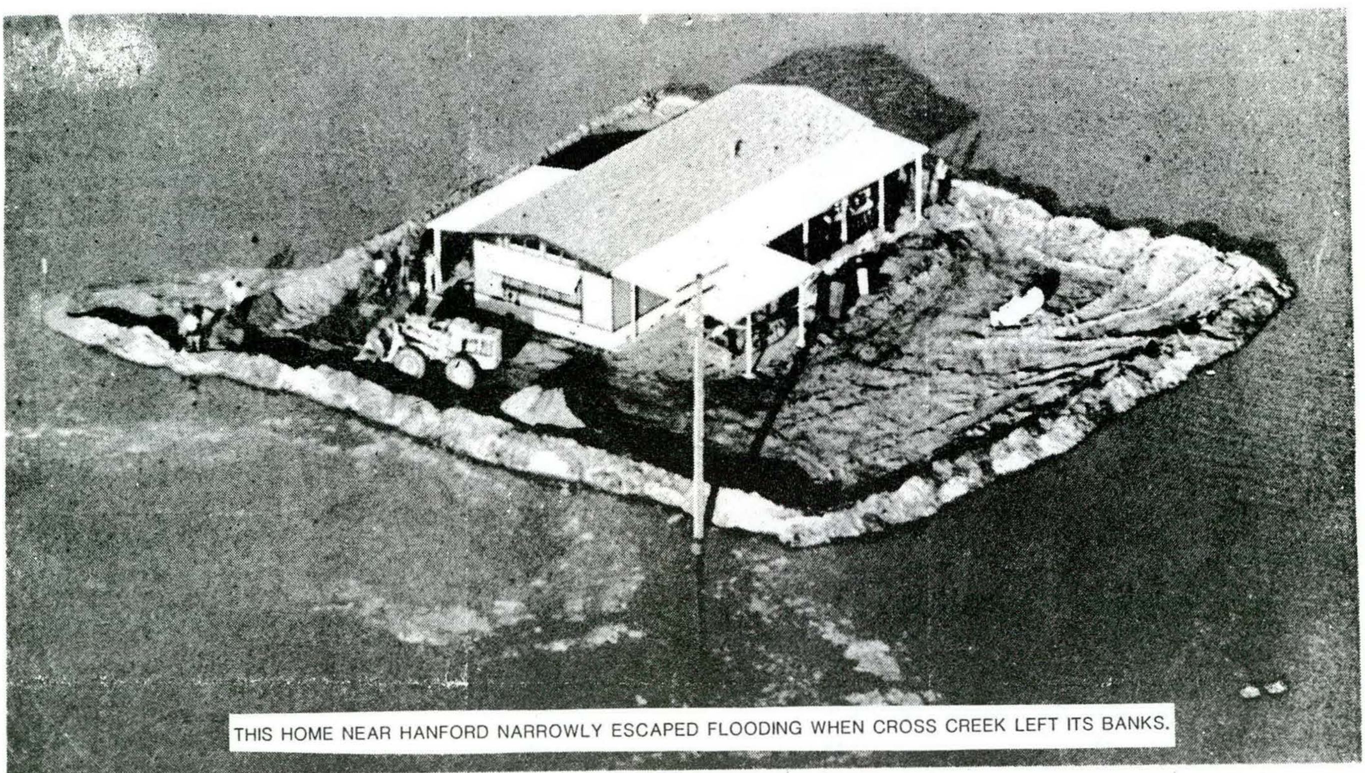
**LAKE ELSINORE**

## San Bernardino County

In terms of human despair and frustration, few areas in the State can equal circumstances paralleling those endured by the residents in the Hampshire Avenue area in San Bernardino.

Just above the Hampshire Avenue area is Harrison Canyon. Last summer, fires in the small, steep canyon burned the vegetation with such intense heat that even the roots of the vegetation were destroyed. Then, on January 9, before the vegetative growth could recover, a rainstorm struck the canyon. Thousands of tons of earth and debris were eroded from the denuded canyon walls, completely filling the small Harrison Canyon debris basin above the Hampshire Avenue area. Again, on January 14, before the debris basin could be cleared, intense rains brought another avalanche of mud and debris, causing the debris basin to overflow. The mud flowed onto Hampshire Avenue and damaged 28 homes. As much as 1.2 metres (4 feet) of mud filled some houses.

The County quickly cleared the debris basin, and volunteers from all conceivable sources rushed to the area and shoveled the mud from the homes and yards. They had nearly finished the task when a new storm on January 28 flushed another 1.2 metres (4 feet) of mud through the neighborhood, again filling the same homes and yards and adding five new homes to the damage list.



THIS HOME NEAR HANFORD NARROWLY ESCAPED FLOODING WHEN CROSS CREEK LEFT ITS BANKS.

Sentinel Photo by Craig Smith

Once again a massive cleanup effort was launched, but on February 16, heavy rains struck the canyon and unleashed a fourth torrent of mud and water into the Hampshire Avenue area. This time, a total of 40 homes were damaged. The damage from the fourth slide was much more severe than on previous occasions, because the mud came with enough force to buckle both interior and exterior walls of the homes, to break windows and to rip doors off their hinges. Residents and volunteers were reluctant to begin cleanup efforts again.

Other communities in the same general area of San Bernardino County also suffered flood damage during January and February. In Fontana, Chino and Cucamonga creeks overflowed, flooding homes and roads. Several bridges were damaged or washed away, resulting in the loss of automobiles and at least one life. Power and phone services were interrupted in many areas. In Alta Loma and Cucamonga, schools were closed on January 29 because flooding in the streets made traveling hazardous.

## San Diego County

At least eight San Diego County residents died as a result of the January and February flooding. The runoff generated by intense storms caused all the County's major reservoirs to overflow, except Lake Henshaw. Sewer lines were ruptured in Oceanside and in Mission Gorge, dumping millions of gallons of raw sewage into rivers and ocean beaches.

A summary of flood events in San Diego County follows:

### San Diego River

During the February storms, the City of Lakeside seemingly was under seige by the San Diego River and its tributaries. On February 18, San Vicente Reservoir spilled, causing the highest flood flows registered in San Vicente Creek since 1943. Combined with flood flows from Slaughterhouse and Wildcat Canyons, the San Vicente Dam spill flooded the Moreno Valley area of Lakeside. Homes, businesses, and roads were engulfed by the flood waters, and many residents had to be transported out of the area by sheriffs' rescue teams in four-wheel drive vehicles.

On February 21, flow in Los Coches Creek, which is normally minor at this time of the year, peaked at levels near the 100-year event. Bridges collapsed, mobile home parks were inundated, and central Lakeside residences and streets were flooded when the creek overflowed its banks before entering the San Diego River at Lakeside.

Two days later, on February 23, El Capitan Reservoir spilled for the first time since 1941. The uncontrolled water eroded fields and ditches and washed out Ashwood Street, the last remaining access to the Moreno Valley area. Moreno Valley residents who were not evacuated earlier were stranded until a temporary bridge could be erected, which required nearly a week.

Fed by the El Capitan and San Vicente Reservoir overflows and the flood flows of Los Coches Creek and other tributaries, the San Diego River unleashed devastation upon everything in its path to the ocean. Roads and bridges in low lying areas were swept away and sewer lines in Mission Gorge were ruptured, contaminating the river and ocean beaches. It took about 2 months to repair the damaged sewer lines.

In San Diego, the high water caused extensive damage to businesses, shopping centers, and golf courses along the river route. Only major crossings in Mission Valley remained open during the flood.

## Bear Valley Hydroelectric Plant

On March 6 an earthen dam located on Bottle Peak, above the canyon site of the antiquated Bear Valley Hydroelectric Plant, failed and dumped 19,000 $m^3$ (5 million gallons) of water on the plant. The avalanche of water carrying trees, mud, and rock completely destroyed the facility, and two employees narrowly escaped death or serious injury when three huge generators were swept away. Canisters of poisonous chlorine gas used for water purification were dislodged, and five persons were treated at Palomar Memorial Hospital after inhaling the toxic gas. Fortunately, no one was seriously injured.

## Cottonwood Creek

The dam at Barrett Lake began spilling on February 15, causing relatively minor flooding along Cottonwood Creek and in the town of Barrett. On February 20, when it seemed certain that Morena Reservoir, which lies above Barrett Lake, would also spill, over 200 residents along Cottonwood Creek were evacuated. As predicted, Morena Reservoir spilled on February 21, and the lowlands along Cottonwood Creek were further inundated. Some damage was sustained by homes, roadways and trailer parks in the flooded area. The flood waters swept across the California-Mexico border and emptied into the Tijuana River, which was already experiencing devastating flood flows resulting from emergency releases from the threatened Rodrigues Dam in Mexico.

## San Dieguito River

The two major dams in the San Dieguito drainage basin, Sutherland and Hodges, overflowed during the February storms, and three smaller dams on Hatfield Creek were damaged. Below the Sutherland Reservoir, cropland in the San Pasquel Valley suffered damage, and below Hodges Dam, bridges at Via Santa Fe and El Camino Real were damaged. At Del Mar, some residents and animals were evacuated when race track and fair ground areas flooded.

## San Luis Rey River

On January 29, Oceanside was declared a disaster area by city officials. Extensive flooding had closed many roads and threatened the $1 million Douglas Drive Bridge which crosses the San Luis Rey River. City workers, with help from about 60 Camp Pendleton marines, worked through the night to fill a 9-metre (30-foot) wide gap between the river bank and bridge abutment. Huge concrete blocks, crumpled car bodies, and rocks were dropped into the gap to deter further erosion.

The Casitas Poquitas Recreational Vehicle Park was almost entirely flooded, and all 140 recreational vehicle spaces were evacuated.

In addition to the flooding, a health hazard was created when a broken sewer line near Pilgrim Creek began dumping 13 300 $m^3$ (3.5 million gallons) of raw sewage per day into the San Luis Rey River. Also, a 30-metre (100-foot) section of a 46-centimetre (18-inch) sewer pipe along Oceanside Boulevard ruptured and spilled raw sewage into Loma Alta Creek at a rate of 1 140 $m^3$ (300,000 gallons) per day.

## Sweetwater River

Both Sweetwater and Loveland Reservoirs overflowed on February 19, causing flooding in National City and Chula Vista. The majority of the flood damage reported was limited to small bridges and park areas.

## Tijuana River

During late January the watershed area behind Rodriguez Dam, which extends 80 kilometres (50 miles) inland, received over 250 millimetres (10 inches) of rain. On January 30, Rodriguez Dam, which was constructed in 1930 with a design capacity of 138,000 $(DAM)^3$ (112,000 AF) rose to 146,000 $(DAM)^3$ (118,000 AF) and began spilling. Mexican officials, fearing the possible collapse of the dam, opened the flood gates to relieve the pressure behind the dam and notified American officials that flood releases were being made. American officials hesitated to respond because of jurisdictional questions. The dam, which is located in Mexico, is not subject to California laws. Thus no evacuation plan had been prepared. (Major California dams require an evacuation plan to protect people living beneath the dams in the event of failure or major releases). Moreover, flood releases that were expected to be 50 $m^3$/sec. (1,800 cfs) eventually reached 790 $m^3$/sec. (28,000 cfs), 15 times greater than planned. The largest flood flows in 50 years in the Tijuana River resulted. At the same time, emergency releases of 57 $m^3$/sec. (2,000 cfs) were being made from Barrett Dam in California on Cottonwood Creek -- a tributary. The Tijuana River claimed the lives of at least eight Mexican citizens in Northern Mexico. On the American side of the border numerous horses and other animals were drowned, and 40 farm families were evacuated from the Tijuana River Valley.

In February, flood flows occurred again, peaking on February 21 at 937 $m^3$/sec. (33,100 cfs) at the Mexican border, crossing into California. Damage estimates in California, for the January and February 1980 flooding, were $300,000 for agricultural improvements, $200,000 for livestock, $300,000 for homes, $1.1 million for roads and bridges, and $2.4 million for farm land erosion, totaling $4.3 million.

THE TIJUANA RIVER WINDS ITS WAY TO THE PACIFIC ALONG A NEW PATH AFTER JANUARY AND FEBRUARY 1980 FLOWS EXCEEDING 850 $m^3$/sec (30,000 cfs) FORCED IT FROM ITS BANKS.

## Santa Barbara County

On February 20, Santa Barbara County officials declared a local emergency as a result of storm damage which began about January 8. On February 21 the Governor's Office proclaimed a state of emergency to exist in the county.

Seasonal total precipitation for Santa Barbara on February 20 had climbed to 504 millimetres (19.87 inches) or 156 percent of normal for that time of year. The precipitation, however, was still far below the 678 millimetres (26.72 inches), or 210 percent of normal recorded by February 20, 1978.

Preliminary estimates of damage from the January - February storm, which was confined mainly to roads and flood control facilities, was $2 million. Damage of note occurred when a section of the 1900 block of Chapala Street in Santa Barbara collapsed after a subterranean culvert blew out, undermining a section of pavement.

A washout also occurred at a bridge construction site on Highway 166, the main east-west artery in northern Santa Barbara County. The bridge is located about 64 kilometres (40 miles) east of Santa Maria, and the road was closed to all traffic for a short period until repairs could be made.

Along the Pacific Coast shore, heavy wave action caused extensive erosion and structural damage in the Santa Barbara Yacht Club area. About 200 people were alerted for evacuation from beach front apartment buildings in Carpenteria due to the extremely high surf.

## Ventura County

On Saturday morning, February 16, the west levee of Calleguas Creek failed at a point about ½ kilometre downstream from the Hueneme Road bridge. Row crops, such as lettuce, spinach, celery, cauliflower, and strawberries in the lower Oxnard Plain were destroyed, and citrus and avocado trees were feared lost because of their susceptibility to root rot.

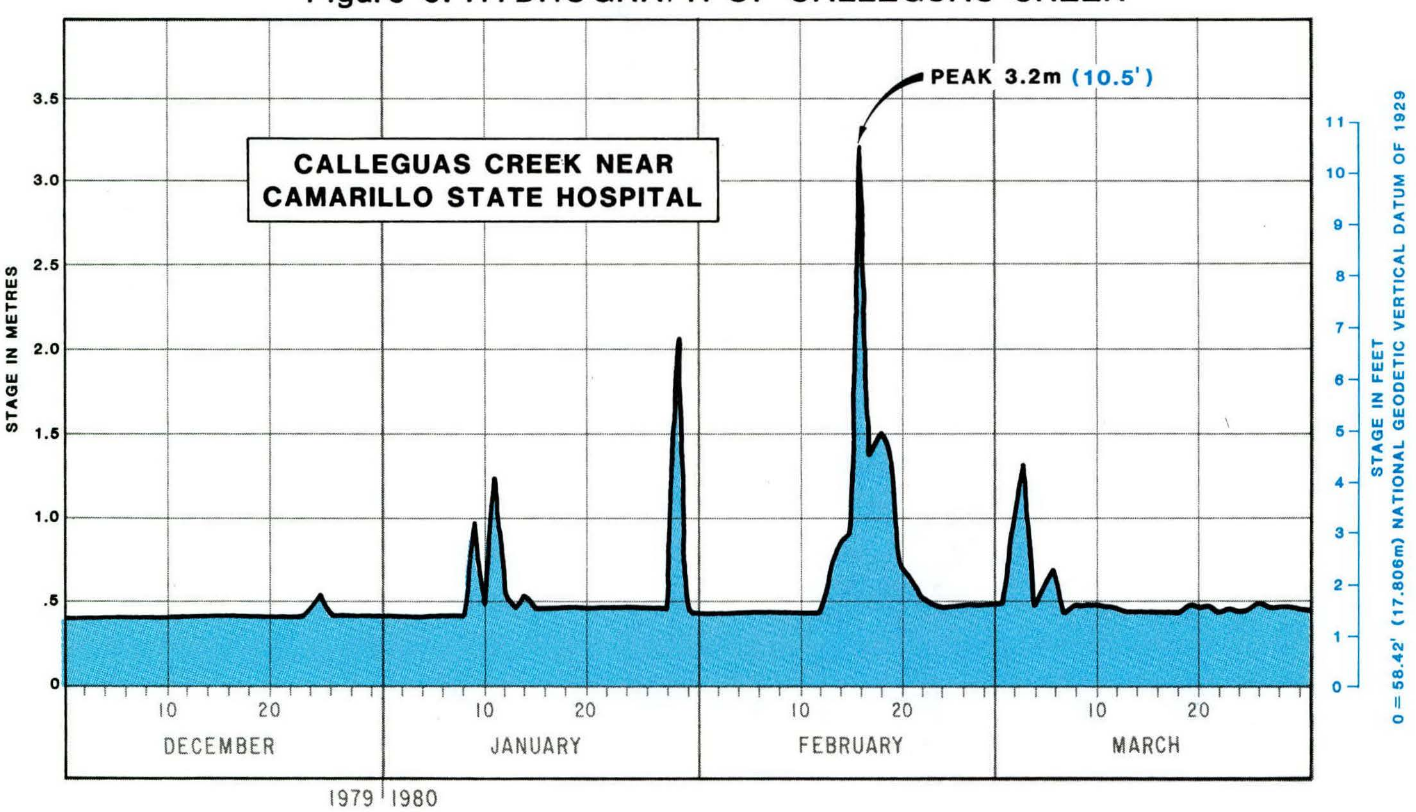
Extensive flooding also occurred in the dependent housing area of the Point Mugu Naval Air Station. The first onslaught occurred Sunday morning as waters rushed across Highway 1 on February 17 and was repeated in the late evening of the same day. Approximately 3,000 persons were evacuated from 568 housing units and 442 homes as flood waters reached depths of 0.7 metres (30 inches). Military trucks equipped with deep-water snorkel devices participated in the evacuation.

Rainfall amounts for the period ranged from 226 mm (9 inches) to 550 mm (22 inches) at various locations in the county. Runoff from the 62 200-hectare (240-sq. mile) drainage basin reached the 50-year frequency event of 710 $m^3$/sec. (25,000 cfs), (see Figure 6). Lake Casitas, the largest reservoir, reached the highest level ever recorded and Piru Dam spilled at the rate of 42.5 $m^3$/sec. (1,500 cfs).

Additional flooding occurred in Santa Paula. Forty homes were damaged by mud and water when local channels overflowed their banks. Sespe Creek flood waters damaged a bridge abutment and railroad tracks near Filmore.

The total damage for the County was estimated at $69 million, with agriculture sustaining the heaviest losses.

Figure 6. HYDROGRAPH OF CALLEGUAS CREEK



## Figure 7. REFERENCE MAP FOR HYDROGRAPHS

Figure 8. HYDROGRAPHS OF THE SMITH AND KLAMATH RIVERS

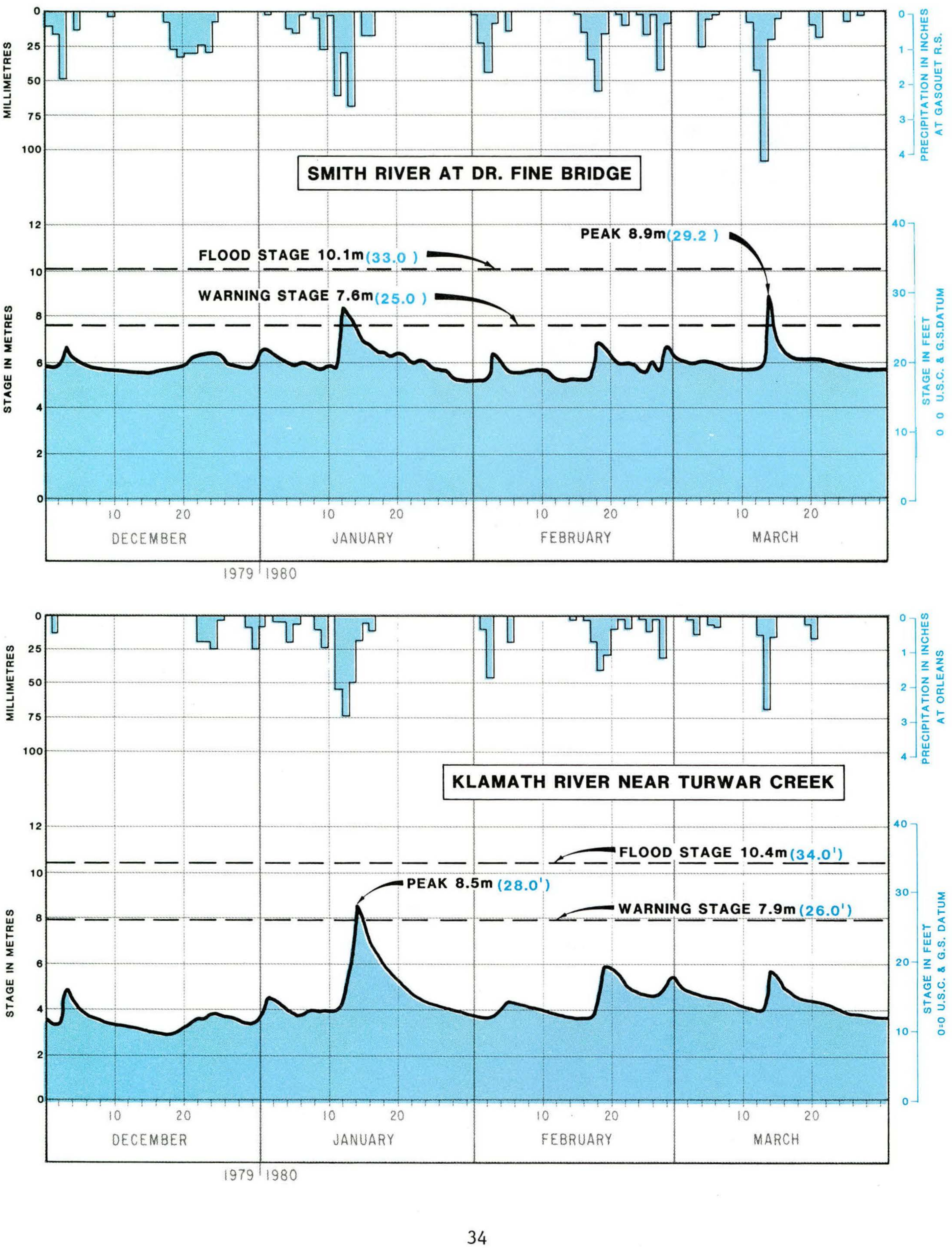
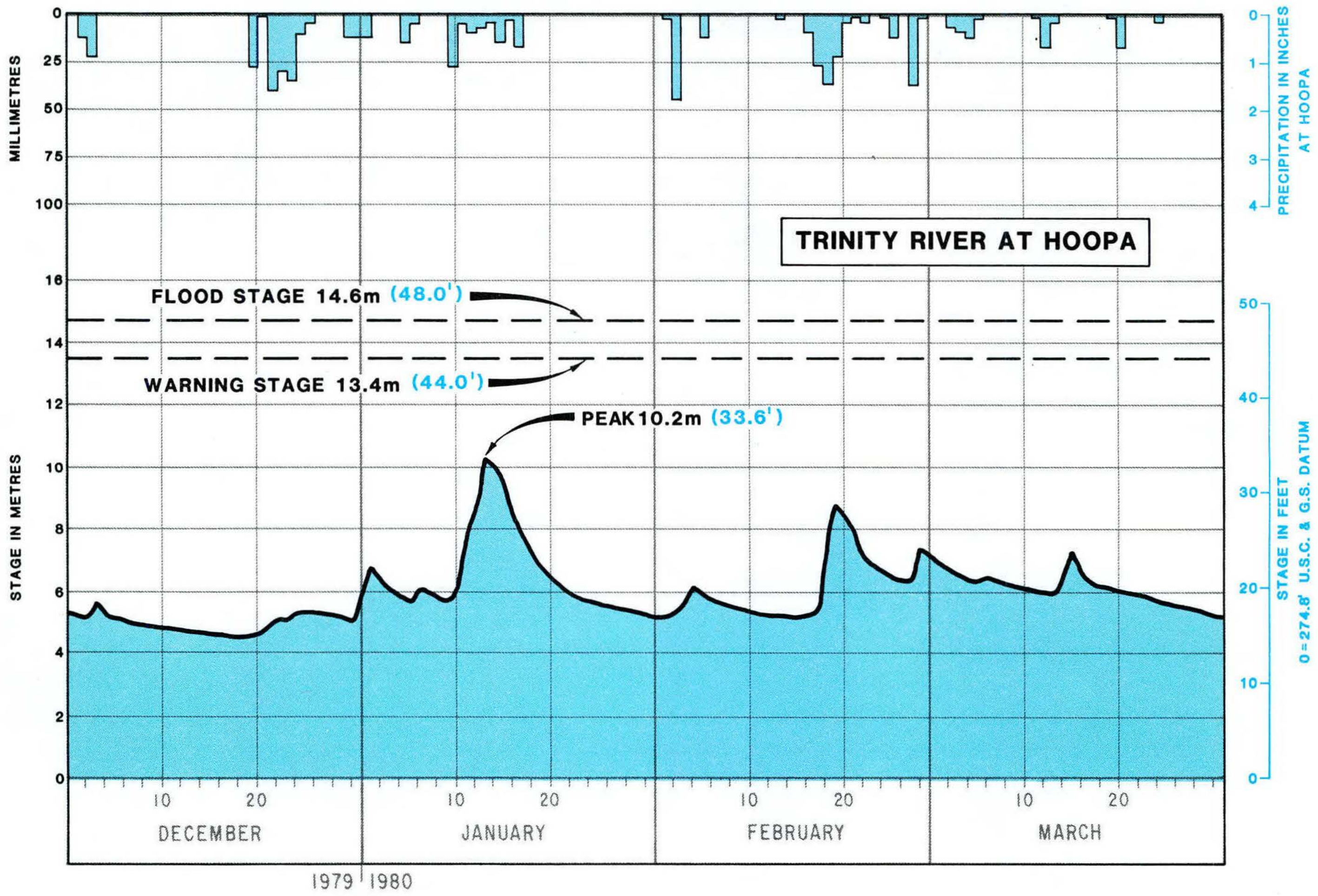


Figure 9. HYDROGRAPHS OF THE TRINITY AND EEL RIVERS



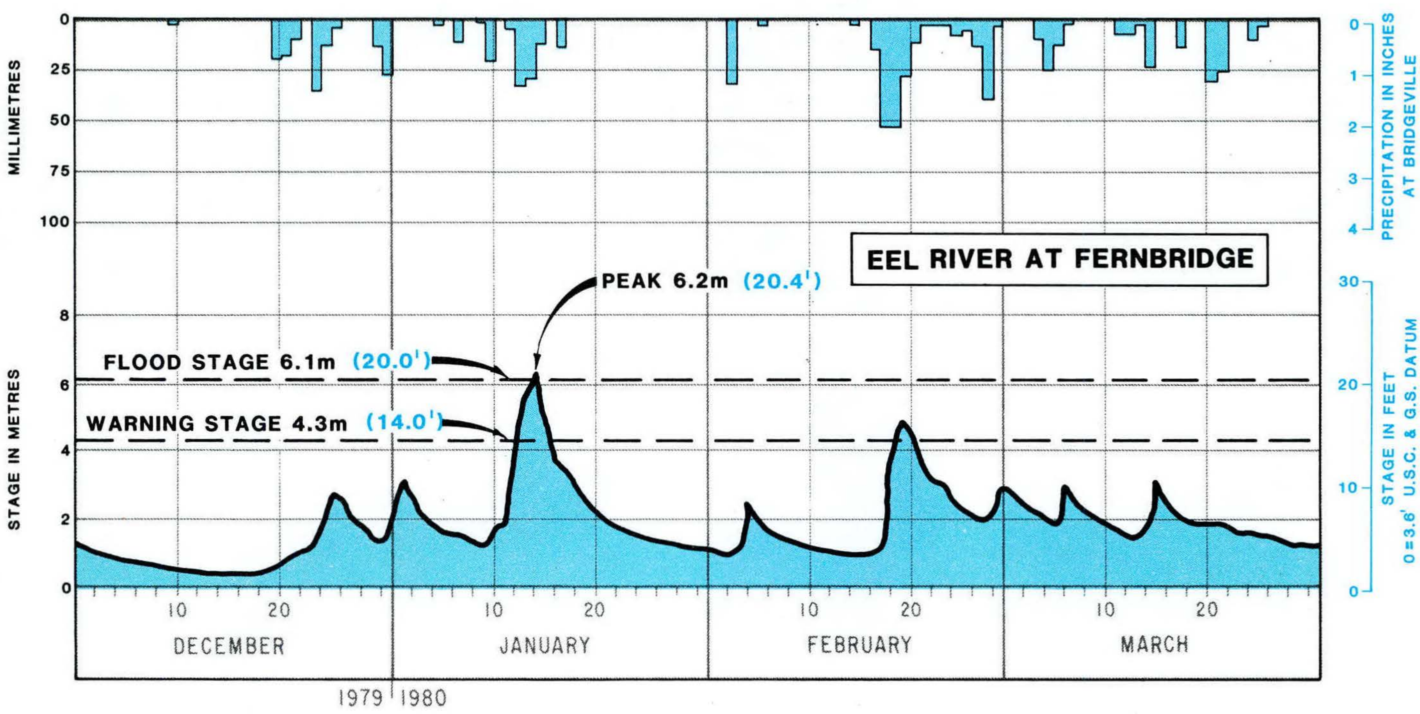
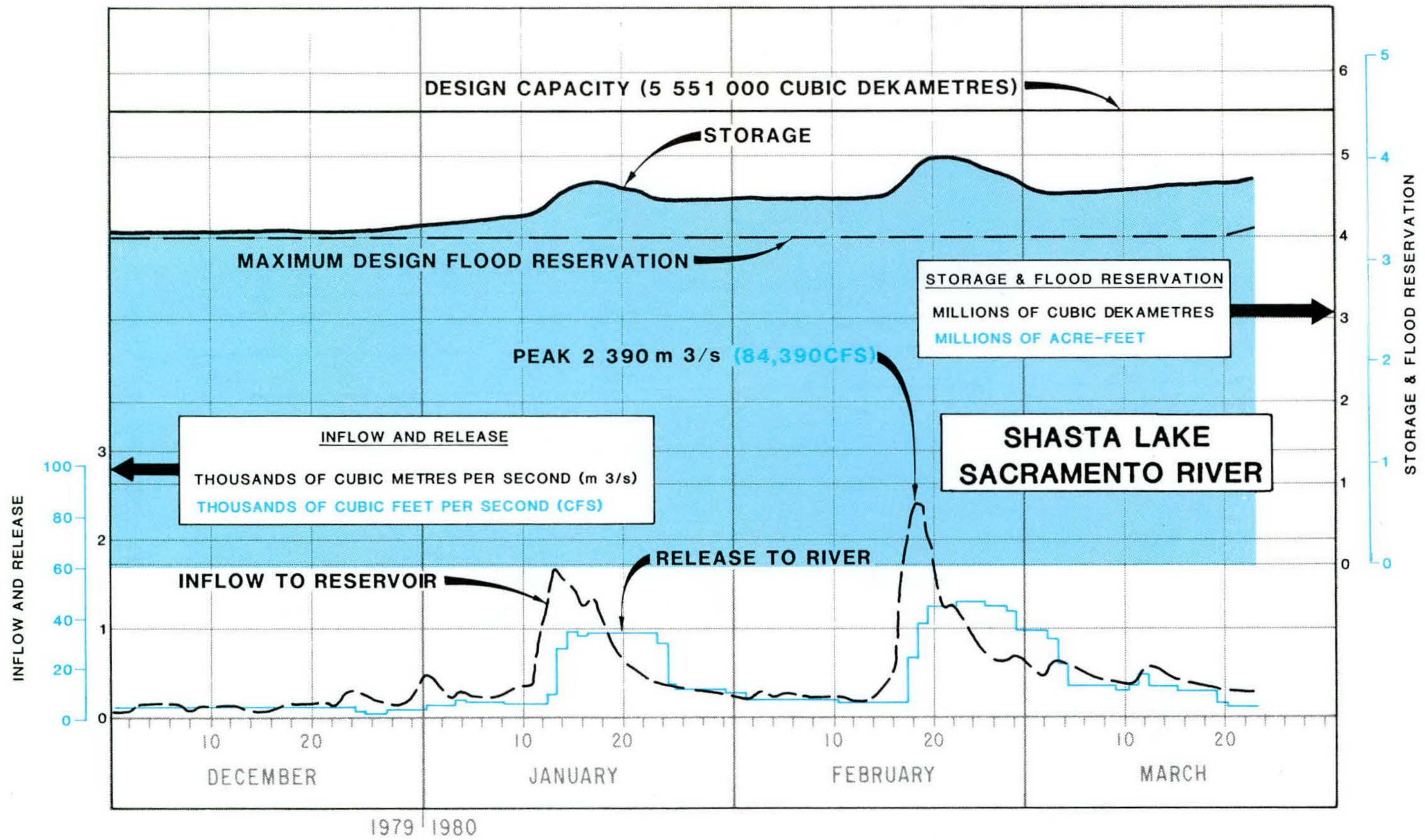
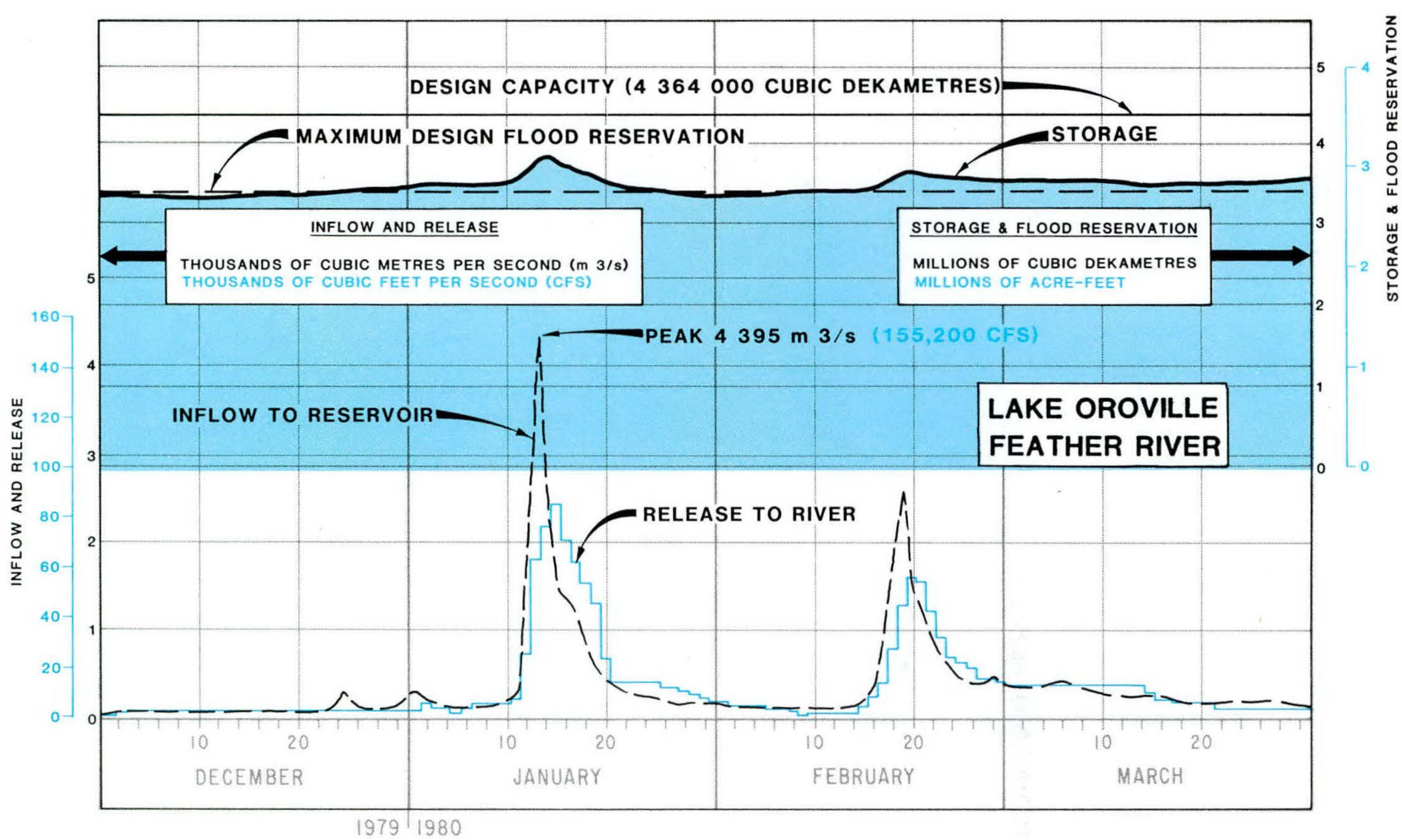
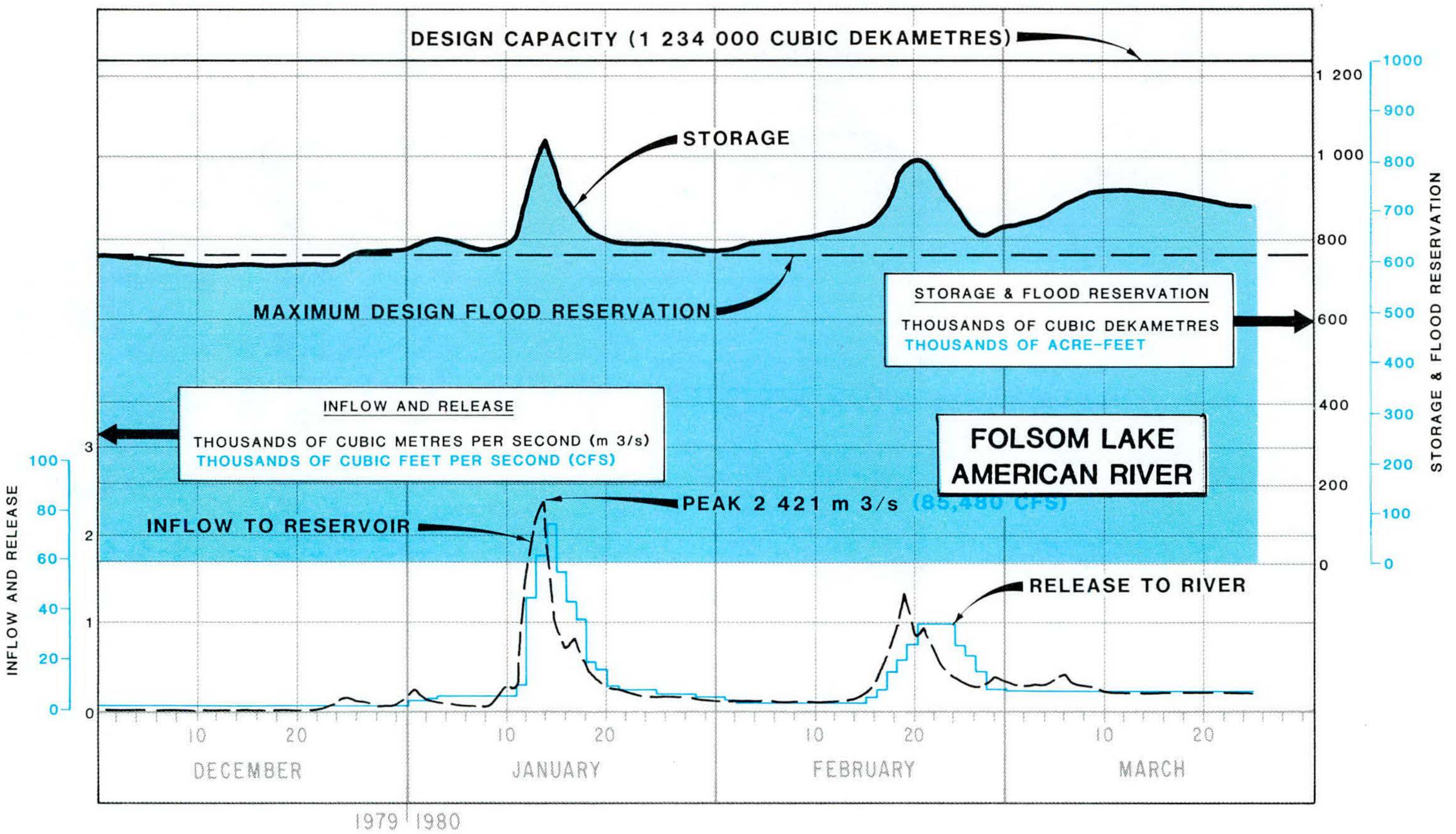



Figure 10. HYDROGRAPHS OF SHASTA LAKE AND LAKE OROVILLE



## Figure 11. HYDROGRAPHS OF FOLSOM LAKE AND NEW MELONES RESERVOIR



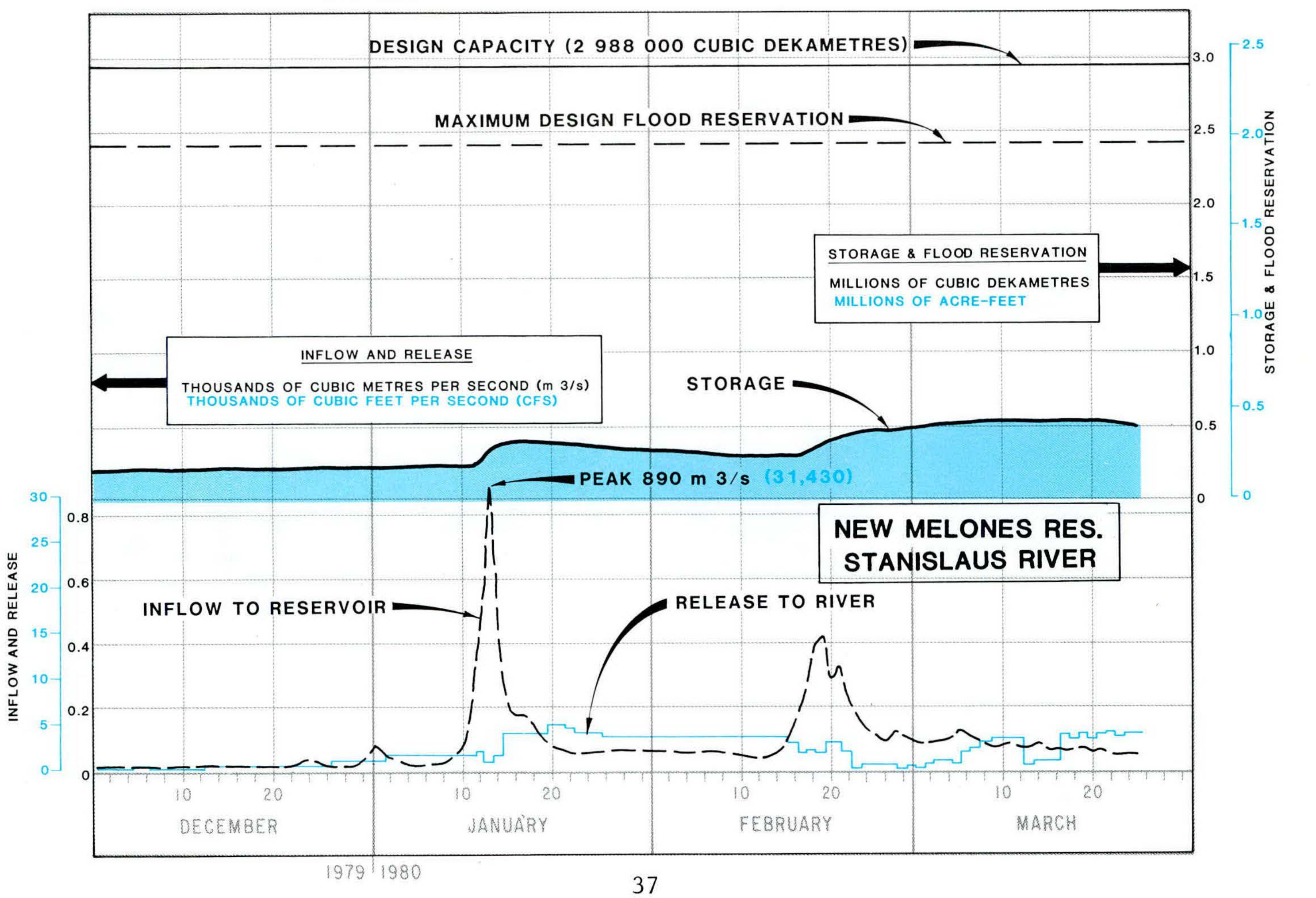
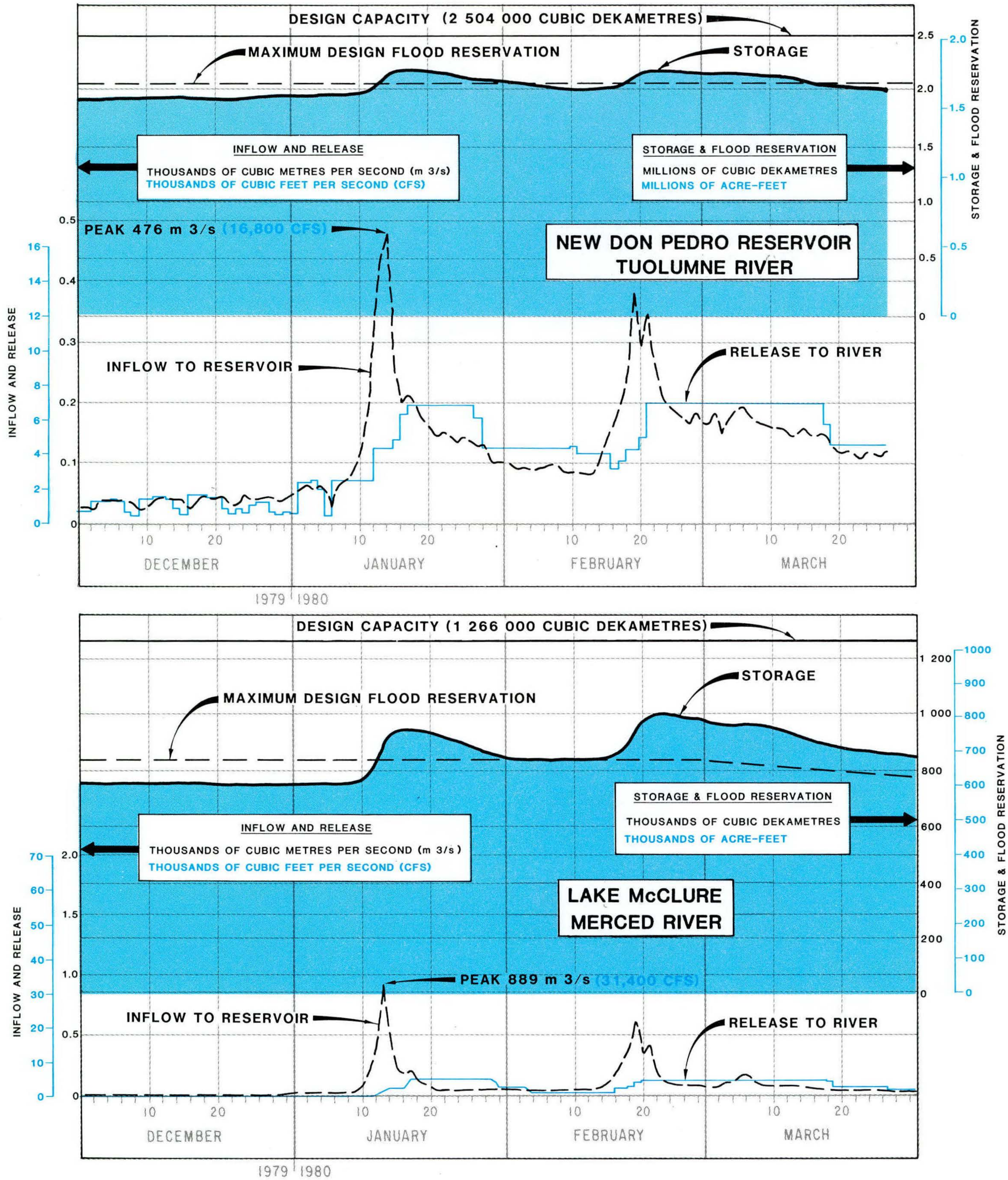
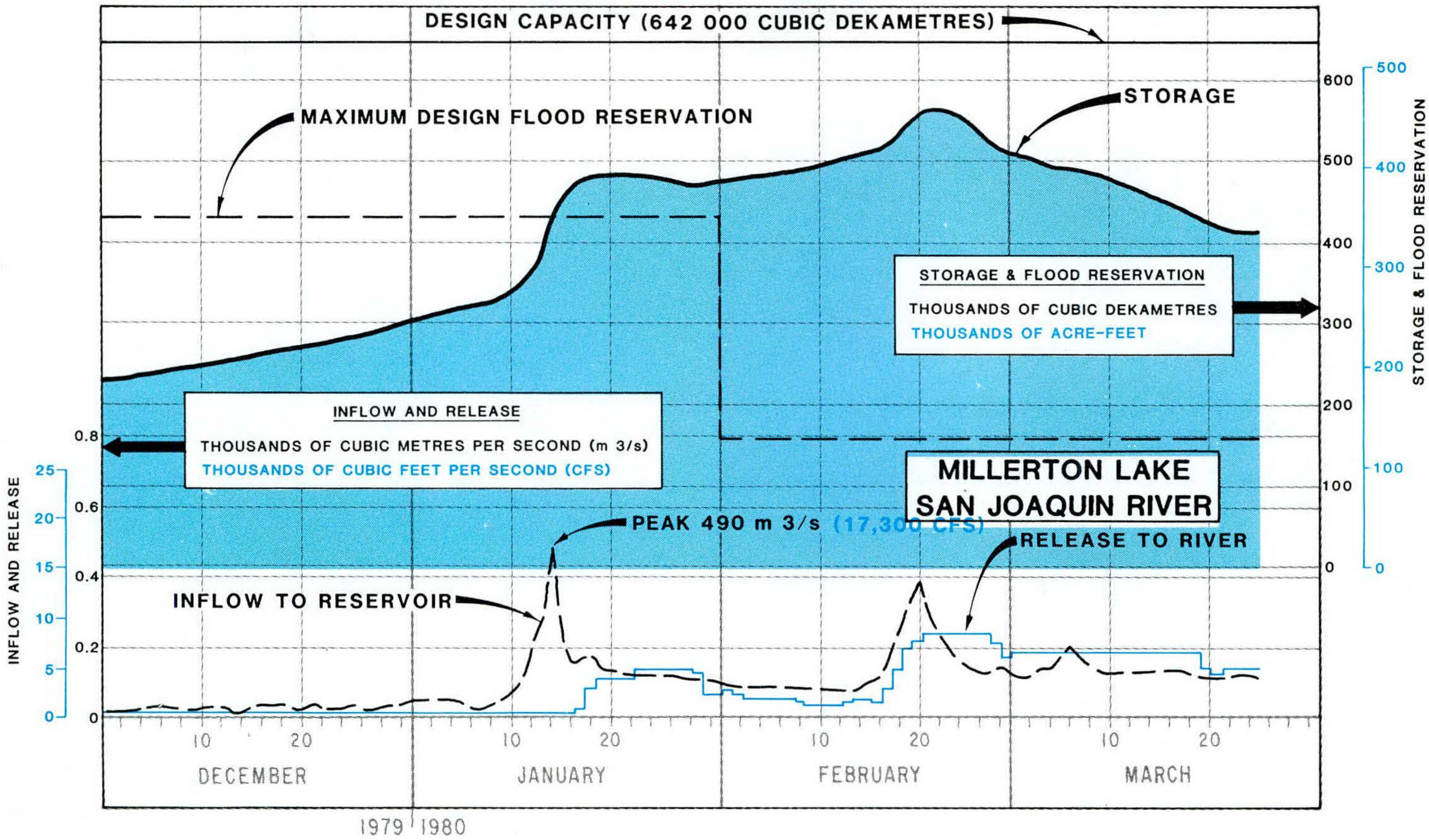



Figure 12. HYDROGRAPHS OF NEW DON PEDRO RESERVOIR AND LAKE McCLURE

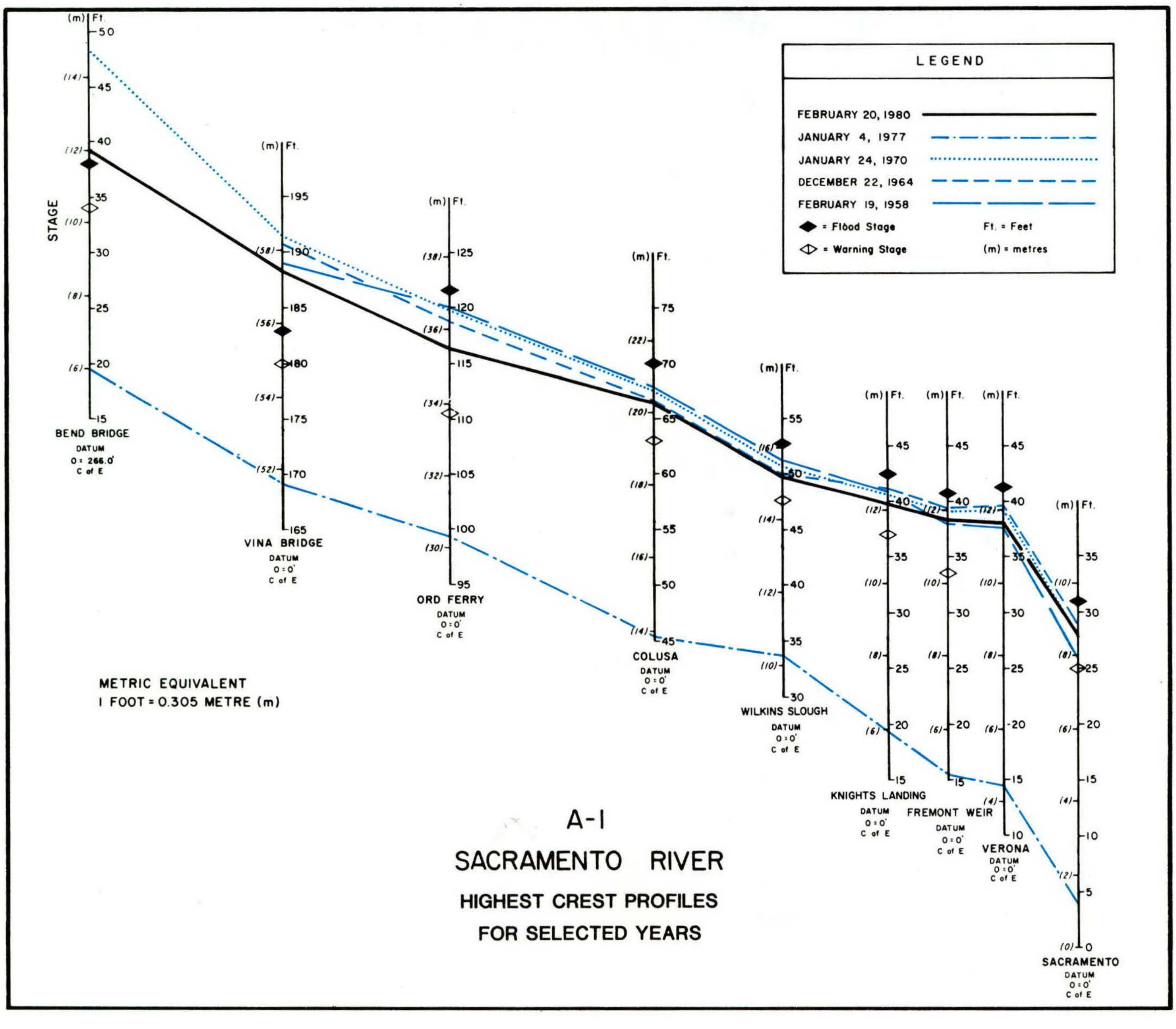


## Figure 13. HYDROGRAPH OF MILLERTON LAKE



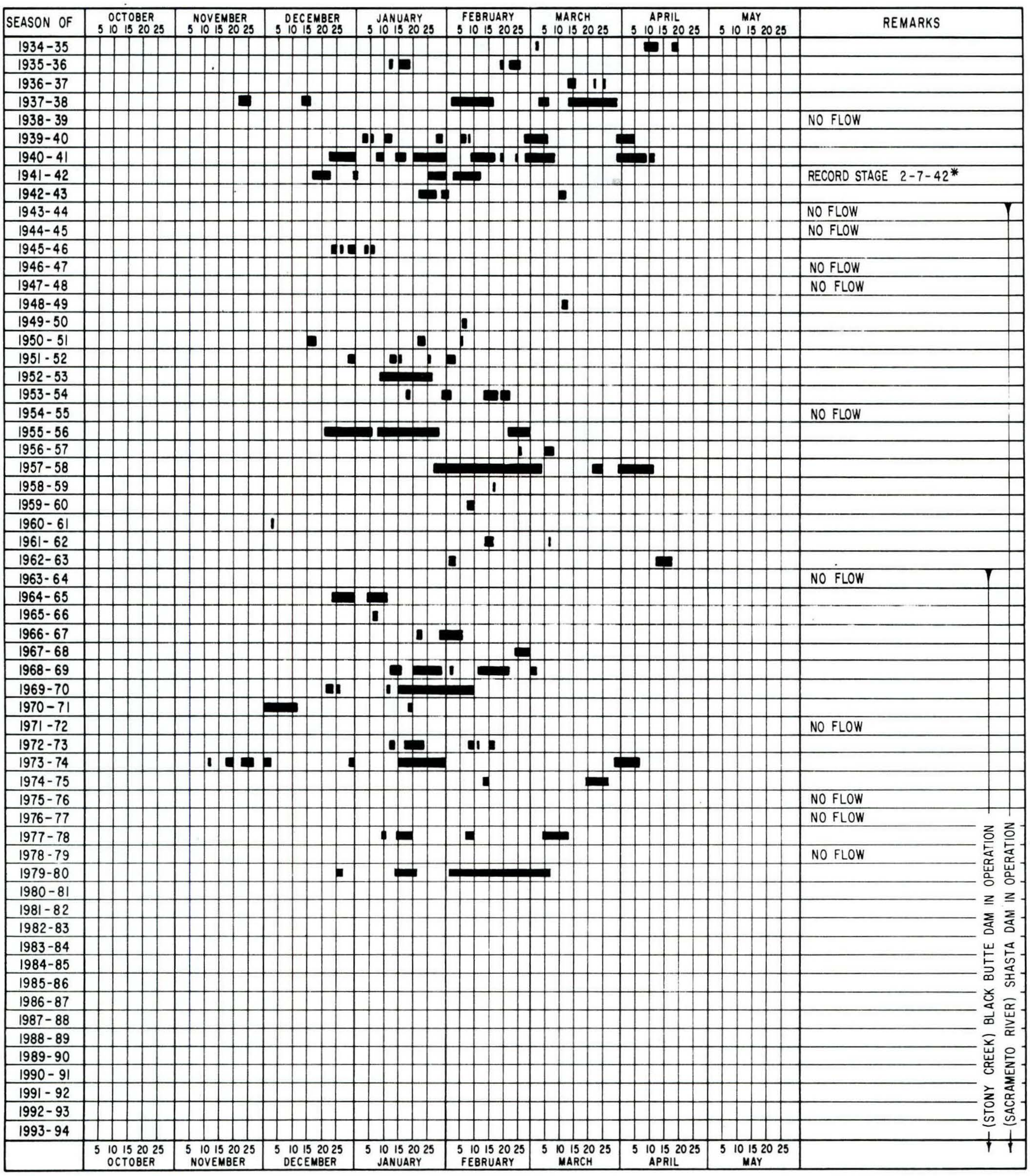
# APPENDIX

Sacramento River Crest
and
Weir Overflow Records




A-1
SACRAMENTO RIVER
HIGHEST CREST PROFILES
FOR SELECTED YEARS

# A-2, PERIOD OF RECORD OF OVERFLOW OF THE MOULTON WEIR




NOTE:

Data compiled from records of D.W.R. stream gaging station "Sacramento River at Moulton Weir."

Datum: 0 = 0' U.S.E.D.

Period of record: 1935 to present

Crest elevation = 76.75 feet (23.41 metres)

Metric Equivalent:
1 FOOT = 0.305 METRES

LEGEND

Designates periods of flow over weir

* 83.8 feet
(25.6 metres)

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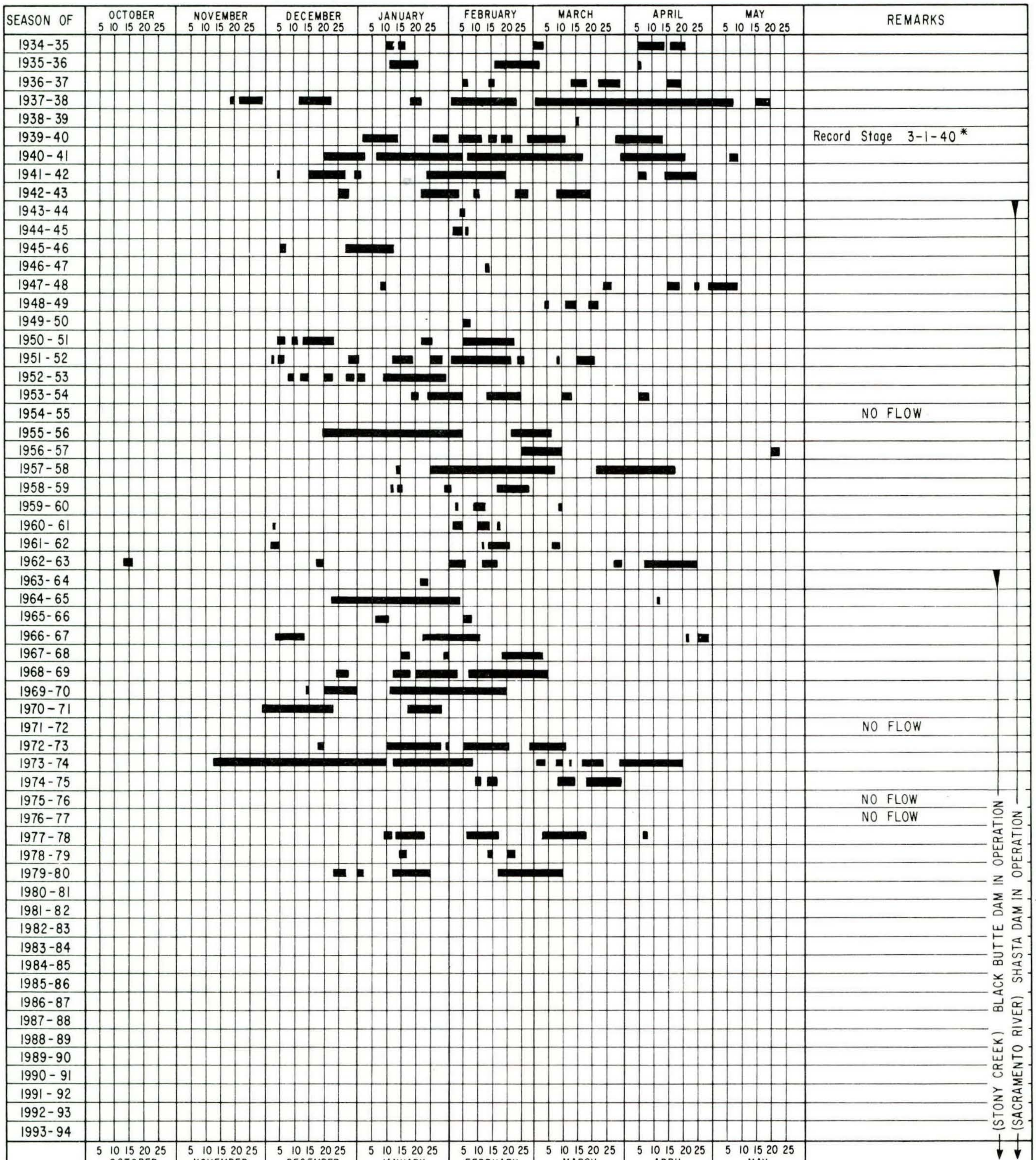
# A-3, PERIOD OF RECORD OF OVERFLOW OF THE COLUSA WEIR




NOTE:

Data compiled from records of D.W.R. stream gaging station Sacramento River at Colusa Weir

Datum: 0 = 0' U.S.E.D.

Period of record: 1935 to present

Crest elevation: 61.80 feet (18.85 metres)

Metric Equivalent:
1 FOOT = 0.305 METRES

LEGEND

Designates periods of flow over weir

* 70.6 feet (21.5 metres)

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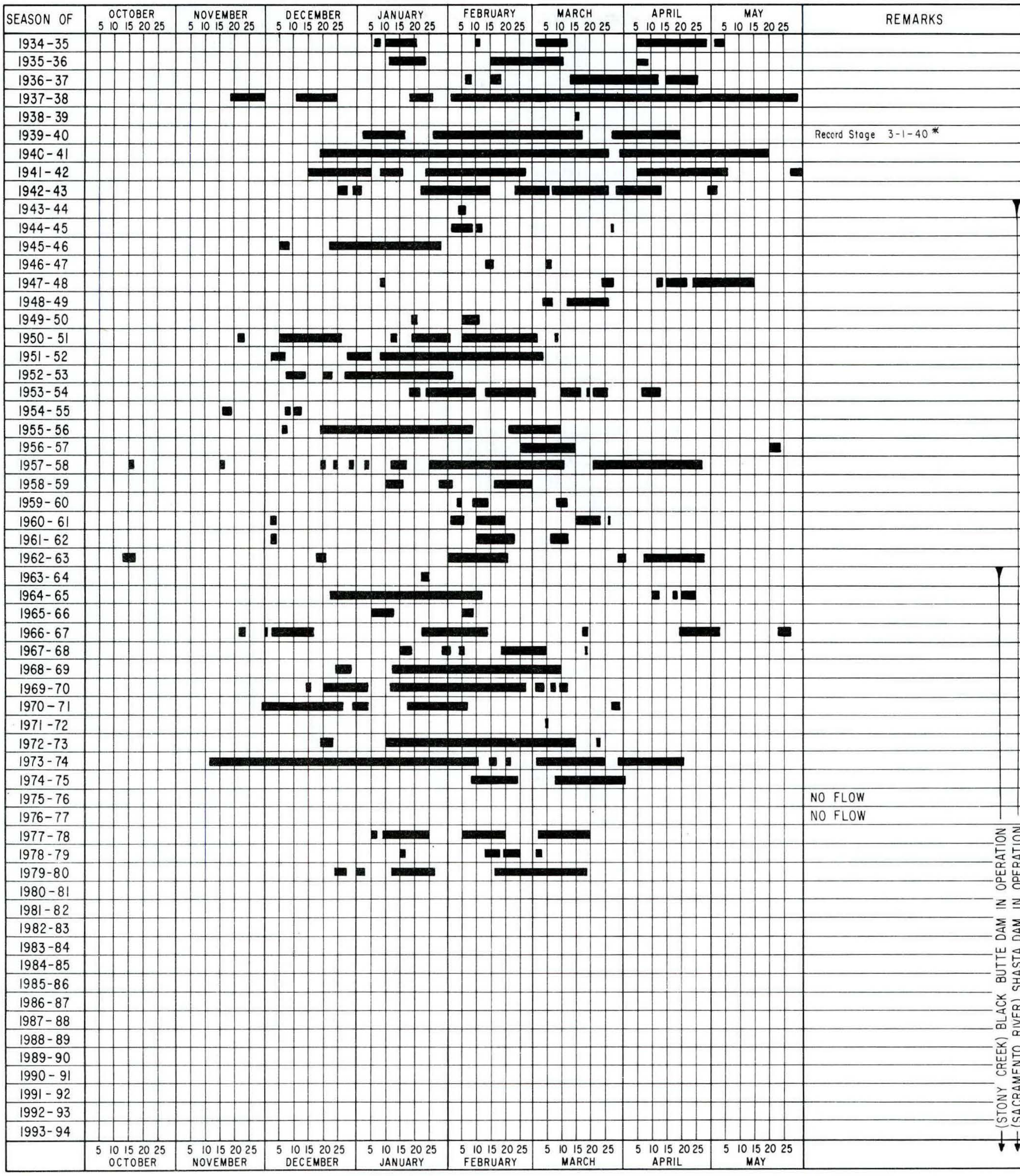
# A-4, PERIOD OF RECORD OF OVERFLOW OF THE TISDALE WEIR




NOTE:

Data compiled from records of D.W.R. stream gaging station "Sacramento River at Tisdale Weir"

Datum: 0=0' U.S.E.D.

Period of record: 1935 to present

Crest elevation = 45.45 feet (13.86 metres)

Metric Equivalent:

1 FOOT = 0.305 METRES

LEGEND

▬ Designates periods of flow over weir

*53.3 feet
(16.3 metres)

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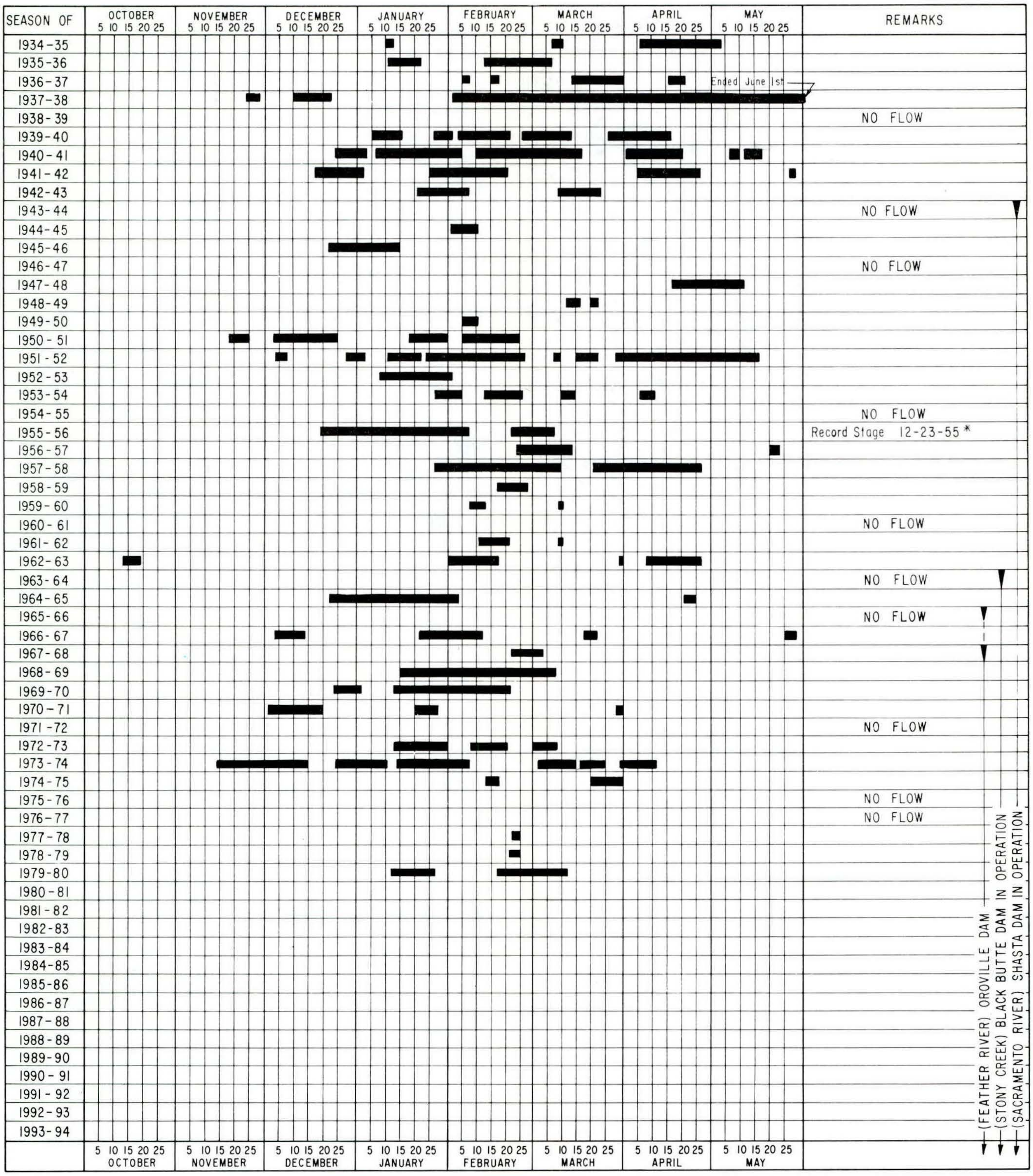
# A-5, PERIOD OF RECORD OF OVERFLOW OF THE FREMONT WEIR




NOTE:

Data compiled from records of D.W.R. stream gaging station "Sacramento River at Freemont Weir, West End"

Datum: 0 = 0' U.S.E.D.

Period of record: 1934 to present

Crest elevation = 33.50 feet (10.22 metres)

Metric Equivalent:

1 FOOT = 0.305 METRES

LEGEND

Designates periods of flow over weir

* 39.7 feet
(12.1 metres)

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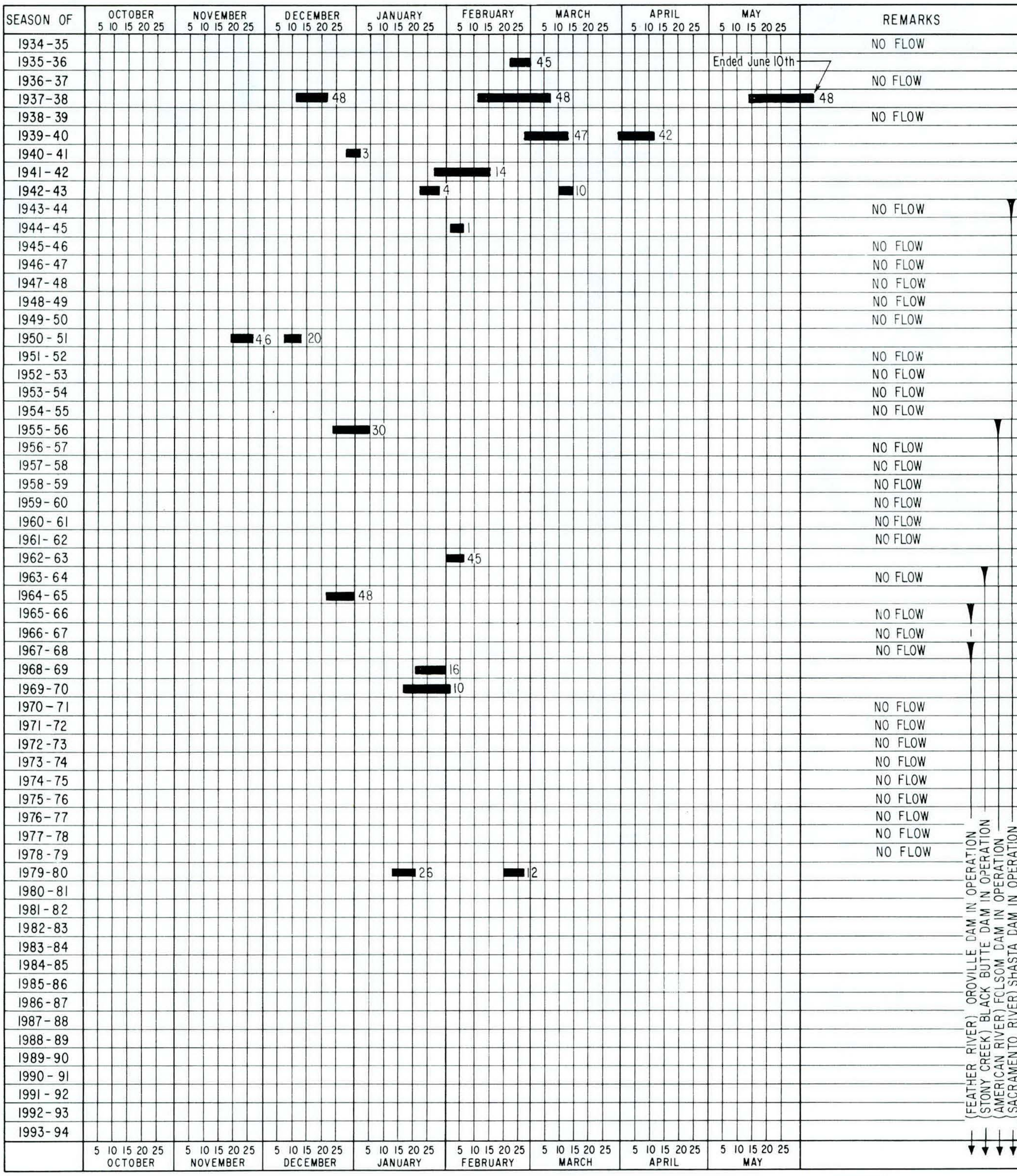
# A-6, PERIOD OF RECORD OF OVERFLOW OF THE SACRAMENTO WEIR




NOTE:

Data compiled from records of D.W.R. stream gaging station "Sacramento Weir Spill to Yolo Bypass, near Sacramento.

Datum: 0=0' U.S.E.D.

Period of record: 1926 to present

Crest elevation = 24.75 feet (7.55 metres)

Elevation of top of gates = 31.0 feet (9.46 metres)

Metric Equivalent:
1 FOOT = 0.305 METRES

LEGEND

▬ 5 Designates periods of flow over weir and total number of gates opened.

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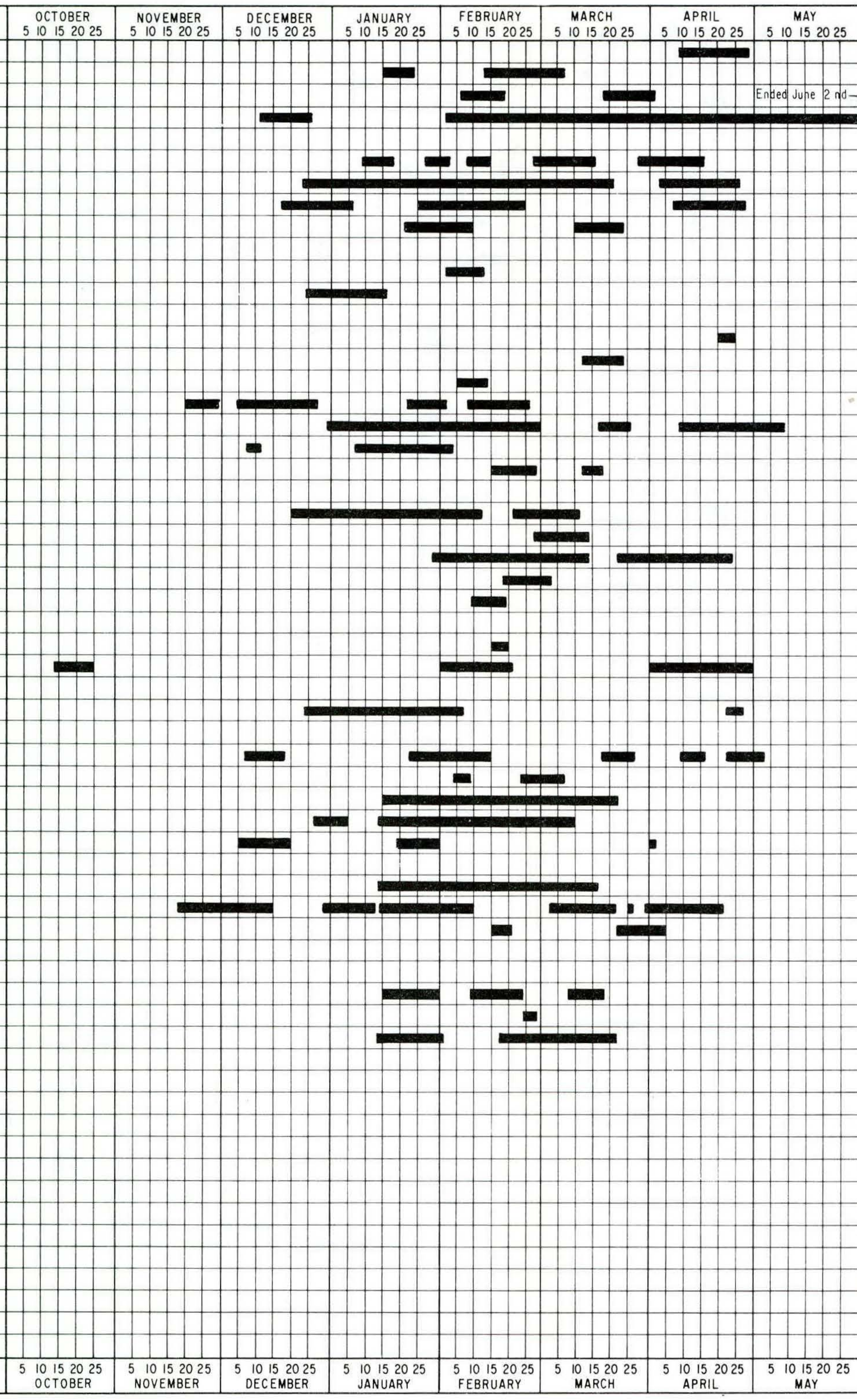
# A-7, PERIOD OF RECORD OF INUNDATION OF THE YOLO BYPASS




| SEASON OF | MAX-STAGE AT LISBON GAGE FEET | METRES |
|---|---|---|
| 1934-35 | 17.5' | (5.34 m) |
| 1935-36 | 19.3' | (5.89 m) |
| 1936-37 | 15.1' | (4.61 m) |
| 1937-38 | 21.0' | (6.41 m) |
| 1938-39 | NOT INUNDATED | |
| 1939-40 | 22.5' | (6.86 m) |
| 1940-41 | 20.2' | (6.16 m) |
| 1941-42 | 22.8' | (6.95 m) |
| 1942-43 | 20.1' | (6.13 m) |
| 1943-44 | NOT INUNDATED | |
| 1944-45 | 16.8' | (5.12 m) |
| 1945-46 | 18.5' | (5.64 m) |
| 1946-47 | NOT INUNDATED | |
| 1947-48 | 12.9' | (3.94 m) |
| 1948-49 | 13.3' | (4.06 m) |
| 1949-50 | 15.6' | (4.76 m) |
| 1950-51 | 20.2' | (6.16 m) |
| 1951-52 | 17.9' | (5.46 m) |
| 1952-53 | 18.4' | (5.61 m) |
| 1953-54 | 15.4' | (4.70 m) |
| 1954-55 | NOT INUNDATED | |
| 1955-56 | 23.4' | (7.14 m) |
| 1956-57 | 15.2' | (4.64 m) |
| 1957-58 | 21.1' | (6.44 m) |
| 1958-59 | 16.8' | (5.12 m) |
| 1959-60 | 17.8' | (5.43 m) |
| 1960-61 | NOT INUNDATED | |
| 1961-62 | 13.5' | (4.12 m) |
| 1962-63 | 22.6' | (6.89 m) |
| 1963-64 | NOT INUNDATED | |
| 1964-65 | 24.7' | (7.53 m) |
| 1965-66 | NOT INUNDATED | |
| 1966-67 | 20.6' | (6.28 m) |
| 1967-68 | 14.5' | (4.42 m) |
| 1968-69 | 21.7' | (6.62 m) |
| 1969-70 | 23.9' | (7.29 m) |
| 1970-71 | 15.6' | (4.76 m) |
| 1971-72 | NOT INUNDATED | |
| 1972-73 | 19.7' | (6.01 m) |
| 1973-74 | 21.6' | (6.59 m) |
| 1974-75 | 15.8' | (4.82 m) |
| 1975-76 | NOT INUNDATED | |
| 1976-77 | NOT INUNDATED | |
| 1977-78 | 18.9' | (5.76 m) |
| 1978-79 | 11.9' | (3.63 m) |
| 1979-80 | 22.4' | (6.83 m) |
| 1980-81 | | |
| 1981-82 | | |
| 1982-83 | | |
| 1983-84 | | |
| 1984-85 | | |
| 1985-86 | | |
| 1986-87 | | |
| 1987-88 | | |
| 1988-89 | | |
| 1989-90 | | |
| 1990-91 | | |
| 1991-92 | | |
| 1992-93 | | |
| 1993-94 | | |

(FEATHER RIVER) OROVILLE DAM IN OPERATION
(STONY CREEK) BLACK BUTTE DAM IN OPERATION
(AMERICAN RIVER) FOLSOM DAM IN OPERATION
(SACRAMENTO RIVER) SHASTA DAM IN OPERATION

NOTE:

Data compiled from records of D.W.R. stream gaging station "Yolo Bypass near Lisbon."

Datum: 0 = U.S.E.D. Datum

Period of Record: 1914 to Present

Assumed overflow of Bypass at stage above 11.5' (3.51 metres) on the Lisbon gage.

Metric Equivalent:
1 FOOT = 0.305 METRES

LEGEND

▬ Designates period of inundation of Bypass.

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## CONVERSION FACTORS

| Quantity | To Convert from Metric Unit | To Customary Unit | Multiply Metric Unit By | To Convert to Metric Unit Multiply Customary Unit By |
|---|---|---|---|---|
| Length | millimetres (mm) | inches (in) | 0.03937 | 25.4 |
| | centimetres (cm) for snow depth | inches (in) | 0.3937 | 2.54 |
| | metres (m) | feet (ft) | 3.2808 | 0.3048 |
| | kilometres (km) | miles (mi) | 0.62139 | 1.6093 |
| Area | square millimetres ($mm^2$) | square inches ($in^2$) | 0.00155 | 645.16 |
| | square metres ($m^2$) | square feet ($ft^2$) | 10.764 | 0.092903 |
| | hectares (ha) | acres (ac) | 2.4710 | 0.40469 |
| | square kilometres ($km^2$) | square miles ($mi^2$) | 0.3861 | 2.590 |
| Volume | litres (L) | gallons (gal) | 0.26417 | 3.7854 |
| | megalitres | million gallons ($10^6$ gal) | 0.26417 | 3.7854 |
| | cubic metres ($m^3$) | cubic feet ($ft^3$) | 35.315 | 0.028317 |
| | cubic metres ($m^3$) | cubic yards ($yd^3$) | 1.308 | 0.76455 |
| | cubic dekametres ($dam^3$) | acre-feet (ac-ft) | 0.8107 | 1.2335 |
| Flow | cubic metres per second ($m^3/s$) | cubic feet per second ($ft^3/s$) | 35.315 | 0.028317 |
| | litres per minute (L/min) | gallons per minute (gal/min) | 0.26417 | 3.7854 |
| | litres per day (L/day) | gallons per day (gal/day) | 0.26417 | 3.7854 |
| | megalitres per day (ML/day) | million gallons per day (mgd) | 0.26417 | 3.7854 |
| | cubic dekametres per day ($dam^3/day$) | acre-feet per day (ac-ft/day) | 0.8107 | 1.2335 |
| Mass | kilograms (kg) | pounds (lb) | 2.2046 | 0.45359 |
| | megagrams (Mg) | tons (short, 2,000 lb) | 1.1023 | 0.90718 |
| Velocity | metres per second (m/s) | feet per second (ft/s) | 3.2808 | 0.3048 |
| Power | kilowatts (kW) | horsepower (hp) | 1.3405 | 0.746 |
| Pressure | kilopascals (kPa) | pounds per square inch (psi) | 0.14505 | 6.8948 |
| | kilopascals (kPa) | feet head of water | 0.33456 | 2.989 |
| Specific Capacity | litres per minute per metre drawdown | gallons per minute per foot drawdown | 0.08052 | 12.419 |
| Concentration | milligrams per litre (mg/L) | parts per million (ppm) | 1.0 | 1.0 |
| Electrical Conductivity | microsiemens per centimetre (uS/cm) | micromhos per centimetre | 1.0 | 1.0 |
| Temperature | degrees Celsius (°C) | degrees Fahrenheit (°F) | (1.8 × °C)+32 | (°F−32)/1.8 |

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Department of Water Resources
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Sacramento
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