SANTA ANA RIVER WATERMASTER

FOR

ORANGE COUNTY WATER DISTRICT Vs. CITY OF CHINO, et al

CASE No. 117628 -- COUNTY OF ORANGE

NINTH

ANNUAL REPORT

OF THE

SANTA ANA RIVER WATERMASTER

1978-79

MARCH 30, 1980

SANTA ANA RIVER WATERMASTER

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

WATERMASTER
MAX BOOKMAN
WILLIAM J. CARROLL
JAMES C. HANSON
DONALD L. HARRIGER
William R. Mills, Jr.

MAILING ADDRESS
P. O. BOX 5367
ORANGE, CALIFORNIA 92667
TELEPHONE: (714) 835-4447

March 30, 1979

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

Gentlemen:

On behalf of the Santa Ana River Watermaster, transmitted herewith is the "Eighth Annual Report of the Santa Ana River Watermaster - 1977-78", dated March 30, 1979.

Sincerely yours,

Santa Ana River Watermaster

By: Max Bookman
Max Bookman, Chairman

Attachment (Distribution List)

Enclosure

cc: Watermasters:
William J. Carroll
James C. Hanson
William R. Mills, Jr.
Donald L. Harriger

SANTA ANA RIVER WATERMASTER

Distribution List for Santa Ana River Watermaster Annual Report

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Chino Basin Municipal Water District
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Ray W. Ferguson, General Manager

San Bernardino Valley Municipal
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San Bernardino, California 92408
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Western Municipal Water District
of Riverside County
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Riverside, California 92506
Howard A. Hicks, General Manager

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Honorable John P. McMurray
Judge of the Superior Court
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Clerk of Superior Court
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Santa Ana, California 92701

SANTA ANA RIVER WATERMASTER

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

WATERMASTER
MAX BOOKMAN
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P. O. BOX 5367
ORANGE, CALIFORNIA 92667
TELEPHONE: (714) 835-4447

March 30, 1980

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

Re: Watermaster Report for 1978-79

Gentlemen:

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

The principal findings of the Watermaster for the water year 1978-79 are as follows:

At Prado

(1)	Base Flow at Prado	72,069 acre-feet
(2)	Annual Weighted TDS of Total Flow	582 ppm
(3)	Annual Adjusted Base Flow	79,156 acre-feet
(4)	Cumulative Adjusted Base Flow	475,958 acre-feet
(5)	Cumulative Entitlement of OCWD	378,000 acre-feet
(6)	Cumulative Credit	97,958 acre-feet
(7)	One-third of Cumulative Debit	0 acre-feet
(8)	Minimum Required Base Flow in 1979-80	34,000 acre-feet

At Riverside Narrows

(1)	Base Flow at Riverside Narrows	26,590 acre-feet
(2)	Annual Weighted TDS of Base Flow	707 ppm
(3)	Annual Adjusted Base Flow	26,456 acre-feet
(4)	Cumulative Adjusted Base Flow	165,097 acre-feet
(5)	Cumulative Entitlement of CBMWD and WMWD	137,250 acre-feet
(6)	Cumulative Credit	27,847 acre-feet
(7)	One-third of Cumulative Debit	0 acre-feet
(8)	Minimum Required Base Flow in 1979-80	12,420 acre-feet

The above findings show that at the end of the water year 1978-79 there was a credit of 97,958 acre-feet in the obligations of Chino Basin Municipal Water District and Western Municipal Water District in the discharge of Base Flow downstream from Prado Dam. During the water year 1979-80 the minimum required Base Flow is 34,000 acre-feet. At Riverside Narrows, there was a credit of 27,847 acre-feet. The obligation of San Bernardino Valley Municipal Water District during the water year 1979-80 is a minimum Base Flow of 12,420 acre-feet.

During October and November of 1978-79 water year, a small amount of State water (Nontributary Flow) was purchased by Orange County Water District and released from the Rialto Reach of the Foothill Feeder at OC-59 into San Antonio Creek near Upland. The Committee found this small amount of water did not permit the completion of its study of methods of determining the quantity and quality of released Nontributary Flow that actually passed Prado. Therefore, the Committee did not make a final determination but intends to continue investigation of this matter and to make a final determination and adjustment at some subsequent time.

Sincerely yours,

SANTA ANA RIVER WATERMASTER

By: Max Bookman
Max Bookman

Donald L. Harriger
Donald L. Harriger

William J. Carroll
William J. Carroll

William R. Mills, Jr.
William R. Mills, Jr.

James C. Hanson
James C. Hanson

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES
(Located at Back of Report)

APPENDICES
(Located at Back of Report)

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CHAPTER I
WASTERMASTER ACTIVITIES

This is the ninth 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 Watershed; namely, the San Bernardino Valley Municipal Water District, Western Municipal Water District of Riverside County, Chino Basin Municipal Water District and Orange County Water District (see 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 1978-79 water year the Santa Ana River Watermaster Committee consisted of Max Bookman, William J. Carroll, James C. Hanson, William R. Mills, Jr. and Donald L. Harriger. Mr. Bookman served as Chairman during the 1978-79 water year, and Mr. Mills served 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.

Section 7(c) of the Judgment requires the Watermaster to report to the Court and to each party not more than five months after the end of each water year starting with 1970-71. Due to delays in obtaining the necessary basic data for this water year, a request for a 60-day extension in submitting the report was approved by the Court. 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 was shared by the parties to the Judgment. Such costs are set forth in Table 1. The USGS measured and computed the mean daily discharge of Santa Ana River at Mission Boulevard, MWD Crossing, Prado Park, and below Prado Dam as well as the daily discharge of the Riverside Water Quality Control Plant into the Santa Ana River. Discharge measurements were also provided for two smaller streams tributary to Prado Reservoir; Chino Creek at Schaefer Avenue and Cucamonga Creek near Mira Loma.

The 1978-79 discharge record for the USGS gaging station Santa Ana River below Prado Dam is considered by the USGS to be a "Good" record. During 1979 Prado Reservoir storage space was utilized to regulate the storm inflows allowing the reservoir releases to be maintained at a relatively constant rate throughout the year. Discharges ranged from a maximum of 580 cubic feet per second to a minimum of 12 cubic feet per second. The mean annual discharge was approximately 200 cubic feet per second, and only on two occasions did the average daily release rate exceed 500 cubic feet per second. The Prado Dam releases were therefore confined to the concrete lined low-flow channel during the entire season accounting for the "Good" record which was obtained. The high-stage control section which lies between the low-flow channel and the north bank of the flood control channel was reconstructed during 1979 by Orange County Water District. Since the releases were confined to the low-flow channel during 1979 this high-stage control section was not utilized, however, it is anticipated that the modification of this control section will greatly improve the quality of the record obtained during high flows in the future.

Additional data related to the operation of Prado Reservoir were obtained from the Corps of Engineers and water quality data were supplied to the Watermaster by the State Department of Water Resources, Riverside and Corona City Sanitation Departments and the Chino Basin Municipal Water District. Data regarding the discharge of State water into the Santa Ana River were provided by the Metropolitan Water District and the State Department of Water Resources.

TABLE 1

COSTS TO THE PARTIES AND USGS FOR MEASUREMENTS WHICH PROVIDE DATA USED BY THE SANTA ANA RIVER WATERMASTER
July 1, 1978 to June 30, 1979

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT		
At Riverside Water Quality Control Plant		
Surface Water Gage	$ 492.00	
Water Quality Monitor/TDS Samples	1,033.00	
At Riverside Narrows (MWD Crossing)		
Water Quality Monitor/TDS Samples	417.00	
Dozer	416.00	
At Prado Park		
Surface Water Gage	490.00	
Dozer	75.00	
Install Wire Weight Gage	50.00	
At Mission Boulevard		
Surface Water Gage	390.00	
Dozer	150.00	
Install Wire Weight Gage	50.00	$ 3,563.00
WESTERN MUNICIPAL WATER DISTRICT		
Same as SBVMWD	$ 3,563.00	
Cucamonga Creek Discharge	875.00	
Chino Creek Discharge	583.00	5,021.00
CHINO BASIN MUNICIPAL WATER DISTRICT		
Same as WMWD		5,023.00[1]
ORANGE COUNTY WATER DISTRICT		
At Prado Dam		
Water Quality Monitor/TDS Samples, Water Quality Sampling and Conductivity Programs	$ 9,450.00	
At Prado Park		
Surface Water Gage	980.00	
Dozer	150.00	
Install Wire Weight Gage	100.00	
At Mission Boulevard		
Surface Water Gage	780.00	
Dozer	300.00	
Install Wire Weight Gage	100.00	
San Antonio Creek Water Quality Program	1,700.00	
Chino Creek		
Surface Water Gage	583.00	
Cleaning Control Area	1,200.00	15,343.00
TOTAL FOR PARTIES		28,950.00
UNITED STATES GEOLOGICAL SURVEY		28,950.00
GRAND TOTAL		$57,900.00

[1] Difference results from rounding

During 1978-79, collection of reliable discharge data at the USGS gaging station, Santa Ana River at MWD Crossing (Riverside Narrows) continued to be a difficult problem. The concrete low-flow control structure, submerged by sand during the previous year, remained inoperative and during the year the downstream movement of sand deposits seriously affected the stage-discharge relationship for the station. The USGS increased the frequency of its direct discharge measurements in order to develop the record; however, the overall quality of the record for 1978-79 is considered by the USGS to be only "Poor".

The electrical conductivity equipment at MWD Crossing, a target of continuing vandalism, was removed during the 1978-79 water year. Data necessary for implementation of the water quality provisions of the judgment were obtained by the analysis of 14 grab samples taken during the year.

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 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 memnber. All other Watermaster administrative costs and expenses are borne by the parties, with OCWD paying 40 percent of the cost and CBMWD, SBVMWD and WMWD 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 May 26, 1978 the Watermaster adopted a budget for the fiscal year 1978-79 in the amount of $10,000. At its meeting on June 1, 1979 the Watermaster adopted a budget for the fiscal year 1979-80 in the amount of $10,000. Table 2 shows the items and amounts included in said budgets together with actual expenses for the fiscal year 1978-79.

TABLE 2

SANTA ANA RIVER WATERMASTER BUDGET AND EXPENSES

	July 1, 1978 to June 30, 1979 Budget	July 1, 1978 to June 30, 1979 Expenses	July 1,1979 to June 30, 1980 Budget
Administration	$ 2,500.00	$ 1,687.00	$ 2,500.00
Support Engineering Services	6,000.00	4,781.00	6,000.00
Reproduction of Annual Report	1,500.00	1,166.00	1,500.00
Total	$10,000.00	$ 7,634.00	$10,000.00

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 1978-79 is included herein as Appendix E.

CHAPTER II
WATER SUPPLY CONDITIONS

The precipitation in the Santa Ana River Watershed during 1978-79, as represented by rainfall measured at San Bernardino, was nearly normal in terms of the Base Period average. While the total flow in the Santa Ana River during the water year 1978-79 increased, effects of the heavy rainfall during 1977-78 continued to be felt with the Base Flow at both Riverside Narrows and Prado showing substantial increases over the 1977-78 amounts.

Precipitation During 1978-79

During the 1978-79 water year, the precipitation at the San Bernardino County Hospital amounted to 17.51 inches, which is 97 percent of the Base Period average. Most of the precipitation was distributed over the months of November through March. The maximum monthly precipitation of 4.68 inches occurred during March.

Figure 1 shows the seasonal precipitation from 1931-32 through 1978-79 and the accumulated departure from the 1934-35 through 1959-60 Base Period average.

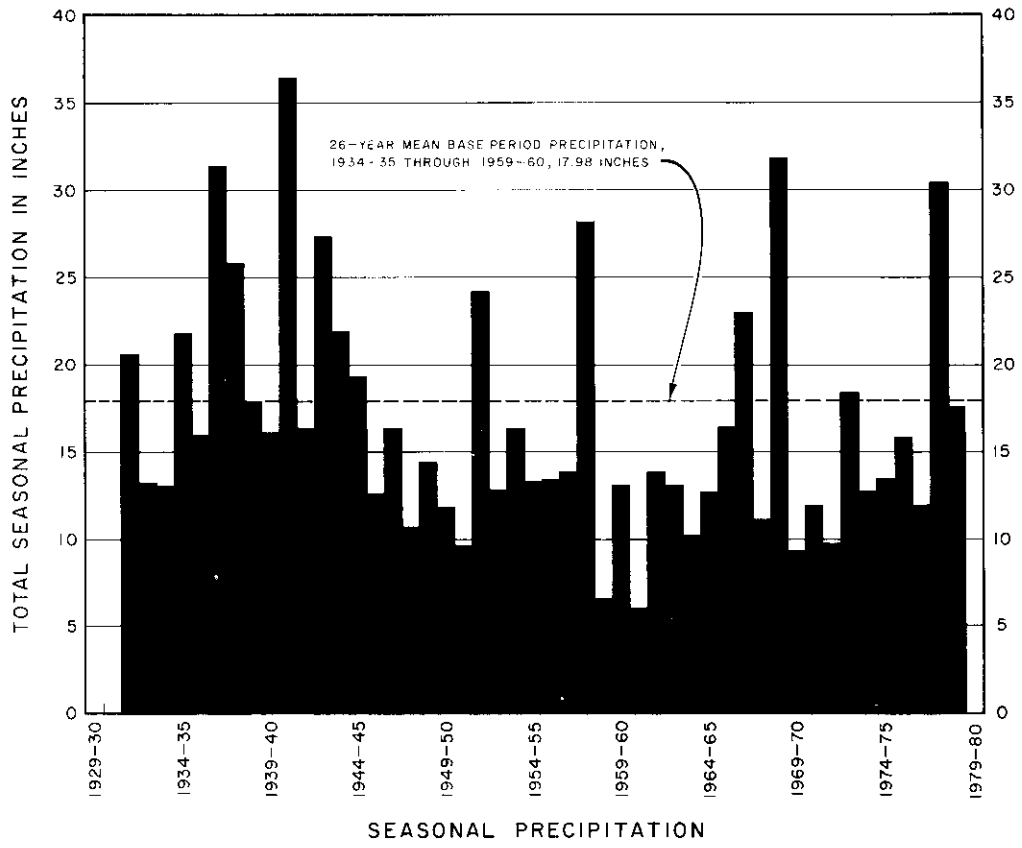
Runoff During 1978-79

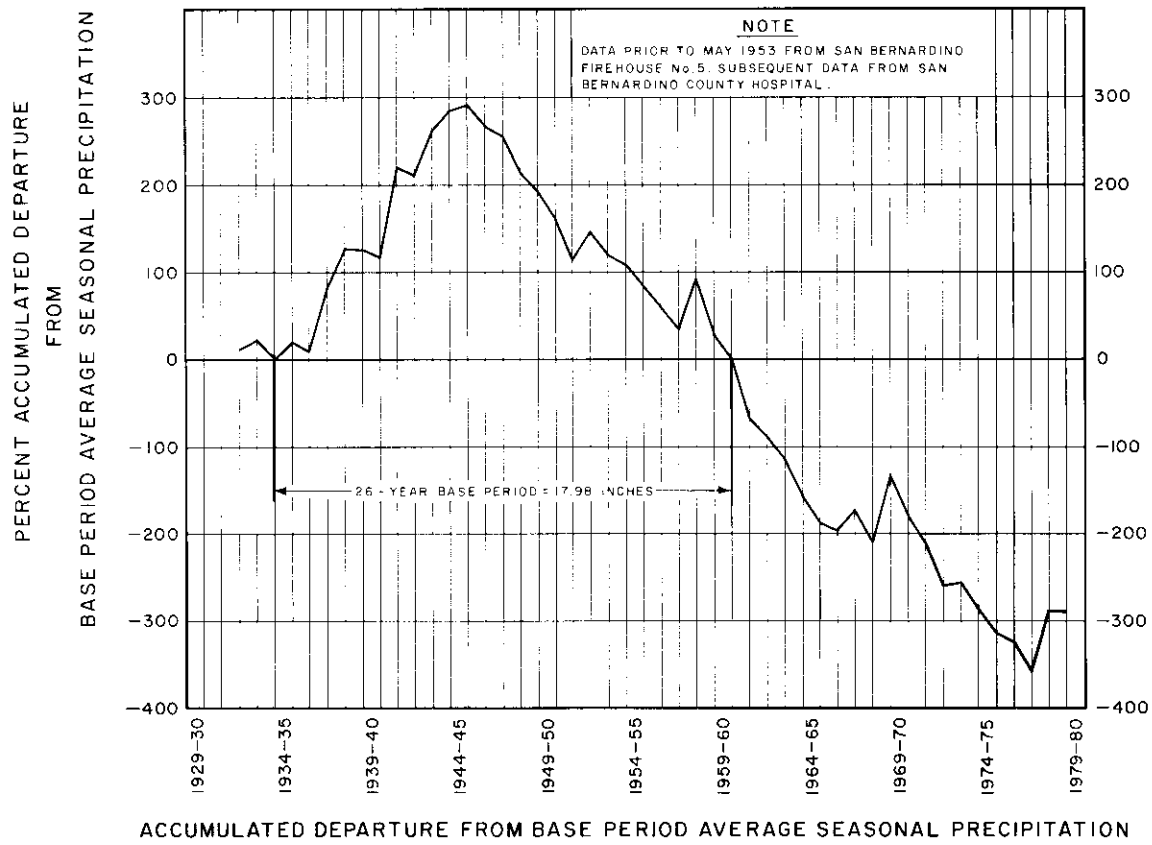
Below Prado Dam

During 1978-79, the Total Flow of the Santa Ana River at Prado Dam, less Nontributary Flow, was 145,198 acre-feet, which is well above the 26 -year Base Period (1934-35 through 1959-60) average of 78,780 acre-feet per year.

Since 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 generally increased. During the nine-year period (1970-71 through 1978-79) since the Judgment went into effect, the Base Flow has averaged 49,846 acre-feet per year. This compares to the 26-year Base Period average of 47,470 acre-feet, and the Base Flow requirement under the Judgment of 42,000 acre-feet. The 1978-79 Base Flow amounted to 72,069 acre-feet, an increase of about 22,223 acre-feet over the nine-year average.

Figure 2 shows the Storm and Base Flow components of the Total Flow in the Santa Ana River below Prado Dam.





VARIATION IN PRECIPITATION AT SAN BERNARDINO

FEBRUARY 1980

FIGURE 1

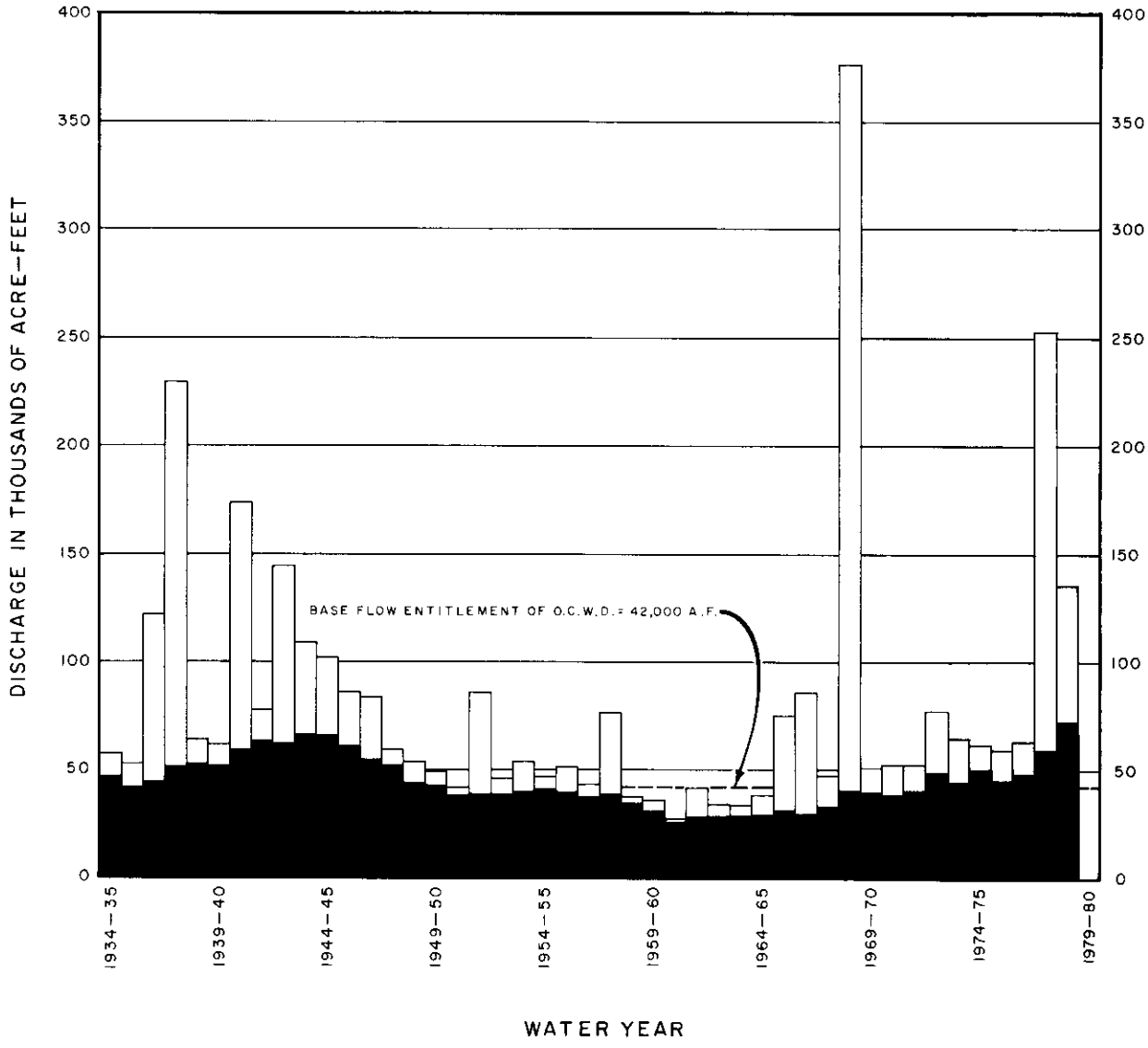
NOTE

DISCHARGE EXCLUDES IMPORTED M.W.D. COLORADO RIVER OR STATE WATER PROJECT WATER BEING TRANSPORTED IN THE SANTA ANA RIVER.

LEGEND

STORM FLOW

BASE FLOW



DISCHARGE OF SANTA ANA RIVER BELOW PRADO DAM

FEBRUARY 1980

FIGURE 2

At Riverside Narrows

The Total Flow less Nontributary Flow at Riverside Narrows for the 1978-79 water year was 47,916 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 nine-year period 1970-71 through 1978-79 the Base Flow has averaged 18,529 acre-feet per year. The 1978-79 Base Flow amounted to 26,590 acre-feet, an increase of 8,061 acre-feet over the nine-year average.

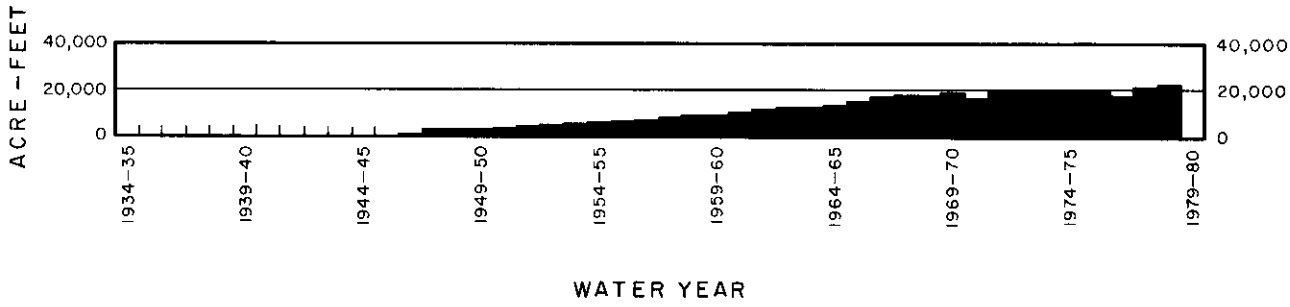
Figure 3 shows the components of Total Flow in the Santa Ana River at Riverside Narrows and the sewage effluent from the Riverside Water Quality Control Plant for the period from 1934-35 through 1978-79.

Sewage Effluent From Riverside Water Quality Control Plant

Since the late 1940's, the sewage 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 sewage effluent from the treatment plant was 18,657 acre-feet. During this period, wastewater effluent discharged by the City of Riverside increased at a rate of about 800 acre-feet per year. Since 1969-70, the wastewater effluent discharge has not varied significantly. This trend is illustrated on Figure 3. The wastewater discharge of the Riverside Water Quality Control Plant during 1978-79 was 21,259 acre-feet.

Effluent From CMBWD Regional Wastewater Treatment Plants

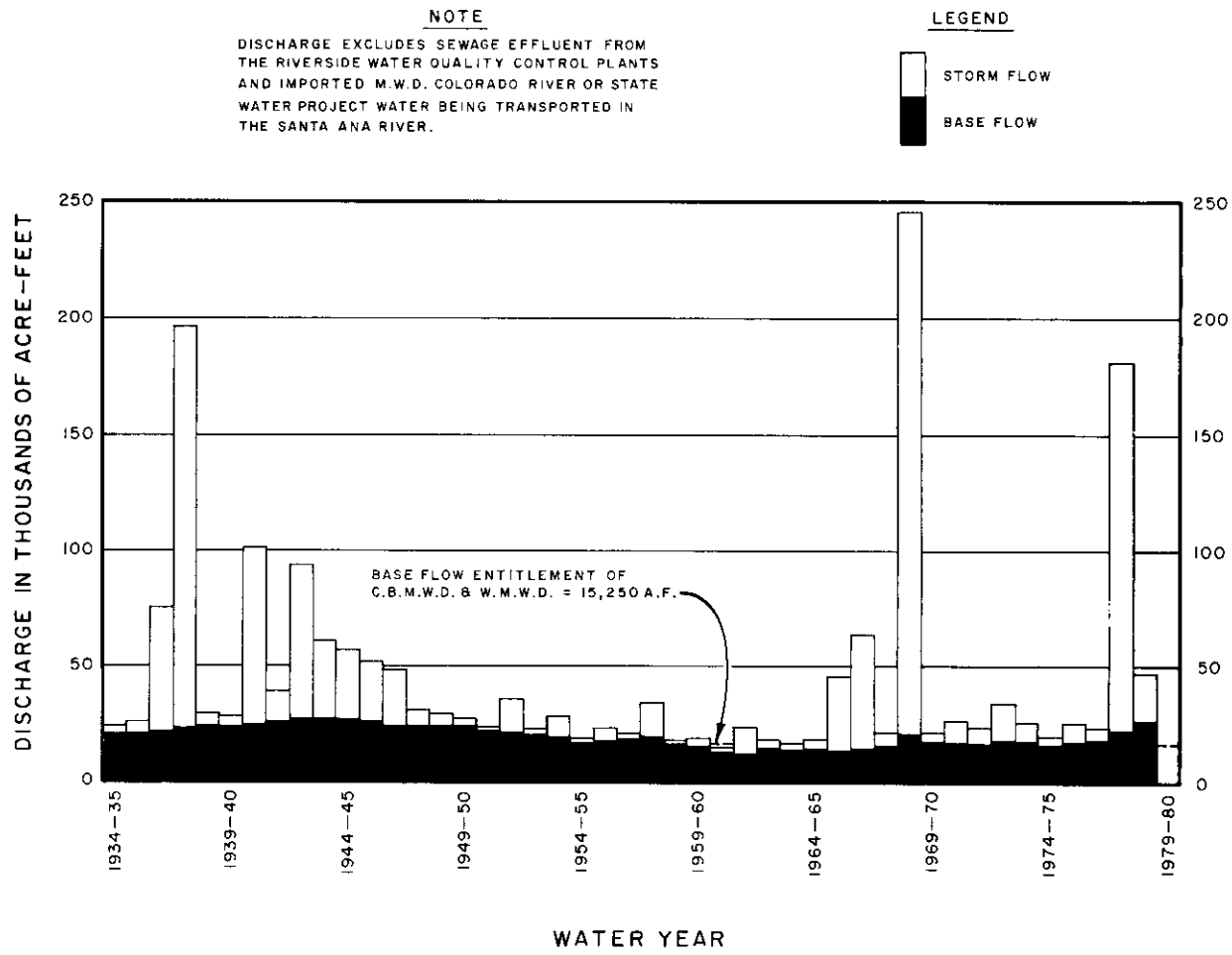
During the 1978-79 water year, CBMWD's Regional Plants No. 1 and 2 discharged 19,824 acre-feet of effluent to the Santa Ana River.



SEWAGE EFFLUENT FROM RIVERSIDE WATER QUALITY CONTROL PLANTS

NOTE

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



DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS

FEBRUARY 1980

FIGURE 3

REVISED

CHAPTER III

BASE FLOW AT PRADO

This chapter deals with determinations of: 1) the components of flow at Prado Dam, which include Nontributary Flow; 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 145,198 acre-feet, measured at the USGS gaging station below Prado Dam. Separated into its components, Base Flow was 72,069 acre-feet, Storm Flow was 62,646 acre-feet, Nontributary Flow during 1978-79 due to the release of State water above Riverside Narrows during 1972-73 was 606 acre-feet, and Nontributary Flow due to State water that passed Prado Dam was assumed to be 9,897 acre-feet. The above determination of Nontributary Flow resulting from releases at San Antonio Creek is based on two adjustments for losses: 1) turnout gate leakage of 1.3 cfs at the Montclair spreading basin; 2) the assumption that 98 percent of the State water released at OC-59 has passed the Montclair Spreading Basin, and through Prado. The assumption is subject to review and the above amounts are subject to revision in subsequent years. The components of flow of the Santa Ana River at Prado Dam for each month in the 1978-79 water year are listed in Table 3, and are shown graphically on Plate 2.

Nontributary Flow

Since May 1973, OCWD has 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, 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 1978-79, the credit is 606 acre-feet, assumed to be distributed uniformly throughout the year, as shown in Table 3.

TABLE 3

COMPONENTS OF FLOW AT PRADO DAM FOR
WATER YEAR 1978/79 (acre-feet)

Month	USGS Measured Outflow	Change in Storage(1)	Computed Inflow	Storm Flow	Base Flow	Nontributary Water San Antonio Creek(2)	Nontributary Water Riverside Narrows(3)
October	12,322	(18)	12,304	-0-	4,546	7,707	51
November	9,354	528	9,882	2,258	5,383	2,190	51
December	9,037	2,106	11,143	4,595	6,497	-0-	51
January	19,490	2,612	22,102	14,801	7,250	-0-	51
February	12,907	5,032	17,939	10,576	7,312	-0-	51
March	10,990	17,318	28,308	20,039	8,218	-0-	51
April	15,917	(194)	15,723	8,365	7,308	-0-	50
May	11,369	(2,505)	8,864	2,012	6,802	-0-	50
June	12,752	(7,964)	4,788	-0-	4,738	-0-	50
July	16,991	(12,008)	4,983	-0-	4,933	-0-	50
August	9,842	(4,887)	4,955	-0-	4,905	-0-	50
September	4,227	-0-	4,227	-0-	4,177	-0-	50
Total	145,198	20	145,218	62,646	72,069	9,897	606

(1) The monthly change in storage included in the monthly components of flow.
(2) State water released into San Antonio Creek during 1978-79 assumed to have reached Prado Dam in 1978-79.
(3) That portion of State water released during 1972-73 upstream of Riverside Narrows, determined to have reached Prado Dam in 1978-79.

Releases to San Antonio Creek

During water year 1978-79, 10,061 acre-feet of State water were purchased by OCWD and released from the Rialto Reach of the Foothill Feeder at OC-59 into San Antonio Creek near Upland. The measured flows at OC-59 are set forth in Appendix A. The Watermaster determined that additional testing and sampling programs should be made to quantify the extent of losses between OC-59 and the Prado Dam gage, however, due to the very limited releases, this program could not be continued in water year 1978-79. The Committee did not make a final determination and intends to continue investigation of the disposition of State water released into San Antonio Creek since the water year 1973-74, and to make

a final determination and adjustment for each of these years at some subsequent time. For the purpose of arriving at findings in this report, the Committee utilized the following procedures:

1. Since State water was being discharged at the beginning of the water year, and because the travel time between OC-59 and the Below Prado Gage was assumed for computation purposes, to be 12 hours, a total of 10,210 acre-feet of State water was assumed to be the actual amount available during the year 1978-79 before losses.
2. An amount of 111 acre-feet was deducted from the 10,210 acre-feet because of a loss in the Montclair Spreading Basins due to a leaking gate.
3. A second loss of 2% of the remainder (10,210 - 111 = 10,199) was deducted to arrive at the final figure of 9,897 acre-feet passing the Below Prado Gage.

The monthly and annual amounts are shown in Table 3.

Storm Flow

Generally during storms, the 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 gradually reduced by the controlled releases to the downstream water conservation facilities operated by Orange County Water District. The general procedure used by the members of the Watermaster to separate the 1978-79 flow components was the same as used for previous years and is fully described in the Fifth Annual Report. Monthly and annual quantities of Storm Flow are shown in Table 3.

During the 1978-79 water year, water was stored behind Prado Dam during the periods October 1 to October 11; and November 10 to August 14. During these periods, the water stored in Prado Reservoir varied up to a maximum of 28,930 acre-feet and the maximum mean daily flow released to the Santa Ana River was 580 cfs.

Base Flow

The determination of Base Flow was affected, as in the previous six years, by the State water which was released upstream of Prado Dam. The monthly and annual amounts are shown in Table 3.

Water Quality

The weighted average total dissolved solids (TDS) for the total flow passing Prado, including Nontributary Flow, was found to be 560 ppm. This determination was based on continuous measurements of electrical conductivity (EC) by the USGS at the Santa Ana River below Prado and a statistical correlation of EC and TDS.

The EC of the river was recorded hourly on a punched tape by USGS. The USGS also collected 23 samples and performed laboratory analyses for EC and TDS. Results of these analyses, listed in Table B-1, Appendix B, were used to develop the correlation between EC and TDS as shown on Figure 4.

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.

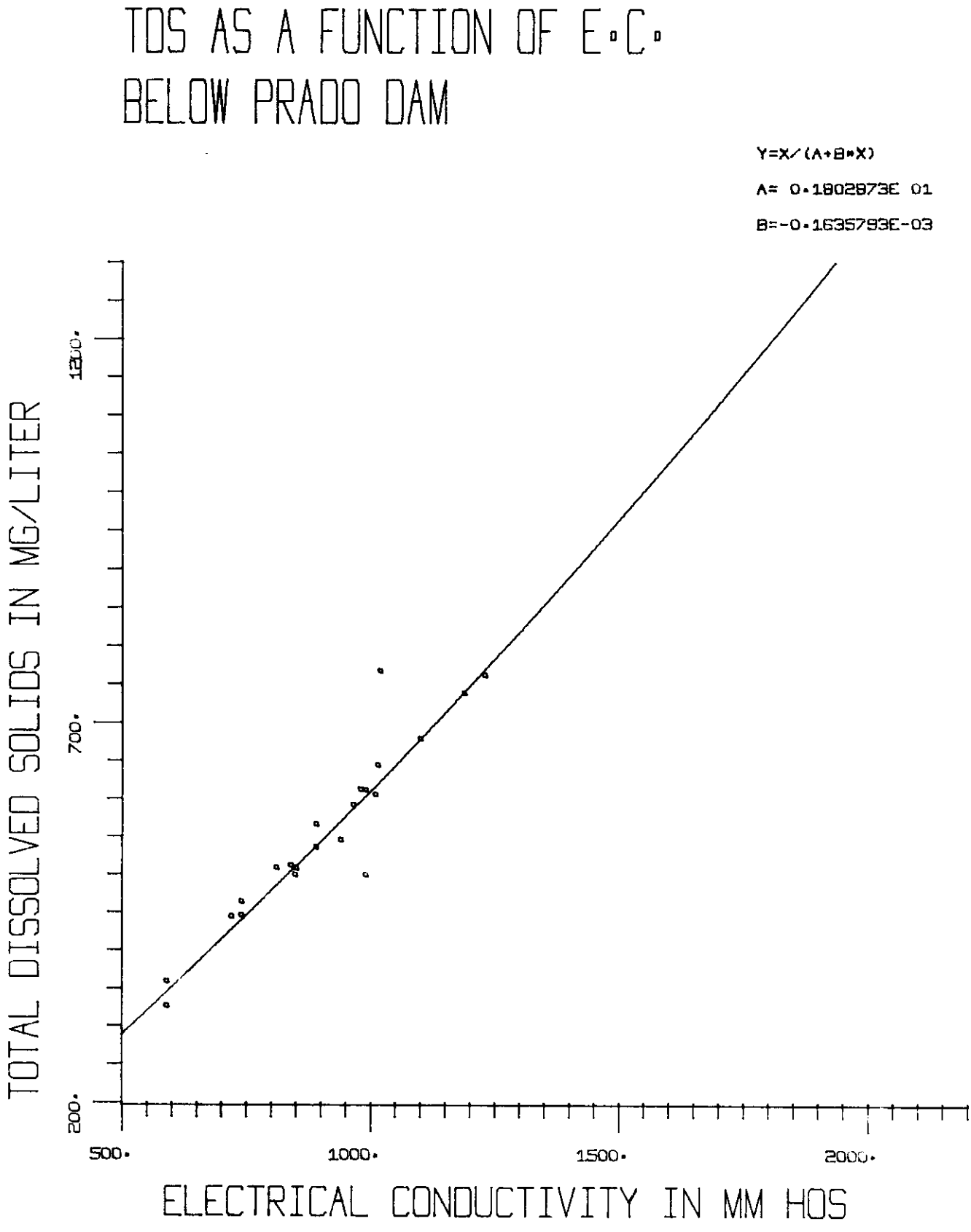
The plot of TDS on Plate 3 shows the effects of the State water. In general, the TDS fluctuated in the 406 to 571 ppm range when State water was being released during the first 44 days of the water year. After the releases of State water the TDS ranged from 238 to 818 ppm.

Water Quality Adjustment for Nontributary Flow

The weighted average annual TDS value of 560 ppm, shown in Table B-3, Appendix B, represents the quality of Total Flow which includes Nontributary Flow from release of State water to San Antonio Creek and Santa Ana River above Riverside Narrows. 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.

	Annual Flow	Avg. TDS	(Annual Flow) x (Avg. TDS)
1. Total Flow	145,198 A.F.	560 ppm	81,310,880 A.F.-ppm
2. Nontributary Flow Riverside Narrows	606 A.F.	242 ppm	146,652 A.F.-ppm
3. Nontributary Flow San Antonio Creek	9,897 A.F.	281 ppm	2,781,057 A.F.-ppm
4. Total Flow less Nontributary Flow	134,695 A.F.		78,383,171 A.F.-ppm
5. Av. TDS of total Flow less Non-tributary Flow	78,383,171 divided by 134,695 = 582 ppm		

FIGURE 4


TDS AS A FUNCTION OF E.C.
BELOW PRADO DAM
Y=X/(A+B*X)
A= 0.1802873E 01
B=-0.1635793E-03
TOTAL DISSOLVED SOLIDS IN MG/LITER
1200.
700.
200.
500.
1000.
1500.
2000.
ELECTRICAL CONDUCTIVITY IN MM HOS

The flow weighted average TDS of the State water released to San Antonio Creek in 1978-79 was 275 ppm as shown in Table C-1, Appendix C. This was adjusted to 281 ppm for use in the above calculation to reflect the evapotranspiration associated with the assumption that 2 percent of the water released was lost. The flow weighted average TDS of State water released above Riverside Narrows during 1972-73 was 235 ppm and was similarly adjusted to 242 ppm to reflect a 3 percent evapotranspiration loss.

After adjusting for releases of State water, the weighted average annual TDS of Storm Flow and Base Flow for 1978-79 was 582 ppm. It is understood that the water quality adjustment will be changed for years subsequent to 1973-74 at the same time the final determination of the disposition of State water released into San Antonio Creek is made.

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 ppm	$Q - \frac{35}{42,000} Q\,(TDS-800)$
700 ppm - 800 ppm	Q
Less than 700 ppm	$Q + \frac{35}{42,000} Q\,(700-TDS)$

Where: Q - Base Flow actually received.

The weighted average annual TDS of 582 ppm is less than 700 ppm. Therefore, the Base Flow of 72,069 acre-feet must be adjusted by the equation above for TDS less than 700 ppm. Thus the Adjusted Base Flow is as follows:

$$(72,069 \text{ A.F.}) + \frac{35}{42,000} (72,069 \text{ A.F.})(700-582) = 79,156 \text{ A.F.}$$

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 Watermaster's findings at Prado for 1978-79 required under the Judgment are as follows:

1.	Base Flow at Prado	72,069	acre-feet
2.	Annual Weighted TDS of Total Flow	582	ppm
3.	Annual Adjusted Base Flow	79,156	acre-feet
4.	Cumulative Adjusted Base Flow	475,958	acre-feet
5.	Cumulative entitlement of OCWD	378,000	acre-feet
6.	Cumulative Credit	97,958	acre-feet
7.	One-Third of Cumulative Debit	0	acre-feet
8.	Minimum Required Base Flow in 1979-80	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 47,916 acre-feet, measured at the USGS gaging station just upstream of the MWD Upper Feeder Crossing. Separated into its components, Base Flow was 26,590 acre-feet, Storm Flow was 20,708 acre-feet, and Nontributary Flow due to the release of State water above Riverside Narrows was 618 acre-feet. The components of flow of the Santa Ana River at Riverside Narrows for each month in the 1978-79 water year are listed in Table 4 and graphically shown on Plate 4.

TABLE 4

COMPONENTS OF FLOW AT RIVERSIDE NARROWS FOR WATER YEAR 1978-79
(Quantities in Acre-Feet)

		Total Flow USGS Measurement	Storm Flow	Base Flow	Nontributary Flow
1978	October	1,982	0	1,931	51
	November	2,237	160	2,026	51
	December	2,565	726	1,788	51
1979	January	6,766	4,850	1,865	51
	February	4,481	2,002	2,428	51
	March	11,117	8,028	3,038	51
	April	6,718	3,852	2,814	52
	May	3,673	1,090	2,531	52
	June	2,146	0	2,094	52
	July	1,982	0	1,930	52
	August	2,152	0	2,100	52
	September	2,097	0	2,045	52
Total Acre-Feet		47,916	20,708	26,590	618

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 previous reports. For the water year 1978-79 the amount of State water reaching Riverside Narrows has been agreed upon as 618 acre-feet.

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 (618 acre-feet divided by 12 months) and subtracted from the sum of the Base Flow and Nontributary Flow to arrive at Base Flow. The Base Flow was determined to be 26,590 acre-feet, as shown on Table 4.

Water Quality

The weighted average total dissolved solids (TDS) for the Base Flow plus Nontributary Flow at Riverside Narrows was found to be 696 ppm and for Base Flow only was found to be 707 ppm. This determination of the water quality was made using periodic grab samples taken and analyzed for TDS by the USGS. The data for this analysis are listed in Tables D-1 and D-2, Appendix D.

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 and Riverside Narrow is:	Then the Adjusted Base Flow shall be determined by the formula:
Greater than 700 ppm	$Q - \frac{11}{15,250} Q (TDS-700)$
600 ppm - 700 ppm	Q
Less than 600 ppm	$Q + \frac{11}{15,250} Q (600-TDS)$

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 1977-78 was 707 ppm. Therefore, a downward adjustment to the Base Flow of 134 acre-feet is necessary, and the Adjusted Base Flow for 1978-79 is 26,456 acre-feet.

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 Barrows 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 1978-79 required under the Judgment are as follows:

1.	Base Flow at Riverside Narrows	26,590 acre-feet
2.	Annual Weighted TDS of Base Flow	707 ppm
3.	Annual Adjusted Base Flow	26,456 acre-feet
4.	Cumulative Adjusted Base Flow	165,097 acre-feet
5.	Cumulative entitlement of CBMWD and WMWD	137,250 acre-feet
6.	Cumulative Credit	27,847 acre-feet
7.	One-Third of Cumulative Debit	0 acre-feet
8.	Minimum Required Base Flow in 1978-79	12,420 acre-feet

APPENDIX A

STATE WATER RELEASED BY MWD TO SAN ANTONIO CREEK NEAR UPLAND

CONNECTION OC-59

1978-79

PREPARED BY

DONALD L. HARRIGER

TABLE A-1

NONTRIBUTARY WATER FROM OC-59

MONTHLY TOTALS

(Acre Feet)

WATER YEAR 1978-79

Month	Released	Delayed [1]
October	7,894	7,945
November	2,167	2,265
December	0	0
January	0	0
February	0	0
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
Total	10,061 A.F.	10,210 A.F.

[1] Released Nontributary Water delayed 12 hours to reflect the estimated travel time between OC-59 and Prado.

NONTRIBUTARY WATER FROM OC-59

OCTOBER 1978

(CFS Days)

Day	Released at OC-59	Delayed [1/]
1	151	151
2	151	151
3	151	151
4	150	151
5	147	148
6	149	147
7	151	151
8	151	151
9	152	151
10	150	152
11	150	150
12	150	151
13	150	150
14	150	150
15	150	150
16	150	150
17	148	149
18	118	142
19	99	99
20	99	99
21	101	99
22	103	102
23	102	103
24	101	101
25	101	100
26	100	101
27	100	100
28	102	101
29	100	102
30	101	101
31	100	101
	3,980 CFS Days 7,894 A.F.	4,005 CFS Days 7,945 A.F.

1/ See Footnote to TABLE A-1

NONTRIBUTARY WATER FROM OC-59

NOVEMBER 1978

(CFS Days)

Day	Released at OC-59	Delayed 1/
1	100	100
2	100	100
3	100	100
4	102	100
5	103	103
6	102	102
7	83	96
8	76	76
9	76	76
10	77	76
11	76	77
12	76	76
13	24	62
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0	0
	1,093 CFS Days 2,167 A.F.	1,142 CFS Days 2,265 A.F.

1/ See Footnote to TABLE A-1

APPENDIX B

WATER QUALITY-
SANTA ANA RIVER BELOW PRADO DAM

1978-79

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 was calculated using the punched tape from the Prado water quality recorder, processed by a newly developed computer program designed by USGS. Input to the program included hourly specific conductivity data from the recorder tape, which was flow weighted using hourly discharge measurements from the water stage recorder.

2. Laboratory analyses of the 23 grab samples taken by the USGS below Prado Dam during the 1978-79 season were run to determine both specific conductance and TDS. Data from the grab samples are given in Table B-2. Results of these analyses were used to prepare a correlation between specific conductance and the corresponding TDS. A detailed discussion of this statistical analysis is presented in the Fifth Annual Watermaster Report. The resulting graph of plotted data points and equation of the best fit line are shown in Chapter III of this report.

3. The equation from the curve fitting operation was then used to determine the mean daily TDS corresponding to the mean daily specific conductance values for each day of the year. These data are given in Table B-2.

4. 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 560 ppm of total dissolved solids for the 1978-79 water year. The weighted TDS calculation for the water year 1978-79 is shown in Table B-3.

TABLE B-1

U.S.G.S WATER QUALITY SAMPLES
BELOW PRADO DAM WATER YEAR 1978-79

Date	E.C.	T.D.S.	Date	E.C.	T.D.S.
Oct. 1978	750	464	Apr. 1979	730	449
	820	510		860	511
Nov. 1978	858	501	May 1979	850	515
	1,240	762		950	548
Dec. 1978	850	516	Jun. 1979	1,020	607
Jan. 1979	990	614	Jul. 1979	975	594
	600	330		1,000	503
	600	362			
	900	567	Aug. 1979	1,025	645
				1,030	768
Feb. 1979	750	450			
	1,000	613	Sep. 1979	1,200	740
Mar. 1979	900	539			
	1,110	680			

Table B-2

TOUPS CORPOPATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER Y EAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
OCT 01	203.0	689	408	82824.
OCT 02	208.0	686	406	84448.
OCT 03	210.0	691	409	85890.
OCT 04	213.0	724	430	91590.
OCT 05	214.0	728	432	92448.
OCT 06	216.0	736	438	94608.
OCT 07	218.0	734	436	95048.
OCT 08	219.0	725	431	94389.
OCT 09	218.0	733	436	95048.
OCT 10	251.0	740	440	110440.
OCT 11	230.0	772	461	106030.
OCT 12	221.0	774	462	102102.
OCT 13	218.0	761	453	98754.
OCT 14	218.0	751	447	97446.
OCT 15	217.0	740	440	95480.
OCT 16	218.0	742	441	96138.
OCT 17	223.0	754	449	100127.
OCT 18	215.0	766	457	98255.
OCT 19	175.0	823	493	86275.
OCT 20	171.0	819	491	83961.
OCT 21	174.0	821	492	85608.
OCT 22	176.0	824	494	86944.
OCT 23	164.0	825	495	81180.
OCT 24	168.0	815	488	81984.
OCT 25	174.0	820	491	85434.
OCT 26	178.0	820	491	87398.
OCT 27	176.0	815	488	85888.
OCT 28	177.0	804	481	85137.
OCT 29	180.0	802	480	86400.
OCT 30	180.0	804	481	86580.
OCT 31	189.0	799	478	90342.
TOTAL	6212.			2834196.
MONTHLY WEIGHTED T.D.S.			456	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER YEAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
NOV 01	178.0	840	504	89712.
NOV 02	183.0	864	520	95160.
NOV 03	186.0	874	527	98022.
NOV 04	182.0	879	530	96460.
NOV 05	185.0	887	535	98975.
NOV 06	183.0	874	527	96441.
NOV 07	181.0	876	528	95568.
NOV 08	160.0	923	559	89440.
NOV 09	157.0	922	558	87606.
NOV 10	175.0	899	543	95025.
NOV 11	250.0	942	571	142750.
NOV 12	309.0	853	513	158517.
NOV 13	220.0	930	564	124080.
NOV 14	171.0	1020	624	106704.
NOV 15	144.0	1060	651	93744.
NOV 16	126.0	1100	678	85428.
NOV 17	126.0	1140	705	88830.
NOV 18	125.0	1160	719	89875.
NOV 19	123.0	1190	740	91020.
NOV 20	122.0	1190	740	90280.
NOV 21	122.0	1200	747	91134.
NOV 22	126.0	1040	637	80262.
NOV 23	126.0	1100	678	85428.
NOV 24	126.0	1100	678	85428.
NOV 25	126.0	1070	657	82782.
NOV 26	126.0	1050	644	81144.
NOV 27	122.0	1120	692	84424.
NOV 28	116.0	1190	740	85840.
NOV 29	118.0	1200	747	88146.
NOV 30	122.0	1180	733	89426.
TOTAL	4716.			2867651.
MONTHLY WEIGHTED T.D.S.			608	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM — WATER Y EAR 1978-1979 — TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
DEC 01	122.0	1180	733	89426.
DEC 02	124.0	1200	747	92628.
DEC 03	124.0	1190	740	91760.
DEC 04	125.0	1190	740	92500.
DEC 05	126.0	1220	761	95886.
DEC 06	126.0	1200	747	94122.
DEC 07	125.0	1190	740	92500.
DEC 08	124.0	1190	740	91760.
DEC 09	122.0	1190	740	90280.
DEC 10	121.0	1190	740	89540.
DEC 11	124.0	1200	747	92628.
DEC 12	128.0	1190	740	94720.
DEC 13	129.0	1200	747	96363.
DEC 14	131.0	1230	768	100608.
DEC 15	132.0	1200	747	98604.
DEC 16	135.0	1190	740	99900.
DEC 17	143.0	1170	726	103818.
DEC 18	155.0	1050 *	644	99820.
DEC 19	204.0	930 *	564	115056.
DEC 20	239.0	890 *	537	128343.
DEC 21	203.0	935 *	567	115101.
DEC 22	164.0	1025 *	627	102828.
DEC 23	162.0	1030 *	630	102060.
DEC 24	162.0	1030 *	630	102060.
DEC 25	162.0	1035 *	634	102708.
DEC 26	159.0	1040 *	637	101283.
DEC 27	157.0	1045 *	641	100637.
DEC 28	157.0	1045 *	641	100637.
DEC 29	157.0	1045 *	641	100637.
DEC 30	157.0	1050 *	644	101108.
DEC 31	157.0	1050 *	644	101108.
TOTAL	4556.			3080429.
MONTHLY WEIGHTED T.D.S.			676	

* Mean Daily E.C. Estimated

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER Y EAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
JAN 01	146.0	1080 *	664	96944.
JAN 02	146.0	977	595	86870.
JAN 03	140.0	1040	637	89180.
JAN 04	140.0	1060	651	91140.
JAN 05	146.0	1060	651	95046.
JAN 06	342.0	455	263	89946.
JAN 07	580.0	413	238	138040.
JAN 08	566.0	559	327	185082.
JAN 09	421.0	679	401	168821.
JAN 10	172.0	776	463	79636.
JAN 11	347.0	834	501	173847.
JAN 12	433.0	848	510	220830.
JAN 13	420.0	881	531	223020.
JAN 14	417.0	918	556	231852.
JAN 15	410.0	897	542	222220.
JAN 16	412.0	838	503	207236.
JAN 17	403.0	800	479	193037.
JAN 18	408.0	813	487	198696.
JAN 19	333.0	891	538	179154.
JAN 20	283.0	871	525	148575.
JAN 21	279.0	927	562	156798.
JAN 22	279.0	926	561	156519.
JAN 23	316.0	873	526	166216.
JAN 24	339.0	895	540	183060.
JAN 25	337.0	843	506	170522.
JAN 26	292.0	929	563	164396.
JAN 27	263.0	941	571	150173.
JAN 28	262.0	948	575	150650.
JAN 29	258.0	952	578	149124.
JAN 30	258.0	926	561	144738.
JAN 31	278.0	824	494	137332.
TOTAL	9626.			4848700.
MONTHLY WEIGHTED T.D.S.			493	

* Mean Daily E.C. Estimated

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER YEAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
FEB 01	297.0	860 *	518	153846.
FEB 02	303.0	855 *	514	155742.
FEB 03	286.0	860 *	518	148148.
FEB 04	262.0	870 *	524	137288.
FEB 05	278.0	802	480	133440.
FEB 06	300.0	891	538	161400.
FEB 07	264.0	934	566	149424.
FEB 08	224.0	987	601	134624.
FEB 09	235.0	942	571	134185.
FEB 10	217.0	953	579	125643.
FEB 11	215.0	945	573	123195.
FEB 12	214.0	929	563	120482.
FEB 13	215.0	920	557	119755.
FEB 14	214.0	907	548	117272.
FEB 15	212.0	911	551	116812.
FEB 16	212.0	887	535	113420.
FEB 17	209.0	887	535	111815.
FEB 18	209.0	953	579	121011.
FEB 19	209.0	968	589	123101.
FEB 20	209.0	986	601	125609.
FEB 21	211.0	1000	610	128710.
FEB 22	215.0	1030	630	135450.
FEB 23	217.0	952	578	125426.
FEB 24	217.0	886	535	116095.
FEB 25	217.0	890	537	116529.
FEB 26	216.0	873	526	113616.
FEB 27	215.0	892	538	115670.
FEB 28	215.0	975	593	127495.
TOTAL	6507.			3605203.
MONTHLY WEIGHTED T.D.S.			554	

* Mean Daily E.C. Estimated

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER Y EAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
MAR 01	191.0	1040	637	121667.
MAR 02	174.0	1090	671	116754.
MAR 03	174.0	1080	664	115536.
MAR 04	174.0	1070	657	114318.
MAR 05	174.0	1020	624	108576.
MAR 06	172.0	979	596	102512.
MAR 07	194.0	1010	617	119698.
MAR 08	206.0	990	603	124218.
MAR 09	188.0	983	599	112612.
MAR 10	177.0	958	582	103014.
MAR 11	179.0	948	575	102925.
MAR 12	179.0	941	571	102209.
MAR 13	177.0	925	560	99120.
MAR 14	172.0	918	556	95632.
MAR 15	177.0	927	562	99474.
MAR 16	174.0	944	573	99702.
MAR 17	172.0	959	583	100276.
MAR 18	172.0	1030	630	108360.
MAR 19	174.0	1100	678	117972.
MAR 20	172.0	1090	664	114208.
MAR 21	172.0	985	600	103200.
MAR 22	172.0	856	515	88580.
MAR 23	169.0	799	478	80782.
MAR 24	169.0	833	500	84500.
MAR 25	169.0	892	538	90922.
MAR 26	169.0	916	554	93626.
MAR 27	174.0	925	560	97440.
MAR 28	179.0	938	569	101851.
MAR 29	182.0	961	584	106288.
MAR 30	199.0	893	539	107261.
MAR 31	215.0	744	443	95245.
TOTAL	5541.			3228478.
MONTHLY WEIGHTED T.D.S.			583	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER Y EAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
APR 01	218.0	599	351	76518.
APR 02	220.0	639	376	82720.
APR 03	220.0	717	425	93500.
APR 04	249.0	726	431	107319.
APR 05	265.0	713	423	112095.
APR 06	271.0	713	423	114633.
APR 07	265.0	723	429	113685.
APR 08	268.0	723	429	114972.
APR 09	268.0	727	432	115776.
APR 10	268.0	725	431	115508.
APR 11	261.0	726	431	112491.
APR 12	265.0	714	424	112360.
APR 13	265.0	730	434	115010.
APR 14	265.0	772	461	122165.
APR 15	261.0	789	471	122931.
APR 16	299.0	768	458	136942.
APR 17	324.0	769	459	148716.
APR 18	320.0	742	441	141120.
APR 19	316.0	740	440	139040.
APR 20	285.0	753	448	127680.
APR 21	265.0	817	490	129850.
APR 22	265.0	876	528	139920.
APR 23	265.0	878	529	140185.
APR 24	268.0	855	514	137752.
APR 25	268.0	832	499	133732.
APR 26	265.0	816	489	129585.
APR 27	265.0	787	470	124550.
APR 28	265.0	779	465	123225.
APR 29	265.0	770	459	121635.
APR 30	261.0	755	450	117450.
TOTAL	8025.			3623065.
MONTHLY WEIGHTED T.D.S.			451	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM — WATER YEAR 1978-1979 — TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
MAY 01	251.0	767	457	114707.
MAY 02	154.0	761	453	69762.
MAY 03	12.0	920	557	6684.
MAY 04	80.0	827	496	39680.
MAY 05	198.0	810	485	96030.
MAY 06	197.0	813	487	95939.
MAY 07	222.0	836	502	111444.
MAY 08	235.0	833	500	117500.
MAY 09	191.0	848	510	97410.
MAY 10	116.0	863	519	60204.
MAY 11	157.0	932	565	88705.
MAY 12	197.0	992	605	119185.
MAY 13	197.0	958	582	114654.
MAY 14	197.0	945	573	112881.
MAY 15	185.0	962	585	108225.
MAY 16	200.0	947	575	115000.
MAY 17	197.0	937	568	111896.
MAY 18	197.0	910	550	108350.
MAY 19	197.0	886	535	105395.
MAY 20	197.0	889	536	105592.
MAY 21	197.0	894	540	106380.
MAY 22	197.0	894	540	106380.
MAY 23	197.0	899	543	106971.
MAY 24	197.0	914	553	108941.
MAY 25	194.0	927	562	109028.
MAY 26	194.0	931	564	109416.
MAY 27	194.0	935	567	109998.
MAY 28	194.0	938	569	110386.
MAY 29	194.0	940	570	110580.
MAY 30	194.0	944	573	111162.
MAY 31	203.0	936	567	115101.
TOTAL	5732.			3103586.
MONTHLY WEIGHTED T.D.S.			541	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER YEAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
JUN 01	191.0	927	562	107342.
JUN 02	191.0	941	571	109061.
JUN 03	191.0	963	585	111735.
JUN 04	191.0	961	584	111544.
JUN 05	194.0	968	589	114266.
JUN 06	194.0	965	587	113878.
JUN 07	124.0	997	608	75392.
JUN 08	69.0	966	587	40503.
JUN 09	185.0	1030	630	116550.
JUN 10	185.0	1030	630	116550.
JUN 11	182.0	1030	630	114660.
JUN 12	182.0	1010	617	112294.
JUN 13	182.0	993	605	110110.
JUN 14	209.0	987	601	125609.
JUN 15	226.0	992	605	136730.
JUN 16	226.0	992	605	136730.
JUN 17	226.0	989	603	136278.
JUN 18	238.0	984	599	142562.
JUN 19	251.0	987	601	150851.
JUN 20	251.0	979	596	149596.
JUN 21	254.0	995	607	154178.
JUN 22	258.0	1010	617	159186.
JUN 23	258.0	1010	617	159186.
JUN 24	258.0	1020	624	160992.
JUN 25	258.0	1030	630	162540.
JUN 26	251.0	1030	630	158130.
JUN 27	251.0	1040	637	159887.
JUN 28	251.0	1040	637	159887.
JUN 29	251.0	1040	637	159887.
JUN 30	251.0	1030	630	158130.
TOTAL	6429.			3924244.
MONTHLY WEIGHTED T.D.S.			610	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER Y EAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
JUL 01	251.0	1020	624	156624.
JUL 02	271.0	999	610	165310.
JUL 03	288.0	984	599	172512.
JUL 04	282.0	981	597	168354.
JUL 05	282.0	982	598	168636.
JUL 06	282.0	985	600	169200.
JUL 07	282.0	984	599	168918.
JUL 08	278.0	993	605	168190.
JUL 09	278.0	996	607	168746.
JUL 10	278.0	996	607	168746.
JUL 11	275.0	1000	610	167750.
JUL 12	275.0	994	606	166650.
JUL 13	271.0	987	601	162871.
JUL 14	271.0	981	597	161787.
JUL 15	268.0	963	585	156780.
JUL 16	268.0	951	577	154636.
JUL 17	265.0	976	594	157410.
JUL 18	265.0	991	604	160060.
JUL 19	261.0	993	605	157905.
JUL 20	261.0	990	603	157383.
JUL 21	261.0	981	597	155817.
JUL 22	261.0	951	577	150597.
JUL 23	282.0	953	579	163278.
JUL 24	295.0	986	601	177295.
JUL 25	295.0	996	607	179065.
JUL 26	295.0	981	597	176115.
JUL 27	292.0	997	608	177536.
JUL 28	288.0	991	604	173952.
JUL 29	285.0	982	598	170430.
JUL 30	282.0	968	589	166098.
JUL 31	278.0	956	581	161518.
TOTAL	8566.			5130169.
MONTHLY WEIGHTED T.D.S.			599	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM WATER YEAR 1978-1979 TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
AUG 01	275.0	954	579	159225.
AUG 02	275.0	976	594	163350.
AUG 03	271.0	986	601	162871.
AUG 04	271.0	995	607	164497.
AUG 05	268.0	1010	617	165356.
AUG 06	265.0	1050	644	170660.
AUG 07	261.0	1040	637	166257.
AUG 08	268.0	1030	630	168840.
AUG 09	271.0	1030	630	170730.
AUG 10	261.0	1030	630	164430.
AUG 11	254.0	1050	644	163576.
AUG 12	238.0	1060	651	154938.
AUG 13	226.0	1080	664	150064.
AUG 14	133.0	1220	761	101213.
AUG 15	92.0	1190	740	68080.
AUG 16	86.0	1180	733	63038.
AUG 17	86.0	1140	705	60630.
AUG 18	82.0	1150	712	58384.
AUG 19	88.0	1130	699	61512.
AUG 20	86.0	1110	685	58910.
AUG 21	90.0	1050	644	57960.
AUG 22	88.0	1040	637	56056.
AUG 23	82.0	1030	630	51660.
AUG 24	78.0	1010	617	48126.
AUG 25	78.0	1020	624	48672.
AUG 26	76.0	1030	630	47880.
AUG 27	75.0	1040	637	47775.
AUG 28	88.0	1040	637	56056.
AUG 29	84.0	1080	664	55776.
AUG 30	84.0	1100	678	56952.
AUG 31	82.0	1110	685	56170.
TOTAL	4962.			3179644.
MONTHLY WEIGHTED T.D.S.			641	

Table B-2 (Continued)

TOUPS CORPORATION

WEIGHTED T.D.S. CALCULATION SHEET

BELOW PRADO DAM — WATER Y EAR 1978-1979 — TDS=EC/(-0.000164(EC)+ 1.802870)

MONTH-DAY	U.S.G.S. MEAN DAILY FLOW (CFS-DAY)	U.S.G.S. MEAN DAILY SPECIFIC CONDUCTANCE (E.C.) (MICROMHOS)	MEAN DAILY ADJUSTED T.D.S. (PPM)	MEAN DAILY FLOW TIMES ADJUSTED T.D.S.
SEP 01	75.0	1140	705	52875.
SEP 02	75.0	1130	699	52425.
SEP 03	73.0	1140	705	51465.
SEP 04	75.0	1160	719	53925.
SEP 05	84.0	1210	754	63336.
SEP 06	69.0	1200	747	51543.
SEP 07	69.0	1190	740	51060.
SEP 08	68.0	1210	754	51272.
SEP 09	66.0	1220	761	50226.
SEP 10	63.0	1230	768	48384.
SEP 11	65.0	1260	789	51285.
SEP 12	66.0	1300	818	53988.
SEP 13	71.0	1250	782	55522.
SEP 14	82.0	1220	761	62402.
SEP 15	95.0	1200	747	70965.
SEP 16	75.0	1150	712	53400.
SEP 17	76.0	1090	671	50996.
SEP 18	79.0	1080	664	52456.
SEP 19	77.0	1100	678	52206.
SEP 20	76.0	1120	692	52592.
SEP 21	64.0	1180	733	46912.
SEP 22	63.0	1160	719	45297.
SEP 23	63.0	1140	705	44415.
SEP 24	66.0	1110	685	45210.
SEP 25	66.0	1080	664	43824.
SEP 26	66.0	1100	678	44748.
SEP 27	64.0	1120	692	44288.
SEP 28	64.0	1140	705	45120.
SEP 29	68.0	1140	705	47940.
SEP 30	68.0	1130	699	47532.
TOTAL	2131.			1537609.
MONTHLY WEIGHTED T.D.S.			722	

TABLE B-3

SUMMARY OF WEIGHTED TDS
BELOW PRADO DAM WATER YEAR 1978-1979

	Monthly Flow cfs-day	Monthly Flow Times TDS	Monthly Weighted TDS
October	6,212	2,834,196	456
November	4,716	2,867,651	608
December	4,556	3,080,429	676
January	9,826	4,848,700	493
February	6,507	3,605,203	554
March	5,541	3,228,478	583
April	8,025	3,623,065	451
May	5,732	3,103,586	541
June	6,429	3,924,244	610
July	8,566	5,130,169	599
August	4,962	3,179,644	641
September	2,131	1,537,609	722
Total	73,203	40,962,974	
Yearly Weighted TDS			560

APPENDIX C

WATER QUALITY-
STATE WATER RELEASED
AT OC-59

1978-79

PREPARED BY

WILLIAMS R. MILLS, JR.

TABLE C-1

SUMMARY OF WEIGHTED TDS
OF NONTRIBUTARY WATER RELEASED
FROM OC-59 FOR WATER YEAR 1978-1979

	Monthly Flow (Acre-Feet) [1]	Monthly Flow Times TDS	Monthly Weighted TDS [2]
October	7,787	2,242,656	288
November	2,221	504,167	227
December	-0-	-0-	-0-
January	-0-	-0-	-0-
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	10,008	2,746,823	
Yearly Weighted TDS			274

[1] Based on USGS measurements, it was estimated that 111 acre-feet of this flow entered the Montclair Spreading Basin through gate leakage.

[2] Water quality measured at Devil Canyon Afterbay by DWR.

APPENDIX D

WATER QUALITY - SANTA ANA RIVER AT RIVERSIDE NARROWS

1978-79

PREPARED BY

DONALD L. HARRIGER

TABLE D-1

U.S.G.S. WATER QUALITY ANALYSES

SANTA ANA RIVER AT RIVERSIDE NARROWS

WATER YEAR 1978-79

Date	E.C. @25° C	T.D.S. mg/ℓ
1978		
Oct. 03	1090	713
Nov. 01	1127	722
Dec. 04	1140	733
1979		
Jan. 02	1130	721
08	850	529
Feb. 05	1080	673
Mar. 02	700	417
May. 02	467	295
Jun. 12	1130	706
Jul. 06	1000	714
24	1090	675
Aug. 02	1000	706
23	1150	702
Sep. 06	1120	679

TABLE D-2

FLOW WEIGHTED TDS OF COMBINED
BASE FLOW AND NONTRIBUTARY WATER
AT RIVERSIDE NARROWS
WATER YEAR 1978-79

		Combined Base Flow and Nontributary Water		Acre Feet Times TDS
		Acre Feet[1]	TDS[2]	
1978	October	1982	715	1,417,130
	November	2076	724	1,503,024
	December	1839	725	1,333,275
1979	January	1916	700	1,341,200
	February	2480	675	1,674,000
	March	3091	680	2,101,880
	April	2866	687	1,968,942
	May	2582	695	1,794,490
	June	2146	705	1,512,930
	July	1982	695	1,377,490
	August	2152	697	1,499,944
	September	2097	675	1,415,475
	TOTAL	27,208		18,939,780

$$\text{Combined Flow Weighted TDS} = \frac{18,939,780}{27,208} = 696 \text{ mg/}\ell$$

(1) Base Flow plus Nontributary Flow from TABLE 4

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

APPENDIX E

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, 1979

ELLIS C. DIEHL, C.P.A. (1925-1956)
BRYN B. EVANS, C.P.A.
WIN G. PETERS, C.P.A.
DONALD H. PETERSON, C.P.A.
DONALD E. CALLAHAN, C.P.A.
L. PETER SCHERER, C.P.A.
PHILIP H. HOLTKAMP, C.P.A.

DIEHL, EVANS AND COMPANY
CERTIFIED PUBLIC ACCOUNTANTS
1910 NORTH BUSH STREET
SANTA ANA, CALIFORNIA 92706
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OTHER OFFICES AT:
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CARLSBAD, CALIFORNIA 92008
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448 SOUTH ESCONDIDO BOULEVARD
ESCONDIDO, CALIFORNIA 92025
(714) 741-3141

July 17, 1979

ACCOUNTANTS' REPORT

Santa Ana River Watermaster
Santa Ana, California

We have examined the statement of assets and liabilities arising from cash transactions of the Santa Ana River Watermaster as of June 30, 1979 and the related statement of revenue collected and 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, revenue and the related assets are recognized when received 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, 1979, 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, 1979

ASSETS

Cash in checking account	$ 497
Cash in savings account	7,081
TOTAL ASSETS	$ 7,578

LIABILITIES AND FUND BALANCE

Liabilities	$ -
Fund balance	7,578
TOTAL LIABILITIES AND FUND BALANCE	$ 7,578

See accompanying 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, 1979

		Actual	Budget	Over (Under) Budget
REVENUE COLLECTED:				
Water district contributions:				
Orange County Water District		$ 4,000	$ 4,000	$ -
Chino Basin Municipal Water District		2,000	2,000	-
San Bernardino Valley Municipal Water District		2,000	2,000	-
Western Municipal Water District		2,000	2,000	-
Interest from savings account		285	-	285
TOTAL REVENUE COLLECTED		10,285	10,000	285
EXPENSES PAID:				
Professional engineering services		4,781	6,000	(1,219)
Administrative expenses:				
Office and secretarial expense	$ 1,327			
Auditing services	360	1,687	2,500	(813)
Annual reports		1,166	1,500	(334)
TOTAL EXPENSES PAID		7,634	10,000	(2,366)
EXCESS OF REVENUE COLLECTED OVER EXPENSES PAID		2,651	$ -	$(2,651)
FUND BALANCE AT JULY 1, 1978		4,927		
FUND BALANCE AT JUNE 30, 1979		$ 7,578		

See accompanying accountants' report and notes to financial statements.

SANTA ANA RIVER WATERMASTER

NOTES TO FINANCIAL STATEMENTS

June 30, 1979

1. SIGNIFICANT ACCOUNTING POLICIES:

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 judgment 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.

See accompanying accountants' report.

SANTA ANA RIVER WATERSHED

MT. SAN ANTONIO
ELEV. 10080'

CAJON SUMMIT
ELEV. 4259'

SAN GABRIEL MOUNTAINS

SAN BERNARDINO COUNTY

LOS ANGELES COUNTY

SAN ANTONIO WASH

CUCAMONGA CREEK

CAJON WASH

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

CHINO BASIN MUNICIPAL WATER DISTRICT

POMONA
ELEV. 848'

ONTARIO
ELEV. 998'

CHINO
ELEV. 730'

CHINO CREEK

PRADO RESERVOIR

RIVERSIDE NARROWS GAGING STATION

RIVERSIDE NARROWS

PRADO GAGING STATION

PRADO DAM

CORONA
ELEV. 678'

TEMESCAL WASH

WESTERN MUNICIPAL WATER DISTRICT OF RIVERSIDE COUNTY

ELEV. 1049'
SAN BERNARDINO

EAST TWIN CREEK

BERNARDINO CREEK

WARM CREEK

CITY CREEK

SAN TIMOTEO CANYON

COLTON

SLOVER MOUNTAIN
ELEV. 980'

JURUPA MOUNTAINS

PEDLEY HILLS

LA LOMA HILLS

RIVERSIDE COUNTY

ELEV. 858'
RIVERSIDE

REDLANDS
ELEV. 1357'

MENTONE
ELEV. 1640'

CRAFTON HILLS

YUCAIPA PLAIN

YUCAIPA
ELEV. 2682'

YUCAIPA HILLS

BEAR CREEK

ELEV. 6738'
BIG BEAR LAKE

SANTA ANA RIVER

SAN GORGONIO MOUNTAIN
ELEV. 11502'

PIGEON PASS
ELEV. 1910'

BADLANDS

BEAUMONT PLAIN

ELEV. 2600'
BEAUMONT

SAN GORGONIO PASS
ELEV. 2616'

SAN JACINTO MOUNTAINS

SAN JACINTO FAULT

SANTIAGO CREEK

SANTA ANA MOUNTAINS

SANTIAGO PEAK
ELEV. 5687'

THE GAVILAN

TEMESCAL PLATEAU

PUENTE HILLS

BUENA PARK
ELEV. 75'

FULLERTON
ELEV. 164'

ANAHEIM
ELEV. 157'

SEAL BEACH

SANTA ANA
ELEV. 111'

NEWPORT BEACH

ORANGE COUNTY WATER DISTRICT

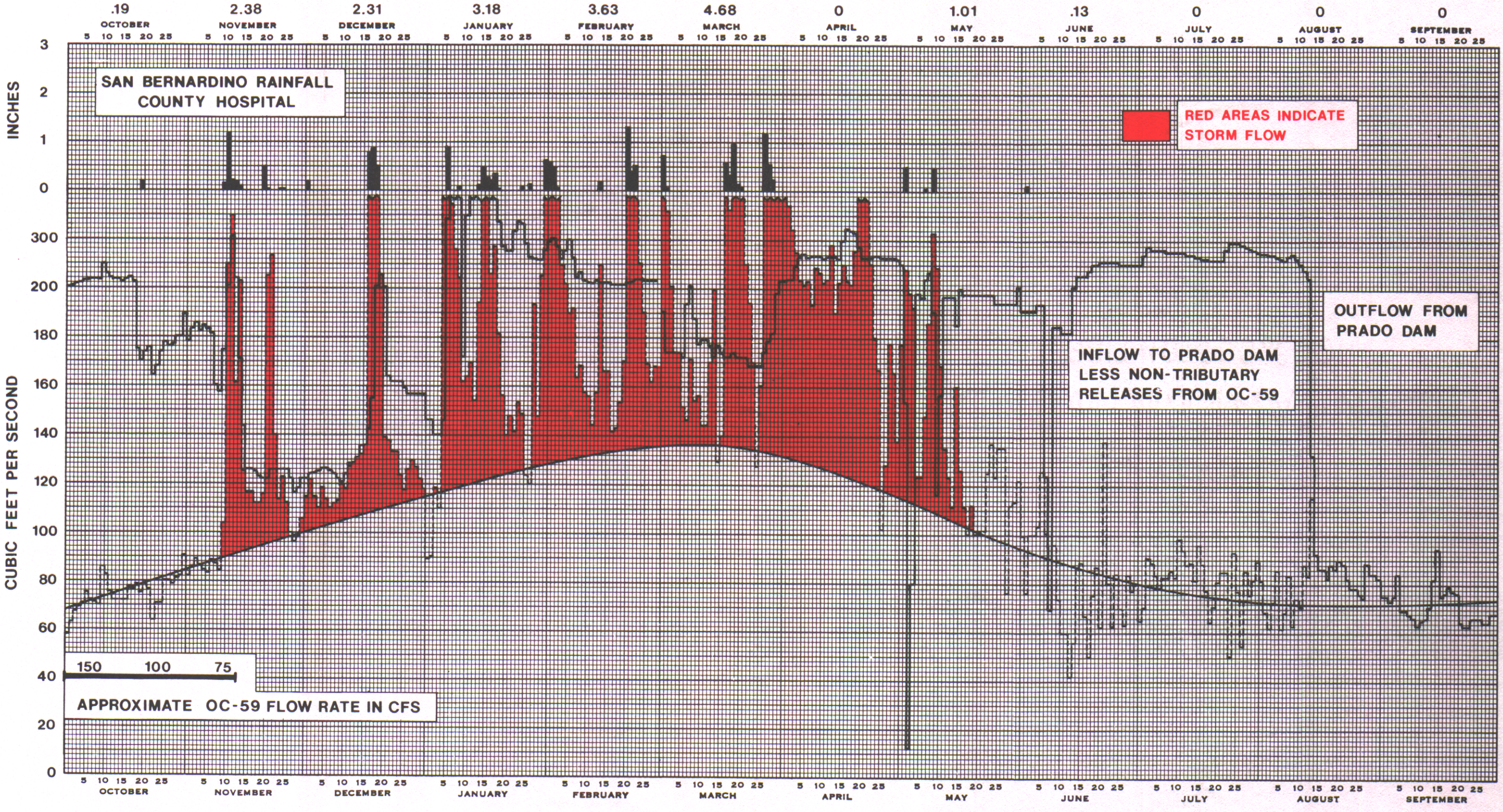
SAN JOAQUIN HILLS

PACIFIC OCEAN

N

SCALE OF MILES
4 0 4 8

PLATE 1



FLOW OF SANTA ANA RIVER BELOW PRADO DAM

PLATE 2

WATER YEAR 1978-79

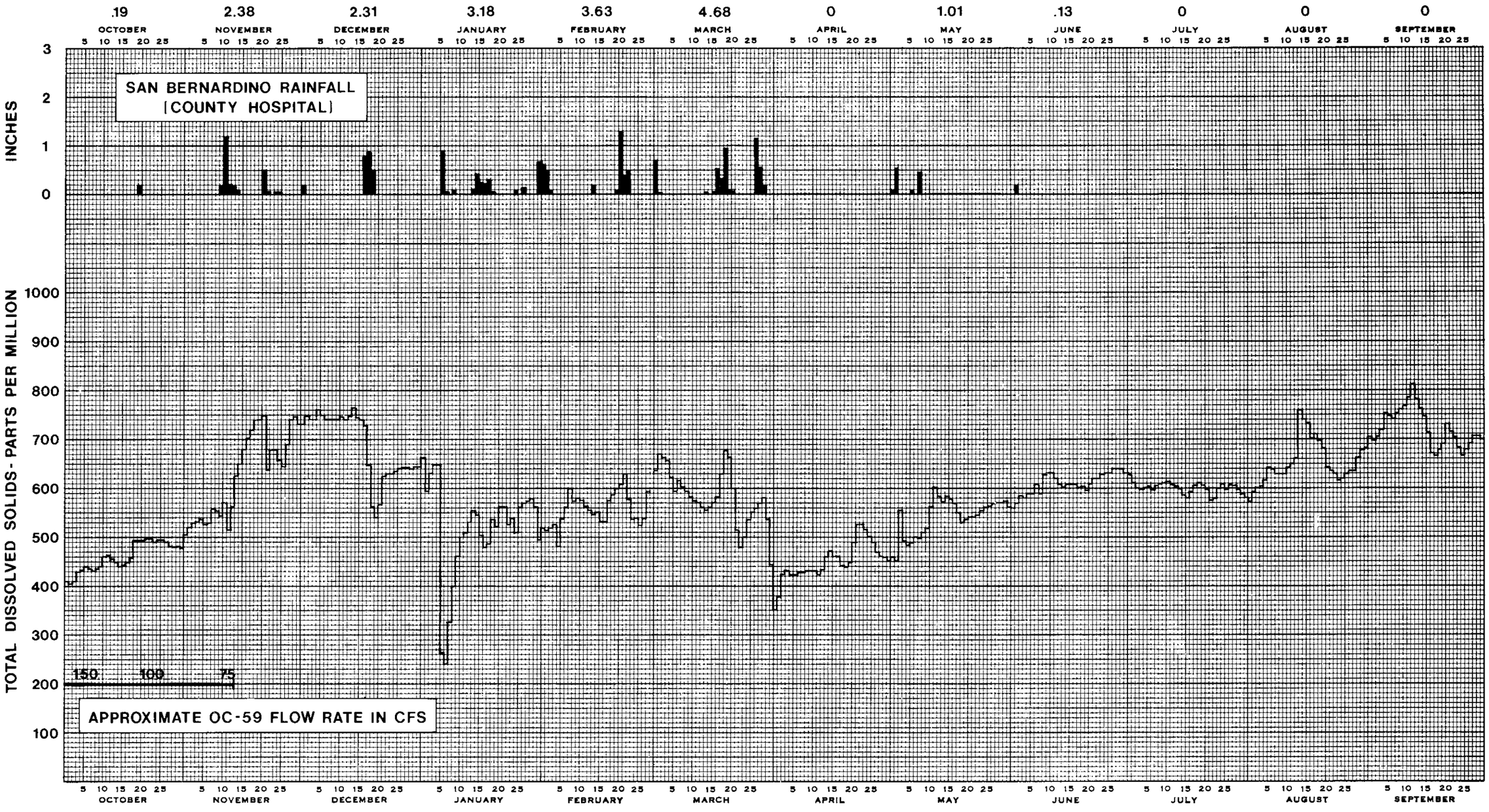


PLATE 3

DISSOLVED SOLIDS IN SANTA ANA RIVER BELOW PRADO DAM

WATER YEAR 1978-79

OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
0.19"	2.38"	2.31"	3.18"	3.63"	4.68"	T	1.01"	0.13"	0.00"	T	T

INCHES

SAN BERNARDINO RAINFALL
(County Hospital)

C.F.S.

SANTA ANA RIVER
SURFACE FLOW AT MISSION BLVD.

CUBIC FEET PER SECOND

SANTA ANA RIVER
SURFACE FLOW AT
RIVERSIDE NARROWS

BIG BEAR RELEASES

DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS

PLATE 4
Water Year 1978-79