# A Half Century of Watching Floods

Maurcie (Maury) Roos, P.E., Chief Hydrologist (part time)
Division of Flood Management
California Department of Water Resources
3310 El Camino Ave, Room 200
Sacramento, CA 95821

Tel: (916) 574-2625
E-mail: mroos@water.ca.gov
Web: www.water.ca.gov

BIOGRAPHICAL SKETCH

Mr. Roos is Chief Hydrologist (part time) with the California Department of Water Resources in its Division of Flood Management located in Sacramento. He had 43 years of experience as a water engineer with DWR when he retired from full time service in July 2000.

He continues to work part time as a retired annuitant providing advice on flood forecasting, hydrology, water supply and snowmelt forecasting and staff meteorology. Related topics include floods and droughts, global warming, weather modification, and participation in elements of the California Water Plan update (Bulletin 160). For years he has been attempting to track climate change issues as well, especially as they relate to water supply in California.

Prior to retirement, he oversaw work on flood forecasting, hydrology, water supply and snowmelt forecasting, staff meteorology, and related subjects. As Chief Hydrologist, he also provided (and continues to provide) advice on drought, floods, global warming, and weather modification and tries to keep abreast of ongoing water and flood planning studies.

Mr. Roos received a B.S. in Civil Engineering from San Jose State University in 1957 and has been employed by the Department of Water Resources since then. His career began with a series of studies on channels, levees, proposed water transfer works, and water quality in the Sacramento-San Joaquin River Delta. From 1965 through 1978, he worked on various water planning studies and reservoir system operation studies, and evaluated water requirements, supplies, and potential water system developments in the Department's Division of Planning.

In 1979, he began his current assignment in the Division of Flood Management, primarily on flood and water supply forecasting. He was one of the authors of several editions of DWR Bulletin 160, the Department's main water planning document. During the past 10 years, he has had opportunity to share expertise in Israel, northern India, Nigeria, and China.

ABSTRACT

The purpose of this talk is to present some personal observations on the big floods we have seen in northern California the past half century or so starting with 1950. There are at least three types of floods in California – winter season general floods, spring and early summer snowmelt floods, and strong thunderstorm floods. A personal look at the big floods of 1950, 1955, 1964, 1969, 1983, 1986, 1995, and 1997 and seeing the floods getting larger over the years. Flood forecasting has improved greatly over the past 30 years, largely from three factors: computer advances, data gathering, especially with the California Data Exchange Center (CDEC), and quantitative precipitation forecasts.

# A Half Century of Watching Floods

by Maurice Roos

The purpose of this talk is to present some personal observations on the big floods we have seen in northern California the past half century or so. There are at least three types of floods in California. First is the winter season general flood which covers a large area. Another is a spring and early summer snowmelt flood originating from the higher elevation central and southern Sierra which occurs about once in 10 years on the average. The third type is a local flood from strong thunderstorms with very intense rain over a relatively small area. These local storms originate in moist tropical or subtropical air and include the flash floods of southern California when remnants of eastern Pacific hurricanes get carried into the State. Sometimes intense cells develop in the warm sector of major winter storms.

But the most feared flooding comes from the general winter season storms covering a wide area. These storms are slow moving with a long southwesterly fetch extending toward Hawaii, the so-called "pineapple connection". Often there is a near balance between a high pressure area to the south of California and a strong low pressure area off the northern California or Oregon coast. The greater the pressure difference, the stronger the southwesterly winds, which can reach speeds of 100 km/hr or more at 3000 meters over the San Francisco Bay area. The line of strongest air mass contrast, the frontal zone, can ripple back and forth several hundred kilometers but produces almost continuous rain to fairly high elevations over a broad zone in northern or central California (and less commonly in southern California). This warm southwesterly flow pattern is evident in practically all of our large general floods.

An important factor is the mountain barriers. As moisture-laden air is blown over the mountains such as the Sierra Nevada, the air is lifted and cooled with additional rain and snow. Typically the orographic precipitation is three to four times the amount in the lowlands. For example, the 1600 meter elevation Blue Canyon weather station northeast of Sacramento averages about 1600 millimeters of precipitation per year, some 3.5 times the 450 mm expected at Sacramento in the middle of the Central Valley.

This talk, though, is about my experiences. First I will summarize the big floods of note. They are:

| | |
|---|---|
| November – December | 1950 |
| December | 1955 |
| February | 1963 |
| December | 1964 |
| January | 1969 |
| | |
| March | 1983 |
| February | 1986 |
| January – March | 1995 |
| January | 1997 |

---

Chief Hydrologist, Part Time. California Department of Water Resources, Sacramento.
Email mroos@water.ca.gov
Presented on April 13 to the 2007 California Extreme Precipitation Symposium.

The bigger ones for the Feather, American, and Cosumnes River basin are shown on the following bar chart. The 3 day unimpaired flood rates have been converted to ratios over median to make them more comparable. Sometimes there are significant differences in different regions of the Sierra. Note for example the dropoff to the north in the Feather River of the water year 1951 event. Also of interest is the relative size of the 1997 flood on the Feather River which is significantly bigger than that of the American River.

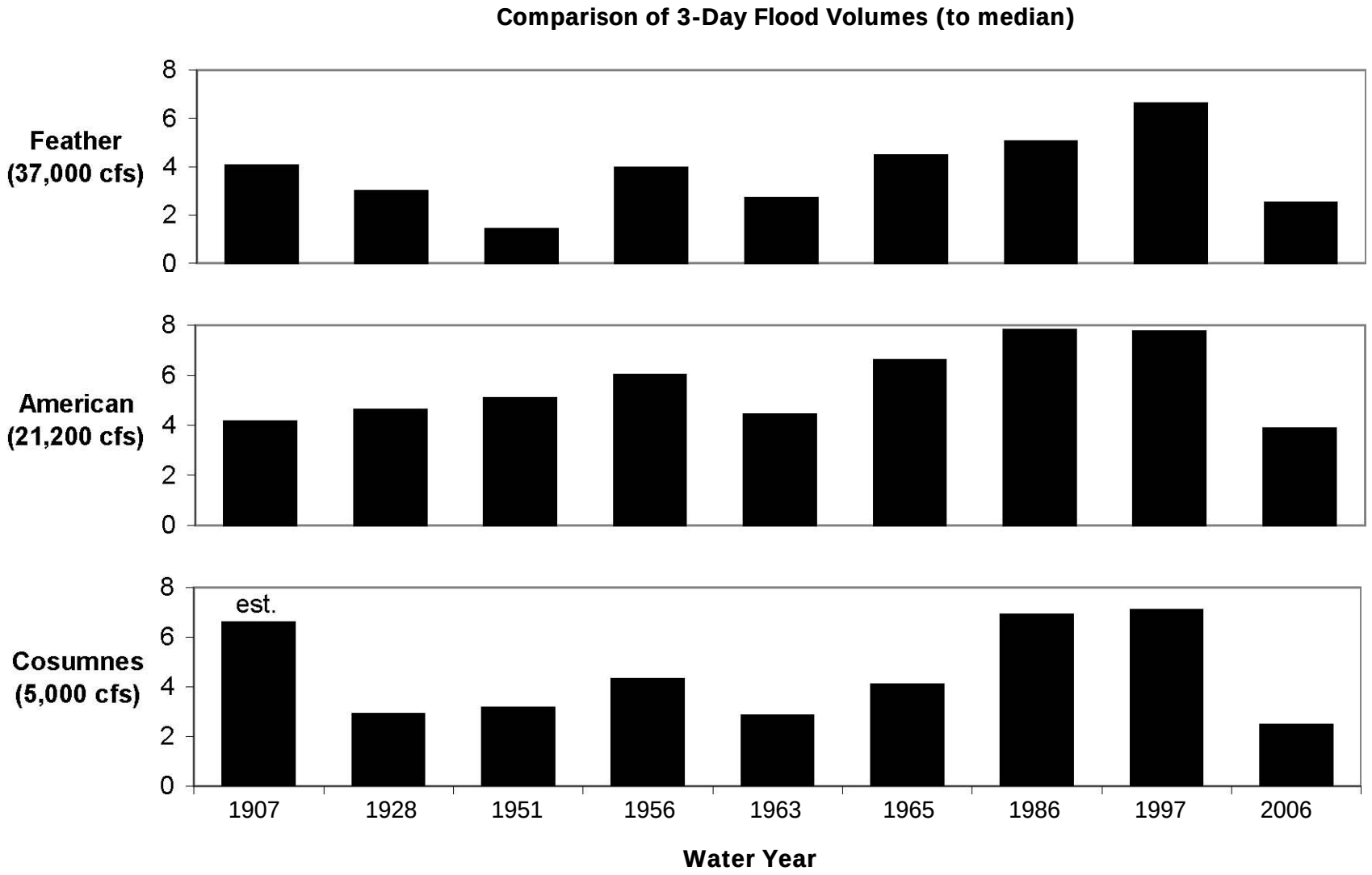
My first experience was the huge lower San Joaquin River flood in December 1950 which was the largest of record until 1997. This, of course, was pre New Melones, New Don Pedro and New Exchequer reservoirs. The low levees were readily overtopped or broken and the bottom lands, as we called them, were inundated. The Durham Ferry road (now Airport Way) at Vernalis gaging station was on an elevated fill from high ground to the river bridge. As I drove over to the west side in my father's pickup there were some low spots where I could only tell the edge of the road by the ripple marks. Vehicles were higher centered then, although the brakes would get wet and not work well.

The next big event was December 1955 just before Christmas. This was a huge event in the central San Joaquin Valley, comparable with 1997. I had been out in the desert with some friends and we were trying to get back home by Christmas. North of Madera, Highway 99 was closed due to flooding, so we were diverted westward on some country road eventually to head north toward Merced. I remember the wakes from cars looking much like motorboat wakes and going slowly as traffic backed up. We did eventually make it home in Ripon, albeit later than expected. Since the Stanislaus was flooding too, I went out that evening to look at it near what is now Caswell State Park. I could hear the water roaring from a waterfall going over a levee. After the water went down, I looked at the levee again and was surprised to find that it held with only minor erosion. That levee was hard clay.

As you know that storm and flood saw the tragic break in the Feather River near Yuba City which flooded 100,000 acres and cost 38 lives. When I came to work for the Department of Water Resources in 1957 one of my first assignments was to locate high water marks in the Delta, especially along the Mokelumne River system, and determine elevations of various Delta channels for use in flood control design. I didn't realize how far down into the Delta poison oak grows, the Mokelumne River area near Thornton was loaded with it.

The next flood experience was the December 1964 event which was even bigger in the northern part of the State than the 1955 flood. This one set a record for flow in any river in California with the 752,000 cfs peak measured in the Eel River at Scotia. That flood destroyed many communities in the North Coast region of California and has not been matched since. It may have been a 600 year flood. The flood had amazing power; large logs operated as battering rams smashing structures and taking out bridges. The only major river bridge left in service in the whole region was the old concrete bridge across the Eel River near Ferndale.

My experience started Christmas evening when I was called downtown and assigned to lead a Forestry crew from Stockton onto Twitchell Island to try to shore up a crumbling levee on the southeast side. The levees were so soft we couldn't bring any vehicles there by land, so we had a motorboat flotilla to convey lumber (for floodwalls) sandbags and supplies. I got back home late the following night, turned in, and had an early morning call that I was needed on Bethel


Comparison of 3-Day Flood Volumes (to median)
Feather
(37,000 cfs)
American
(21,200 cfs)
Cosumnes
(5,000 cfs)
est.
0
2
4
6
8
1907
1928
1951
1956
1963
1965
1986
1997
2006
Water Year

Island. Driving down there I found it impossible to drive the island perimeter because of brush on the levee. We knew a high tide was coming and a Corps clamshell dredge was trying to beef up a levee section on the northwest side. As the high tide came, springs of water popped up all over the levee toe and slope and I figured it was a goner. We had a harrowing moment when a large leak sprang out, but were able to stop it with a ring of sandbags. As a last fix one of the prisoners stomped two sandbags into the boil to stop it completely. I still remember the look on his face when I told him we needed to pull those bags out so water would flow and not build up pressure. He did so, but very reluctantly. One lesson I remember was how difficult it was to get up to date high tide information in the field; we had one radio but reception was poor and radio traffic was heavy and it was hard to get an open message slot to headquarters for the latest tide stage information.

Water year 1969 was also very wet. Sherman Island flooded from a break on the south side. Again the power of debris was noted. Wooden logs and lumber in the waves battered homes and other structures and ruined them.

In 1979, I moved from Statewide Planning to the Division of Flood Management, on flood forecasting. In January 1980 we got a surprise with a fairly large flood on the Feather River which was handled quite well. About a week later, when Delta stages were elevated because of lingering flood runoff, a fierce north wind pushed a surge into the southern delta, flooding Webb Tract and Holland in the afternoon of the 18th. There probably was no relationship, but Jones Tract flooded that summer.

Water year 1983, the big El Nino year, was the wettest in our history with nearly twice average runoff statewide. There were numerous high and sustained high flow events peaking in early March and it was a huge snowmelt year. Tulare Lake reappeared. Although there was a long period of high water and massive seepage problems, I don't remember anything outstanding from that flood year.

The next large flood event was the February 1986 flood. We started the month worrying about a dry year. Then we had the Valentine's Day storm which wetted the watersheds followed by the President's Day floods. We got a half year's precipitation in 10 days and the storm was particularly heavy on the Feather, Yuba, and American Rivers. For the first time since construction in 1968, Oroville dam releases went to the full objective 150,000 cfs. The American River situation was more critical, as Folsom was filling with about 100,000 AF upstream temporarily stored behind a failing coffer dam. Flows were increased to about 130,000 cfs, 15,000 cfs over the objective flows. The reservoir actually surcharged 1.56 feet, some 18,000 AF, more than the nominal full pool. This was a wakeup call for Sacramento and led to some revisions to the flood control diagram and style of operations. Rain rates were around 0.3 inches per hour; another several hours could have been a disaster.

At the height of the flood I was working with Bob Burnash and Gary Hester on a projection of a peak stage on the Feather at Yuba City where they were considering evacuation of a hospital in Marysville. We were asked late that night to refine the forecast peak stage; if it reached 77 feet they would need to evacuate. The telemetry gage on the Yuba River at Narrows had been lost, so we had only one verification point on the Yuba hydrograph from that morning. We eventually called for 76.5 feet; the emergency people said they would stay put, and we waited on pins and needles to see what would happen. This time the forecast was a success; the water peaked at 76.3 feet, about ¼ foot under our projections. But we were not always that good.

1995 had a lot of flooding with a big San Joaquin region spring snowmelt, but was not so bad in the Sacramento River basin. The Russian River also reached near record stage in January and the Napa River in March. In March of 1995 we had record flooding on the Salinas River and on Arroyo Pasajero near Coalinga where the stream washed out the I-5 bridge.

Floods keep getting bigger. In 1997 we had the big New Year 's day storm, which may have rivaled the legendary 1862 flood. That flood was notable in the sustained intensity of rainfall, the volume of flood water, and the area extent – from the Oregon border to the southern Sierra. In spite of Bill Mork's warning I guess I did not appreciate the scale of this event until it was underway. In fact, the first wave in the storm series was not nearly as wet as forecasted. But the storm made up for it later. The watersheds were wet, with low snow from a cold storm before Christmas, and, although we expected some areas to get really soaked, I don't think we thought the intensity of the storm system would be maintained as it moved south into the San Joaquin River basin during the first two days of January.

Flood forecasting has improved greatly over the past 30 years, largely from 3 factors: computer advances, data gathering, especially with the California Data Exchange Center (CDEC), and quantitative precipitation forecasts. The River Forecast Center used to get a sheet of 6, 12, and 24 hour precipitation forecasts for a number of grid points and basins from the adjoining National Weather Services forecast office. I always appreciated the colorful descriptive language skills of Milo Radulovich, one of the lead forecasters, in describing the weather situation. Meanwhile the flood forecasters would be busy manually plotting hydrographs, blue for stage and red for flow, as data came in.

Getting data was no easy thing. When I started the State had put in a new set of telemetry on the North Coast and Sacramento River system, interrogated by radio from a punched tape loop. Some stations such as those on the Central Coast had telephone telemarks where one phoned the station and listened amid the static of stormy days for a series of beeps which gave the stage in feet and tenths. We might only get a few believable stage readings in a day. Often the phone was busy as local officials or individuals were also checking stages. Now, when we look at CDEC groups we expect to see a full grid of measurements, whether river stage or precipitation, for each hour. But it is good to remember that this is a relatively new achievement and takes a lot of maintenance to keep the data stream coming.

Setting up the hydromet category of specialists in the CNRFC was a good move too, I think. As many of you know these experts provide QPF now out to 5 days and runoff models and hydrographs go out as far to provide guidance. That information, although progressively more uncertain for future days, has been a valuable service to reservoir operators and emergency service people.

So what are my impression of a half century of watching water and floods? First I do not regret for a minute going into the water engineering/hydrology field. I belong to the builder generation and I think we have done a lot to improve the welfare of our society and state and that I have been able to contribute useful services to our profession, to DWR, and to the people of California. I hope the Lord will give me many more years of health and ability to be a bridge to the younger generation and to provide some historical perspective at times.