SANTA ANA RIVER WATERMASTER

FOR

ORANGE COUNTY WATER DISTRICT

VS. CITY OF CHINO ,et al

CASE NO. 117628-COUNTY OF ORANGE

FOURTEENTH

ANNUAL REPORT

OF THE

SANTA ANA RIVER WATERMASTER

1983-84

APRIL 8, 1985

SANTA ANA RIVER WATERMASTER

FOR
ORANGE COUNTY WATER DISTRICT VS. CITY OF CHINO, ET AL
CASE NO. 117628 — COUNTY OF ORANGE

WATERMASTER
HARVEY O. BANKS
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April 8, 1985

To: Clerk of Superior Court of Orange County
and all Parties

Re: Watermaster Report for 1983-84

Gentlemen:

We have the honor of submitting herewith the Fourteenth Annual Report of the Santa Ana River Watermaster.

The principal findings of the Watermaster for the water year 1983-84 are as follows:

At Prado

(1)	Base Flow at Prado	109,231 acre-feet
(2)	Annual Weighted TDS of Base and Storm Flows	627 mg/l
(3)	Annual Adjusted Base Flow	115,876 acre-feet
(4)	One-half Lake Elsinore Discharge Reaching Prado Dam and Recharging Orange County Groundwater Basin	4,602 acre-feet
(5)	Cumulative Adjusted Base Flow	1,019,514 acre-feet
(6)	Cumulative Entitlement of OCWD	588,000 acre-feet
(7)	Cumulative Credit	431,514 acre-feet
(8)	One-third of Cumulative Debit	0 acre-feet
(9)	Minimum Required Base Flow in 1984-85	34,000 acre-feet

At Riverside Narrows

(1)	Base Flow at Riverside Narrows	56,948 acre-feet
(2)	Annual Weighted TDS of Base Flow	647 mg/l
(3)	Annual Adjusted Base Flow	56,948 acre-feet
(4)	Cumulative Adjusted Base Flow	357,050 acre-feet
(5)	Cumulative Entitlement of CBMWD and WMWD	213,500 acre-feet
(6)	Cumulative Credit	143,550 acre-feet
(7)	One-third of Cumulative Debit	0 acre-feet
(8)	Minimum Required Base Flow in 1984-85	12,420 acre-feet

The above findings show that at the end of the 1983-84 water year Chino Basin Municipal Water District and Western Municipal Water District have a cumulative credit of 431,514 acre-feet to their Base Flow obligation at Prado Dam. San Bernardino Valley Municipal Water District has a cumulative credit of 143,550 acre-feet to its Base Flow obligation at Riverside Narrows.

Because of continued high water levels in Lake Elsinore, pumping from Lake Elsinore and discharge to Temescal Wash was again undertaken intermittently from October 17 to January 14. The discharge of water from Lake Elsinore to the Santa Ana River is considered a rare event and was not contemplated under this Judgment. In view of this special case and since a portion of the water pumped from Lake Elsinore was determined by the Watermaster to have been recharged to the groundwater basin in Orange County, one-half of such amount has been considered a credit against the Upper Area Base Flow Obligation at Prado Dam.

Sincerely yours,

SANTA ANA RIVER WATERMASTER

By:

Harvey O. Banks

Donald L. Harriger

William J. Carroll

William R. Mills, Jr.

James C. Hanson

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CHAPTER I
WATERMASTER ACTIVITIES

This is the fourteenth annual report of the Santa Ana River Watermaster required by the stipulated Judgment in the case of Orange County Water District vs. City of Chino, et al, entered by the court on April 17, 1969. This stipulated Judgment became effective on October 1, 1970 and contains a declaration of rights of the entities in the lower area of the Santa Ana River Basin downstream of Prado Dam as against those in the upstream area, and provides a physical solution to implement the provisions of the Judgment. The physical solution accomplishes, in general, a regional intrabasin allocation of the surface flow of the Santa Ana River System. All defendants and cross-defendants were dismissed except the four major public water districts within the Santa Ana River Basin; namely, the San Bernardino Valley Municipal Water District (SBVMWD), Western Municipal Water District (WMWD), Chino Basin Municipal Water District (CBMWD) and Orange County Water District (OCWD). The boundaries of these districts are shown on Plate 1. This arrangement leaves to each of the major hydrologic units in the watershed the determination and regulation of individual rights therein and the development and implementation of its own basin management plan. The history of the litigation and the Summary of the Judgment were included in the annual report for the water year 1974-75.

In order to administer the provisions of the Judgment, the court appointed a Watermaster composed of five persons. During the 1983-84 water year, the Santa Ana River Watermaster Committee consisted of Harvey O. Banks, William J. Carroll, James C. Hanson, William R. Mills, Jr. and Donald L. Harriger. Mr. Banks serves as Chairman, and Mr. Mills serves as Secretary. The office of the Santa Ana River Watermaster is located at 972 Town and Country Rd., P.O. Box 5367, Orange, California 92667.

The time for submission of the annual report is now seven months after the end of each water year. The items to be reported upon are listed in the letter of transmittal of this report.

Stream Flow and Water Quality Measurements

Stream flow measurements and water quality data required by the Watermaster are, for the most part, furnished by the U.S. Geological Survey (USGS). The financing of the cooperative monitoring program with the USGS is shared by the parties to the Judgment. These costs are set forth in Table 1.

The USGS measured and computed the mean daily discharge of the Santa Ana River at MWD Crossing and below Prado Dam. Runoff data have also been provided for several smaller streams tributary to Prado Reservoir; namely, Chino Creek at Schaefer Avenue, Cucamonga Creek near Mira Loma and Temescal Wash at Corona, and for the Santa Ana River near Mentone, at E Street in San Bernardino and at Mission Blvd.

Precipitation during 1983-84 was below normal and totaled 10.81 inches at San Bernardino County Hospital. Only 1.88 inches were recorded after December 1983. Despite the below normal rainfall, storm runoff was continuous from October to the end of April at both the Riverside Narrows and at Prado. Storm runoff occurred again in late July and in mid-September.

The 1983-84 discharge record for the USGS gaging station, "Santa Ana River below Prado" is considered by the USGS to be a "good" record. Twenty-three direct discharge measurements, which ranged from 98 to 697 cubic feet per second, were made during the year. Beginning on October 1, 1983, the discharge was regulated by Prado Reservoir with a maximum of 16,536 acre-feet in storage on December 26, 1983. The maximum average daily discharge after regulation by Prado Reservoir occurred on December 28, 1983 and amounted to 1,940 cubic feet per second. The mean annual discharge was approximately 246 cubic feet per second.

TABLE 1

COSTS TO THE PARTIES AND USGS FOR MEASUREMENTS WHICH PROVIDE DATA USED BY THE SANTA ANA RIVER WATERMASTER

October 1, 1983 to September 30, 1984

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT		
At Riverside Narrows (MWD Crossing)		
Water Quality Monitor/TDS Samples	$ 575	
Dozer	333	
At Mission Boulevard		
Surface Water Gage	436	$ 1,344
WESTERN MUNICIPAL WATER DISTRICT		
Same as SBVMWD	$ 1,345	
Cucamonga Creek Discharge	1,600	
Chino Creek Discharge	1,066	4,011
CHINO BASIN MUNICIPAL WATER DISTRICT		
Same as WMWD		4,011
ORANGE COUNTY WATER DISTRICT		
At Prado Dam		
Water Quality Monitor/TDS Samples, Water Quality Sampling and Conductivity Programs	$11,275	
At Mission Boulevard		
Surface Water Gage	872	
Chino Creek		
Surface Water Gage	1,067	13,214
TOTAL FOR PARTIES		$22,580
UNITED STATES GEOLOGICAL SURVEY		19,600
GRAND TOTAL		$42,180

Data related to the operation of Prado Reservoir were obtained from the Corps of Engineers. Water quality data were supplied to the Watermaster by the State Department of Water Resources, City of Riverside and City of Corona Sanitation Departments and Chino Basin Municipal Water District.

The overall 1983-84 discharge record for the USGS gaging station "Santa Ana River at MWD Crossing" is considered by the USGS to be a poor record at both low and high stages because of the shifting channel. The water stage recorder was inoperative most of the time due to the shifting of flow to the opposite side of the channel. Control of the channel by bulldozing was not attempted. The concrete low-flow control structure, submerged by 3 to 4 feet of sand during previous years, remained inoperative. The continuous downstream movement of sand deposits, however, continued to affect the stage discharge relationship for the station. Twenty-five direct discharge measurements which ranged from 58 to 838 cfs were made during the year which helped to improve the overall quality of the record.

Water was pumped from Lake Elsinore and discharged into Temescal Wash starting on October 1 and continued intermittently through January 14. Data on the amount pumped and daily spill from Lee Lake were furnished by Riverside County Flood Control and Water Conservation District and Temescal Water Company, respectively. Quality data were provided by Riverside County Health Department and Temescal Water Company.

Compilation and Analysis of Basic Data

The Watermaster has established procedures for compiling and analyzing the basic data necessary to carry out the provisions of the Judgment. The records maintained by the Watermaster have been listed in prior annual reports. Based on these data, determinations were made of the Base Flow, Storm Flow, Nontributary Flow, Lake Elsinore flow passing Prado, and relationships between electrical conductivity (EC) and total dissolved solids (TDS). These determinations are explained in detail in Chapters III and IV.

Administration Costs

In accordance with Paragraph 7(d) of the Judgment, the fees and expenses of each of the members of the Watermaster are to be borne by the district which nominated such member. All other Watermaster administrative costs and

expenses are borne by the parties, with OCWD paying 40 percent of the cost and WMWD, SBVMWD, and CBMWD each paying 20 percent of the cost. The Judgment further provides that the Watermaster may from time to time, at its discretion, require advances of operating capital from the parties.

At its meeting on June 22, 1983, the Watermaster adopted a budget for the fiscal year 1983-84 in the amount of $14,000. At its meeting on May 10, 1984 the Watermaster adopted a budget for the fiscal year 1984-85 in the amount of $14,000. Table 2 shows the items and amounts included in said budgets together with actual expenses for the fiscal year 1983-84.

TABLE 2

SANTA ANA RIVER WATERMASTER BUDGET AND EXPENSES

	July 1, 1983 to June 30, 1984 Budget	July 1, 1983 to June 30, 1984 Expenses	July 1,1984 to June 30, 1985 Budget
Administration	$ 3,000.00	$2,696.00	$ 3,000.00
Support Engineering Services	8,000.00	8,474.00	8,000.00
Reproduction of Annual Report	3,000.00	1,960.00	3,000.00
Total	$14,000.00	$13,130.00	$14,000.00

An audit prepared by Diehl, Evans and Company showing the details of income and expenses of the Santa Ana River Watermaster for the fiscal year 1983-84 is included herein as Appendix F.

Summary of Findings

A summary of findings by the Watermaster for the period 1970-71 through 1983-84 is presented in Table 3. The Base Flow obligations at both Riverside Narrows and Prado Dam provided for in the Judgment have been met and cumulative credits have been established.

TABLE 3

SUMMARY OF FINDINGS AT PRADO

Water Year	Rainfall (in)(1)	Total Flow (ac-ft)(2)	Base Flow (ac-ft)	Weighted TDS (mg/l)(3)	Adjusted Base Flow (ac-ft)	Cumulative Credit (ac-ft)
1970-71	11.97	51,864	38,402	727	38,402	(3,598)
1971-72	9.62	51,743	40,416	707	40,416	(5,182)
1972-73	18.46	77,484	48,999	638	51,531	4,349
1973-74	12.72	63,620	43,106	633	45,513	7,862
1974-75	13.49	61,855	50,176	694	51,263	17,125
1975-76	15.86	59,209	45,627	635	48,098	23,223
1976-77	11.95	62,953	48,387	660	50,000	31,223
1977-78	30.47	252,837	58,501	383	73,955	63,178
1978-79	17.51	134,486	71,863	580	79,049	100,227
1979-80	30.93	527,760	82,509	351	106,505	164,732
1980-81	10.45	117,888 (4)	74,875 (5)	728	74,875 (5)	205,652 (6)
1981-82	18.34	143,702	81,548	584	89,431	253,083
1982-83	32.36	426,273 (4)	111,692 (5)	411	138,591 (5)	353,036 (6)
1983-84	10.81	178,395 (4)	109,231 (5)	627	115,876 (5)	431,514 (6)

AT RIVERSIDE NARROWS

Water Year	Rainfall (in)(1)	Total Flow (ac-ft)(2)	Base Flow (ac-ft)	Weighted TDS (mg/l)(3)	Adjusted Base Flow (ac-ft)	Cumulative Credit (ac-ft)
1970-71	11.97	24,112	17,061	704	17,012	1,762
1971-72	9.62	22,253	16,157	712	16,017	2,529
1972-73	18.46	32,571	17,105	700	17,105	4,384
1973-74	12.72	24,494	16,203	700	16,203	5,337
1974-75	13.49	19,644	15,445	731	15,100	5,187
1975-76	15.86	26,540	17,263	723	16,977	6,914
1976-77	11.95	23,978	18,581	722	18,286	9,950
1977-78	30.47	181,760	22,360	726	21,941	16,641
1978-79	17.51	47,298	26,590	707	26,456	27,847
1979-80	30.93	254,077 (8)	25,549 (8)	676	25,549	38,146
1980-81	10.45	34,278	19,764	715	19,550	42,446
1981-82	18.34	83,050	32,778	678	32,778	59,974
1982-83	32.36	279,987	57,128	610	57,128	101,852
1983-84	10.81	82,745	56,948	647	56,948	143,550

(1) Measured at San Bernardino County Hospital.
(2) Does not include Nontributary Flow.

(3) For Base and Storm Flow at Prado and Base Flow only at Riverside Narrows.
(4) Includes 16,090 acre-feet of water pumped from Lake Elsinore which passed Prado Dam in 1980-81; 7,720 acre-feet in 1982-83 and 12,550 acre-feet in 1983-84.
(5) Excludes water pumped from Lake Elsinore.
(6) Includes 8,045 acre-feet in 1979-80, 3,362 acre-feet in 1982-83, and 4,602 acre-feet in 1983-84 of Lake Elsinore discharge.
(7) Includes Rubidoux Wastewater in 1979-80 and subsequent years.

Note: For the years 1973-74 through 1979-80, a correction has been made for different losses of State water than assumed in reports published for these years. The values changed are Base Flow, weighted TDS, and adjusted Base Flow, and these changes in turn have changed the cumulative credit for these years. See Appendix C in the Twelth Annual Report, 1981-1982.

CHAPTER II
WATER SUPPLY CONDITIONS

The precipitation in the Santa Ana River Watershed during 1983-84, as represented by rainfall measured at San Bernardino County Hospital, was about 60 percent of normal in terms of the Base Period average. Accordingly, the total flow of the Santa Ana River below Prado Dam during the 1983-84 water year decreased to 178,730 acre-feet as compared to a total flow of 426,273 acre-feet which occurred in the previous year. Despite below normal rainfall in the Santa Ana River Watershed during 1983-84 the effects of the heavy rainfall which occurred in 1977-78, 1979-80 and 1982-83 continue to be felt with the Base Flow amounts at Riverside Narrows and Prado of 56,948 acre-feet and 109,231 acre-feet respectively. These Base Flows are only slightly less than the all time highs that occurred in 1982-83.

Precipitation During 1983-84

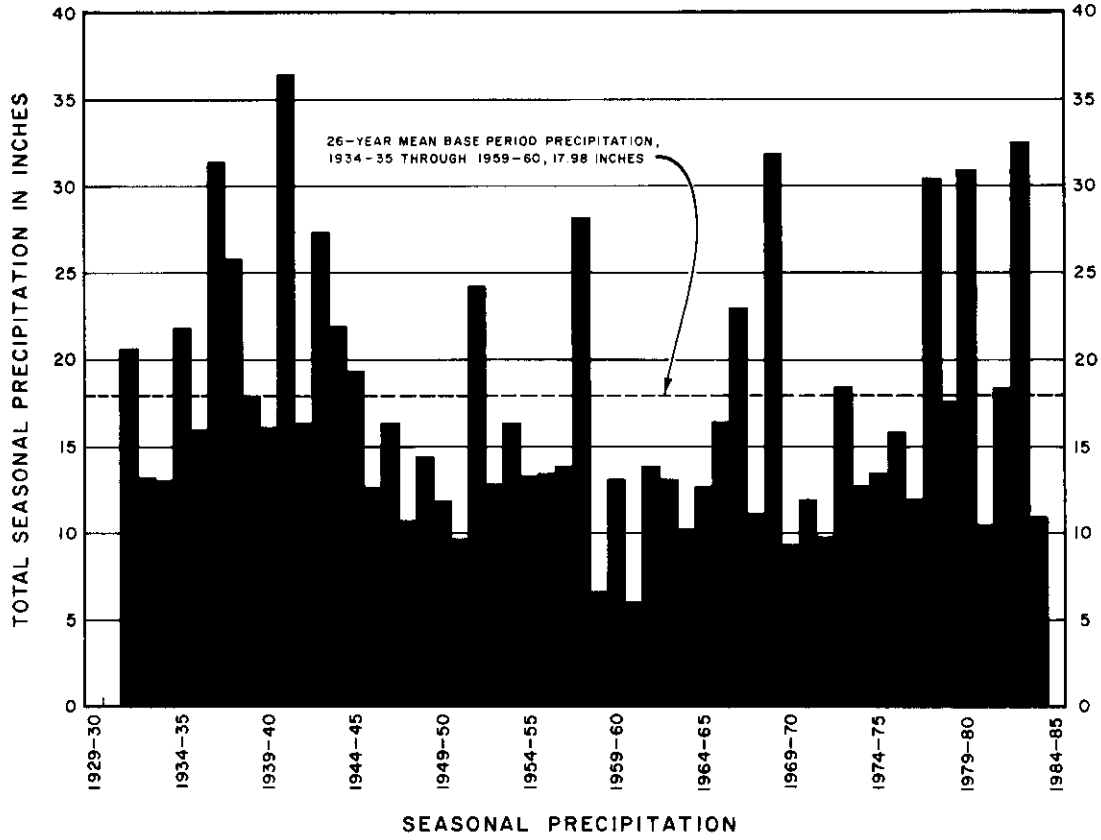
During the 1983-84 water year, the precipitation at the San Bernardino County Hospital amounted to 10.81 inches, which is 60 percent of the Base Period average. Most of the precipitation, 83 percent, occurred during the months of October, November and December. The maximum monthly precipitation of 3.55 inches occurred during November.

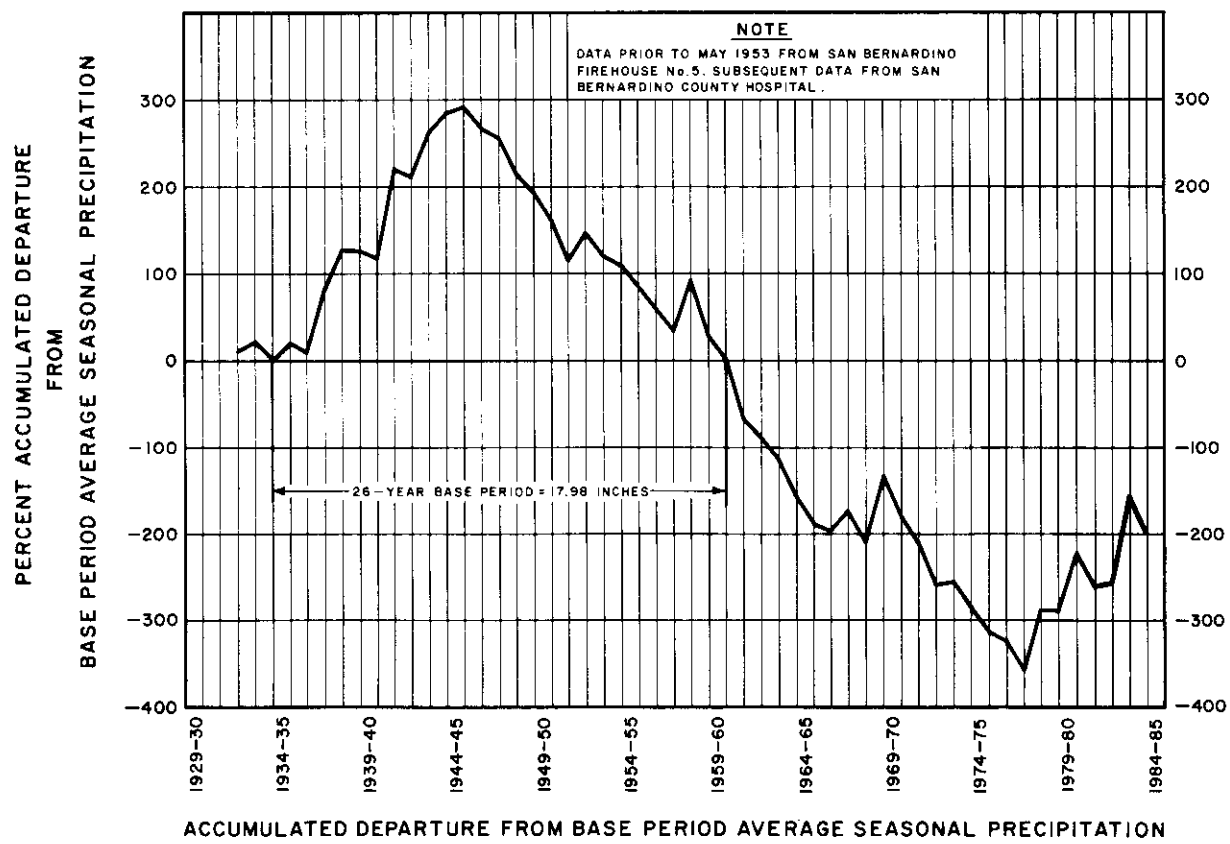
Figure 1 shows the seasonal precipitation from 1931-32 through 1983-84 and the accumulated departure from the 1934-35 through 1959-60 Base Period average.

Runoff During 1983-84

Below Prado Dam

The total seasonal flow at Prado for the 1983-84 water year less Non-tributary Flow was 178,395 acre-feet which is well above the Base Period (1934-35 through 1959-60) average of 78,780 acre-feet per year.





VARIATION IN PRECIPITATION AT SAN BERNARDINO

FIGURE 1

After 1943-44, the Base Flow at Prado Dam progressively decreased and reached a low in 1960-61 of 26,190 acre-feet. Since that year, the Base Flow has substantially increased. During the fourteen-year period (1970-71 through 1983-84) since the Judgment went into effect, the Base Flow, unadjusted for quality, has averaged 64,667acre-feet per year. This compares to the 26-year Base Period average of 47,470 acre-feet and the Base Flow requirements under the Judgment of 42,000 acre-feet. The 1983-84 Base Flow amounted to 109,231 acre-feet, an increase of 44,564 acre-feet over the fourteen-year average.

The calculated inflow to Prado Reservoir during the month of December amounted to 33,439 acre-feet or 19 percent of the seasonal total. The maximum storage in Prado Reservoir occurred on December 26, 1983 when 16,536 acre-feet (about 8 percent of the reservoir capacity at spillway level) was in storage. The maximum release of 1,940 cfs from Prado Reservoir occurred on December 28, 1983.

Figure 2 shows the Storm and Base Flow components of the Total Flow and the estimated contribution to the outflow from Lake Elsinore in the Santa Ana River below Prado Dam during the period 1934-35 through 1983-84.

At Riverside Narrows

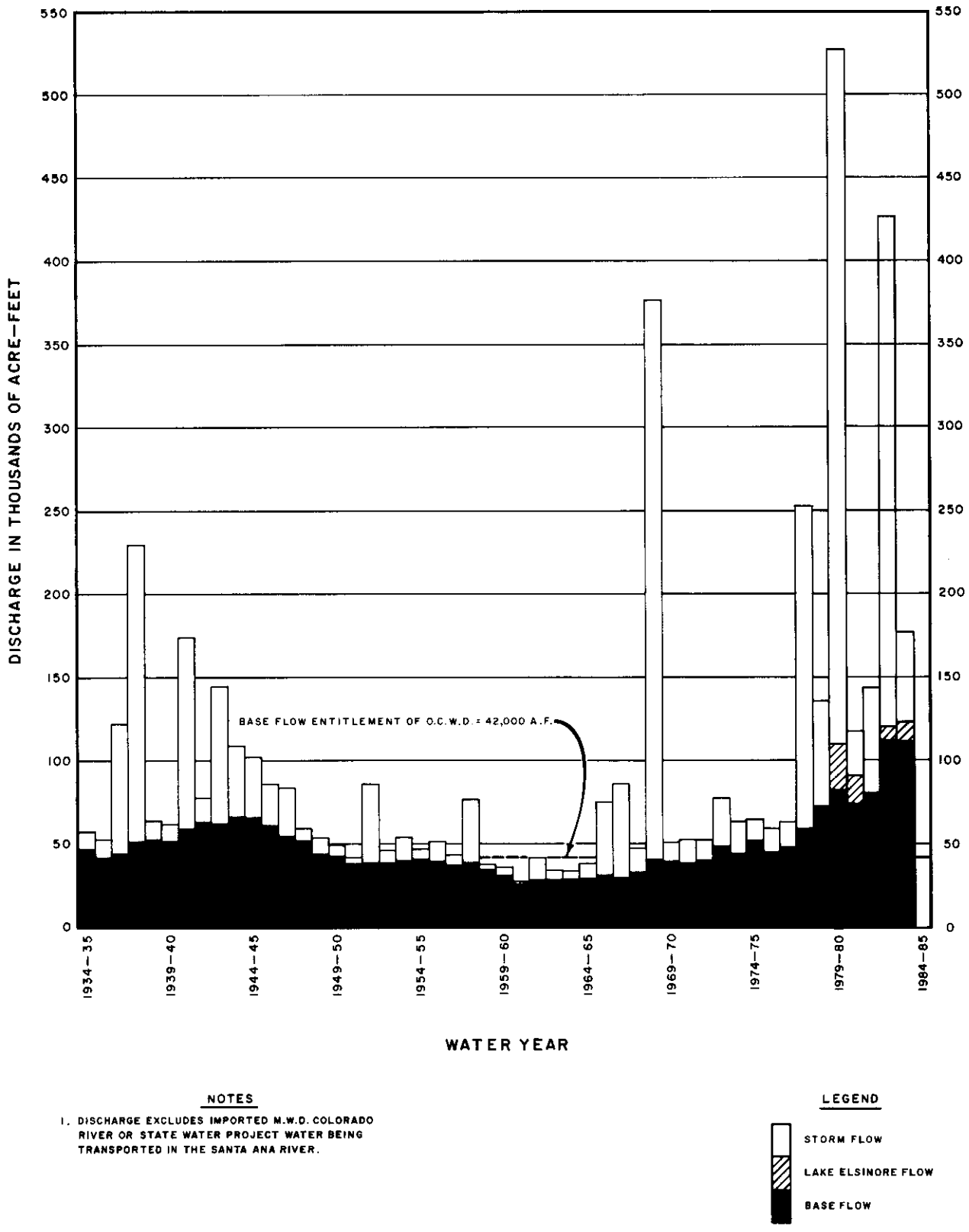
The Total Flow less Nontributary Flow of the Santa Ana River at Riverside Narrows for the 1983-84 water year was 82,745 acre-feet.

The Base Flow at Riverside Narrows decreased from 27,120 acre-feet in 1943-44 to an all-time low of 13,450 acre-feet in 1965-66. Since that time, the Base Flow at Riverside Narrows has gradually increased. During the fourteen-year period 1970-71 through 1983-84, the Base Flow has averaged 25,638 acre-feet per year. The 1983-84 Base Flow amounted to 56,948 acre-feet, an increase of 31,310 acre-feet over the fourteen-year average.

Figure 3 shows the components of Total Flow in the Santa Ana River at Riverside Narrows for the period from 1934-35 through 1983-84.

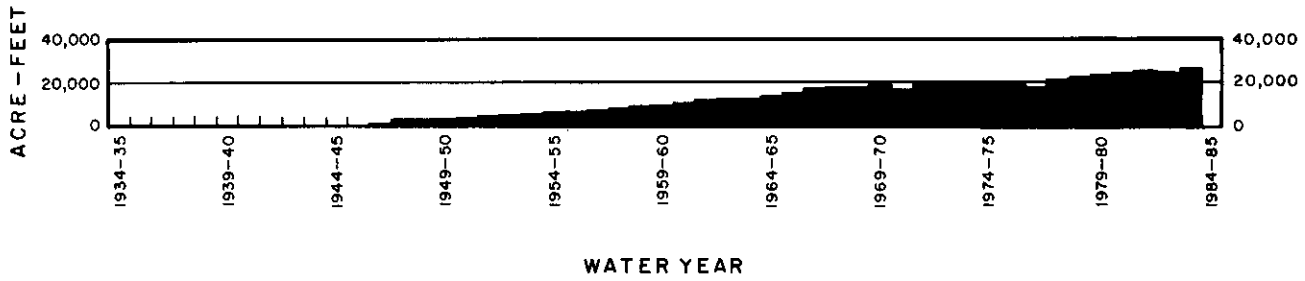
Wastewater Effluent Discharges

A portion of the Base Flow at Prado is made up of treated wastewater effluent discharged from the Riverside Water Quality Control Plant, the Chino Basin Municipal Water District's Regional Plants No. 1 and 2 and the City of Corona Treatment Plant.

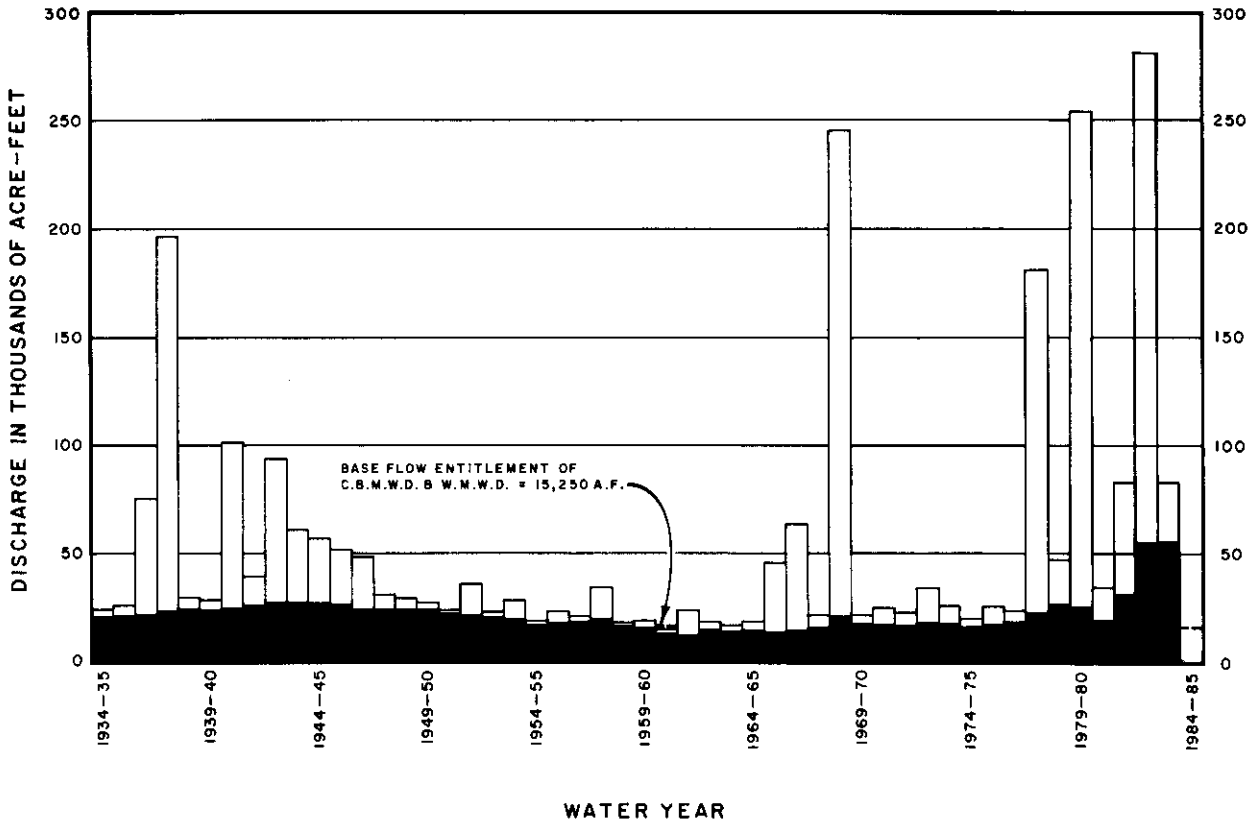


DISCHARGE OF SANTA ANA RIVER BELOW PRADO DAM

FIGURE 2



SEWAGE EFFLUENT FROM RIVERSIDE WATER QUALITY CONTROL PLANT



NOTES

1. DISCHARGE EXCLUDES SEWAGE EFFLUENT FROM THE RIVERSIDE WATER QUALITY CONTROL PLANT AND IMPORTED M.W.D. COLORADO RIVER OR STATE WATER PROJECT WATER BEING TRANSPORTATION IN THE SANTA ANA RIVER.

2. DISCHARGE OF WASTEWATER FROM RUBIDOUX INCLUDED IN BASE FLOW COMMENCING IN 1979-80.

LEGEND

STORM FLOW

BASE FLOW

DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS

FIGURE 3

Since the late 1940's, the wastewater effluent from the Riverside Water Quality Control Plant, which is discharged at the Riverside Narrows between Pedley Bridge and the MWD Crossing, has been increasing in amount. In 1949-50, the amount of treated effluent discharged was 3,960 acre-feet. By 1959-60, the discharge had increased to 9,900 acre-feet. By 1969-70, the discharge of effluent from the treatment plant was 18,657 acre-feet. The wastewater discharge of the Riverside Water Quality Control Plant during 1983-84 was 26,092 acre-feet.

CBMWD's Regional Plants No. 1 and 2 began discharging to the Santa Ana River in 1971-72 and 1973-74, respectively, and in 1983-84 discharged 24,902 acre-feet of effluent to the Santa Ana River.

The City of Corona Sewage Treatment Plant discharged 3,192 acre-feet of treated wastewater effluent to the River in 1970-71. This discharge has increased to 6,196 acre-feet in 1983-84.

Table 4 sets forth the amount of treated wastewater effluent discharged to the Santa Ana River between Riverside Narrows and Prado Dam during the period 1970-71 through 1983-84. The values show that over the last fourteen years, the amount of treated wastewater discharged to the River between these two points has more than doubled.

TABLE 4

TREATED WASTEWATER EFFLUENT DISCHARGED TO THE SANTA ANA RIVER RIVERSIDE NARROWS TO PRADO DAM

(ACRE-FEET)

Year	Riverside	Corona	CBMWD #1	CBMWD #2	Total
1970-71	18,619	3,192	0	0	21,811
1971-72	19,006	3,227	6,742	0	28,975
1972-73	19,061	3,342	10,384	0	32,878
1973-74	19,561	3,507	11,435	2,322	36,825
1974-75	19,343	4,015	14,960	2,282	40,600
1975-76	19,579	4,699	15,448	2,947	42,673
1976-77	18,766	5,012	14,638	3,381	41,797
1977-78	20,314	5,201	14,651	4,061	44,227
1978-79	21,068	5,393	15,035	5,069	46,565
1979-80	22,910	5,364	14,413	5,523	48,210
1980-81	24,180	5,590	17,269	5,264	52,303
1981-82	25,643	5,409	19,575	5,364	55,991
1982-83	25,020	5,862	20,787	4,294	55,963
1983-84	26,092	6,196	20,948	3,954	57,190

CHAPTER III
BASE FLOW AT PRADO

This chapter deals with determinations of: 1) the components of flow at Prado Dam, which include Nontributary Flow, discharge from Lake Elsinore, Storm Flow, and Base Flow; and 2) the adjusted Base Flow at Prado credited to CBMWD and WMWD.

Total Flow at Prado

The total flow of the Santa Ana River at Prado amounted to 178,730 acre-feet, measured at the USGS gaging station below Prado Dam, which amount included 789 acre feet of storage carried over from the previous year. Separated into its components, Base Flow was 109,231 acre-feet, Storm Flow was 55,825 acre-feet. Nontributary Flow during 1983-84 due to the release of State water above Riverside Narrows during 1972-73 was 335 acre-feet, and discharge due to the pumpout program from Lake Elsinore that passed Prado Dam was 12,550 acre-feet. The components of flow of the Santa Ana River at Prado Dam for each month in the 1983-84 water year are listed in Table 5, and are shown graphically on Plate 2.

Nontributary Flow

Since May 1973, OCWD has from time to time purchased State water for the replenishment of the groundwater basins in Orange County. The water has been released at two locations: Santa Ana River above Riverside Narrows and San Antonio Creek near Upland.

Releases Above Riverside Narrows

As fully discussed in Appendix F of the Fifth Annual Report, the Watermaster Committee made a determination of a schedule of credits to OCWD for State Water released above Riverside Narrows during 1972-73. For 1983-84 the credit is 335 acre-feet, assumed to be distributed uniformly throughout the year, as shown in Table 5.

TABLE 5

COMPONENTS OF FLOW AT PRADO DAM
FOR WATER YEAR 1983-84
(acre-feet)

Month	Prado Outflow	Storage Change (1)	Computed Inflow	Elsinore Discharge	Storm Flow	Base Flow	Nontrib. Flow (2)
October	21,159	(795)	20,364	1,132	10,830	8,374	28
November	18,182	9,370	27,552	4,495	13,449	9,580	28
December	38,692	(5,249)	33,443	4,605	17,306	11,504	28
January	25,192	(4,119)	21,073	2,318	6,524	12,203	28
February	13,774	(2)	13,772	0	2,732	11,012	28
March	12,295	8	12,303	0	1,783	10,492	28
April	10,365	14	10,379	0	1,444	8,907	28
May	9,044	(16)	9,028	0	289	8,711	28
June	8,154	0	8,154	0	0	8,126	28
July	7,589	0	7,589	0	543	7,018	28
August	7,284	0	7,284	0	191	7,065	28
September	7,000	0	7,000	0	734	6,239	27
Total	178,730	(789)	177,941	12,550	55,825	109,231	335

(1) The monthly change in storage is included in the monthly components of flow.

(2) That portion of State water released during 1972-73 upstream of Riverside Narrows, determined to have reached Prado Dam in 1983-84.

Releases to San Antonio Creek

During water year 1983-84, OCWD did not purchase State water to be released from the Rialto Reach of the Foothill Feeder at OC-59 into San Antonio Creek near Upland. Therefore, there was no Nontributary Flow of State water through Prado Dam from this source during 1983-84.

Discharge from Lake Elsinore

Due to the continued high water levels resulting from the storms during the 1982-83 water year, the Lake Elsinore pumpout program was initiated on June 22, 1983. This pumpout program continued intermittently into the 1983-84 water year until January 14, 1984. A total volume of 13,817 acre-feet was discharged to Temescal Wash from the Lake by the program during water year 1983-84.

To determine the amount of Lake Elsinore discharge reaching Prado Dam, data for spill from Lee Lake were used. Due to the fact that Storm Flow occurred during the Lake Elsinore pumpout program, the scalping procedure could not be used to determine the amount of Lake Elsinore discharge reaching Prado Dam. As there was no surface diversion between Lee Lake and Prado Dam, it was assumed 5 percent of the spill from Lee Lake was lost prior to reaching Prado Dam. The procedure is identical to the procedure used to determine the volume of Lake Elsinore discharge passing Prado Dam during the 1982-83 water year. The total amount of Lake Elsinore discharge passing Prado Dam in the water year 1983-84 was 12,550 acre-feet. This total and the monthly distribution are shown in Table 5.

Storm Flow

Generally during storms, the U.S. Army Corps of Engineers operates the Prado gates so that some of the storm runoff is temporarily held in storage behind the dam. As the storm ends, Prado Reservoir storage is generally reduced by the controlled releases to the downstream water conservation facilities operated by OCWD. Monthly and annual quantities of Storm Flow are shown in Table 5.

The U.S. Army Corps of Engineers has an established operations guideline schedule with respect to required reservoir releases for specific water surface elevations. With water elevations above 490 feet, the elevation of the top of the debris pool, water is released at a progressive increase in flowrate to a maximum of 5,000 cfs. This maximum flowrate is maintained until the water surface

elevation reaches the spillway crest elevation at 543 feet. The original reservoir operation plan, although never officially changed, was modified during water year 1977-78 by an Executive Order from President Carter which requested all government agencies to make every effort to maximize water conservation.

During water-year 1979-80, the Corps of Engineers initiated a study to reevaluate its operations schedule to increase the water conservation potential of Prado Reservoir while maintaining flood control protection for downstream areas. The study has not been completed and Prado Dam was operated generally under the original guidelines during the water year 1983-84.

During the 1983-84 water year, more than 100 acre-feet of water was stored behind Prado Dam during the periods October 1 to October 11, 1983; November 2 to November 12, 1983; November 14, 1983 to January 1, 1984; and January 2 to January 23, 1984. During those periods, the water stored in Prado Reservoir varied up to a maximum of 16,536 acre-feet and the maximum mean daily flow released to the Santa Ana River was 1,940 cfs.

Base Flow

The determination of Base Flow was affected by Nontributary Flow which had been released above Riverside Narrows and the discharge from Lake Elsinore this year reaching Prado Dam via the Temescal Wash. The general procedure used by the members of the Watermaster to separate the 1983-84 flow components was the same as used for previous years and is fully described in the Fifth Annual Report. The monthly and annual amounts are shown in Table 5.

Water Quality

The weighted average total dissolved solids (TDS) for the total flow passing Prado Dam, including Nontributary Flow released above Riverside Narrows was found to be 633 mg/l. This determination was based on continuous measurements of electrical conductivity (EC) by the USGS at the Santa Ana River below Prado, supplemented by grab samples of EC and TDS, and a statistical correlation of EC and TDS.

The EC of the outflow at Prado Dam was recorded hourly on a punched tape by the USGS. The USGS collected a total of 30 grab samples and performed laboratory analyses for TDS. A correlation between TDS and EC was developed using the TDS data from the grab samples and the EC recorded by the

meter at the times when the samples were collected. Data used for the statistical analysis are listed in Table B-1, Appendix B. The statistical analysis yields the best fit equation shown below:

$$TDS = 1020 - (369735 \div EC)$$

where: TDS = mg/l
EC = micromhos/cm

Application of the equation relating EC to TDS provided hourly TDS values. Using hourly data, flow weighted average daily values for TDS were computed and are listed in Table B-2, Appendix B.

The plot of TDS on Plate 3 shows the daily average TDS concentration of flow of the Santa Ana River passing Prado Dam. The daily average TDS concentration was calculated from the continuous EC measurements and the correlation of EC and TDS. As daily TDS concentration could not be determined during the period when continuous EC data were not available, TDS was assumed to be unchanged unless there was a change in the amount of storm flow reaching Prado Dam. The TDS concentration would decrease at the on-set of a storm and would increase with a decrease in storm flow; the extent of the increase or decrease in TDS concentration was determined by the TDS concentration of the next available grab sample. In the case when two samples were taken during a period of no change in the amount of storm flow, the average TDS of the two samples was considered as the TDS of the flow during the period.

Water Quality Adjustment for Nontributary Flow and Discharge from Lake Elsinore

The weighted average annual TDS value of 633 mg/l, shown in Table B-3, Appendix B, represents the quality of Total Flow which includes Nontributary Flow from release of State water to Santa Ana River above Riverside Narrows and discharge from Lake Elsinore due to the pumpout program. The Judgment requires that Base Flow shall be subject to adjustment based on the TDS of Base Flow and Storm Flow only. Hence, the following determination of Base Flow plus Storm Flow TDS has been made.

The flow weighted average TDS of State water released above Riverside Narrows during 1972-73 was 235 mg/l and was adjusted to 242 mg/l to reflect a 3 percent evapotranspiration loss of the water released.

The flow weighted average TDS of Lake Elsinore water at the point of release to the Temescal Wash in 1983-84 was 652 mg/l as shown in Table C-1, Appendix C. A total of 13,817 acre-feet was pumped from Lake Elsinore. It is assumed that the amount of salt transported down the Temescal Wash to Prado Dam was unchanged. As there was no surface diversion of water between the discharge point at Lake Elsinore and Prado Dam, a total of 9,005,580 acre-feet-mg/l of salt reached Prado Dam due to the pumpout program.

		Annual Flow (acre-feet)	Average TDS (mg/l)	Annual Flow X Average TDS (acre-feet-mg/l)
1.	Total Flow	178,730	633	113,136,090
2.	Nontributary Flow Riverside Narrows	335	242	81,070
3.	Lake Elsinore Flow	12,550 (1)	718 (2)	9,005,580 (3)
4.	Total Base and Storm Flows	165,845		104,049,440
5.	Average TDS of Total Base and Storm Flows	104,049,440 ÷ 165,845 = 627 mg/l		

(1) 95 percent of Lee Lake spillage was asssumed to have reached Prado Dam.

(2) Determined from total salts transported down Temescal Wash to Prado Dam and total flow reaching Prado Dam and Lake Elsinore.

(3) Determined from pumped out volume from Lake Elsinore and average TDS at the discharge outlet.

After adjusting for Nontributary Flows of State water from Riverside Narrows, the weighted average annual TDS of Storm Flow and Base Flow for 1983-84 was 627 mg/l.

Adjusted Base Flow

According to the Judgment, "The amount of Base Flow at Prado received during any year shall be subjected to adjustment based on weighted average annual TDS in Base Flow and Storm Flow at Prado as follows:

If the Weighted Average TDS in Base Flow and Storm Flow at Prado is:	Then the Adjusted Base Flow shall be determined by the formula:
Greater than 800 mg/l	$Q - \frac{35}{42,000} Q\ (TDS-800)$
700 mg/l - 800 mg/l	Q
Less than 700 mg/l	$Q + \frac{35}{42,000} Q\ (700-TDS)$

Where: Q = Base Flow actually received."

The weighted average annual TDS of 627 mg/l is less than 700 mg/l. Therefore, the Base Flow of acre-feet must be adjusted by the above equation for TDS less than 700 mg/l. Thus the Adjusted Base Flow is as follows:

$$(109,231 \text{ A.F.}) + \frac{35}{42,000} (109,231 \text{ A.F.})(700-627) = 115,876 \text{ A.F.}$$

Entitlement and Credit or Debit

From pages 12 and 13 of the Judgment, the following obligation of the CBMWD and WMWD is given: "CBMWD and WMWD shall be responsible for an average annual Adjusted Base Flow of 42,000 acre-feet at Prado..... CBMWD and WMWD each year shall be responsible for not less than 37,000 acre-feet of Base Flow at Prado, plus one-third of any cumulative debit; provided, however, that for any year commencing on or after October 1, 1986, when there is not cumulative debit, or for any year prior to 1986 whenever the cumulative credit exceeds 30,000 acre-feet, said minimum shall be 34,000 acre-feet."

The Watermasters agreed that Lake Elsinore flows were not envisioned during the formulation of the Judgment and because of the occurrence of Lake

Elsinore water at Prado, the Watermaster decided, as in previous years, to credit one-half of the amount of Lake Elsinore flow recharging the groundwater basin in Orange County against the Base Flow obligation at Prado Dam.

Of the 12,550 acre-feet of Lake Elsinore discharge reaching Prado Dam, 3,346 acre-feet flowed past the gage in the Santa Ana River at Fifth Street and was considered as lost to the ocean. Therefore, a net amount of 9,204 acre-feet of Lake Elsinore discharge recharged the Orange County groundwater basin in 1983-84. One-half of such amount has been considered a credit against the Upper Area Base Flow obligation at Prado Dam. Thus, an additional 4,602 acre-feet were credited to the Cumulative Adjusted Base Flow.

The Watermaster's findings at Prado for 1983-84 required under the Judgment are as follows:

1.	Total Flow at Prado	178,730	acre-feet
2.	Base Flow at Prado	109,231	acre-feet
3.	Annual Weighted TDS of Base and Storm Flows	627	mg/l
4.	Annual Adjusted Base Flow	115,876	acre-feet
5.	One-half Lake Elsinore Discharge reaching Prado Dam and Recharging Orange County Groundwater Basin	4,602	acre-feet
6.	Cumulative Adjusted Base Flow	1,019,514	acre-feet
7.	Cumulative Entitlement of OCWD	588,000	acre-feet
8.	Cumulative Credit	431,514	acre-feet
9.	One-Third of Cumulative Debit	0	acre-feet
10.	Minimum Required Base Flow in 1984-85	34,000	acre-feet

CHAPTER IV
BASE FLOW AT RIVERSIDE NARROWS

This chapter deals with determination of 1) the components of flow at Riverside Narrows, which include Nontributary Flow, Storm Flow, and Base Flow; and 2) the adjusted Base Flow at Riverside Narrows credited to SBVMWD.

Total Flow at Riverside Narrows

The total flow of the Santa Ana River at Riverside Narrows amounted to 83,087 acre-feet, measured at the USGS gaging station near the MWD Upper Feeder Crossing. Separated into its components, Base Flow was 56,948 acre-feet, Storm Flow was 27,684 acre-feet, and Nontributary Flow due to a prior release of State water above Riverside Narrows was 342 acre-feet. Included in Base Flow are 1,887 acre-feet of wastewater from Rubidoux Community Services District which now bypasses the USGS gaging station. This item is discussed on the following page. The components of flow of the Santa Ana River at Riverside Narrows for each month in the 1983-84 water year are listed in Table 6 and graphically shown on Plate 4.

Nontributary Flow

During the period May through September, 1973, 11,617 acre-feet of State water from the East Branch of the California Aqueduct was purchased by the Orange County Water District and released into the Santa Ana River in the vicinity of Colton.

The Watermaster's determination of the effect of these releases has been discussed in the Fifth Annual Report of the Watermaster. For the water year 1983-84 the amount of State water reaching Riverside Narrows has been agreed upon as 342 acre-feet.

TABLE 6

COMPONENTS OF FLOW AT RIVERSIDE NARROWS FOR WATER YEAR 1983-84

(acre-feet)

	Total Flow USGS Measurement	Storm Flow	Non-tributary Flow	Rubidoux Wastewater	Base(1) Flow
October	9,901	4,911	29	140	5,101
November	12,774	7,319	29	165	5,591
December	15,945	9,840	29	172	6,248
January	8,485	2,259	29	169	6,366
February	6,157	804	29	146	5,470
March	5,335	533	29	153	4,926
April	4,671	764	28	151	4,030
May	3,794	14	28	156	3,908
June	3,749	0	28	152	3,873
July	4,417	702	28	157	3,844
August	4,106	355	28	164	3,887
September	3,753	183	28	162	3,704
Total	83,087	27,684	342	1,887	56,948

(1) Base Flow includes Rubidoux wastewater.

Base Flow

Based on the hydrograph shown on Plate 4 and utilizing in general the same procedures reflected in the Work Papers of the engineers (as referenced in Paragraph 2 of the Engineering Appendix of the Judgment), a separation was made between Storm Flow and the sum of Base Flow and Nontributary Flow.

Nontributary Flow was assumed to be equally distributed throughout the year (342 acre-feet divided by 12 months) and subtracted from the sum of the Base Flow and Nontributary Flow as shown on Table 6.

In April 1980, Rubidoux Community Services District made the first delivery of wastewater to the regional waste treatment plant at Riverside. Prior to that time, Rubidoux had discharged to the river upstream of the Riverside Narrows Gaging Station. Wastewater from Rubidoux during water year 1983-84, in the

amount of 1,887 acre-feet as shown in Appendix E, has been added to the streamflow as measured at the gaging station. The Base Flow was determined to be 56,948 acre-feet, as shown on Table 6.

Water Quality

The determination of quality of water at the Riverside Narrows Gaging Station was made using periodic grab samples taken and analyzed for TDS by the USGS, the City of Riverside and the Department of Water Resources. The results are summarized in Appendix D, Table D-1. Table D-2 shows the flow weighted quality of the flow including the Nontributary Flow and excluding the Rubidoux wastewater. The Base Flow quality resulting from exclusion of the Nontributary Flow and inclusion of the Rubidoux wastewater is shown in the following table as 647 mg/l.

		Annual Flow (acre-feet)	Avg. TDS (mg/l)	(Annual Flow) x (Avg. TDS) (acre-feet - mg/l)
1.	Base Flow including Nontributary Flow and excluding Rubidoux Wastewater	55,403	640	35,466,386
2.	Less Nontributary Flow	342	237	81,054
3.	Plus Rubidoux Wastewater	1,887	760	1,434,640
4.	Base Flow	56,948	647	36,819,972

Adjusted Base Flow at Riverside Narrows

The Judgment provides that the amount of Base Flow at Riverside Narrows received during any year shall be subject to adjustment based on the weighted average annual TDS in such Base Flow as follows:

If the Weighted Average TDS in Base Flow at Riverside Narrow is:	Then the Adjusted Base Flow shall be determined by the formula:
Greater than 700 mg/l	$Q - \frac{11}{15,250} Q\ (TDS-700)$
600 mg/l - 700 mg/l	Q
Less than 600 mg/l	$Q + \frac{11}{15,250} Q\ (600-TDS)$

Where: Q = Base Flow actually received.

From the previous subsection, the weighted average annual TDS in the Base Flow at Riverside Narrows for the water year 1983-84 was 647 mg/l. Therefore, no adjustment is necessary, and the Adjusted Base Flow for 1983-84 is 56,948.

Entitlement and Credit or Debit

Paragraph 5(b) of the Judgment states that "SBVMWD shall be responsible for an average annual Adjusted Base Flow of 15,250 acre-feet at Riverside Narrows... SBVMWD each year shall be responsible at Riverside Narrows for not less than 13,420 acre-feet of Base Flow plus one-third of any cumulative debit, provided, however, that for any year commencing on or after October 1, 1986, when there is no cumulative debit, or for any year prior to 1986 whenever the cumulative credit exceeds 10,000 acre-feet, said minimum shall be 12,420 acre-feet."

The Watermaster's findings at Riverside Narrows for 1983-84 required under the Judgment are as follows:

1.	Base Flow at Riverside Narrows	56,948	acre-feet
2.	Annual Weighted TDS of Base Flow	647	mg/l
3.	Annual Adjusted Base Flow	56,948	acre-feet
4.	Cumulative Adjusted Base Flow	357,050	acre-feet
5.	Cumulative Entitlement of CBMWD and WMWD	213,500	acre-feet
6.	Cumulative Credit	143,550	acre-feet
7.	One-Third of Cumulative Debit	0	acre-feet
8.	Minimum Required Base Flow in 1984-85	12,420	acre-feet

APPENDIX A

STATE WATER RELEASED BY MWD TO SAN ANTONIO CREEK NEAR UPLAND

CONNECTION OC-59

1983-84

PREPARED BY

DONALD L. HARRIGER

TABLE A-1

NONTRIBUTARY WATER FROM OC-59
MONTHLY TOTALS
(Acre-Feet)

WATER YEAR 1983-84

No Water was Released in 1983-84 from OC-59 for
Orange County Water District

APPENDIX B

WATER QUALITY-
SANTA ANA RIVER BELOW PRADO DAM

1983-84

PREPARED BY

WILLIAM R. MILLS, JR.

METHOD OF ANALYZING WATER QUALITY DATA

Utilizing the USGS water quality records, the following analyses were performed by the Watermaster to determine the annual weighted TDS:

1. Mean daily flow weighted specific conductivity (EC) was calculated using the punched tape from the Prado water quality recorder, processed by a computer program designed by USGS. Input to the program included hourly EC data from the recorder tape, which was flow weighted using hourly discharge measurements from the water stage recorder. However, due to recorder malfunction, hourly EC data were not available from November 24-25, 1983, December 2-4, 25-26, 1983 and January 7 through February 14, 1984.

2. Laboratory analyses of the 30 grab samples taken by the USGS below Prado Dam during the 1983-84 season were run to determine both EC and TDS. Data from the grab samples are given in Table B-1. Results of these analyses were used to prepare a correlation between EC recorded on punched tape of the USGS at the times when the grab samples were collected and the corresponding TDS. A detailed discussion of this statistical analysis is presented in the Fifth Annual Watermaster Report.

3. The equation from the curve fitting operation was then used to determine the mean daily TDS corresponding to the mean daily EC values for each day of the year except for the period when the recorder was not functioning.

4. The TDS for the period when EC data were not available was estimated from grab sample data. The TDS concentration was assumed to be unchanged unless there was a change in the amount of storm flow. TDS concentration would increase when there was a decrease in storm flow and decrease with an increase in storm flow; the extent of the increase or

decrease in TDS concentration was determined by the TDS concentration of the next available grab sample. In the case when the samples were taken during a period of no change in the amount of storm flow, the average TDS of the two samples was considered as the TDS of the flow during the period.

5. The mean daily TDS values were then multiplied by the mean daily flow as shown in Table B-2. These products were then summed and divided by the total flow for the year to determine the weighted average TDS value for the water year. This value for TDS for the total flow including nontributary water was 633 mg/l of TDS for the 1983-84 water year. The weighted TDS calculation for the water year 1983-84 is shown in Table B-3.

TABLE B-1

USGS WATER QUALITY SAMPLES
BELOW PRADO DAM DURING WATER YEAR 1983-84

Date		EC (1) (micromhos/cm)	TDS (2) (mg/l)
OCTOBER	3	560	328
	19	1,080	677
NOVEMBER	4	1,110	684
	17	1,280	725
	17	1,230	725
DECEMBER	2	885	606
	19	975	625
JANUARY	9	1,140	693
	24	1,120	708
	24	1,120	685
FEBRUARY	9	1,180	731
	22	1,170	695
MARCH	2	1,180	718
	29	1,150	721
	29	1,140	734
APRIL	3	1,140	724
	13	1,160	715
	13	1,160	729
MAY	7	1,140	717
	25	1,140	698
	25	1,140	698
JUNE	5	1,120	706
	21	1,130	642
JULY	9	1,170	699
	23	1,110	671
	23	1,110	682
AUGUST	7	1,110	683
	16	1,120	698
SEPTEMBER	7	1,130	716
	25	1,120	710

(1) Field EC recording at the time of sampling
(2) Based on analysis of grab samples.

TABLE B-2

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

OCTOBER, 1983

DAY	PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	240	568	370	88724
2	566	568	370	209241
3	644	556	356	229029
4	567	608	413	233893
5	435	643	446	193841
6	495	677	474	234872
7	488	712	501	244652
8	604	742	522	315488
9	588	774	543	319244
10	565	804	561	316828
11	536	835	578	309717
12	516	860	591	304802
13	226	891	606	136879
14	227	921	619	140553
15	222	953	633	140450
16	218	985	645	140667
17	217	1000	651	141243
18	210	1000	651	136687
19	222	1100	685	151960
20	247	1100	685	169072
21	260	1100	685	177971
22	239	1100	685	163596
23	226	1100	685	154698
24	222	1100	685	151960
25	213	1100	685	145799
26	215	1100	685	147168
27	243	1100	685	166334
28	245	1100	685	167703
29	244	1100	685	167019
30	261	1100	685	178656
31	264	1100	685	180709
TOTAL	10665			5959458
MONTHLY FLOW WEIGHTED TDS				559

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

NOVEMBER, 1983

DAY	PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	223	1100	685	152644
2	183	962	636	116440
3	268	1100	685	183447
4	290	1100	685	198506
5	285	1100	685	195084
6	282	1100	685	193030
7	281	1100	685	192346
8	279	1200	713	198791
9	276	1200	713	196654
10	264	1200	713	188104
11	254	1200	713	180979
12	424	1100	685	290230
13	1430	697	490	700929
14	296	848	585	173047
15	128	871	596	76305
16	153	1000	651	99586
17	205	1000	651	133433
18	256	1000	651	166628
19	276	1000	651	179646
20	279	1000	651	181599
21	263	960	635	167133
22	233	982	644	150079
23	233	999	651	151572
24	140	999	651	91073
25	289	736	518	149780
26	462	736	518	239440
27	462	682	478	221064
28	266	788	551	146678
29	273	854	588	160437
30	211	931	623	131556
TOTAL	9164			5606239
MONTHLY FLOW WEIGHTED TDS				612

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

DECEMBER, 1983

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	344	996	649	223396
2	356	907	613	218221
3	175	907	613	107272
4	181	888	604	109371
5	260	888	604	157107
6	316	896	608	192120
7	392	872	597	233874
8	446	885	603	268870
9	485	883	602	291922
10	483	908	613	296286
11	482	913	616	296748
12	444	918	618	274332
13	401	931	623	250019
14	398	914	616	245209
15	399	979	643	256541
16	399	1000	651	259706
17	401	984	645	258597
18	401	986	646	258902
19	400	985	645	258104
20	417	1000	651	271422
21	444	990	647	287338
22	484	1000	651	315032
23	619	1000	651	402902
24	581	1000	651	378168
25	406	1100	685	277909
26	702	1100	685	480522
27	1210	903	611	739521
28	1940	619	423	821233
29	1910	540	336	641630
30	1850	607	412	761289
31	1780	726	511	910202
TOTAL	19506			10743765
MONTHLY FLOW WEIGHTED TDS				551

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

JANUARY, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	1650	778	545	899891
2	1210	930	623	753905
3	303	960	635	192552
4	218	957	634	138273
5	238	1100	685	162912
6	267	1100	685	182763
7	293	1100	685	200560
8	294	1200	713	209479
9	331	1200	713	235842
10	353	1200	713	251518
11	385	1200	713	274318
12	403	1200	713	287143
13	403	1200	713	287143
14	400	1200	713	285006
15	399	1200	713	284293
16	315	1200	713	224442
17	334	1100	685	228624
18	403	1100	685	275855
19	398	1100	685	272433
20	405	1100	685	277224
21	410	1100	685	280647
22	401	1100	685	274486
23	395	1100	685	270379
24	394	1100	685	269695
25	341	1100	685	233416
26	304	1100	685	208089
27	288	1100	685	197137
28	292	1100	685	199875
29	291	1100	685	199191
30	288	1100	685	197137
31	292	1100	685	199875
TOTAL	12698			8454102
MONTHLY FLOW WEIGHTED TDS				666

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

FEBRUARY, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	282	1100	685	193030
2	273	1100	685	186870
3	286	1100	685	195768
4	263	1100	685	180025
5	261	1200	713	185966
6	258	1200	713	183829
7	252	1200	713	179554
8	244	1200	713	173853
9	221	1200	713	157466
10	243	1200	713	173141
11	248	1200	713	176704
12	245	1200	713	174566
13	245	1200	713	174566
14	241	1200	713	171716
15	228	1200	713	162453
16	229	1200	713	163166
17	267	1200	713	190241
18	238	1200	713	169578
19	227	1200	713	161741
20	217	1200	713	154616
21	221	1200	713	157466
22	224	1200	713	159603
23	226	1200	713	161028
24	225	1200	713	160316
25	220	1200	713	156753
26	221	1200	713	157466
27	217	1200	713	154616
28	214	1200	713	152478
29	210	1200	713	149628
TOTAL	6946			4918200
MONTHLY FLOW WEIGHTED TDS				708

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

MARCH, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	198	1200	713	141078
2	215	1200	713	153191
3	210	1200	713	149628
4	209	1200	713	148915
5	204	1200	713	145353
6	206	1200	713	146778
7	215	1200	713	153191
8	208	1100	685	142377
9	212	1100	685	145115
10	207	1100	685	141692
11	207	1100	685	141692
12	208	1100	685	142377
13	206	1100	685	141008
14	230	1100	685	157436
15	242	1100	685	165650
16	204	1100	685	139639
17	208	1100	685	142377
18	199	1100	685	136216
19	186	1100	685	127318
20	183	1100	685	125264
21	180	1100	685	123211
22	185	1100	685	126633
23	180	1100	685	123211
24	178	1200	713	126828
25	185	1200	713	131815
26	190	1100	685	130056
27	195	1100	685	133478
28	186	1200	713	132528
29	189	1200	713	134665
30	188	1200	713	133953
31	187	1200	713	133240
TOTAL MONTHLY FLOW	6200	WEIGHTED TDS		4315911 696

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

APRIL, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	195	1200	713	138940
2	190	1100	685	130056
3	186	1100	685	127318
4	183	1100	685	125264
5	179	1100	685	122526
6	197	1100	685	134847
7	191	1100	685	130740
8	187	1100	685	128002
9	184	1100	685	125949
10	171	1100	685	117050
11	180	1100	685	123211
12	183	1200	713	130390
13	172	1100	685	117735
14	169	1100	685	115681
15	164	1000	651	106746
16	159	1000	651	103492
17	160	1000	651	104143
18	164	1000	651	106746
19	201	950	631	126918
20	222	980	643	142823
21	176	1000	651	114557
22	157	1000	651	102190
23	137	1100	685	93777
24	157	1000	651	102190
25	159	1000	651	103492
26	160	1000	651	104143
27	156	1000	651	101539
28	162	1100	685	110890
29	164	1100	685	112259
30	162	1100	685	110890
TOTAL	5227			3514502
MONTHLY FLOW WEIGHTED TDS				672

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

MAY, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	178	1100	685	121842
2	169	1100	685	115681
3	168	1100	685	114997
4	166	1100	685	113628
5	160	1100	685	109521
6	156	1100	685	106783
7	149	1200	713	106165
8	148	1200	713	105452
9	144	1200	713	102602
10	146	1200	713	104027
11	144	1200	713	102602
12	150	1200	713	106877
13	148	1100	685	101307
14	149	1100	685	101991
15	150	1100	685	102676
16	149	1100	685	101991
17	151	1100	685	103360
18	146	1100	685	99938
19	145	1100	685	99253
20	142	1100	685	97200
21	146	1100	685	99938
22	141	1100	685	96515
23	130	1100	685	88986
24	142	1100	685	97200
25	149	1100	685	101991
26	140	1200	713	99752
27	141	1200	713	100464
28	128	1200	713	91202
29	128	1200	713	91202
30	130	1200	713	92627
31	128	1200	713	91202
TOTAL	4561			3168968
MONTHLY FLOW WEIGHTED TDS				695

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

JUNE, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	130	1100	685	88986
2	135	1100	685	92408
3	143	1100	685	97884
4	141	1100	685	96515
5	148	1100	685	101307
6	151	1100	685	103360
7	150	1100	685	102676
8	144	1100	685	98569
9	141	1100	685	96515
10	138	1100	685	94462
11	134	1100	685	91724
12	144	1100	685	98569
13	144	1100	685	98569
14	141	1100	685	96515
15	156	1100	685	106783
16	145	1100	685	99253
17	146	1100	685	99938
18	138	1100	685	94462
19	134	1100	685	91724
20	130	1100	685	88986
21	134	1100	685	91724
22	130	1100	685	88986
23	131	1100	685	89670
24	132	1100	685	90355
25	137	1100	685	93777
26	133	1100	685	91039
27	121	1100	685	82825
28	117	1100	685	80087
29	119	1100	685	81456
30	125	1100	685	85563
TOTAL MONTHLY FLOW	4112			2814680
WEIGHTED TDS				685

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

JULY, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	122	1100	685	83509
2	120	1100	685	82140
3	122	1100	685	83509
4	116	1100	685	79402
5	114	1200	713	81227
6	117	1200	713	83364
7	120	1200	713	85502
8	119	1200	713	84789
9	111	1200	713	79089
10	109	1200	713	77664
11	104	1200	713	74101
12	102	1200	713	72676
13	100	1200	713	71251
14	103	1200	713	73389
15	121	1200	713	86214
16	138	1200	713	98327
17	127	1100	685	86932
18	123	1100	685	84194
19	117	1100	685	80087
20	131	1100	685	89670
21	129	1100	685	88301
22	125	1100	685	85563
23	123	1100	685	84194
24	122	1100	685	83509
25	117	1100	685	80087
26	115	1100	685	78718
27	115	1100	685	78718
28	128	1100	685	87617
29	194	1100	685	132794
30	174	1000	651	113255
31	149	1000	651	96983
TOTAL	3827			2646778
MONTHLY FLOW WEIGHTED TDS				692

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

AUGUST, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	148	1100	685	101307
2	131	1100	685	89670
3	123	1100	685	84194
4	126	1100	685	86247
5	125	1100	685	85563
6	121	1100	685	82825
7	120	1100	685	82140
8	111	1100	685	75980
9	113	1100	685	77349
10	116	1100	685	79402
11	114	1100	685	78033
12	115	1100	685	78718
13	109	1100	685	74611
14	109	1100	685	74611
15	110	1100	685	75295
16	123	1100	685	84194
17	118	1100	685	80771
18	122	1100	685	83509
19	126	1100	685	86247
20	127	1100	685	86932
21	128	1100	685	87617
22	133	1100	685	91039
23	130	1100	685	88986
24	119	1100	685	81456
25	118	1100	685	80771
26	117	1100	685	80087
27	111	1100	685	75980
28	108	1100	685	73926
29	103	1100	685	70504
30	99	1100	685	67766
31	100	1100	685	68450
TOTAL	3673			2514183
MONTHLY FLOW WEIGHTED TDS				685

1. TDS = 1020 - (369735/EC)

TABLE B-2 (continued)

WEIGHTED TDS CALCULATION

SANTA ANA RIVER AT PRADO DAM - WATER YEAR 1983-84

SEPTEMBER, 1984

DAY	OUTFLOW PRADO OUTFLOW (cfs-day)	DAILY MEAN EC (micromhos)	COMPUTED TDS (1) (mg/l)	OUTFLOW x TDS
1	100	1100	685	68450
2	85	1000	651	55326
3	97	1100	685	66397
4	98	1100	685	67081
5	98	1100	685	67081
6	93	1100	685	63659
7	93	1100	685	63659
8	91	1100	685	62290
9	95	1100	685	65028
10	114	1100	685	78033
11	132	1100	685	90355
12	135	1100	685	92408
13	124	1100	685	84878
14	117	1100	685	80087
15	114	1100	685	78033
16	125	1100	685	85563
17	199	1100	685	136216
18	147	1100	685	100622
19	134	1100	685	91724
20	125	1100	685	85563
21	130	1100	685	88986
22	129	1100	685	88301
23	131	1100	685	89670
24	125	1100	685	85563
25	122	1100	685	83509
26	113	1200	713	80514
27	120	1100	685	82140
28	118	1100	685	80771
29	116	1100	685	79402
30	110	1100	685	75295
TOTAL	3530			2416607
MONTHLY FLOW WEIGHTED TDS				685

1. TDS = 1020 - (369735/EC)

TABLE B-3

SUMMARY OF WEIGHTED TDS

BELOW PRADO DAM WATER YEAR 1983-84

MONTH	MONTHLY FLOW (cfs-day)	MONTHLY WEIGHTED TDS (mg/l)	MONTHLY FLOW TIMES TDS
OCTOBER	10,665	559	5,959,458
NOVEMBER	9,164	612	5,606,239
DECEMBER	19,506	551	10,743,765
JANUARY	12,698	666	8,454,102
FEBRUARY	6,946	708	4,918,200
MARCH	6,200	696	4,315,911
APRIL	5,227	672	3,514,502
MAY	4,561	695	3,168,968
JUNE	4,112	685	2,814,680
JULY	3,827	692	2,646,778
AUGUST	3,673	685	2,514,183
SEPTEMBER	3,530	685	2,416,607
TOTAL	90,109		57,073,393
YEARLY WEIGHTED TDS		633	

APPENDIX C

WATER QUALITY-
LAKE ELSINORE DISCHARGE

1983-84

PREPARED BY

WILLIAM R. MILLS, JR.

TABLE C-1

SUMMARY OF WEIGHTED TDS

OF WATER PUMPED FROM LAKE ELSINORE

FOR WATER YEAR 1983-84

Month	Acre-Feet[1]	TDS[2] (mg/l)	Acre-Feet Times TDS
October	1,773	664	1,177,272
November	4,945	640	3,164,800
December	4,778	636	3,038,808
January	2,321	700	1,624,700
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	0	0	0
July	0	0	0
August	0	0	0
September	0	0	0
Total	13,817	9,005,580	
Yearly Weighted TDS			652

(1) Data supplied by the Riverside County Flood Control and Water Conservation District.

(2) Monthly water quality of water sampled at the discharge of the pumps.

APPENDIX D

WATER QUALITY - SANTA ANA RIVER AT RIVERSIDE NARROWS

1983-84

PREPARED BY

DONALD L. HARRIGER

TABLE D-1

WATER QUALITY ANALYSIS
SANTA ANA RIVER AT RIVERSIDE NARROWS
WATER YEAR 1983-84

Date		TDS (mg/l)	EC (micromhos/cm)	Source
Oct	04	545*	890	C of R
	06	508*	760	USGS
	13	594	770	C of R
	20	590	937	DWR
	21	589	871	USGS
	27	619	870	C of R
Nov	01	626	800	C of R
	04	608	975	USGS
	10	638	900	C of R
	15	570*	810	C of R
	16	527*	850	USGS
	24	539*	860	C of R
	29	559*	880	C of R
Dec	08	600	900	C of R
	09	592	880	USGS
	13	591	900	C of R
	22	652	980	C of R
	27	331*	330	C of R
	27	223*	362	USGS
Jan	05	563	840	C of R
	09	600	931	DWR
	10	564	900	C of R
	19	598	900	C of R
	24	642	910	C of R
	27	644	984	USGS
Feb	02	625	910	C of R
	07	644	940	C of R
	10	662	1,010	USGS
	16	652	960	C of R
	16	643	1,050	DWR
	21	666	1,000	C of R

TABLE D-1

WATER QUALITY ANALYSIS
SANTA ANA RIVER AT RIVERSIDE NARROWS
WATER YEAR 1983-84 (Continued)

Date		TDS (mg/l)	EC (micromhos/cm)	Source
Mar	01	666	990	C of R
	01	681	1,010	USGS
	06	678	1,000	C of R
	15	665	1,010	USGS
	15	620*	1,040	C of R
	20	657	900	C of R
	29	696	980	C of R
Apr	03	503	1,060	C of R
	12	659	970	C of R
	17	660	1,010	C of R
	23	673	1,010	DWR
	26	662	1,040	C of R
May	01	644	990	C of R
	04	692	1,060	USGS
	10	675	980	C of R
	15	664	1,000	C of R
	16	672	1,030	USGS
	24	648	920	C of R
	29	654	1,000	C of R
June	07	646	970	C of R
	12	662	1,020	USGS
	12	635	920	C of R
	21	670	1,000	C of R
	26	686	1,050	C of R
July	05	662	980	C of R
	09	720	1,080	DWR
	10	669	960	C of R
	16	659	1,000	USGS
	19	646	920	C of R
	24	677	1,040	C of R
	26	654	1,020	USGS

TABLE D-1

WATER QUALITY ANALYSIS
SANTA ANA RIVER AT RIVERSIDE NARROWS
WATER YEAR 1983-84 (Continued)

Date		TDS (mg/l)	EC (micromhos/cm)	Source
Aug	02	647	940	C of R
	07	633	890	C of R
	08	648	1,000	USGS
	16	686	990	C of R
	21	691	1,000	C of R
	26	684	1,030	DWR
	28	654	1,020	USGS
	30	652	1,020	C of R
Sept	10	664	1,010	USGS
	13	662	910	C of R
	18	680	1,000	C of R
	24	665	980	C of R
	26	665	1,000	USGS
	27	686	1,080	C of R

* These TDS values not utilized in computing the averages shown in Table D-2. The reason not utilized is because they reflect storm flow values.

TABLE D-2

FLOW WEIGHTED TDS OF FLOW AT RIVERSIDE NARROWS
(Including Nontributary Flow and Excluding Wastewater From Rubidoux)

WATER YEAR 1983-84

	Month	Acre Feet(1)	TDS(2) (mg/l)	Acre Feet Times TDS
1983	October	4,990	598	2,984,020
	November	5,455	624	3,403,920
	December	6,105	608	3,711,840
1984	January	6,226	601	3,741,826
	February	5,353	648	3,468,744
	March	4,802	673	3,231,746
	April	3,907	663	2,590,341
	May	3,780	664	2,509,920
	June	3,749	659	2,470,591
	July	3,715	669	2,485,335
	August	3,751	663	2,486,913
	September	3,570	667	2,381,190
Total		55,403		35,466,386
Flow Weighted TDS		$\frac{35,466,386}{55,403}$ = 640		

(1) Total Flow minus Storm Flow from Table 6.

(2) Estimated average TDS based on water quality data from Table D-1.

APPENDIX E

QUANTITY AND QUALITY OF WASTEWATER FROM RUBIDOUX COMMUNITY SERVICES DISTRICT

1983-84

PREPARED BY

DONALD L. HARRIGER

TABLE E-1

QUANTITY AND QUALITY OF WASTEWATER FROM RUBIDOUX DISCHARGED BELOW THE RIVERSIDE NARROWS GAGING STATION

WATER YEAR 1983-84

Month	Acre-Feet	TDS (mg/l)	Acre-Feet Times TDS
October	140	791	110,740
November	165	760	125,400
December	172	766	131,752
January	169	753	127,257
February	146	758	110,668
March	153	746	114,138
April	151	752	113,552
May	156	785	122,460
June	152	769	116,888
July	157	745	116,965
August	164	748	122,672
September	162	754	122.148
Total	1,887	---	1,434,640

$$\frac{1,434,640}{1,887} = 760 \text{ mg/l}$$

Average Flow Weighted Quality of Wastewater = 760 mg/l.

APPENDIX F

SANTA ANA RIVER WATERMASTER
FINANCIAL STATEMENTS WITH REPORT
ON
EXAMINATION BY CERTIFIED PUBLIC ACCOUNTANTS

SANTA ANA RIVER WATERMASTER

FINANCIAL STATEMENTS

WITH REPORT ON EXAMINATION BY CERTIFIED PUBLIC ACCOUNTANTS

JUNE 30, 1984

ELLIS C. DIEHL, C.P.A. (1925-1956)
BRYN B. EVANS, C.P.A.
WIN C. PETERS, C.P.A.
DONALD H. PETERSON, C.P.A.
DONALD E. CALLAHAN, C.P.A.
L. PETER SCHERER, C.P.A.
RODNEY K. McDANIEL, C.P.A.
RALPH H. WEINTRAUB, C.P.A.
PHILIP H. HOLTKAMP, C.P.A.
THOMAS M. PERLOWSKI, C.P.A.

DIEHL, EVANS AND COMPANY
A PARTNERSHIP OF ACCOUNTANCY CORPORATIONS
CERTIFIED PUBLIC ACCOUNTANTS
1910 NORTH BUSH STREET
SANTA ANA, CALIFORNIA 92706
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(619) 741-3141

July 20, 1984

ACCOUNTANTS' REPORT

Santa Ana River Watermaster
Orange, California

We have examined the statement of assets and liabilities arising from cash transactions of the Santa Ana River Watermaster as of June 30, 1984 and the related statement of revenue collected, expenses paid and changes in fund balance for the year then ended. Our examination was made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

As described in Note 1, the Watermaster's policy is to prepare its financial statements on the basis of cash receipts and disbursements; consequently, certain revenue and the related assets are recognized when received rather than when earned and certain expenses are recognized when paid rather than when the obligation is incurred. Accordingly, the accompanying financial statements are not intended to present financial position and results of operations in conformity with generally accepted accounting principles.

In our opinion, the aforementioned financial statements present fairly the assets and liabilities arising from cash transactions of the Santa Ana River Watermaster at June 30, 1984, and the revenue collected and expenses paid for the year then ended, on the basis of accounting described in Note 1, which basis has been applied in a manner consistent with that of the preceding year.

Diehl, Evans and Company

SANTA ANA RIVER WATERMASTER

STATEMENT OF ASSETS AND LIABILITIES
ARISING FROM CASH TRANSACTIONS

June 30, 1984

ASSETS

Cash in checking account	$ 500
Cash in savings account	129
TOTAL ASSETS	$ 629

LIABILITIES AND FUND BALANCE

Liabilities	$ -
Fund balance	629
TOTAL LIABILITIES AND FUND BALANCE	$ 629

See accountants' report and notes to financial statements.

SANTA ANA RIVER WATERMASTER

STATEMENT OF REVENUE COLLECTED, EXPENSES
PAID AND CHANGES IN FUND BALANCE

For the year ended June 30, 1984

		Actual	Budget	Over (Under) Budget
REVENUE COLLECTED:				
Water district contributions (Note 3):				
Orange County Water District		$ -	$ 5,600	$ (5,600)
Chino Basin Municipal Water District		-	2,800	(2,800)
San Bernardino Valley Municipal Water District		-	2,800	(2,800)
Western Municipal Water District		-	2,800	(2,800)
Interest from savings account		560	-	560
TOTAL REVENUE COLLECTED		560	14,000	(13,440)
EXPENSES PAID:				
Professional engineering services		8,474	8,000	474
Administrative expenses:				
Office and secretarial expense	$ 2,096			
Auditing services	600	2,696	3,000	(304)
Annual reports		1,960	3,000	(1,040)
TOTAL EXPENSES PAID		13,130	14,000	(870)
EXCESS OF EXPENDITURES PAID OVER REVENUE COLLECTED		(12,570)	$ -	$(12,570)
FUND BALANCE AT JULY 1, 1983		13,199		
FUND BALANCE AT JUNE 30, 1984		$ 629		

See accountants' report and notes to financial statements.

SANTA ANA RIVER WATERMASTER

NOTES TO FINANCIAL STATEMENTS

June 30, 1984

1. ACCOUNTING METHOD:

The Watermaster uses the cash receipts and disbursements method of accounting for all of its financial activity.

2. ORGANIZATION AND HISTORY:

The Santa Ana River Watermaster is composed of a committee of five representatives of four water districts. Two representatives serve from Orange County Water District and one representative each serves from Chino Basin Municipal Water District, Western Municipal Water District and San Bernardino Valley Municipal Water District. The committee was established on April 23, 1969 by order of the Superior Court of California in Orange County as part of a judgement resulting from a lawsuit by Orange County Water District as plaintiff vs. City of Chino, et al, as defendants.

Costs and expenses incurred by the individual representatives are reimbursed directly from the water districts. Collective Watermaster costs and expenses are budgeted and paid for by the Watermaster after receiving contributions from the water districts. Water district contributions are made in the following ratios:

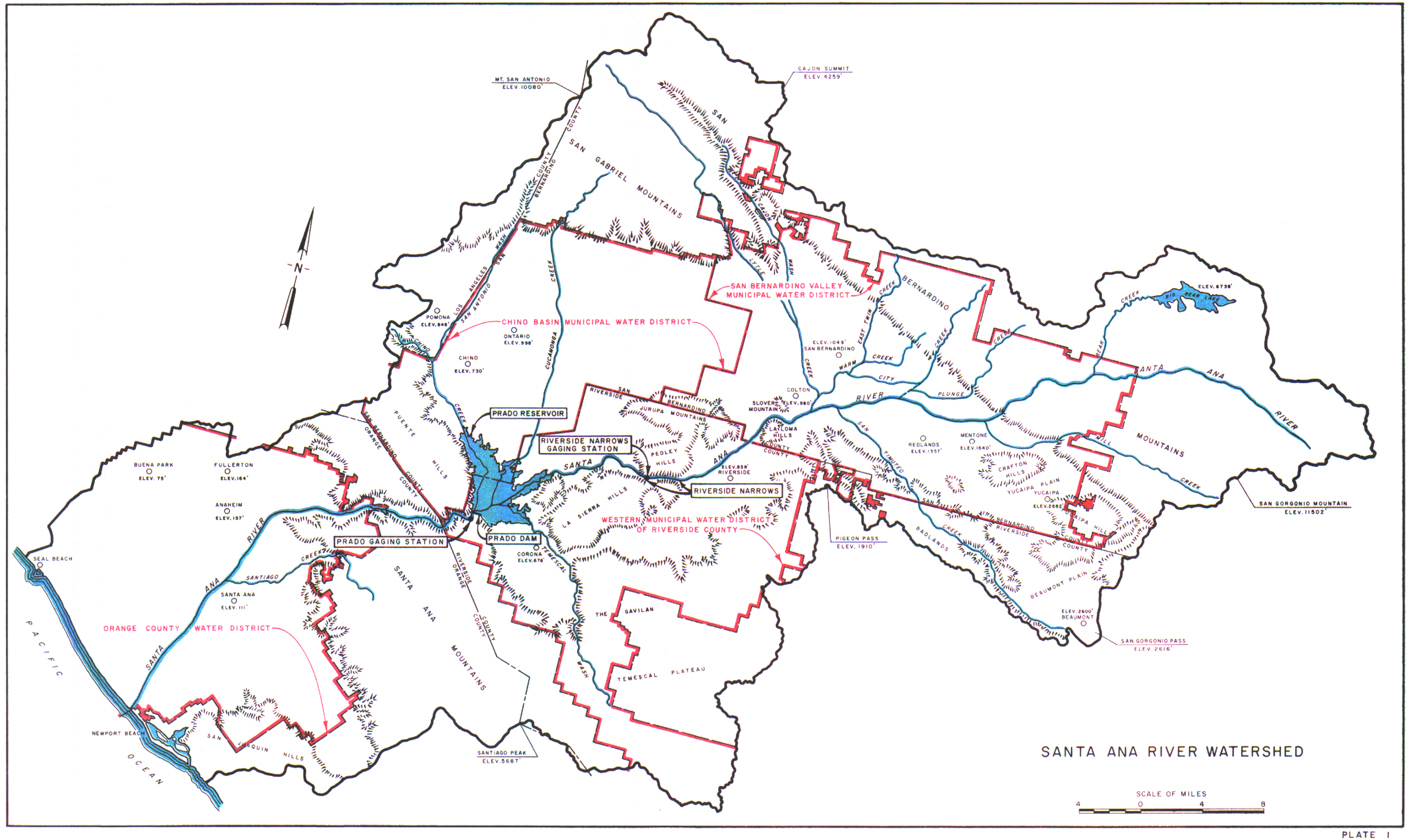
Orange County Water District	40%
Chino Basin Municipal Water District	20
Western Municipal Water District	20
San Bernardino Valley Municipal Water District	20
Total	100%

The Watermaster issues a report each year to satisfy its obligation to monitor and test water flows from the Upper Area to the Lower Area of the Santa Ana River.

3. WATER DISTRICT REVENUE CONTRIBUTIONS:

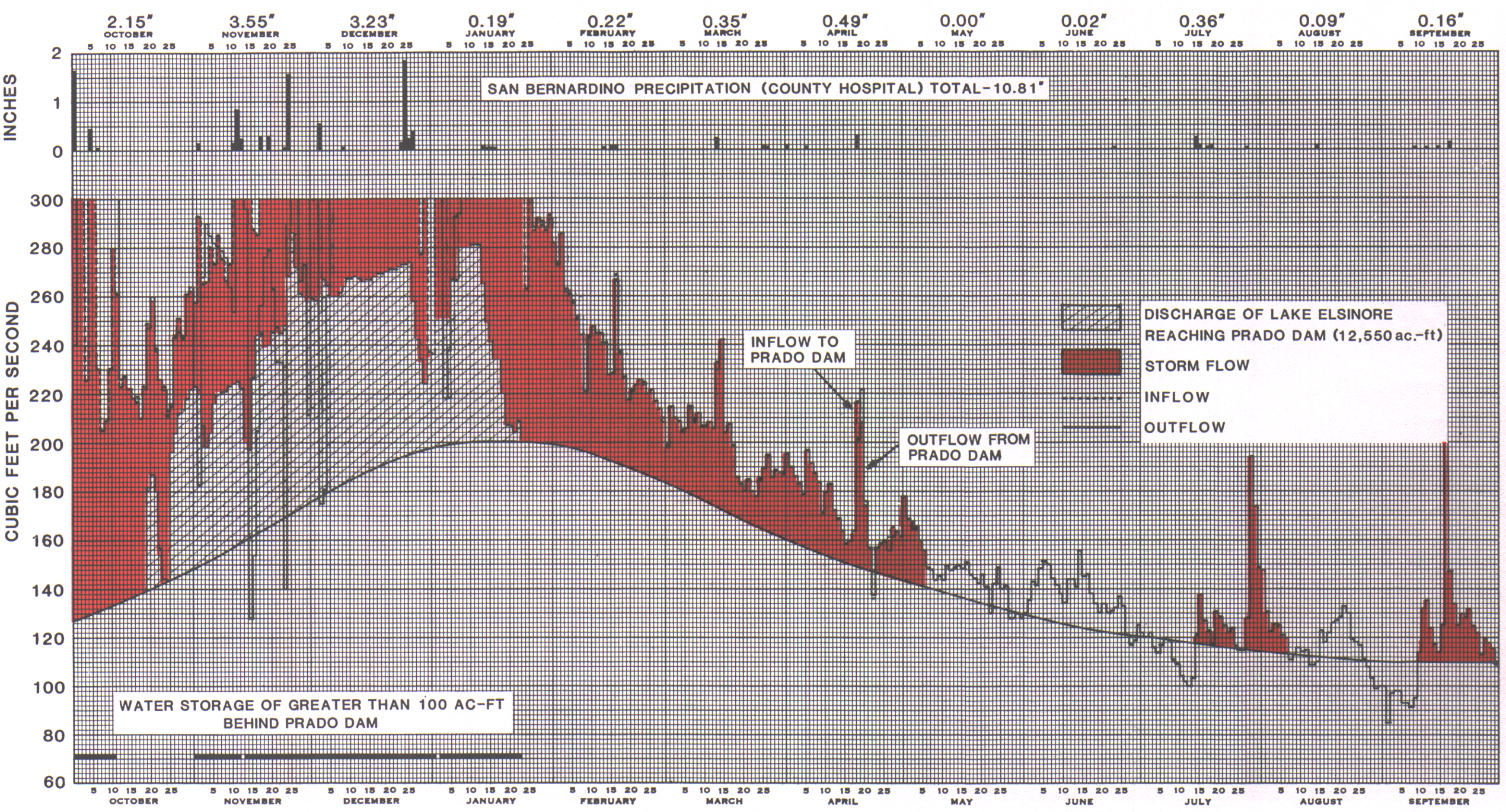
Budgeted water district contributions for the year ended June 30, 1984 were not requested for payment until after June 30, 1984 since cash was available for payment of expenses incurred prior to year-end.

See accountants' report.



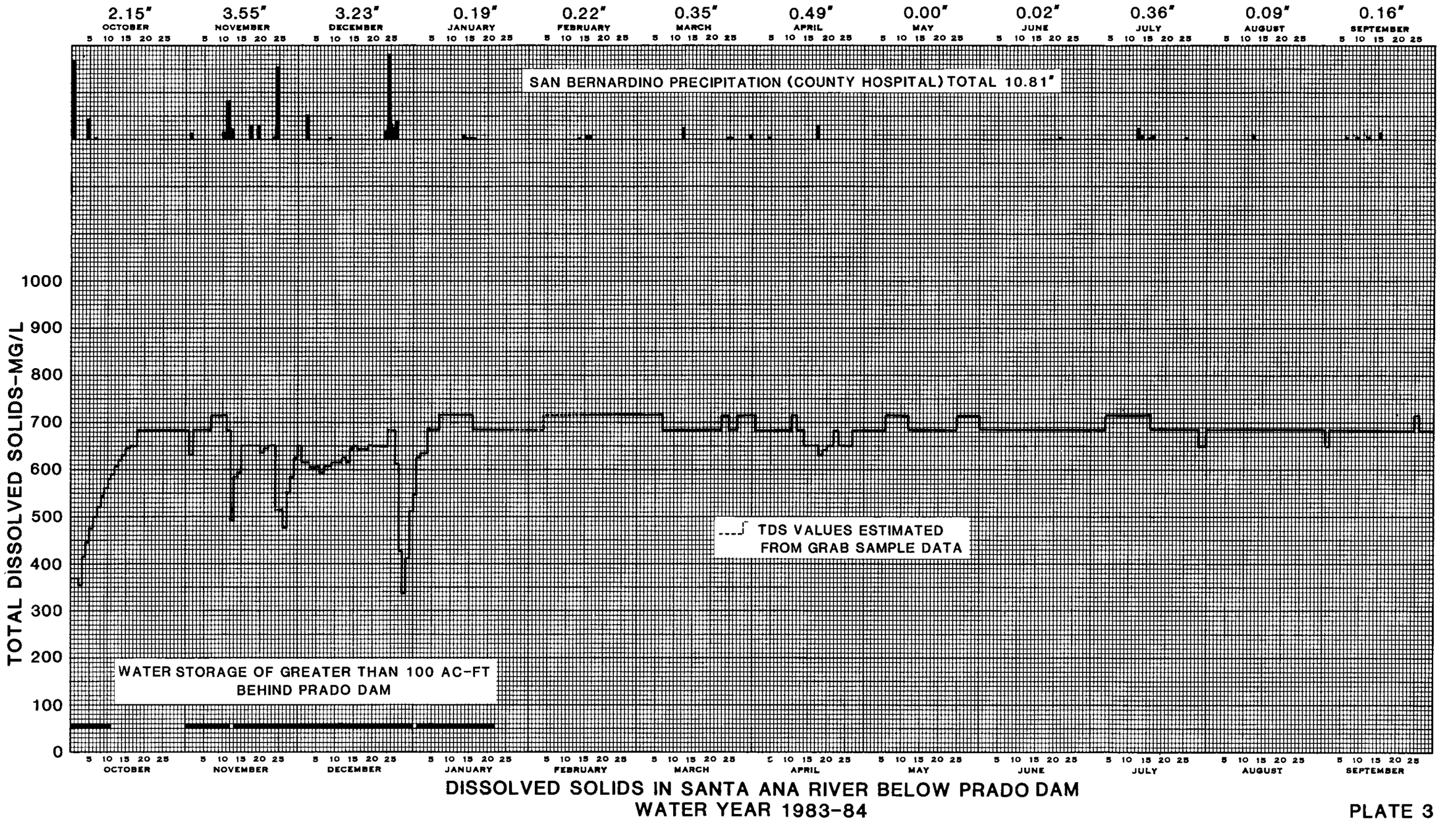
SANTA ANA RIVER WATERSHED

PLATE I



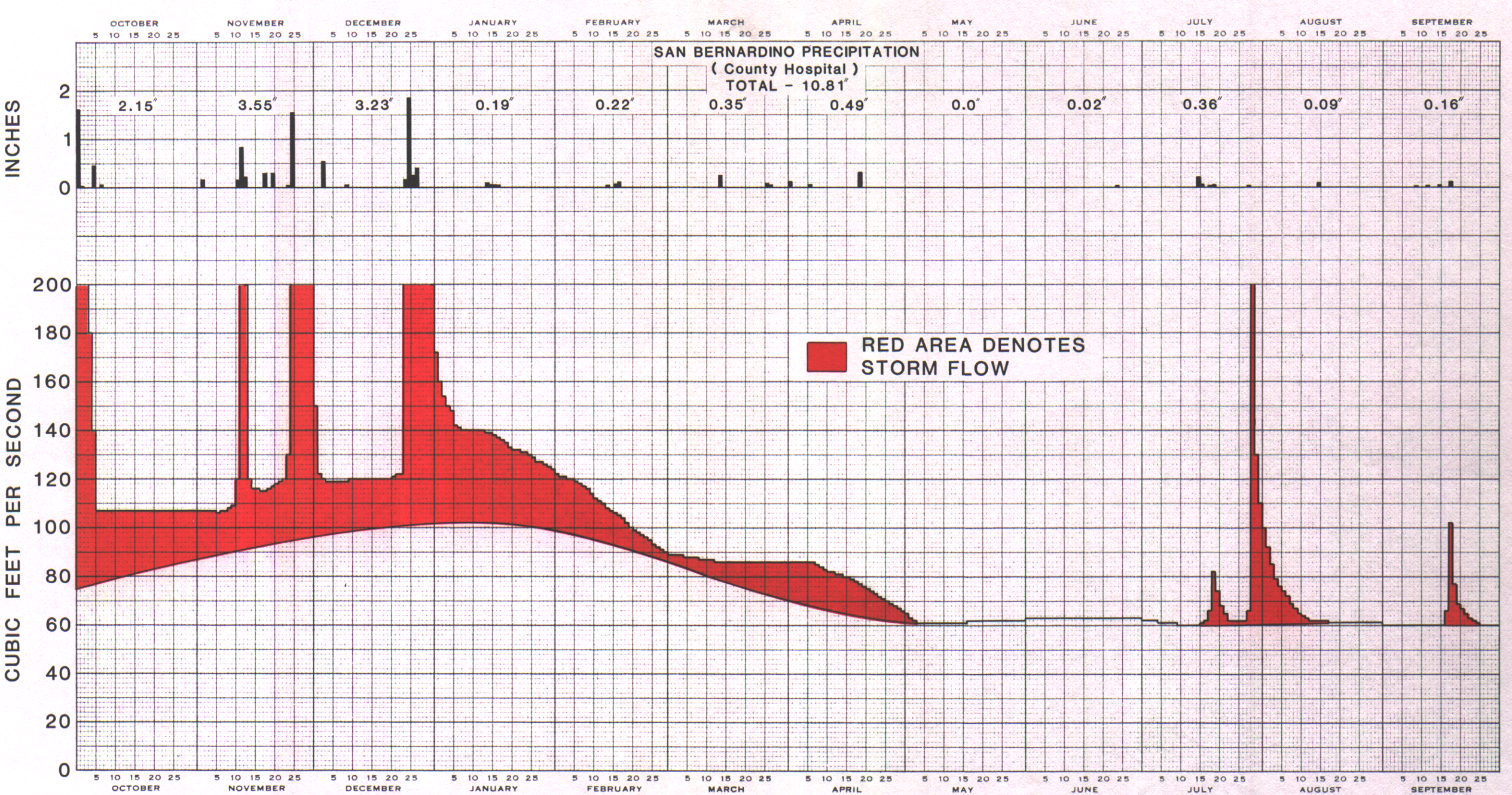
DISCHARGE OF SANTA ANA RIVER BELOW PRADO DAM AND SAN BERNARDINO PRECIPITATION
WATER YEAR 1983-84

PLATE 2



DISSOLVED SOLIDS IN SANTA ANA RIVER BELOW PRADO DAM
WATER YEAR 1983-84

PLATE 3



DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS & SAN BERNARDINO PRECIPITATION
WATER YEAR 1983 - 84

PLATE 4