SANTA ANA RIVER WATERMASTER

FOR

ORANGE COUNTY WATER DISTRICT

VS. CITY OF CHINO et al.

CASE NO. 117628 - COUNTY OF ORANGE

TWENTY-SEVENTH

ANNUAL REPORT

OF THE

SANTA ANA RIVER WATERMASTER

FOR WATER YEAR

OCTOBER 1, 1996 - SEPTEMBER 30, 1997

APRIL 30, 1998

SANTA ANA RIVER WATERMASTER

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

WATERMASTER
William J. Carroll
Bill B. Dendy
Donald L. Harriger
William R. Mills, Jr.
Robert L. Reiter

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April 30, 1998

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

Re: Watermaster Report for Water Year October 1, 1996 - September 30, 1997

Ladies and Gentlemen:

We have the honor of submitting herewith the Twenty-seventh Annual Report of the Santa Ana River Watermaster. We wish to point out that the supporting basic data heretofore presented as Appendices are bound separately and are available upon request from the office of the Secretary of the Watermaster.

The principal findings of the Watermaster for the water year 1996-97 are as follows:

<u>At Prado</u>

1	Base Flow at Prado	136,676 acre-feet
2	Annual Weighted TDS in Base and Storm Flows	514 mg/L
3	Annual Adjusted Base Flow	157,861 acre-feet
4	Cumulative Adjusted Base Flow	2,818,554 acre-feet
5	Cumulative Entitlement of OCWD	1,134,000 acre-feet
6	Cumulative Credit	1,684,554 acre-feet
7	One-third of Cumulative Debit	0 acre-feet
8	Minimum Required Base Flow in 1997-98	34,000 acre-feet

At Riverside Narrows

1	Base Flow at Riverside Narrows	62,618 acre-feet
2	Annual Weighted TDS in Base Flow	624 mg/L
3	Annual Adjusted Base Flow	62,618 acre-feet
4	Cumulative Adjusted Base Flow	1,036,803 acre-feet
5	Cumulative Entitlement of CBMWD and WMWD	411,750 acre-feet
6	Cumulative Credit	625,053 acre-feet
7	One-third of Cumulative Debit	0 acre-feet
8	Minimum Required Base Flow in 1997-98	12,420 acre-feet

The above findings show that at the end of the 1996-97 water year, Chino Basin Municipal Water District and Western Municipal Water District have a cumulative credit of 1,684,554 acre-feet to their Base Flow obligation at Prado Dam. San Bernardino Valley Municipal Water District has a cumulative credit of 625,053 acre-feet to its Base Flow obligation at Riverside Narrows.

Based on these findings, the Watermaster concludes that there was full compliance with the provisions of the Stipulated Judgment in 1996-97.

The Watermaster continued to exercise surveillance over the many active and proposed projects within the watershed for their potential effect on Base Flow.

Sincerely yours,

Santa Ana River Watermaster

By: William J. Carroll
William J. Carroll

Donald L. Harriger

Bill B. Dendy
Bill B. Dendy

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

Robert L. Reiter
Robert L. Reiter

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B Daily Precipitation Data at San Bernardino County Hospital

C Santa Ana River Watermaster Financial Statements with Report on Examination by Orange County Water District Controller

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CHAPTER I

WATERMASTER ACTIVITIES AND WATER CONDITIONS

Introduction

This is the Twenty-seventh Annual Report of the Santa Ana River Watermaster. It covers water year 1996-97. The annual report is 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 (Case No. 117628-County of Orange). The Stipulated Judgment became effective on October 1, 1970, and contains a declaration of rights of the water users and other entities in the Lower Area of the Santa Ana River Basin downstream of Prado Dam as against those in the Upper Area tributary to Prado Dam, and provides a physical solution to satisfy those rights. The physical solution accomplishes, in general, a regional intrabasin allocation of the surface flow of the Santa Ana River System. The Judgment leaves to each of the major hydrologic units in the basin the determination and regulation of individual rights therein and the development and implementation of its own water management plan, subject only to compliance with the physical solution.

In order to administer the provisions of the Judgment, the court appoints a Watermaster composed of five persons. Since January 15, 1997, the Santa Ana River Watermaster Committee has consisted of William J. Carroll, Bill B. Dendy, William R. Mills, Jr., Donald L. Harriger, and Robert L. Reiter. In 1996-97, Mr. Carroll served as chairman and Mr. Reiter continued to serve as secretary/treasurer. The Watermaster's duty is to maintain a continuous accounting of each of the items listed in the letter of transmittal hereof and to report thereon annually to the court and the parties. The time for submission of the annual report is seven months after the end of the water year.

History of Litigation

The complaint in the case was filed by Orange County Water District on October 18, 1963, seeking an adjudication of water rights against substantially all water users in the area tributary to Prado Dam within the Santa Ana River Watershed, but excluding the area tributary to Lake Elsinore. Thirteen cross-complaints were filed in 1968, extending the adjudication to include substantially all water users in the area downstream from Prado Dam. With some 4,000 parties involved in the case (2,500 from the Upper Area and 1,500 from the Lower Area), it became obvious that every effort should be made to arrive at a settlement and physical solution in order to avoid enormous and unwieldy litigation.

Efforts to arrive at a settlement and physical solution were pursued by public officials, individuals, attorneys, and engineers. Attorneys for the parties organized in order to facilitate settlement discussions and, among other things, provided guidance for the formation and activities of an engineering committee to provide information on the physical facts.

An initial meeting of the engineers representing the parties was held on January 10, 1964. Agreement was reached that it would be beneficial to undertake jointly the compilation of basic data. Liaison was established with the Department of Water Resources, State of California, to expedite the acquisition of data. Engineers representing the parties were divided into subcommittees which were given the responsibility of investigating such things as the boundary of the Santa Ana River watershed and its subareas, standardization of the terminology, the location and description of wells and diversion facilities, waste disposal and transfer of water between subareas.

In response to a request from the attorneys' committee at a meeting held April 17, 1964, on April 30, 1964, the joint engineering committee prepared a list of preliminary engineering studies directed toward settlement of the Santa Ana River water rights litigation. Special assignments were made to individual engineers on selected items requested by the attorneys' committee.

The attorneys and engineers for the defendants then commenced a series of meetings separate from the representatives of the plaintiffs in order to consolidate their positions and to determine a course of action. On October 7, 1964, engineers for the defendants presented the results of the studies made by the joint engineering committee. The defendants' attorneys requested that additional information be provided on the methods of measuring flow at Prado Dam, the historical supply and disposal of water passing Prado Dam, segregation of flow into components, and determination of the amount of supply which was usable by the downstream area. On December 11, 1964, the supplemental information was presented to the defendants' attorneys.

During 1965, engineers and attorneys for the defendants held numerous conferences and conducted additional studies in an attempt to determine their respective positions in the case. Early in 1966, the plaintiff and defendants exchanged drafts of possible principles of settlement. Commencing March 22 and ending April 13, 1966, four meetings were held by the engineers to discuss the draft of principles for settlement.

On February 25, 1968, the defendants submitted a request to the Court that the Order of Reference be issued requesting the California Department of Water Resources to determine the physical facts. On May 9, 1968, the plaintiffs' attorney submitted motions opposing the Order of Reference and requested that a preliminary injunction be issued. In the meantime, every effort was being made to come to an agreement on the Stipulated Judgment. Commencing on February 28, 1968 and extending until May 14, 1968, six meetings were held to determine the scope of physical facts on which agreement could be reached so that if an Order of Reference were to be approved by the Court, the work under the proposed reference would not repeat the extensive basic data collection and compilation which had already been completed and on which engineers for both plaintiffs and defendants had reached substantial agreement. Such basic data were compiled and published in two volumes under date of May 14, 1968 entitled "Appendix A, Basic Data."

On May 21, 1968, an outline of a proposal for settlement of the case was prepared and a committee of attorneys and engineers for the parties commenced preparation of the settlement documents. On June 16, 1968, the Court held a hearing on the motions it had received requesting a preliminary injunction and an Order of Reference. The parties requested that the Court delay the preliminary hearings on these motions in view of the efforts toward settlement that were underway. The plaintiff, however, was concerned regarding the necessity of bringing the case to trial within the statutory limitation and, accordingly, on July 15, 1968, submitted a motion to set the complaint in the case for trial. On October 15, 1968, the trial was commenced and was adjourned after one-half day of testimony on behalf of the plaintiff. Thereafter, the parties filed with the Court the necessary Settlement Documents including a Stipulation for Judgment. The Court entered the Judgment on April 17, 1969, along with Stipulations and Orders dismissing all defendants and cross-defendants except for the four major public water districts overlying in aggregate, substantially all of the major areas of water use in the watershed. The districts, the locations of which are shown on Plate 1, "Santa Ana River Watershed", are as follows:

(1) Orange County Water District (OCWD), representing all lower basin entities located within Orange County downstream of Prado Dam.

(2) Western Municipal Water District (WMWD), representing middle basin entities located within Riverside County on both sides of the Santa Ana River primarily upstream from Prado Dam.

(3) Chino Basin Municipal Water District (CBMWD), located in the San Bernardino County Chino Basin area, representing middle basin entities within its boundaries and located primarily upstream from Prado Dam.

(4) San Bernardino Valley Municipal Water District (SBVMWD), representing all entities within its boundaries, and embraced within the upper portion of the Riverside Basin area, the Colton Basin area (being an upstream portion of the middle basin) and the San Bernardino Basin area, being essentially the upper basin.

Summary of Judgment

Declaration of Rights

The Stipulated Judgment sets forth a declaration of rights. Briefly stated, the Judgment provides that the water users in the Lower Area have rights, as against the water users in the Upper Area, to receive certain average and minimum annual amounts of non-storm flow at Prado Dam, together with the right to all storm flow reaching Prado Dam. Water users in the Upper Area have the right as against the water users in the Lower Area to divert, pump, extract, conserve, store and use all surface and ground water supplies originating within the Upper Area, so long as the Lower Area receives the

water to which it is entitled under the Judgment and there is compliance with all of its provisions.

Definitions

Essential to understanding the physical solution in the Judgment is understanding certain important terms therein:

(1) Storm Flow - That portion of the total surface flow which originates from precipitation and runoff and which passes a point of measurement (either Riverside Narrows or Prado Dam), without having first percolated to ground water storage in the zone of saturation, calculated in accordance with procedures referred to in the Judgment.

(2) Base Flow - That portion of the total surface flow passing a point of measurement (either Riverside Narrows or Prado Dam) which remains after deduction of storm flow, nontributary flows, exchange water purchased by OCWD, and certain other flows as determined by the Watermaster.

(3) Adjusted Base Flow - Actual base flow in each year adjusted for water quality pursuant to formulas specified in the Judgment. The adjustment of Base Flow for water quality is intended to provide an incentive to the Upper Area to maintain a better quality of water in the river. When the total dissolved solids (TDS) is lower than a specified value at one of the measuring points, the water quantity obligation is lower. When the TDS is higher than a specified value, the water quantity obligation is higher. This is the first comprehensive adjudication in Southern California in which the quality of water is taken into consideration in the quantification of water rights.

(4) Credits and Debits - Under the accounting procedures provided for in the Judgment, credits accrue in any year when the Adjusted Base Flow exceeds 15,250 acre-feet at Riverside Narrows or 42,000 acre-feet at Prado Dam. Debits accrue in any year when the Adjusted Base flow falls below those levels. Credits or debits accumulate year to year.

Obligation at Riverside Narrows

SBVMWD has an obligation to CBMWD and WMWD to assure an average annual Adjusted Base Flow of 15,250 acre-feet at Riverside Narrows, subject to the following:

(1) A minimum Adjusted Base Flow of 13,420 acre-feet plus one-third of any cumulative debit.

(2) After October 1, 1986, if no cumulative debit exists, the minimum Adjusted Base Flow shall be 12,420 acre-feet.

(3) Prior to 1986, if the cumulative credits exceed 10,000 acre-feet, the minimum Adjusted Base Flow shall be 12,420 acre-feet.

(4) All cumulative debits shall be removed by the discharge of a sufficient Base Flow at Riverside Narrows at least once in any ten consecutive years following October 1, 1976. Any cumulative credits shall remain on the books of account until used to offset any subsequent debits or until otherwise disposed of by SBVMWD.

(5) The Base Flow at Riverside Narrows shall be adjusted using weighted average annual TDS in such Base Flow in accordance with the formula set forth in the Judgment.

Obligation at Prado Dam

CBMWD and WMWD have a joint obligation to OCWD to assure an average annual Adjusted Base Flow of 42,000 acre-feet at Prado Dam, subject to the following:

(1) Minimum Adjusted Base Flow at Prado shall not be less than 37,000 acre-feet plus one-third of any cumulative debit.

(2) After October 1, 1986, if no cumulative debit exists, the minimum Adjusted Base Flow quantity shall be 34,000 acre-feet.

(3) Prior to 1986, if the cumulative credit exceeds 30,000 acre-feet, the minimum Adjusted Base Flow shall be 34,000 acre-feet.

(4) Sufficient quantities of Base Flow shall be provided at Prado to discharge completely any cumulative debits at least once in any ten consecutive years following October 1, 1976. Any cumulative credits shall remain on the books of account until used to offset any debits, or until otherwise disposed of by CBMWD and WMWD.

(5) The Base Flow at Prado during any year shall be adjusted using the weighted average annual TDS in the total flow at Prado (Base Flow plus Storm Flow) in accordance with the formula set forth in the Judgment.

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 discharges of the Santa Ana River below Prado Dam and at The Metropolitan Water District of Southern California (MWDSC) Upper Feeder Crossing (Riverside Narrows). Discharge data have also been provided for the Santa Ana River at E Street in San Bernardino and for other smaller streams tributary to Prado Reservoir; namely, Chino Creek at Schaefer Avenue, Cucamonga Creek near Mira Loma, and Temescal Wash in the City of Corona (Appendix A).

The 1996-97 daily mean discharge record for the USGS gaging station, "Santa Ana River below Prado," is considered by the USGS to be a "good" record. Extremes for this period saw a maximum daily mean discharge of 4,820 cubic feet per second (cfs) on January 26, 1997 and a minimum daily mean discharge of 155 cfs on October 30, 1996. Maximum daily mean discharges are mitigated by the utilization of storage in the reservoir behind Prado Dam, upstream of the USGS gaging station.

The 1996-97 daily mean discharge record for the USGS gaging station, "Santa Ana River at MWD Crossing", is considered by the USGS to be "fair" below 900 cfs and "poor" above 900 cfs. Extremes for this period were a maximum daily mean discharge of 3,730 cfs on January 26, 1997 and a minimum daily mean discharge of 60 cfs on August 29, 1997.

As discussed in Chapter II, Nontributary Flow due to release of State Water Project water from the OC-59 turnout into San Antonio Creek totaled 42,322 acre-feet. In addition, the Arlington Desalter operated during the 1996-97 water year and discharged 6,151 acre-feet of product water into a channel tributary to the Santa Ana River.

Precipitation during 1996-97 totaled 18.64 inches as measured at the San Bernardino County Hospital and reported by the National Oceanic and Atmospheric Administration (Appendix B). The rainfall total was 104% of the 26-year base period (1934-35 through 1959-60) average of 17.98 inches. Plate 2 shows annual precipitation from 1934-35 through 1996-97.

TABLE 1
COSTS TO THE PARTIES AND USGS FOR MEASUREMENTS WHICH PROVIDE DATA USED BY THE SANTA ANA RIVER WATERMASTER

October 1, 1996 to September 30, 1997

USGS GAGING STATION NAME	Total Cost	USGS Share	Parties' Share
Santa Ana River at MWD Crossing (Riverside Narrows			
Surface Water Gage	$18,650	$9,325	$9,325
Water Quality Monitoring/TDS Sampling	$7,250	$3,625	$3,625
Chino Creek at Schaefer	$13,300	$6,650	$6,650
Cucamonga Creek at Mira Loma	$13,300	$6,650	$6,650
Santa Ana River below Prado Dam			
Surface Water Gage	$13,300	$6,650	$6,650
Water Quality Monitoring/TDS Sampling	$16,150	$8,075	$8,075
Water Quality Conductance Program	$1,500	$0	$1,500
Daily Records Reporting	$1,150	$0	$1,150
TOTAL COST	$84,600		
TOTAL USGS SHARE OF COST		$40,975	
TOTAL PARTIES SHARE OF COST			$43,625

COST DISTRIBUTION AMONG PARTIES		
Chino Basin Municipal Water District	20%	$8,725
Orange County Water District	40%	$17,450
San Bernardino Valley Municipal Water District	20%	$8,725
Western Municipal Water District	20%	$8,725
TOTAL COST SHARED BY PARTIES		$43,625

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 Stipulated Judgment. 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 II and III.

Watermaster Service Expenses

In accordance with Paragraph 7(d) of the Stipulated Judgment, the fees and expenses of each of the members of the Watermaster are borne by the district which nominated such member. All other Watermaster service expenses are borne by the parties, with OCWD paying 40% of the cost and WMWD, SBVMWD, and CBMWD each paying 20% of the cost. The Stipulated Judgment further provides that the Watermaster may from time to time, at its discretion, require advances of operating funds from the parties.

At its meeting on April 5, 1996, the Watermaster adopted a budget for the fiscal year 1996-97 in the amount of $12,000. Table 2 shows the items and amount included in said budget. The expenses for the fiscal year 1996-97 are also shown. The budget for fiscal year 1997-98 was adopted on April 4, 1997. A financial review was performed by OCWD and is contained in Appendix C.

TABLE 2

WATERMASTER SERVICE BUDGET AND EXPENSES

Budget Item	July 1, 1996 to June 30, 1997 Budget	July 1, 1996 to June 30, 1997 Expenses	July 1, 1997 to June 30, 1998 Budget
Support Services	$9,500.00	$15,481.97[1]	$9,500.00
Reproduction of Annual Report	2,500.00	4,061.14[1]	2,500.00
TOTAL	$12,000.00	$19,543.11	$12,000.00

(1) Expenses appear high because1995-96 expenses were paid after June 30, 1996.

Summary of Findings

A summary of findings by the Watermaster for the period 1970-71 through 1996-97 is presented in Table 3. Note that the Base Flow obligations at both Prado Dam and Riverside Narrows as provided for in the Stipulated Judgment have been met and cumulative credits have accrued.

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	76,375	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	143,367	81,548	584	89,431	253,083
1982-83	32.36	425,938[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]
1984-85	12.86	162,912	125,023[8]	617	133,670	523,184
1985-86	17.86	196,565	127,215[8]	567	141,315	622,499
1986-87	8.08	140,538	119,848	622	127,638	708,137
1987-88	13.78	170,279[9]	124,104[9]	582	136,308	802,445
1988-89	12.64	152,743[9]	119,572[9]	583	131,230	891,675
1989-90	8.53	144,483	119,149[10]	611	127,986	977,611
1990-91	15.48	191,321	111,151[11]	514	128,379	1,064,040
1991-92	16.54	193,225	106,948[11]	499	124,869	1,146,909
1992-93	30.92	568,677	128,068[11]	368	163,499	1,268,408
1993-94	11.62	158,241	111,186[11]	611	119,432	1,345,840
1994-95	25.14	424,017[4]	123,468[11]	415	152,792[5]	1,458,394[6]
1995-96	11.92	194,797	131,861[11]	514	152,299	1,568,693
1996-97	18.64	204,610	136,676[11]	514	157,861	1,684,554

TABLE 3 (Continued)

SUMMARY OF FINDINGS
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	17,021	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	253,817	25,549[7]	676	25,549	38,146
1980-81	10.45	34,278	19,764	715	19,550	42,446
1981-82	18.34	82,708	32,778	678	32,778	59,974
1982-83	32.36	279,645	57,128	610	57,128	101,852
1983-84	10.81	82,745	56,948	647	56,948	143,550
1984-85	12.86	78,771	69,722[8]	633	69,772	198,072
1985-86	17.86	99,258	68,220[8]	624	68,220	251,042
1986-87	8.08	77,752	59,808	649	59,808	295,600
1987-88	13.78	79,706	55,324	620	55,324	335,674
1988-89	12.64	62,376	52,259	607	52,259	372,683
1989-90	8.53	58,159	53,199	590	53,583	411,016
1990-91	15.48	73,790	45,041[11]	616	45,041	440,807
1991-92	16.54	71,427	40,306	620	40,306	465,863
1992-93	30.92	267,043	41,434	634	41,434	492,047
1993-94	11.62	45,006	31,278[11]	677	31,278	508,075
1994-95	25.14	243,411	45,562[11]	646	45,562	538,387
1995-96	11.92	81,786	54,548[11]	625	54,548	577,685
1996-97	18.64	104,518	62,618[11]	624	62,618	625,053

TABLE 3 (Continued)

(1) Measured at San Bernardino County Hospital.
(2) Excludes Nontributary Flow and Exchange Waters.
(3) For Base and Storm Flow at Prado and Base Flow only at Riverside Narrows.
(4) Includes Lake Elsinore discharges which passed Prado Dam totaling 16,090 acre-feet in 1980-81; 7,720 acre-feet in 1982-83; 12,550 acre-feet in 1983-84 and 14,697 acre-feet in 1994-95.
(5) Excludes water discharged from Lake Elsinore.
(6) Includes a credit for a portion of Lake Elsinore discharges totaling 8,045 acre-feet in 1980-81; 3,362 acre-feet in 1982-83; 4,602 acre-feet in 1983-84; and 1,762 acre-feet in 1994-95.
(7) Includes Rubidoux Wastewater in 1979-80 and subsequent years.
(8) Includes groundwater pumped from San Bernardino Basin and released to the river in accordance with Court Orders approving agreement and allowing temporary additional extractions of water from the San Bernardino Basin Area.
(9) Excludes Nontributary Flow released to San Antonio Creek by MWDSC under the Ontario/MWDSC Exchange Program.
(10) Excludes water discharged to Santa Ana River from Arlington Desalter in 1989-90 and subsequent years in accordance with an agreement between OCWD, WMWD, and Santa Ana Watershed Project Authority.
(11) Excludes groundwater pumped from San Bernardino, Colton, and Riverside Basins and discharged to the Santa Ana River to flow to OCWD under the Exchange Water agreements.

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. These changes, in turn, have changed the cumulative credit for these years. See Appendix C in the Twelfth Annual Report (1981-82).

CHAPTER II

BASE FLOW AT PRADO

This chapter deals with determinations of 1) the components of flow at Prado, which include Nontributary Flow, Arlington Desalter discharge, Exchange Water, Storm Flow and Base Flow and 2) the Adjusted Base Flow at Prado credited to CBMWD and WMWD.

Flow at Prado

During the 1996-97 water year, the flow of the Santa Ana River as measured at the USGS gaging station below Prado Dam amounted to 249,685 acre-feet. There was no storage behind the dam at the beginning of the year. Storage at the end of the water year was nine acre-feet. Inflow to the reservoir included 136,676 acre-feet of Base Flow and 61,783 acre-feet of Storm Flow, based on an adjusted Prado Reservoir storage-elevation curve described in the following section. Of the nontributary flow due to State Water Project water released to San Antonio Creek at turnout OC-59, 42,322 acre-feet were determined to have reached Prado Reservoir during 1996-97. Nontributary flows due to the Arlington Desalter and Exchange programs totaled 6,151 acre-feet and 2,762 acre-feet, respectively. The monthly components of flow of the Santa Ana River at Prado Dam for 1996-97 are listed in Table 4 and are shown graphically on Plate 3. Historical Base and Storm Flows of the Santa Ana River below Prado during the period 1934-35 through 1996-97 are presented on Plate 4.

Prado Reservoir Storage-Elevation Curve Adjustment

The Watermaster calculates inflow to Prado Reservoir by adjusting outflow data using change in reservoir storage. Reservoir storage is based on a storage-elevation curve last updated by the U.S. Army Corps of Engineers (ACOE) in 1988. The ACOE reports that sedimentation averaged about 200 acre-feet per year between 1969 and 1979. Such sedimentation affects the accuracy of the storage-elevation curve when the storage in the reservoir is low. This inaccuracy results in anomalies in the calculated inflow near the end of each period of reservoir storage.

In 1997, the Watermaster adjusted the Prado Reservoir storage-elevation curve to improve the calculated Santa Ana River inflow hydrograph from which Base Flow and Storm Flow are determined. Assuming an average sedimentation rate of 200 acre-feet per year from 1988 to 1996, the portion of the ACOE storage-elevation curve below elevation 520 feet was adjusted to include a 1,600 acre-feet reservoir storage loss. Elevation 520 feet represents the approximate maximum flood storage elevation attained behind Prado Dam in the last several years where most sedimentation would likely have occurred. The new storage-elevation curve was developed by distributing the 1,600 acre-feet storage loss until the curve produced inflow values without significant anomalies.

TABLE 4

COMPONENTS OF FLOW AT PRADO DAM

WATER YEAR 1996-97
(acre-feet)

Month	USGS Measured Outflow	+ Storage Change (1)	= Computed Inflow	- Lake Elsinore Flows at Prado Dam	- Exchange Water (2)	- San Antonio Creek (3)	- Arlington Desalter	- Storm Flow	= Base Flow
1996									
October	12,089	976	13,065	0	544	0	505	1,051	10,965
November	19,156	1,658	20,814	0	585	0	536	8,157	11,536
December	26,134	(2,303)	23,831	0	198	0	565	10,107	12,960
1997									
January	46,782	6,306	53,088	0	0	0	561	38,378	14,150
February	21,917	(5,958)	15,959	0	111	0	506	2,811	12,531
March	15,661	(678)	14,984	0	284	0	519	228	13,953
April	14,285	7	14,291	0	279	1,311	518	0	12,183
May	17,821	(8)	17,813	0	251	5,934	499	0	11,130
June	17,103	6	17,109	0	127	5,894	493	191	10,403
July	16,082	(6)	16,076	0	150	6,220	474	0	9,232
August	20,501	4	20,505	0	120	11,397	510	0	8,479
Septembe	22,151	5	22,157	0	113	11,565	464	859	9,155
Total	249,685	9	249,694	0	2,762	42,322	6,151	61,783	136,676

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

(2) Exchange Water pumped from the San Bernardino, Colton, and Riverside groundwater basins and discharged into the Santa Ana River less an estimated 5% loss.

(3) State Water Project water released into San Antonio Creek from turnout OC-59 during 1996-97 and calculated to have reached Prado Dam in the 1996-97 water year.

Exchange Programs

On two occasions, WMWD and OCWD have agreed to exchange imported water from MWDSC for pumped groundwater. The pumped groundwater, hereafter referred to as Exchange Water, is delivered via the Santa Ana River, and since it is exchanged for imported water, it is accounted for as Nontributary Water. Because these exchanges are delivered upstream of Prado Dam and are effectively Nontributary Water, the amount of Exchange Water reaching Prado Dam is excluded from the computation of Base Flow and Base Flow quality. This section describes past and current exchange programs. A monthly summary of the 1996-97 Exchange Water deliveries is contained in Appendix D.

Releases of Exchange Water from Riverside Canal

In 1993, OCWD and WMWD entered into an agreement to participate in MWDSC's Demonstration Local Storage (DLS) Program. The agreement provides for delivery of MWDSC water to WMWD with WMWD causing a like amount of groundwater, pumped from the basins above the Riverside Narrows, to be delivered to OCWD via the Riverside Canal and into the Santa Ana River. Because the mechanism is identical to the Drought Emergency Exchange Program, waters discharged to the river under these two programs are combined and termed Exchange Waters.

The Drought Emergency Exchange Program is more fully described in Chapter II of the Twenty-first Annual Report (1990-91). No water under the Drought Emergency Exchange Program was delivered during 1996-97.

During the 1996-97 water year, WMWD delivered 2,762 acre-feet to the Santa Ana River upstream of Prado Dam under the DLS Program. This amount reflects an agreed upon 5% evapotranspiration loss between the point of delivery and Prado Dam.

Nontributary Flow

Since May 1973, OCWD has from time to time purchased State Water Project water for the replenishment of the groundwater basin in Orange County. The water has been released at two locations: Santa Ana River above Riverside Narrows (1972-73 only) and San Antonio Creek near the City of Upland.

Releases to San Antonio Creek

During the 1996-97 water year, 42,913 acre-feet of State Water Project water were released into San Antonio Creek from the Foothill Feeder at turnout OC-59 near Upland. Total monthly deliveries and daily flow rates were provided by the MWDSC. Water losses between OC-59 and Prado Dam were calculated per the procedures set forth in the Twelfth Annual Report (1981-82), Appendix C. Using these procedures, 42,322 acre-feet of the water released from OC-59 were determined to have reached

Prado Dam. Of the amount released, 398 acre-feet (0.93%) were lost to evapotranspiration and 193 acre-feet were in transit at the end of the water year due to the 12-hour delay from the time of release until the water reaches Prado Dam. A monthly summary of Nontributary Flow released from OC-59 into San Antonio Creek is contained in Appendix E.

Arlington Desalter

The underflow from the Arlington groundwater sub-basin has historically been a component of the Santa Ana River flow. These groundwaters have increasingly been degraded through agricultural and other uses. Two parties to the Stipulated Judgment, WMWD and OCWD, as members of the Santa Ana Watershed Project Authority, constructed a groundwater cleanup project which is designed to reduce the poor quality underflow from the sub-basin. This project is known as the Arlington Desalter and consists of five extraction wells and a treatment facility which reduces salinity. The capacity of the facility is approximately 6 million gallons per day (mgd). The facility began operations in July 1990, with OCWD buying the product water delivered through the Santa Ana River. All parties to the Stipulated Judgment agreed that the product water from this facility would be excluded from the computation of Santa Ana River Base Flow and Base Flow quality. During the 1996-97 water year, 6,151 acre-feet of water discharged from the Arlington Desalter was determined to have reached Prado Dam. Daily discharge rates and electrical conductance of product water were provided by OCWD Operations. A summary of Arlington Desalter discharges is contained in Appendix F.

Lake Elsinore Discharge

There were no discharges from Lake Elsinore during the 1996-97 water year.

Storm Flow

Portions of storm flows are retained behind Prado Dam for regulation of downstream flows and for water conservation purposes. The ACOE owns Prado Dam and operates it according to a release schedule utilizing a debris pool elevation of 494 feet until March 1 of each year. In 1994 an agreement was signed by OCWD, ACOE, and the U.S. Fish and Wildlife Service, which provides that between March 1 and August 30 the pool would be raised, given sufficient flows, to elevation 497 feet. This elevation would be increased year by year, as additional biological habitat mitigation by OCWD comes on line, to a maximum elevation of 505 feet. On April 12, 1995, the ACOE, the U.S. Fish and Wildlife Service, and OCWD reached an agreement to accelerate immediately the raising of the seasonal water conservation pool to elevation 505 feet, in exchange for a $1 million contribution by OCWD to U.S. Fish and Wildlife Service to be used to develop Least Bell's vireo habitat by the removal of a non-native plant, *Arundo donax*. Storm flows captured within the reservoir are released following the storm to downstream groundwater recharge facilities. Monthly and annual quantities of Storm Flow are shown in Table 4.

During the 1996-97 water year, the maximum volume of water stored in Prado Reservoir reached 9,080 acre-feet on January 26, 1997. The maximum daily mean flow released from Prado Dam to the Santa Ana River was 4,820 cfs on the same day.

During the year, construction continued on elements of the Santa Ana River Mainstem flood control project, including the Seven Oaks Dam, located on the Santa Ana River above the community of Mentone.

Base Flow

The Base Flow is affected by Nontributary Flow releases to San Antonio Creek, discharges from the Arlington Desalter, deliveries of Exchange Water, and discharges from Lake Elsinore. The general procedure used by the Watermaster to separate the 1996-97 flow components was the same as used for previous years and is fully described in the Fifth (1974-75) and the Twelfth (1981-82) Annual Reports. The monthly and annual quantities of Base Flow are shown in Table 4.

Wastewater Effluent Discharges

A portion of the Base Flow at Prado is made up of treated wastewater effluent discharged from a number of municipal wastewater treatment plants located above Prado Dam. During the 1996-97 water year, about 154,290 acre-feet of effluent were discharged above Prado Dam by major agencies as shown in Table 5.

Water Quality Adjustments

The flow-weighted average TDS for the total flow passing Prado Dam, including Nontributary Flow released above Riverside Narrows, Exchange Water and Arlington Desalter discharge, was found to be 464 milligrams per liter (mg/L). This determination was based on records from a continuous monitoring device, operated by the USGS for EC of the Santa Ana River flow below Prado Dam. This record was supplemented by twenty-five (25) and seventeen (17) grab samples for EC collected by the USGS and OCWD, respectively, and analyzed for TDS.

A correlation between TDS and EC yields the following best fit equation:

$$TDS = EC \times 0.610431$$

(where the units of TDS and EC are mg/L and microsiemens/centimeter, respectively)

Using the daily EC data, flow-weighted average daily values for TDS were calculated using the above equation. The plot of TDS on Plate 5 shows the daily average TDS concentration of the Santa Ana River flow passing Prado Dam. A summary of daily TDS and EC of the Santa Ana River below Prado Dam is contained in Appendix H.

TABLE 5

MUNICIPAL WASTEWATER EFFLUENT DISCHARGED ABOVE PRADO (acre-feet)

Year	Redlands	Beaumont	Yucaipa	San Bernardino	Colton	Rialto	RIX[1]	Riverside	Corona	CBMWD #1	CBMWD #2	CBMWD CCWRF[2]	Total
1970-71	2,650	no record	--	17,860	2,520	2,270	--	18,620	3,190	--	--	--	47,110
1971-72	2,830	no record	--	16,020	2,230	2,400	--	19,010	3,230	6,740	--	--	52,460
1972-73	2,810	450	--	18,670	2,530	2,260	--	19,060	3,340	10,380	--	--	59,050
1973-74	2,770	600	--	17,680	2,530	2,320	--	19,560	3,510	11,440	2,320	--	61,950
1974-75	2,540	570	--	16,750	1,980	2,320	--	19,340	4,020	14,960	2,280	--	64,190
1975-76	2,450	620	--	17,250	2,540	2,240	--	19,580	4,700	15,450	2,950	--	67,160
1976-77	3,170	580	--	17,650	3,260	2,330	--	18,770	5,010	14,640	3,380	--	68,210
1977-78	3,280	620	--	18,590	3,810	2,380	--	20,310	5,200	14,650	4,060	--	72,280
1978-79	3,740	670	--	19,040	3,850	3,050	--	21,070	5,390	15,040	5,070	--	76,250
1979-80	4,190	690	--	20,360	4,190	2,990	--	22,910	5,360	14,410	5,520	--	79,930
1980-81	4,410	690	--	20,550	3,930	3,370	--	24,180	5,590	17,270	5,260	--	84,560
1981-82	4,420	700	--	23,340	3,780	3,470	--	25,640	5,410	19,580	5,360	--	91,000
1982-83	4,530	710	--	24,160	3,600	3,620	--	25,020	5,860	20,790	4,290	--	91,870
1983-84	5,150	800	--	22,080	3,700	3,830	--	26,090	6,200	20,950	3,950	--	91,950
1984-85	4,990	840	--	23,270	3,830	4,070	--	27,750	6,250	25,160	4,280	--	99,600
1985-86	5,200	820	--	24,720	4,010	4,720	--	28,820	5,900	28,240	2,660	--	104,270
1986-87	5,780	880	800	26,810	4,170	5,350	--	30,340	6,170	27,160	5,000	--	110,780

TABLE 5 (continued)

MUNICIPAL WASTEWATER EFFLUENT DISCHARGED ABOVE PRADO (acre-feet)

Year	Redlands	Beaumont	Yucaipa	San Bernardino	Colton	Rialto	RIX[1]	Riverside	Corona	CBMWD #1	CBMWD #2	CBMWD CCWRF[2]	Total
1987-88	6,060	940	1,850	27,880	5,240	6,040	--	34,660	6,050	31,290	5,500	--	122,720
1988-89	5,250	1,030	2,260	27,640	5,550	6,280	--	35,490	8,080	35,510	6,180	--	129,980
1989-90	6,360	1,100	2,370	28,350	5,810	6,260	--	33,210	9,140	34,760	5,730	--	129,620
1990-91	6,690	1,120	2,490	27,570	5,670	6,290	--	32,180	9,110	36,840	6,100	--	130,450
1991-92	6,230	1,150	2,580	25,060	5,660	6,360	--	32,660	9,010	40,360	5,780	1,550	132,670
1992-93	6,880	1,180	2,580	25,550	6,210	6,460	--	34,100	9,600	41,510	5,640	4,720	140,670
1993-94	6,440	1,150	2,710	23,800	5,830	6,540	--	32,640	7,790	37,310	5,430	7,010	132,790
1994-95	6,720	1,180	2,560	26,330	5,500	6,820	--	33,950	7,340	39,680	5,360	8,690	140,390
1995-96	6,550	1,260	2,640	13,240	2,770	6,890	20,760	33,960	7,850	39,590	4,810	9,060	145,480
1996-97	6,510	1,280	2,780	--	--	7,160	42,800	34,240	5,040	39,940	4,790	9,750	154,290

[1]RIX = Rapid Infiltration and Extraction Facility for San Bernadino and Colton, including over-extraction of groundwater

[2]CCWRF = Carbon Canyon Water Reclamation Facility

The amounts shown in this table were determined from data provided by the agencies.

At Prado Dam, the flow-weighted average annual TDS value of 464 mg/L represents the quality of the total flow including releases to San Antonio Creek, Exchange Water, and Arlington Desalter. The Stipulated Judgment requires that Base Flow shall be subject to adjustment based on the TDS of Base Flow and Storm Flow only. Hence a determination of the TDS of Base Flow plus Storm Flow only, is detailed in the following paragraphs.

Adjustment for Exchange Water

The City of Riverside continued to pump groundwater which was discharged into the Riverside Canal for delivery to OCWD. The amount of water discharged to the Santa Ana River during the 1996-97 water year was 2,762 acre-feet after taking into account losses of 5%. Using monthly TDS grab samples collected from Riverside Canal at the Tava Lanes turnout and Riverside wells, and monthly flow values, a flow-weighted average TDS of 522 mg/L was calculated. A summary of Exchange Water quality is contained in Appendix D.

Adjustment for Flow to San Antonio Creek

During the 1996-97 water year, 42,322 acre-feet of the water released from OC-59 was calculated to have reached Prado Dam. A flow-weighted average TDS of 227 mg/L was calculated for State Water Project water delivered from OC-59 to San Antonio Creek. As discussed in the Twelfth Annual Report, studies have indicated that leaching of salts from soils to the OC-59 water occurred as it flowed along Chino Creek to Prado Dam. Therefore, the TDS of the OC-59 water reaching Prado Dam was recalculated to be 232 mg/L as described in Appendix E.

Adjustment for Arlington Desalter

The amount of product water discharged to the Santa Ana River during the 1996-97 water year totaled 6,151 acre-feet. Using daily EC, a 0.64 conversion factor, and daily flow values, a flow-weighted average TDS of 414 mg/L was calculated. A summary of these calculations is contained in Appendix F.

Adjustment for Lake Elsinore Discharges

During the 1996-97 water year, no discharge from Lake Elsinore occurred. Therefore, no water quality adjustment was necessary.

Flow Component	Annual Flow (acre-feet)	Average TDS (mg/L)	Annual Flow x Average TDS (acre-feet x mg/L)
1. Measured Outflow	249,685	464	115,893,753
2. Less Exchange Water	2,762	522	1,442,293
3. Less Nontributary Flow			
San Antonio Creek	42,322	232	9,818,757
4. Less Arlington Desalter	6,151	414	2,544,932
5. Measured Outflow less lines 2, 3, and 4	198,450		102,087,772
Average TDS in total Base and Storm Flow		102,087,772 ÷ 198,450 = 514 mg/L	

After adjusting for Exchange Water, Nontributary Flow, and Arlington Desalter discharges, the weighted average annual TDS of Storm Flow and Base Flow for 1996-97 is 514 mg/L, as shown above.

Adjusted Base Flow at Prado

The Stipulated Judgment provides that the amount of Base Flow at Prado received during any year shall be subjected to adjustment based on weighted average annual TDS of the 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 to 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 514 mg/L is less than 700 mg/L. Therefore, the Base Flow must be adjusted by the above equation for TDS less than 700 mg/L. Thus the Adjusted Base Flow is as follows:

$$(136{,}676 \text{ acre-feet}) + \frac{35}{42{,}000} (136{,}676 \text{ acre-feet}) (700 - 514) = 157{,}861 \text{ acre-feet}$$

Entitlement and Credit or Debit

Paragraph 5(c) of the Stipulated Judgment states that "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 no 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 concerning flow at Prado for 1996-97 required under the Stipulated Judgment are as follows:

1.	Measured Outflow at Prado	249,685 acre-feet
2.	Base Flow at Prado	136,676 acre-feet
3.	Annual Weighted TDS of Base and Storm Flow	514 mg/L
4.	Annual Adjusted Base Flow	157,861 acre-feet
5.	Cumulative Adjusted Base Flow	2,818,554 acre-feet
6.	Cumulative Entitlement of OCWD	1,134,000 acre-feet
7.	Cumulative Credit	1,684,554 acre-feet
8.	One-Third of Cumulative Debit	0 acre-feet
9.	Minimum Required Base Flow in 1997-98	34,000 acre-feet

CHAPTER III

BASE FLOW AT RIVERSIDE NARROWS

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

Flow at Riverside Narrows

The flow of the Santa Ana River at Riverside Narrows amounted to 107,280 acre-feet, measured at the USGS gaging station near the MWDSC Upper Feeder Crossing. Separated into its components, Base Flow was 62,618 acre-feet, Storm Flow was 43,995 acre-feet, and Nontributary Flow of 2,762 acre-feet was in the form of Exchange Water. Included in Base Flow are 2,095 acre-feet of wastewater from Rubidoux Community Services District which now by-passes the USGS gaging station. The Storm and Base Flow components of the flow of the Santa Ana River at Riverside Narrows for each month in the 1996-97 water year are listed in Table 6 and graphically shown on Plate 6. The components of flow of the Santa Ana River at Riverside Narrows during the period 1934-35 through 1996-97 are presented on Plate 7.

Release of Exchange Water

During 1996-97 water year, 2,762 acre-feet of Exchange Water were delivered to the Santa Ana River upstream of the Riverside Narrows. A more complete explanation of the release is described in Chapter II.

Base Flow

Based on the hydrograph shown on Plate 6 and utilizing in general the procedures reflected in the Work Papers of the engineers (as referenced in Paragraph 2 of the Engineering Appendix of the Stipulated Judgment), a separation was made between Storm Flow and the sum of Base Flow and Nontributary Flow.

In April 1980, Rubidoux Community Services District made the first delivery of wastewater to the regional 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 1996-97, in the amount of 2,095 acre-feet, has been added to the stream flow as measured at the gaging station.

TABLE 6

COMPONENTS OF FLOW AT RIVERSIDE NARROWS

FOR WATER YEAR 1996-97
(acre-feet)

Month	USGS Measured Flow	- Storm Flow	- Exchange Water (1)	+ Rubidoux Waste-water	= Base Flow
1996					
October	6,436	835	544	185	5,242
November	11,748	5,658	585	173	5,678
December	9,412	3,733	198	163	5,643
1997					
January	37,047	31,438	0	163	5,772
February	6,605	1,384	111	146	5,255
March	6,049	5	284	166	5,926
April	5,970	0	279	166	5,858
May	5,109	0	251	185	5,044
June	4,860	30	127	179	4,882
July	4,602	0	150	189	4,641
August	4,300	0	120	191	4,372
September	5,141	912	113	189	4,305
Total	107,280	43,995	2,762	2,095	62,618

(1) Exchange Water pumped from the San Bernardino, Colton, and Riverside groundwater basins and discharged into the Santa Ana River, less an estimated 5% loss.

Water Quality

The determination of water quality at the Riverside Narrows Gaging Station was made using periodic grab samples taken and analyzed for TDS by the USGS and the City of Riverside. Water quality data based on samples taken during storm flow periods were not used in the calculations.

The flow-weighted quality of wastewater from Rubidoux was 631 mg/L. The Base Flow quality resulting from exclusion of the Nontributary Flow and inclusion of the Rubidoux wastewater is shown in the following table as 624 mg/L.

Flow Component	Annual Flow (acre-feet)	Average TDS (mg/L)	Annual Flow x Average TDS (acre-feet x mg/L)
1. Base Flow including Nontributary Flow	63,285	619	39,173,415
2. Less Nontributary Flow MWD Exchange Water	2,762	522	1,441,764
3. Plus Rubidoux Wastewater	2,095	631	1,321,945
4. Base Flow less line 2 plus line 3	62,618		39,053,596
Average TDS of Base Flow		39,053,596 ÷ 62,618 = 624 mg/L	

Adjusted Base Flow at Riverside Narrows

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

If the Weighted Average TDS in Base Flow at Riverside Narrows 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 to 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 1996-97 was 624 mg/L. Therefore, no adjustment is necessary, and the Adjusted Base Flow for 1996-97 is 62,618 acre-feet.

Entitlement and Credit or Debit

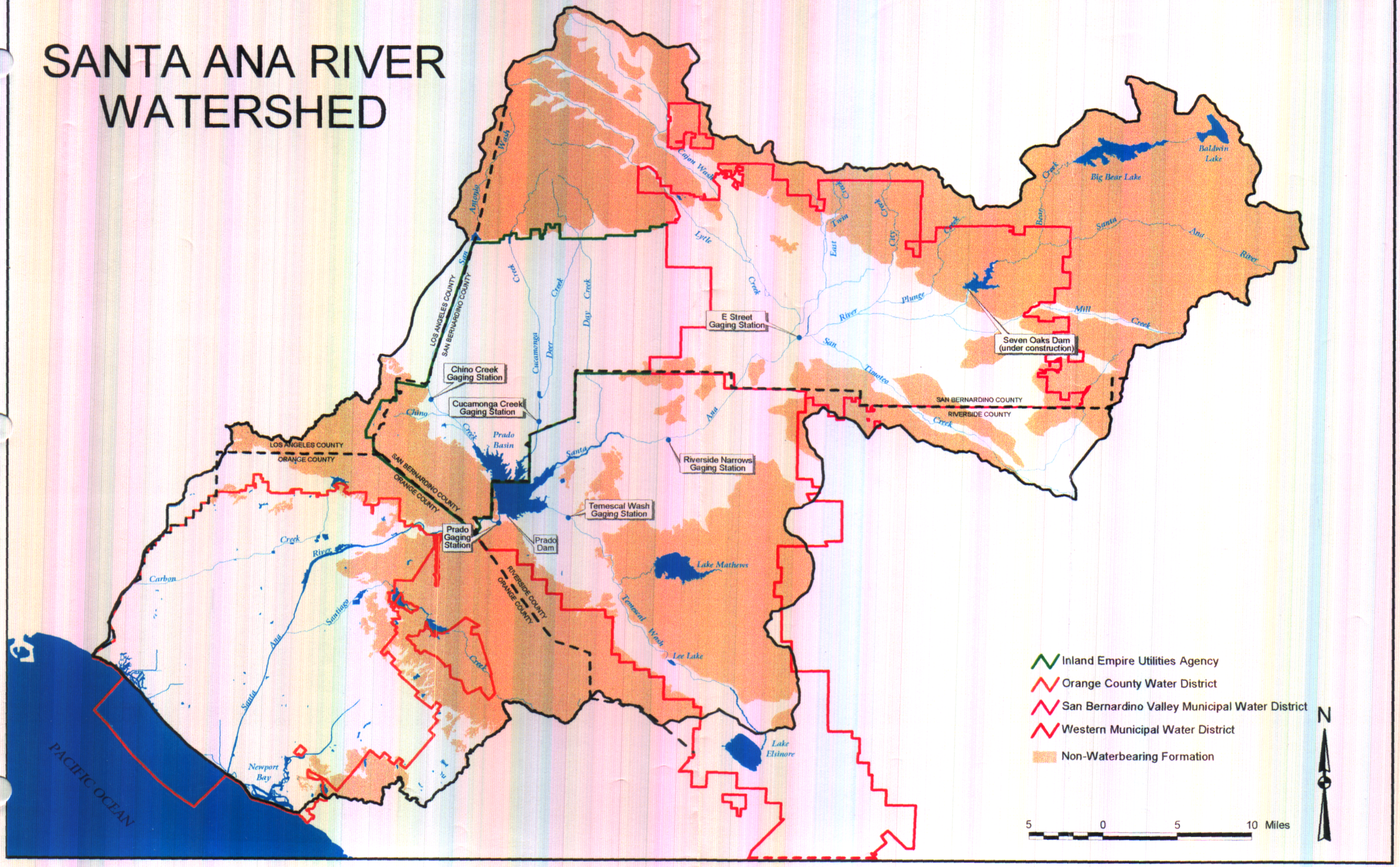
Paragraph 5(b) of the Stipulated Judgment states that "SBVMWD shall be responsible for an average annual Adjusted Base Flow of 15,250 acre-feet at Riverside Narrows . . . SBVMWD each year shall be responsible for not less than 13,420 acre-feet of Base Flow plus one-third of any cumulative debit, provided, 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 concerning flow at Riverside Narrows for 1996-97 required under the Stipulated Judgment are as follows:

1.	Base Flow at Riverside Narrows	62,618 acre-feet
2.	Annual Weighted TDS of Base Flow	624 mg/L
3.	Annual Adjusted Base Flow	62,618 acre-feet
4.	Cumulative Adjusted Base Flow	1,036,803 acre-feet
5.	Cumulative Entitlement of CBMWD and WMWD	411,750 acre-feet
6.	Cumulative Credit	625,053 acre-feet
7.	One-Third of Cumulative Debit	0 acre-feet
8.	Minimum Required Base Flow in 1997-98	12,420 acre-feet

PLATE 1

SANTA ANA RIVER WATERSHED



PRECIPITATION AT SAN BERNARDINO SINCE 1934-35

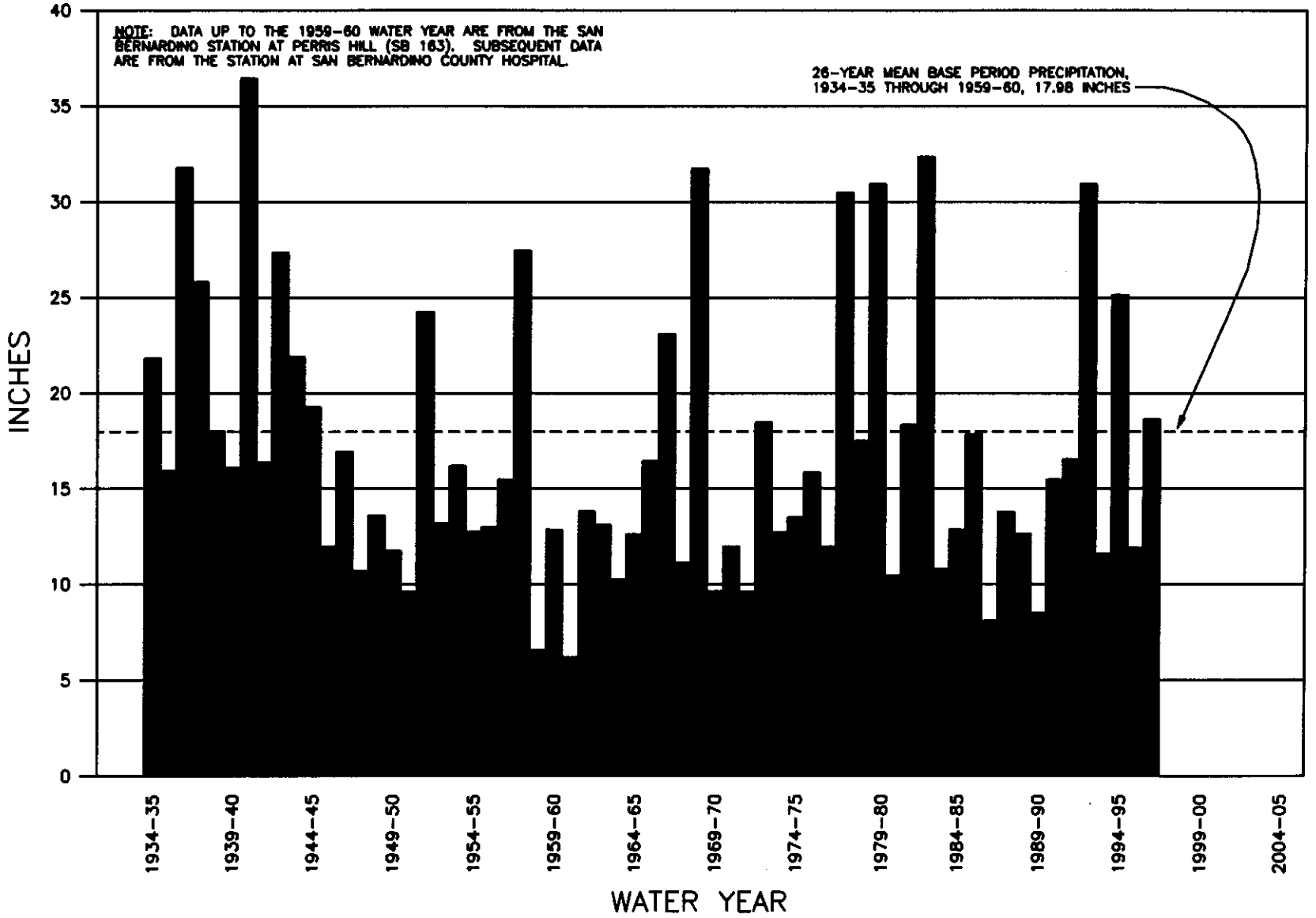
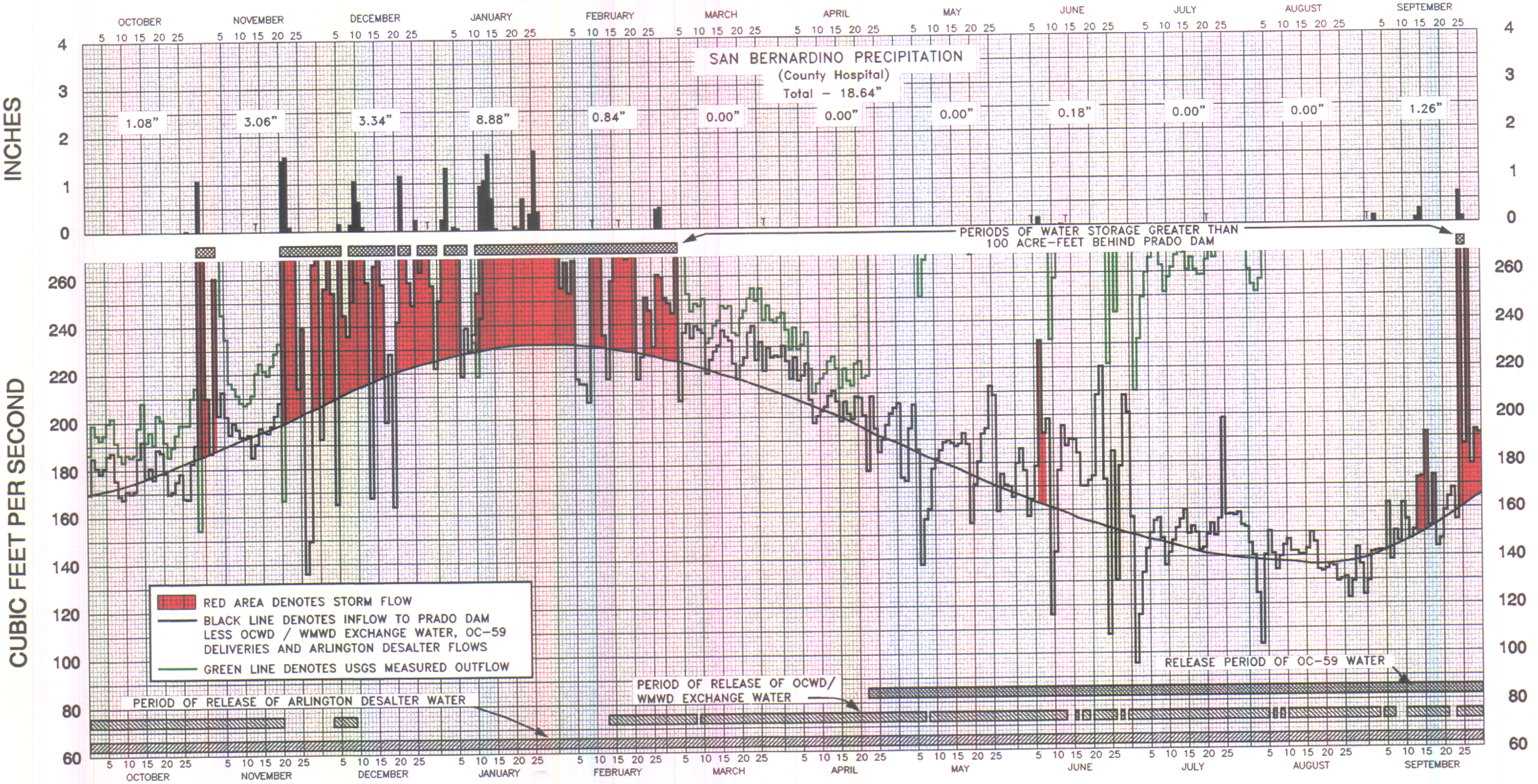


PLATE 2



DISCHARGE OF SANTA ANA RIVER AT PRADO DAM & SAN BERNARDINO PRECIPITATION
WATER YEAR 1996-97

Plate 3

DISCHARGE OF SANTA ANA RIVER AT PRADO SINCE 1934-35

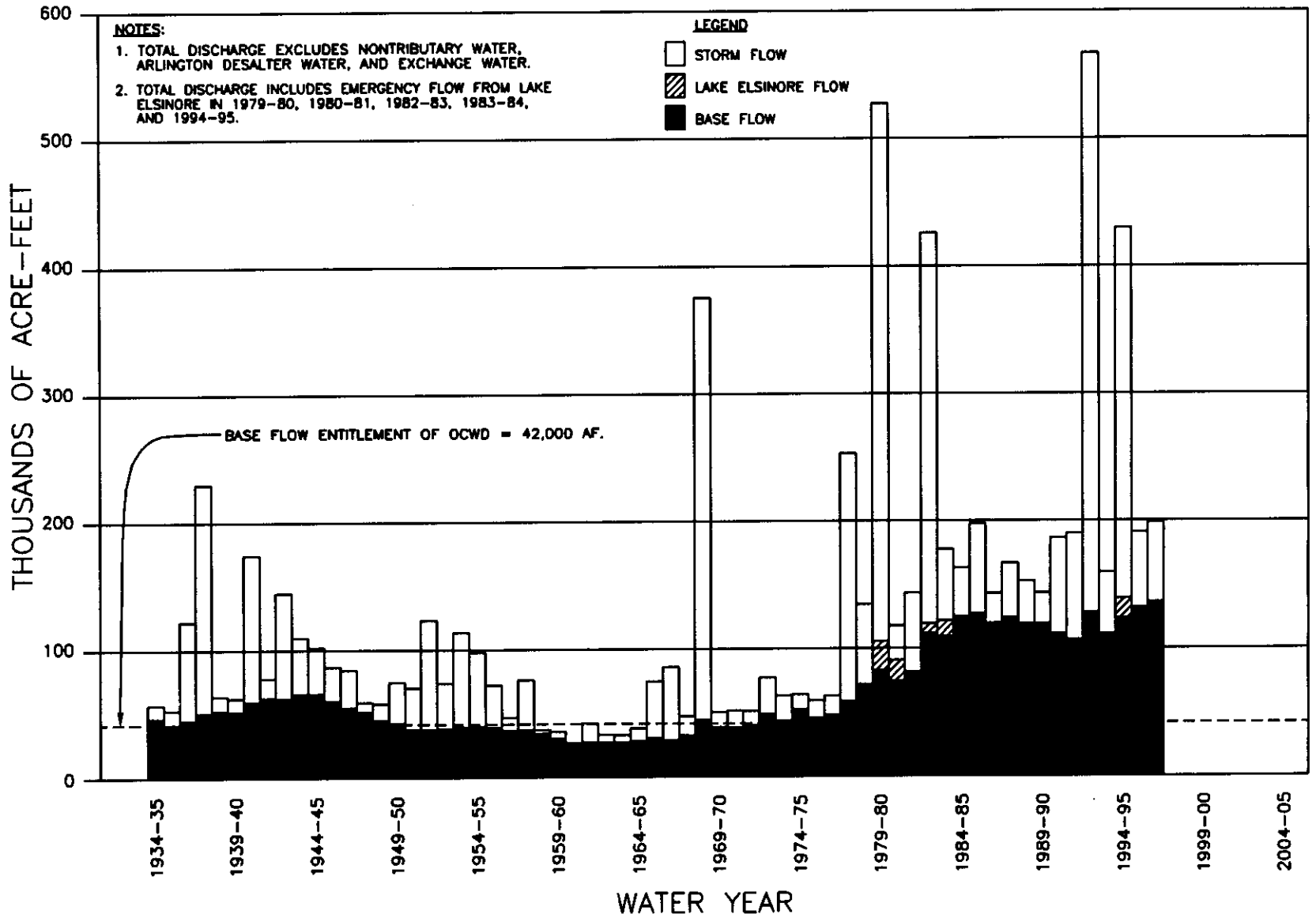
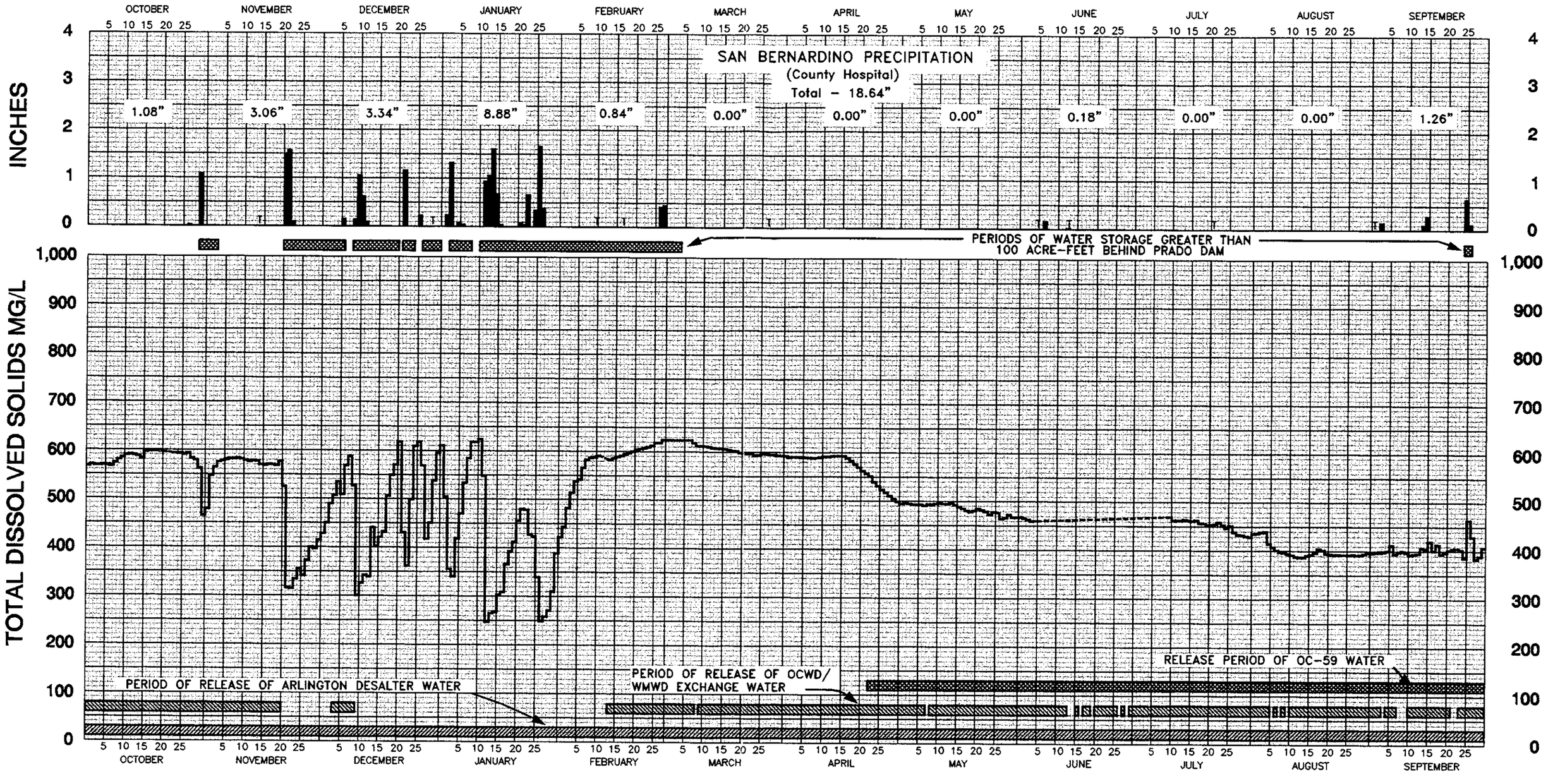
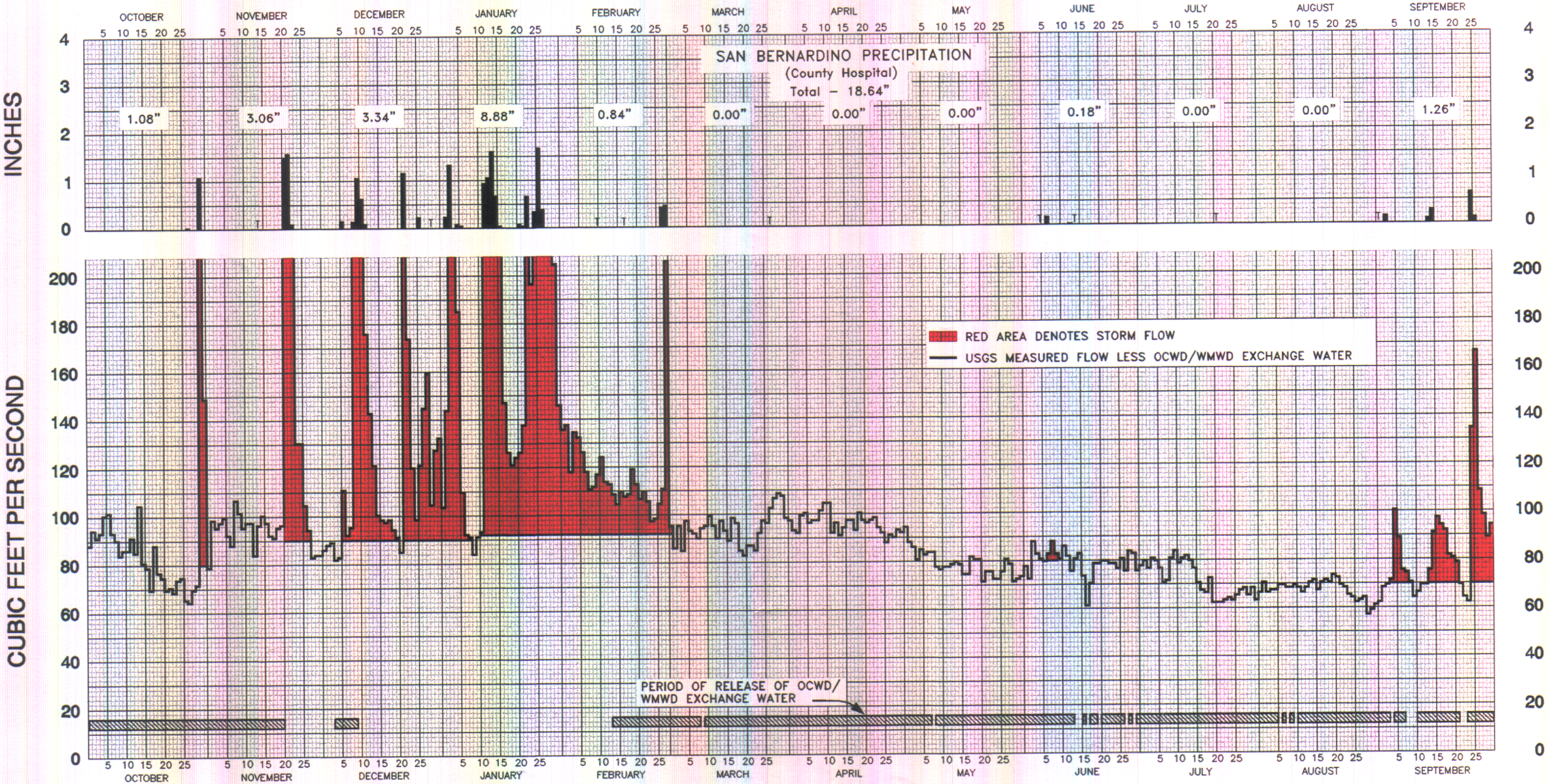


PLATE 4



DISSOLVED SOLIDS IN SANTA ANA RIVER BELOW PRADO DAM
WATER YEAR 1996-97

Plate 5



DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS & SAN BERNARDINO PRECIPITATION
WATER YEAR 1996-97

Plate 6

DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS SINCE 1934-35

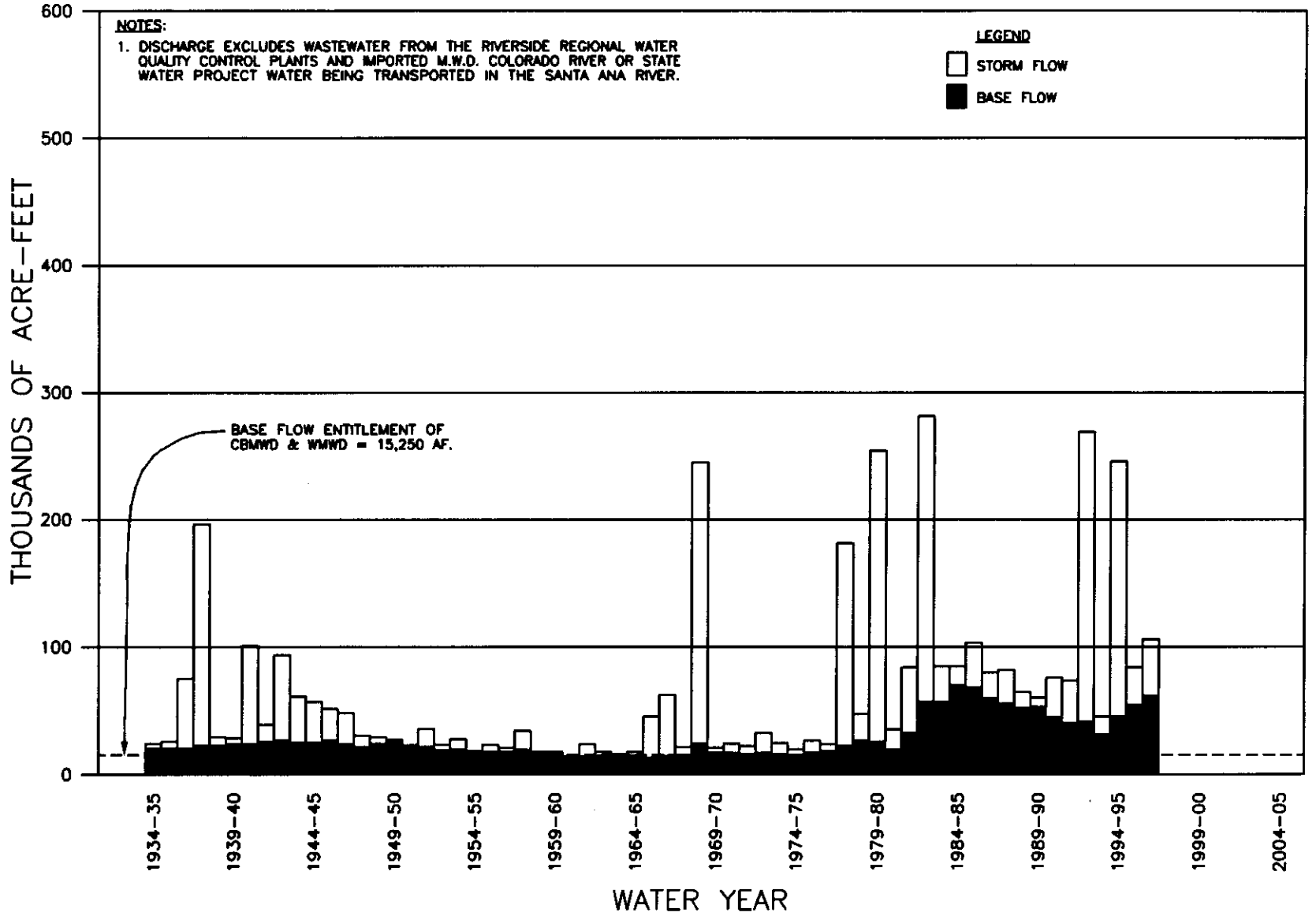


PLATE 7

SANTA ANA RIVER WATERMASTER

FOR

ORANGE COUNTY WATER DISTRICT

VS. CITY OF CHINO et al.

CASE NO. 117628 - COUNTY OF ORANGE

BASIC DATA

FOR THE

TWENTY-SEVENTH ANNUAL REPORT

OF THE

SANTA ANA RIVER WATERMASTER

FOR WATER YEAR

OCTOBER 1, 1996 - SEPTEMBER 30, 1997

APRIL 30, 1998

TABLE OF CONTENTS

Appendix

Note: Totals at the bottom of appendix tables may not appear to add arithmetically because of the hidden rounding of data values to zero decimal places.

APPENDIX A

USGS FLOW MEASUREMENTS OF THE SANTA ANA RIVER BELOW PRADO, AT MWD CROSSING, AND E STREET, AND OF TEMESCAL CREEK ABOVE MAIN STREET (AT CORONA) AND CHINO CREEK AT SCHAEFER AVENUE (NEAR CHINO)

WATER YEAR 1996-97

11074000 SANTA ANA RIVER BELOW PRADO DAM, CA

LOCATION.--Lat 33°53'00", long 117°38'40", in La Sierra Grant, Riverside County, Hydrologic Unit 18070203, on left bank of outlet channel, 2,500 ft downstream from axis of Prado Dam, and 4.5 mi west of Corona.

DRAINAGE AREA.--1,490 mi^2, excludes 768 mi^2 above Lake Elsinore.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--May 1930 to November 1939 (irrigation seasons only), March 1940 to current year. Published as "at Santa Fe Railroad Bridge, near Prado" May 1930 to November 1931, as "at Atchison, Topeka, and Santa Fe Railroad Bridge, near Prado" May 1932 to November 1939, and as "below Prado Dam, near Prado" March 1940 to September 1950.

GAGE.--Water-stage recorder and concrete control since August 1944. Datum of gage is approximately 449 ft above sea level (levels by U.S. Army Corps of Engineers). Prior to Mar. 18, 1940, at about same site at various datums.

REMARKS.--Records good. Flow regulated since 1940 by Prado flood-control reservoir, capacity, 196,200 acre-ft. Natural streamflow affected by extensive ground-water withdrawals, diversion for irrigation, and return flow from irrigated areas. During the current year, the California Water Project released 42,930 acre-ft to the basin. See schematic diagram of Santa Ana River basin.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 7,440 ft^3/s, Feb. 21, 1980, gage height, 6.88 ft; minimum daily, 2.4 ft^3/s, July 29 to Aug. 3, Sept. 20, 1978 (result of gate closure).

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Mar. 2, 1938 reached a discharge of 100,000 ft^3/s, on basis of slope-area measurement of peak flow at site 2.5 mi downstream.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	186	398	481	416	487	312	242	315	286	273	258	338
2	198	385	484	366	487	304	235	285	294	209	252	350
3	194	363	484	390	464	322	227	281	287	230	249	348
4	192	318	481	393	442	331	236	303	268	247	254	347
5	194	243	474	393	439	301	227	313	276	257	304	347
6	199	233	443	452	435	272	229	298	289	263	346	366
7	201	215	332	482	432	250	234	248	335	267	340	345
8	191	213	272	472	428	243	219	263	303	268	343	352
9	186	210	248	339	421	246	209	272	314	260	348	348
10	183	207	322	231	364	245	213	286	230	249	353	361
11	186	206	326	217	336	248	215	291	255	255	356	364
12	185	207	445	241	333	230	217	293	284	259	353	352
13	186	210	545	407	325	232	222	297	302	264	352	355
14	197	219	548	868	328	237	224	299	295	268	351	374
15	207	223	534	928	326	239	219	297	297	265	350	378
16	191	220	542	1080	327	245	211	297	298	258	353	397
17	195	218	534	575	327	244	219	297	292	263	359	357
18	190	222	522	498	396	245	214	301	270	258	355	380
19	202	227	508	492	432	234	212	299	280	256	345	353
20	200	231	486	449	427	233	221	265	289	256	344	350
21	191	167	434	447	421	240	222	279	284	262	344	364
22	185	399	367	461	417	243	215	290	308	266	346	371
23	189	531	476	616	412	248	216	299	332	263	346	371
24	194	530	457	702	403	252	281	299	289	269	340	362
25	198	524	402	695	395	247	295	313	220	308	341	319
26	198	520	285	4820	387	252	295	324	294	272	342	506
27	198	514	260	3700	342	239	302	270	241	270	334	535
28	209	511	337	847	317	245	308	282	287	270	337	388
29	213	503	344	577	---	239	310	281	313	270	353	395
30	155	491	368	545	---	238	313	277	311	267	352	395
31	302	---	435	487	---	240	---	271	---	266	336	---
TOTAL	6095	9658	13176	23586	11050	7896	7202	8985	8623	8108	10336	11168
MEAN	197	322	425	761	395	255	240	290	287	262	333	372
MAX	302	531	548	4820	487	331	313	324	335	308	359	535
MIN	155	167	248	217	317	230	209	248	220	209	249	319
AC-FT	12090	19160	26130	46780	21920	15660	14290	17820	17100	16080	20500	22150

11066460 SANTA ANA RIVER AT MWD CROSSING, NEAR ARLINGTON, CA

LOCATION.--Lat 33°58'07", long 117°26'51", in NE 1/4 SW 1/4 sec.30, T.2 S., R.5 W., Riverside County, Hydrologic Unit 18070203, on left bank at MWD pipeline crossing, 0.8 mi downstream from Union Pacific Railroad Bridge, 1.1 mi upstream from bridge on Van Buren Boulevard, and 3.3 mi north of Arlington.

DRAINAGE AREA.--852 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--March 1970 to current year.

REVISED RECORDS.--WDR CA-83-1: Drainage area.

GAGE.--Water-stage recorder and crest-stage gage. Elevation of gage is 685 ft above sea level, from topographic map. Gage moved to left bank at present datum on June 17, 1993 (formerly on right bank). Prior to Oct. 1, 1984, water-stage recorder at site 300 ft upstream on left bank at different datum.

REMARKS.--Records fair except for discharges above 900 ft^3/s and estimated daily discharges, which are poor. Flow partly regulated by Big Bear Lake (station 11049000). Natural streamflow affected by ground-water withdrawals, diversions for irrigation, and return flows from irrigated areas. The records at this station are equivalent to those collected at Santa Ana River at Riverside Narrows, near Arlington minus the flow at Riverside Water-Quality Control Plant at Riverside Narrows, near Arlington. See schematic diagram of Santa Ana River basin.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 30,700 ft^3/s, Mar. 6, 1995, gage height, 14.47 ft, on basis of area-velocity study; maximum gage height, 20.23 ft, Mar. 4, 1978; minimum daily, 15 ft^3/s, Sept. 7, 8, 1980.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum discharge since at least 1927, 100,000 ft^3/s, Mar. 2, 1938, on basis of slope-area measurement at site 1.1 mi downstream. Flood of Jan. 22, 1862, 320,000 ft^3/s, on basis of slope-conveyance study at site 8.2 mi upstream. Stage at that site was 5 ft higher than that of Mar. 2, 1938.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 1,500 ft^3/s, or maximum:

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Oct. 30	2115	1,750	7.94	Jan. 3	0545	2,920	8.36
Nov. 21	2000	3,920	9.08	Jan. 13	0645	4,010	9.14
Dec. 9	2015	2,780	8.25	Jan. 15	2100	3,090	8.49
Dec. 22	1630	2,760	8.24	Jan. 26	1100	4,820	9.44

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	96	113	86	103	134	96	101	98	79	82	69	65
2	99	120	88	142	136	87	97	92	75	82	74	71
3	96	115	89	1370	117	96	96	91	90	80	70	71
4	98	117	86	308	133	86	102	87	86	84	e71	73
5	105	120	97	182	131	98	103	89	86	84	e71	102
6	106	114	136	109	125	94	100	88	84	80	e71	90
7	99	102	119	92	117	93	101	88	88	73	e71	79
8	97	110	122	91	110	91	100	85	93	75	e70	75
9	92	105	541	84	111	95	105	84	88	83	e70	71
10	93	100	315	91	116	96	109	82	86	86	e70	65
11	92	101	363	93	123	100	109	81	90	82	e70	70
12	97	101	173	774	113	96	97	82	84	83	e70	72
13	91	99	141	1560	112	91	101	83	77	84	e71	73
14	108	111	120	988	115	98	96	84	82	83	e73	79
15	88	115	100	1160	112	94	99	83	83	78	e74	94
16	85	112	98	731	117	91	102	80	75	74	70	100
17	76	107	97	145	115	100	102	80	63	70	72	96
18	94	106	98	125	116	98	98	86	73	70	74	94
19	83	110	94	120	121	87	105	85	80	75	73	84
20	80	111	91	123	114	93	102	85	80	65	75	82
21	75	1140	85	125	108	97	102	76	81	e65	e74	84
22	78	1490	437	136	110	97	103	80	81	e66	e72	71
23	79	397	171	746	107	95	103	80	80	e67	e70	65
24	85	129	119	193	98	102	99	77	80	e67	e68	66
25	87	129	98	825	100	111	97	77	79	e67	e67	136
26	88	104	120	3730	105	110	93	80	83	68	65	166
27	87	94	143	2800	111	116	97	85	77	70	66	110
28	89	83	157	1070	203	113	96	82	86	70	66	100
29	87	84	104	317	---	113	98	76	84	68	60	92
30	445	84	126	201	---	112	97	75	77	72	66	96
31	170	---	131	144	---	104	---	75	---	67	65	---
TOTAL	3245	5923	4745	18678	3330	3050	3010	2576	2450	2320	2168	2592
MEAN	105	197	153	603	119	98.4	100	83.1	81.7	74.8	69.9	86.4
MAX	445	1490	541	3730	203	116	109	98	93	86	75	166
MIN	75	83	85	84	98	86	93	75	63	65	60	65
AC-FT	6440	11750	9410	37050	6610	6050	5970	5110	4860	4600	4300	5140

e Estimated.

11059300 SANTA ANA RIVER AT E STREET, NEAR SAN BERNARDINO, CA

LOCATION.--Lat 34°03'54", long 117°17'58", in San Bernardino Grant, San Bernardino County, Hydrologic Unit 18070203, on left bank, 0.4 mi downstream from E Street Bridge, 0.4 mi upstream from Warm Creek, 1.2 mi downstream from San Timoteo Creek, 2.8 mi south of San Bernardino, and 26 mi downstream from Big Bear Lake.

DRAINAGE AREA.--541 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--March 1939 to September 1954, October 1966 to current year.

GAGE.--Water-stage recorder and crest-stage gage. Elevation of gage is 940 ft above sea level, from topographic map. Prior to Nov. 10, 1950, water-stage recorder on right bank 0.4 mi upstream at datum 964.50 ft above sea level. Nov. 11, 1950, to Sept. 30, 1954, water-stage recorder on both banks 0.4 mi upstream at datum 964.50 ft above sea level. Oct. 1, 1966, to Sept. 30, 1976, water-stage recorder on right bank 0.4 mi upstream at datum 954.50 ft above sea level. Oct. 1, 1976, to Sept. 30, 1977, gage was removed for channel construction. Oct. 1, 1977, to Jan. 28, 1981, water-stage recorder on right bank 0.5 mi upstream at elevation 950 ft above sea level, from topographic map.

REMARKS.--Records poor. Flow partly regulated by Big Bear Lake (station 11049000). Natural flow of stream affected by ground-water withdrawals and diversion for domestic use and irrigation upstream from station. Effluent from sewage reclamation plant 1.0 mi upstream caused sustained flow past gage from 1967 to Mar. 21, 1996. See schematic diagram of Santa Ana River basin.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 28,000 ft^3/s, Feb. 25, 1969, gage height, 11.9 ft, site and datum then in use; no flow for many days many years prior to 1967 and since Mar. 21, 1996.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 1,000 ft^3/s, or maximum, from rating curve extended above 5,930 ft^3/s on basis of critical-depth computations:

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Oct. 30	1445	1,740	5.20	Jan. 3	0415	1,890	5.26
Nov. 21	1630	3,790	5.79	Jan. 13	0345	3,120	5.63
Dec. 9	1915	1,440	5.07	Jan. 15	1815	1,440	5.07
Dec. 22	1300	1,720	5.19	Jan. 26	0745	4,680	5.96

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.00	.00	.00	e28	.02	.00	.00	.00	.00	.00	.00
2	.00	.00	.00	6.4	e25	2.4	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	875	e15	.69	.00	.00	.00	.00	.00	2.1
4	.00	.00	.00	124	e12	.00	.00	.00	.00	.00	.00	9.9
5	.00	.00	.00	51	e9.5	.00	.00	.00	.00	.00	.00	50
6	.00	.00	.00	25	.48	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	11	.67	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	2.2	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	176	2.5	.00	.00	.00	.00	.00	.00	.00	.00
10	.00	.00	192	4.3	.82	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	40	7.9	.40	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	11	358	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	779	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	282	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	434	.00	.00	.00	.00	.00	.00	.00	1.1
16	.00	.00	.00	200	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	62	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	34	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	27	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	47	.00	.00	.00	.00	.00	.00	.00	.00
21	.00	e664	.00	32	.00	.00	.00	.00	.00	.00	.00	.00
22	.00	e806	313	11	.00	.00	.00	.00	.00	.00	.00	.00
23	.00	203	73	231	.00	.00	.00	.00	.00	.00	.00	.00
24	.00	12	9.5	120	.00	.00	.00	.00	.00	.00	.00	.00
25	.21	.00	.00	411	.00	.00	.00	.00	.00	.00	.00	56
26	.00	.00	.00	1900	.00	.00	.00	.00	.00	.00	.00	92
27	.00	.00	13	579	15	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	32	260	105	.00	.00	.00	.00	.00	.00	.00
29	.00	.00	.00	131	---	.00	.00	.00	.00	.00	.00	.00
30	233	.00	.00	96	---	.00	.00	.00	.00	.00	.00	.00
31	3.6	---	.00	35	---	.00	---	.00	---	.00	.00	---
TOTAL	236.81	1685.00	859.50	7138.30	211.87	3.11	0.00	0.00	0.00	0.00	0.00	211.10
MEAN	7.64	56.2	27.7	230	7.57	.10	.000	.000	.000	.000	.000	7.04
MAX	233	806	313	1900	105	2.4	.00	.00	.00	.00	.00	92
MIN	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
AC-FT	470	3340	1700	14160	420	6.2	.00	.00	.00	.00	.00	419

e Estimated.

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CA INSTALLATION 04/03/98

STATION NUMBER 11072100 TEMESCAL C AB MAIN ST A CORONA CA STREAM SOURCE AGENCY USGS
LATITUDE 335321 LONGITUDE 1173343 DRAINAGE AREA 224 DATUM 600 STATE 06 COUNTY 065

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	19	12	12	17	9.2	12	11	8.0	9.8	10	10	8.8
2	21	13	13	25	9.1	11	11	9.7	10	12	12	10
3	22	13	14	26	13	11	15	11	11	11	13	9.9
4	21	12	15	11	8.9	12	11	11	11	13	13	12
5	18	12	20	26	9.0	12	10	9.5	11	13	11	12
6	17	12	30	8.0	9.1	12	10	12	13	13	9.6	12
7	15	12	15	8.6	11	12	9.7	12	11	11	10	13
8	14	13	16	9.1	9.7	13	9.7	11	8.6	11	12	11
9	14	13	112	9.6	9.6	13	8.6	11	11	13	11	8.4
10	13	12	17	9.6	103	12	12	11	9.7	13	12	11
11	15	13	54	11	35	11	11	11	10	12	11	11
12	16	13	16	153	10	12	13	10	9.6	11	11	10
13	18	13	11	171	10	12	12	11	11	12	11	10
14	15	13	9.8	29	10	12	11	11	11	12	9.9	12
15	12	12	9.3	123	11	12	11	11	11	7.3	10	13
16	13	12	8.5	12	11	12	12	11	12	6.5	11	8.1
17	12	12	8.3	11	12	12	12	11	12	12	10	8.1
18	11	12	7.8	10	13	11	12	11	12	5.0	8.3	7.7
19	11	12	8.4	11	10	11	11	11	13	12	9.5	8.2
20	12	11	8.9	11	10	11	11	11	13	9.9	10	9.0
21	11	217	9.5	18	13	12	11	12	14	11	11	10
22	12	89	16	19	12	12	11	11	13	10	9.9	9.7
23	12	14	10	102	11	6.7	10	9.9	14	12	9.6	9.5
24	11	11	10	11	10	4.1	10	5.8	16	12	9.4	9.8
25	11	12	10	171	11	11	10	7.6	18	14	10	88
26	12	11	10	146	14	10	11	11	21	15	10	6.8
27	11	11	44	17	22	6.2	11	11	17	14	10	8.1
28	11	11	24	11	14	13	10	9.6	12	13	9.5	7.3
29	11	12	11	10	---	13	8.8	10	12	12	10	7.3
30	80	12	11	10	---	13	8.9	10	11	12	10	8.9
31	13	---	11	9.8	---	11	---	10	---	11	9.5	---
TOTAL	504	647	572.5	1216.7	430.6	348.0	325.7	323.1	368.7	355.7	324.2	370.6
MEAN	16.3	21.6	18.5	39.2	15.4	11.2	10.9	10.4	12.3	11.5	10.5	12.4
MAX	80	217	112	171	103	13	15	12	21	15	13	88
MIN	11	11	7.8	8.0	8.9	4.1	8.6	5.8	8.6	5.0	8.3	6.8
AC-FT	1000	1280	1140	2410	854	690	646	641	731	706	643	735

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1991 - 1997, BY WATER YEAR (WY)

MEAN	12.7	14.8	16.8	60.5	91.4	92.8	43.8	26.2	15.9	13.5	12.2	12.3
MAX	16.3	24.3	26.4	161	351	349	190	100	34.3	24.9	20.1	15.1
(WY)	1997	1994	1993	1995	1993	1995	1995	1995	1995	1993	1993	1994
MIN	6.22	5.55	10.4	13.0	15.4	11.2	2.89	3.24	7.33	3.56	6.98	7.08
(WY)	1996	1996	1995	1994	1997	1997	1991	1992	1992	1994	1994	1995

SUMMARY STATISTICS	FOR 1996 CALENDAR YEAR		FOR 1997 WATER YEAR		WATER YEARS 1991 - 1997	
ANNUAL TOTAL	8078.6		5786.8			
ANNUAL MEAN	22.1		15.9		34.1	
HIGHEST ANNUAL MEAN					81.8	1995
LOWEST ANNUAL MEAN					14.2	1992
HIGHEST DAILY MEAN	409	Feb 20	217	Nov 21	1660	Feb 19 1993
LOWEST DAILY MEAN	2.5	Aug 14	4.1	Mar 24	.34	Jul 3 1992
ANNUAL SEVEN-DAY MINIMUM	4.7	Aug 13	8.7	Dec 15	.89	Jan 13 1992
INSTANTANEOUS PEAK FLOW			960	Nov 21	3600	Jan 4 1995
INSTANTANEOUS PEAK STAGE			4.62	Nov 21	6.51	Jan 4 1995
ANNUAL RUNOFF (AC-FT)	16020		11480		24730	
10 PERCENT EXCEEDS	31		17		60	
50 PERCENT EXCEEDS	14		11		13	
90 PERCENT EXCEEDS	11		9.1		4.4	

ATISTICS COMPUTED BY: jaagajan DATE: 03/16/1998 AT: 18:19:28

11073360 CHINO CREEK AT SCHAEFER AVENUE, NEAR CHINO, CA

LOCATION.--Lat 34°00'14", long 117°43'34", in Santa Ana del Chino Grant, San Bernardino County, Hydrologic Unit 18070203, on right bank 300 ft downstream from Schaefer Avenue, 0.8 mi downstream from San Antonio Creek, and 1.5 mi southwest of Chino.

DRAINAGE AREA.--48.9 mi^2.

PERIOD OF RECORD.--October 1969 to current year.

REVISED RECORDS.--WDR CA-84-1: 1983(M). WDR CA-95-1: 1992, 1993.

GAGE.--Water-stage recorder. Concrete dikes formed low-water control from October 1975 to Apr. 16, 1991. Elevation of gage is 685 ft above sea level, from topographic map.

REMARKS.--Records good above 10 ft^3/s and fair below. Flow mostly regulated by San Antonio Flood-Control Reservoir, capacity, 7,700 acre-ft. Natural streamflow affected by extensive ground-water withdrawals, diversions for power, domestic use, irrigation, and return flow from irrigated areas. California Water Project reported releases of 42,930 acre-ft to the basin via San Antonio Creek from Rialto Pipeline below San Antonio Dam at a site 10 mi upstream. See schematic diagram of Santa Ana River basin.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 12,700 ft^3/s, Feb. 27, 1983, gage height, 10.32 ft, from rating curve extended above 560 ft^3/s on basis of slope-conveyance study; no flow May 21, June 30, July 1, Oct. 30, Nov. 3, 1977.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Jan. 25, 1969, reached a stage of 9.23 ft, present datum, discharge, 9,200 ft^3/s, on basis of contracted-opening measurement at site 6.1 mi downstream.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.2	1.1	.69	11	1.3	.97	1.2	129	99	111	96	204
2	1.0	.88	.80	47	1.3	1.1	1.1	63	96	105	97	204
3	1.1	.85	.77	76	1.6	1.2	1.2	129	96	105	99	201
4	1.2	.82	.81	1.1	1.2	1.4	1.2	132	99	108	116	194
5	1.2	.70	5.2	6.3	1.2	1.2	1.3	127	98	107	194	197
6	1.1	.73	9.1	.86	1.0	1.0	1.2	130	96	103	191	194
7	1.2	.71	.90	.84	1.0	1.5	1.2	132	92	102	195	197
8	1.3	.79	.90	.94	1.0	.98	1.2	130	90	100	202	198
9	1.0	.93	290	.80	1.0	.98	1.2	127	90	94	206	200
10	1.2	.96	34	.74	6.2	2.0	1.4	136	96	93	202	205
11	1.0	.92	158	.78	2.1	1.7	1.3	138	109	95	202	198
12	1.0	1.0	19	130	1.0	1.1	1.3	136	110	96	197	198
13	.97	.79	2.3	118	3.6	1.2	1.4	134	113	94	200	202
14	1.1	.90	1.2	24	2.2	2.2	1.3	132	106	88	199	204
15	1.1	1.1	.91	95	2.4	2.5	1.4	106	107	91	204	200
16	.99	.67	1.1	2.5	3.1	1.6	1.3	85	107	103	205	197
17	1.2	.62	1.0	1.3	2.8	1.1	1.3	80	106	103	212	202
18	1.2	.67	.97	.99	2.8	1.2	1.4	73	105	106	197	209
19	1.5	.73	.93	.92	2.4	1.2	1.4	72	105	105	199	207
20	1.2	.89	1.0	20	1.1	1.3	1.5	72	103	105	202	205
21	1.3	413	.92	22	1.2	1.2	1.4	77	104	96	196	218
22	1.1	56	93	4.1	1.0	1.3	1.6	76	103	94	199	221
23	.98	1.4	1.7	106	1.0	1.2	38	77	104	93	194	222
24	1.2	1.0	1.3	1.4	1.4	1.2	111	81	103	117	193	226
25	1.1	1.1	1.2	187	1.0	1.2	105	83	107	130	192	198
26	1.1	1.1	1.0	388	1.0	1.1	119	84	108	99	200	88
27	.91	.86	67	11	3.0	1.2	127	89	108	99	197	184
28	1.2	.90	20	3.3	1.3	1.2	124	92	108	96	205	189
29	.97	.88	1.4	2.4	---	1.2	124	104	110	99	206	185
30	151	.70	1.3	2.1	---	1.7	120	109	111	96	200	185
31	2.5	---	1.3	1.9	---	1.2	---	95	---	97	204	---
TOTAL	186.12	493.70	719.70	1268.27	51.2	41.13	896.8	3230	3089	3130	5801	5932
MEAN	6.00	16.5	23.2	40.9	1.83	1.33	29.9	104	103	101	187	198
MAX	151	413	290	388	6.2	2.5	127	138	113	130	212	226
MIN	.91	.62	.69	.74	1.0	.97	1.1	63	90	88	96	88
AC-FT	369	979	1430	2520	102	82	1780	6410	6130	6210	11510	11770

UNITED STATES DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY - CA INSTALLATION 04/03/98

STATION NUMBER 11073495 CUCAMONGA C NR MIRA LOMA CA STREAM SOURCE AGENCY USGS
LATITUDE 335858 LONGITUDE 1173555 DRAINAGE AREA 75.80 DATUM STATE 06 COUNTY 071

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1996 TO SEPTEMBER 1997
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	31	e32	35	54	e35	38	35	29	e34	e33	e35	36
2	36	e31	34	100	e33	39	e34	e30	e33	e34	e35	43
3	34	e31	35	167	e32	36	e33	e31	e32	e31	e34	32
4	32	e33	35	38	e34	33	e34	34	e31	e34	e34	e34
5	28	e32	54	58	e34	36	36	33	e30	e34	e34	e35
6	27	e31	57	40	e35	36	38	e30	e30	e33	38	e35
7	30	31	35	37	e34	33	38	e31	e32	e34	39	36
8	38	30	41	38	e33	e32	37	e31	e33	e35	37	39
9	42	32	396	40	e34	32	35	31	e34	e35	35	35
10	38	33	75	44	34	35	e34	33	e36	e35	34	78
11	40	35	176	49	34	34	e34	34	37	e34	36	54
12	40	35	54	391	32	e34	e33	e33	38	e34	35	42
13	41	36	33	345	35	e35	e32	e33	e36	e35	34	44
14	e40	36	33	71	36	e35	e33	e34	e36	e35	e35	46
15	e38	e35	38	246	38	e34	e33	e36	e35	e34	e35	72
16	e38	e36	e34	38	36	e34	34	37	e35	e33	e35	48
17	e36	e38	e33	e37	40	e35	30	38	e34	e35	e36	47
18	e36	e37	e33	e37	58	e34	29	36	e35	e34	e36	39
19	e37	e37	29	e36	41	e37	29	e35	e35	e35	e35	41
20	e36	e35	31	61	40	e36	31	e35	e34	e36	e34	36
21	e40	715	33	92	37	e34	e32	e33	e34	e36	e36	38
22	e38	303	349	37	37	e35	e34	e34	36	e36	e35	38
23	e37	45	35	182	39	e35	e33	e33	30	e35	e36	37
24	e36	e35	e34	e35	e33	e36	e33	e33	35	e36	34	35
25	e35	e32	e33	442	e36	e34	e32	e32	31	e35	36	193
	33	e31	e34	772	e40	e35	e31	e34	33	e36	35	48
	39	35	77	114	52	e34	e32	e34	36	e35	32	42
	39	34	48	35	37	e35	31	e34	e34	e35	e33	40
29	44	34	31	e33	---	e34	30	e33	e33	e36	e35	37
30	270	32	32	e34	---	e35	30	e33	e33	e35	e34	30
31	31	---	35	e34	---	37	---	e34	---	e34	31	---
TOTAL	1360	1972	2032	3737	1039	1082	990	1031	1015	1072	1083	1410
MEAN	43.9	65.7	65.5	121	37.1	34.9	33.0	33.3	33.8	34.6	34.9	47.0
MAX	270	715	396	772	58	39	38	38	38	36	39	193
MIN	27	30	29	33	32	32	29	29	30	31	31	30
AC-FT	2700	3910	4030	7410	2060	2150	1960	2040	2010	2130	2150	2800

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1986 - 1997, BY WATER YEAR (WY)

MEAN	35.9	36.6	43.9	83.4	79.3	66.1	33.8	28.3	31.0	28.9	30.0	35.9
MAX	52.9	65.7	83.0	265	197	198	54.2	44.9	57.1	46.2	51.8	52.0
(WY)	1988	1997	1993	1993	1993	1995	1995	1992	1992	1992	1992	1986
MIN	20.4	23.4	21.0	26.1	34.9	25.3	20.5	18.5	18.1	19.3	18.5	16.4
(WY)	1987	1989	1987	1989	1989	1988	1987	1988	1988	1987	1987	1988

SUMMARY STATISTICS	FOR 1996 CALENDAR YEAR		FOR 1997 WATER YEAR		WATER YEARS 1986 - 1997	
ANNUAL TOTAL	21369		17823			
ANNUAL MEAN	58.4		48.8		44.3	
HIGHEST ANNUAL MEAN					71.4	1993
LOWEST ANNUAL MEAN					26.6	1987
HIGHEST DAILY MEAN	2490	Feb 20	772	Jan 26	2490	Feb 20 1996
LOWEST DAILY MEAN	26	Feb 29	27	Oct 6	2.5	Jun 6 1987
ANNUAL SEVEN-DAY MINIMUM	30	Jan 1	30	Apr 26	12	Aug 25 1988
INSTANTANEOUS PEAK FLOW			3330	Nov 21	10400	Jan 7 1993
INSTANTANEOUS PEAK STAGE			3.74	Nov 21	5.40	Jan 7 1993
ANNUAL RUNOFF (AC-FT)	42390		35350		32070	
10 PERCENT EXCEEDS	54		46		54	
50 PERCENT EXCEEDS	38		35		30	
90 PERCENT EXCEEDS	31		31		19	

ISTICS COMPUTED BY: jaagajan DATE: 03/13/1998 AT: 09:15:28

e Estimated

APPENDIX B

DAILY PRECIPITATION DATA
AT SAN BERNARDINO COUNTY HOSPITAL

WATER YEAR 1996-97

Table B-1

DAILY PRECIPITATION AT SAN BERNARDINO COUNTY HOSPITAL

1996			1997									
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0	0	0	0	0	0	0	0	0	0	0	TR
2	0	0	0	0.23	0	0	0	0	0	0	0	0.15
3	0	0	0	1.28	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0.08	0	0	0	0	TR	0	0	0
6	0	0	0.15	0.05	0	0	0	0	0.16	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0.14	0	0	0	0	0	0	0	0	0
10	0	0	1.02	0	0	0	0	0	0	0	0	0
11	0	0	0.60	0	TR	0	0	0	0	0	0	0
12	0	0	0.09	0.91	0	0	0	0	0.02	0	0	0
13	0	0	0	1.02	0	0	0	0	TR	0	0	0.10
14	0	0	0	1.55	0	0	0	0	0	0	0	0.27
15	0	TR	0	0.65	0	0	0	0	0	0	0	0
16	0	0	0	0.04	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	TR	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	1.45	0	0.08	0	0	0	0	0	TR	0	0
22	0	1.52	1.12	0.04	0	0	0	0	0	0	0	0
23	0	0.09	0	0.64	0	0	0	0	0	0	0	0
24	0	0	0	TR	0	0	0	0	0	0	0	0.62
25	0	0	0	0.33	0	0	0	0	0	0	0	0.12
26	0	0	0.22	1.61	0	0	0	0	0	0	0	0
27	0.03	0	0	0.37	0.40	TR	0	0	0	0	0	0
28	0	0	0	0	0.44	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	1.05	0	TR	0		0	0	0	0	0	0	0
31	0		0	0		0		0		0	0	
Total	1.08	3.06	3.34	8.88	0.84	0	0	0	0.18	0	0	1.26

TR = Trace

APPENDIX C

SANTA ANA RIVER WATERMASTER
FINANCIAL STATEMENTS WITH REPORT
ON EXAMINATION BY
ORANGE COUNTY WATER DISTRICT CONTROLLER

WATER YEAR 1996-97

ORANGE COUNTY WATER DISTRICT

April 22, 1998

Santa Ana River Watermaster
c/o SBVMWD
P.O. Box 5906
San Bernardino, CA 92412-5906

Gentlemen:

I have reviewed the attached summary of transactions for the checking and savings accounts of the Santa Ana River Watermaster. As part of this review, I have compared the transactions on the attached summary with those shown on the original Bank of America Checking and Savings Account statements.

The transactions on the summary also match those found on original documents. The Checking and Savings Accounts balances as of June 30, 1997, are as shown.

Very truly yours,

ORANGE COUNTY WATER DISTRICT

Barbara Heatherly

Barbara Heatherly
Controller

BH:jlk

SANTA ANA RIVER WATERMASTER

FINANCIAL STATEMENTS

JUNE 30, 1997

SANTA ANA RIVER WATER MASTER

STATEMENT OF ASSETS AND LIABILITIES
ARISING FROM CASH TRANSACTIONS

June 30, 1997

ASSETS

Cash in checking account (Note 3)	$	4,505
Cash in savings account (Note 3)		2,300
TOTAL ASSETS	$	6,805

FUND BALANCE

Fund balance	$	6,805

See independent reviewer's reports and notes to financial statements.

SANTA ANA RIVER WATERMASTER

STATEMENT OF ASSETS AND LIABILITIES
ARISING FROM CASH TRANSACTIONS

June 30, 1997

	Actual	Budget	Over (Under) Budget
REVENUE COLLECTED:			
Water district contributions (Note 2):			
Orange County Water District	$ 4,200	$ 4,800	$ (600)
Chino Basin Municipal Water District	3,100	2,400	700
San Bernardino Valley Municipal Water District	2,100	2,400	(300)
Western Municipal Water District	3,100	2,400	700
Interest from Savings Account	45	-	45
TOTAL REVENUE COLLECTED	12,545	12,000	545
EXPENSES PAID:			
Professional Engineering Service	$ 19,543	$ 9,500	$(10,043)
Administrative Expenses:			
Office and Bank Service Charges	8	0	(8)
Auditing Services	0	0	0
Annual Reports	0	2,500	2,500
TOTAL EXPENSES PAID	19,551	12,000	(7,551)
EXCESS OF REVENUE COLLECTED OVER EXPENSES PAID	(7,006)	0	(7,006)
FUND BALANCE AT JULY 1, 1996	13,811		
FUND BALANCE AT JUNE 30, 1997	$6,805		

See independent reviewer's report and notes to financial statements.

SANTA ANA RIVER WATERMASTER

NOTES TO FINANCIAL STATEMENTS

June 30, 1997

1. SIGNIFICANT ACCOUNTING POLICIES:

Basis of Accounting:

The Santa Ana River Watermaster's ("Watermaster") policy is to prepare its financial statements on the cash basis of accounting; consequently, certain revenues are recognized when received rather than when earned, and certain expenses are recognized when cash is disbursed rather than when the obligation is incurred.

2. ORGANIZATION AND HISTORY:

The Santa Ana River Watermaster is composed of committee of five representatives from 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 the 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 Districts	20%
Total	100%

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

See independent reviewer's report.

3. CASH IN BANK:

The following disclosures are made in accordance with Statement No. 3 of the Governmental Accounting Standards Board (GASB 3):

Cash at June 30, 1997 consisted of the following:

Bank of America:		
Checking account	$	4,505
Savings account		2,300
	$	6,805

All cash is fully insured by the FDIC.

See independent reviewer's report.

APPENDIX D

WATER QUALITY AND FLOW OF EXCHANGE GROUNDWATER DISCHARGED TO THE SANTA ANA RIVER ABOVE PRADO

WATER YEAR 1996-97

PREPARED BY

DONALD L. HARRIGER

TABLE D-1
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97
(acre-feet)

Month	Discharged Below Riverside Narrows	Discharged Above Riverside Narrows (1)
1996		
October	0	544
November	0	585
December	0	198
1997		
January	0	0
February	0	111
March	0	284
April	0	279
May	0	251
June	0	127
July	0	150
August	0	120
September	0	113
Subtotal	0	2,762
Total		2,762

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

October 1996

Day	Discharged Above Riverside Narrows (1) (cfs)
1	7.54
2	4.85
3	4.70
4	5.11
5	4.90
6	4.98
7	5.70
8	6.90
9	8.21
10	6.57
11	6.23
12	6.28
13	6.36
14	3.86
15	7.27
16	6.05
17	5.94
18	6.16
19	5.85
20	5.03
21	4.69
22	7.01
23	9.88
24	10.90
25	11.67
26	21.76
27	22.12
28	18.51
29	15.20
30	10.96
31	23.10
Total in CFS-DAYS	274
Total in AF	544

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

November 1996

Day	Discharged Above Riverside Narrows (1) (cfs)
1	33.54
2	22.01
3	20.40
4	20.06
5	21.23
6	22.49
7	13.92
8	4.12
9	4.21
10	4.62
11	4.01
12	4.10
13	14.91
14	15.12
15	15.22
16	14.79
17	14.76
18	14.62
19	15.28
20	15.20
21	0.54
22	0.00
23	0.00
24	0.00
25	0.00
26	0.00
27	0.00
28	0.00
29	0.00
30	0.00
Total in CFS-DAYS	295
Total in AF	585

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

December 1996

Day	Discharged Above Riverside Narrows (1) (cfs)
1	0.00
2	0.00
3	0.00
4	3.93
5	14.23
6	25.96
7	27.06
8	26.75
9	2.08
10	0.00
11	0.00
12	0.00
13	0.00
14	0.00
15	0.00
16	0.00
17	0.00
18	0.00
19	0.00
20	0.00
21	0.00
22	0.00
23	0.00
24	0.00
25	0.00
26	0.00
27	0.00
28	0.00
29	0.00
30	0.00
31	0.00
Total in CFS-DAYS	100
Total in AF	198

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

January 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	0.00
10	0.00
11	0.00
12	0.00
13	0.00
14	0.00
15	0.00
16	0.00
17	0.00
18	0.00
19	0.00
20	0.00
21	0.00
22	0.00
23	0.00
24	0.00
25	0.00
26	0.00
27	0.00
28	0.00
29	0.00
30	0.00
31	0.00
Total in CFS-DAYS	0
Total in AF	0

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

February 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	0.00
10	0.00
11	0.00
12	0.00
13	0.00
14	7.38
15	7.77
16	8.02
17	8.37
18	8.07
19	3.00
20	1.61
21	1.62
22	1.47
23	1.88
24	1.46
25	1.51
26	1.47
27	1.23
28	1.29
Total in CFS-DAYS	56
Total in AF	111

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

March 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	1.24
2	1.42
3	1.31
4	1.26
5	1.24
6	1.29
7	1.01
8	1.26
9	1.00
10	1.21
11	1.10
12	1.20
13	1.23
14	1.27
15	1.33
16	1.98
17	2.15
18	2.05
19	2.12
20	9.76
21	10.15
22	10.35
23	10.42
24	10.40
25	14.04
26	14.45
27	13.76
28	6.92
29	5.14
30	5.29
31	5.71
Total in CFS-DAYS	143
Total in AF	284

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

April 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	3.73
2	3.55
3	3.51
4	3.03
5	3.47
6	3.54
7	3.66
8	3.42
9	4.50
10	4.56
11	4.51
12	4.77
13	5.33
14	5.28
15	4.62
16	4.78
17	4.69
18	4.69
19	4.88
20	4.68
21	6.14
22	6.34
23	5.46
24	5.09
25	5.13
26	5.45
27	5.89
28	5.85
29	4.89
30	4.98
Total in CFS-DAYS	140
Total in AF	279

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

May 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	3.86
2	4.48
3	4.70
4	5.53
5	4.30
6	4.97
7	4.07
8	0.70
9	5.65
10	4.62
11	3.46
12	4.19
13	4.11
14	4.35
15	4.35
16	4.60
17	5.03
18	4.34
19	4.31
20	4.09
21	4.37
22	4.43
23	4.25
24	4.33
25	4.24
26	4.42
27	4.14
28	2.57
29	4.37
30	2.33
31	1.17
Total in CFS-DAYS	126
Total in AF	251

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

June 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	1.45
2	1.55
3	2.06
4	2.78
5	4.60
6	4.49
7	4.78
8	4.79
9	4.53
10	4.65
11	4.30
12	1.76
13	1.39
14	0.71
15	0.28
16	1.20
17	0.78
18	2.01
19	1.43
20	0.94
21	1.40
22	1.45
23	1.23
24	1.24
25	1.90
26	1.54
27	1.00
28	1.84
29	0.80
30	1.31
Total in CFS-DAYS	64
Total in AF	127

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

July 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	4.15
2	1.86
3	3.18
4	3.11
5	3.53
6	3.16
7	2.23
8	2.52
9	2.29
10	2.17
11	3.21
12	2.19
13	2.16
14	2.77
15	1.34
16	3.06
17	2.46
18	2.50
19	1.99
20	1.71
21	1.82
22	2.55
23	2.63
24	2.36
25	2.56
26	1.91
27	1.80
28	1.41
29	1.53
30	2.75
31	2.62
Total in CFS-DAYS	76
Total in AF	150

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

August 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	2.25
2	2.71
3	2.65
4	3.33
5	3.29
6	0.51
7	1.03
8	0.86
9	1.15
10	0.30
11	1.17
12	2.82
13	1.56
14	1.82
15	1.60
16	1.95
17	1.33
18	2.14
19	1.51
20	1.44
21	1.39
22	1.58
23	1.49
24	1.75
25	2.10
26	2.24
27	2.17
28	1.13
29	1.57
30	6.44
31	2.98
Total in CFS-DAYS	60
Total in AF	120

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-2 (continued)
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

September 1997

Day	Discharged Above Riverside Narrows (1) (cfs)
1	1.82
2	1.55
3	1.23
4	0.93
5	1.62
6	1.41
7	2.93
8	0.15
9	0.00
10	0.00
11	2.84
12	1.66
13	2.58
14	2.78
15	3.23
16	3.18
17	1.75
18	2.22
19	1.72
20	1.22
21	5.05
22	0.52
23	0.17
24	2.66
25	2.50
26	2.33
27	1.91
28	2.29
29	2.99
30	1.77
Total in CFS-DAYS	57
Total in AF	113

(1) Adjusted for a 5% evapotranspiration losses.

TABLE D-3
MWDSC DEMONSTRATION PROGRAM WATER
DISCHARGED TO THE SANTA ANA RIVER
ABOVE PRADO DAM

WATER YEAR 1996-97

Month	Discharge (1) (acre-feet)	TDS (2) (mg/L)	Discharge x TDS
1996			
October	544	567 (2)	308,474
November	585	463 (2)	271,050
December	198	451 (2)	89,463
1997			
January	0	--	0
February	111	639 (2)	71,167
March	284	553 (2)	156,917
April	279	524	145,944
May	251	512	128,293
June	127	507	64,551
July	150	510	76,404
August	120	560	66,933
September	113	558	63,097
Total	2,762		1,442,293

$$\frac{1,442,293}{2,762} = 522 \text{ mg/L}$$

Flow-weighted TDS of pumped groundwater releases to the River = 522 mg/L.

(1) Flow adjusted for a 5% evapotranspiration losses (2,906 x 0.95 = 2,762).
(2) Water quality data from the Riverside Canal was unavailable for the period from October 1996 through March 1997. The flow-weighted TDS of the well discharge to the Canal was used for this period of the year.

APPENDIX E

WATER QUALITY AND DISCHARGE OF WATER RELEASED BY MWDSC TO SAN ANTONIO CREEK NEAR UPLAND (CONNECTION OC-59)

WATER YEAR 1996-97

PREPARED BY

WILLIAM R. MILLS, JR.

TABLE E-1

NONTRIBUTARY WATER FROM OC-59

MONTHLY TOTALS

(acre-feet)

WATER YEAR 1996-97

Month	Released at OC-59	12-Hour Delay (1)	Evaporation Losses (2)	Calculated Flow at Prado
1996				
October	0	0	-	0
November	0	0	-	0
December	0	0	-	0
1997				
January	0	0	-	0
February	0	0	-	0
March	0	0	-	0
April	1,428	1,330	18	1,311
May	6,022	6,024	89	5,934
June	5,972	5,968	74	5,894
July	6,303	6,301	81	6,220
August	11,571	11,474	78	11,397
September	11,617	11,622	57	11,565
Total	42,913	42,720	398	42,322

(1) Released nontributary water is delayed 12 hours to reflect the estimated travel time between OC-59 and Prado Dam.

(2) Monthly evapotranspiration losses calculated per the procedures referenced in the Twelfth Annual Watermaster Report, Appendix C and shown in Table E-3.

TABLE E-2

NONTRIBUTARY WATER FROM OC-59
APRIL 1996
(cfs)

Day	Released at OC-59	12 Hour Delay	Calculated Flow at Prado Dam(1)
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	50	25	25
24	76	63	62
25	99	88	86
26	99	99	98
27	99	99	98
28	99	99	98
29	99	99	98
30	99	99	98
Total (cfs-days)	720	671	661
(AF)	1,428	1,330	1,311

(1) Includes the monthly evapotranspiration loss listed in Table E-1.

TABLE E-2 (continued)

NONTRIBUTARY WATER FROM OC-59
MAY 1996
(cfs)

Day	Released at OC-59	12 Hour Delay	Calculated Flow at Prado Dam(1)
1	98	99	97
2	98	98	97
3	98	98	97
4	98	98	97
5	98	98	97
6	98	98	97
7	98	98	97
8	98	98	97
9	98	98	97
10	98	98	97
11	98	98	97
12	98	98	97
13	98	98	97
14	98	98	97
15	98	98	97
16	98	98	97
17	98	98	97
18	98	98	97
19	98	98	97
20	98	98	97
21	98	98	97
22	98	98	97
23	98	98	97
24	98	98	97
25	98	98	97
26	98	98	97
27	98	98	97
28	98	98	97
29	98	98	97
30	97	98	96
31	97	97	96
Total (cfs-days)	3,036	3,037	2,992
(AF)	6,022	6,024	5,934

(1) Includes the monthly evapotranspiration loss listed in Table E-1.

TABLE E-2 (continued)

NONTRIBUTARY WATER FROM OC-59
JUNE 1996
(cfs)

Day	Released at OC-59	12 Hour Delay	Calculated Flow at Prado Dam(1)
1	100	99	97
2	100	100	99
3	100	100	99
4	100	100	99
5	100	100	99
6	100	100	99
7	100	100	99
8	100	100	99
9	100	100	99
10	100	100	99
11	100	100	99
12	100	100	99
13	100	100	99
14	100	100	99
15	100	100	99
16	100	100	99
17	100	100	99
18	100	100	99
19	100	100	99
20	101	101	99
21	101	101	100
22	101	101	100
23	101	101	100
24	101	101	100
25	101	101	100
26	101	101	100
27	101	101	100
28	101	101	100
29	101	101	100
30	101	101	100
Total			
(cfs-days)	3,011	3,009	2,972
(AF)	5,972	5,968	5,894

(1) Includes the monthly evapotranspiration loss listed in Table E-1.

TABLE E-2 (continued)

NONTRIBUTARY WATER FROM OC-59
JULY 1996
(cfs)

Day	Released at OC-59	12 Hour Delay	Calculated Flow at Prado Dam(1)
1	102	102	100
2	102	102	101
3	102	102	101
4	102	102	101
5	102	102	101
6	102	102	101
7	102	102	101
8	102	102	101
9	102	102	101
10	102	102	101
11	102	102	101
12	102	102	101
13	102	102	101
14	102	102	101
15	102	102	101
16	103	103	101
17	103	103	102
18	103	103	102
19	103	103	102
20	103	103	102
21	103	103	102
22	103	103	102
23	103	103	102
24	103	103	102
25	103	103	102
26	103	103	102
27	103	103	102
28	103	103	102
29	103	103	102
30	103	103	102
31	103	103	102
Total (cfs-days)	3,178	3,177	3,136
(AF)	6,303	6,301	6,220

(1) Includes the monthly evapotranspiration loss listed in Table E-1.

TABLE E-2 (continued)

NONTRIBUTARY WATER FROM OC-59
AUGUST 1996
(cfs)

Day	Released at OC-59	12 Hour Delay	Calculated Flow at Prado Dam(1)
1	100	102	101
2	100	100	99
3	125	113	112
4	150	138	137
5	175	163	161
6	184	179	178
7	200	192	190
8	200	200	199
9	200	200	199
10	200	200	199
11	200	200	199
12	200	200	199
13	200	200	199
14	200	200	199
15	200	200	199
16	200	200	199
17	200	200	199
18	200	200	199
19	200	200	199
20	200	200	199
21	200	200	199
22	200	200	199
23	200	200	199
24	200	200	199
25	200	200	199
26	200	200	199
27	200	200	199
28	200	200	199
29	200	200	199
30	200	200	199
31	200	200	199
Total (cfs-days)	5,834	5,785	5,746
(AF)	11,571	11,474	11,397

(1) Includes the monthly evapotranspiration loss listed in Table E-1.

TABLE E-2 (continued)

NONTRIBUTARY WATER FROM OC-59
SEPTEMBER 1997
(cfs)

Day	Released at OC-59	12 Hour Delay	Calculated Flow at Prado Dam(1)
1	198	199	198
2	198	198	197
3	196	197	196
4	195	196	195
5	195	195	194
6	195	195	194
7	195	195	194
8	195	195	194
9	195	195	194
10	195	195	194
11	195	195	194
12	195	195	194
13	195	195	194
14	195	195	194
15	195	195	194
16	195	195	194
17	195	195	194
18	195	195	194
19	195	195	194
20	195	195	194
21	195	195	194
22	195	195	194
23	195	195	194
24	195	195	194
25	195	195	194
26	195	195	194
27	195	195	194
28	195	195	194
29	195	195	194
30	195	195	194
Total (cfs-days)	5,857	5,860	5,831
(AF)	11,617	11,622	11,565

(1) Includes the monthly evapotranspiration loss listed in Table E-1.

TABLE E-3

EVAPOTRANSPIRATION LOSSES OF STATE WATER FROM OC-59
WATER YEAR 1996-97
SUM OF ALL CHANNEL REACHES
(acre-feet)

Month	State Water Released with 12-hour delay	Rialto Pipeline to Los Serranos Road	Los Serranos to Prado Dam w/o vegetation	Los Serranos to Prado Dam w/ vegetation	Total Evapo-transpiration	Percent of Monthly Release
1997						
April	1,329.9	7.02	9.01	2.45	18.47	1.39%
May	6,023.8	33.33	42.78	13.38	89.49	1.49%
June	5,968.3	30.29	38.88	4.68	73.85	1.24%
July	6,301.5	33.57	43.08	4.68	81.33	1.29%
August	11,474.4	32.21	41.34	4.14	77.69	0.68%
Septembe	11,622.1	24.03	30.84	2.04	56.91	0.49%
Total	42,720	160.45	205.93	31.37	397.75	
				Percent of Annual Releases =		0.93%

TABLE E-3.1

EVAPOTRANSPIRATION LOSSES OF STATE WATER FROM OC-59
WATER YEAR 1996-97
RIALTO PIPELINE TO LOS SERRANOS ROAD

Month	State Water Released with 12-hour delay (AF)	Days of Evaporation	Evapo-transpiration (in) (a)	Computed Evaporation Losses (b)	
				(AF)	(% of release
[1]	[2]	[3]	[4]	[5]	[6]
1997					
April	1,329.9	8	5.63	7.02	0.53%
May	6,023.8	31	7.13	33.33	0.55%
June	5,968.3	30	6.48	30.29	0.51%
July	6,301.5	31	7.18	33.57	0.53%
August	11,474.4	31	6.89	32.21	0.28%
Septembe	11,622.1	30	5.14	24.03	0.21%

(a) At UCR Evapotranspiration Station #44

(b) Evaporation losses=[4]/(days/month)x[3]x(Pan Factor of 1.0)x(area of 56.1 acres)x(1 foot/12 inch

TABLE E-3.2

EVAPOTRANSPIRATION LOSSES OF STATE WATER FROM OC-59
WATER YEAR 1996-97
LOS SERRANOS ROAD TO PRADO DAM (WITHOUT VEGETATION COVER)

Month	State Water Released with 12-hour delay (AF)	Days of Evaporation (+7 days)(a)	Evapo-transpiration (in) (b)	Average Wetted Area (AF) (c)	Computed Evaporation Losses (d)	
					(AF)	(% of release)
[1]	[2]	[3]	[4]	[5]	[6]	[7]
1997						
April	1,329.9	8	5.63	72	9.01	0.68%
May	6,023.8	31	7.13	72	42.78	0.71%
June	5,968.3	30	6.48	72	38.88	0.65%
July	6,301.5	31	7.18	72	43.08	0.68%
August	11,474.4	31	6.89	72	41.34	0.36%
Septembe	11,622.1	30	5.14	72	30.84	0.27%

(a) Period of delivery plus 7 days after stoppage of delivery.
(b) At UCR Evapotranspiration Station #44
(c) Equals 1/2 of 144 acres if the average flow rate of the month is less than 200 cfs and 1/2 of 369 acres if the average flow rate is greater or equal to 200 cfs.
(d) Evaporation losses=[3]x[4]/(days/month)x[5]x(1 foot/12 inches)

TABLE E-3.3

EVAPOTRANSPIRATION LOSSES OF STATE WATER FROM OC-59
WATER YEAR 1996-97
LOS SERRANOS ROAD TO PRADO DAM (WITH VEGETATION COVER)

Month	State Water Released with 12-hour delay (AF)	Days of Evaporation (a)	Evapo-transpiration (in) (b)	Normal Evaporation (in) (c)	Average Wetted Area (AF) (d)	Computed Evaporation Losses (e)	
						(AF)	(% of release)
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
1997							
April	1,329.9	8	5.63	4.10	72	2.45	0.18%
May	6,023.8	31	7.13	4.90	72	13.38	0.22%
June	5,968.3	30	6.48	5.70	72	4.68	0.08%
July	6,301.5	31	7.18	6.40	72	4.68	0.07%
August	11,474.4	31	6.89	6.20	72	4.14	0.04%
Septembe	11,622.1	30	5.14	4.80	72	2.04	0.02%

(a) Period of delivery plus 7 days after stoppage of delivery.
(b) At UCR Evapotranspiration Station #44
(c) Referenced in the 1983 report "Nontributary Losses of State Water Released at OC-59 and Final Adjustments to Base Flows".
(d) Equals 1/2 of 144 acres if the average flow rate of the month is less than 200 cfs and 1/2 of 369 acres if the average flow rate is greater or equal to 200 cfs.
(e) Evaporation losses=[3]x([4]-[5])/(days/month)x[6]x(1 foot/12 inches)

TABLE E-4

CALCULATION OF WEIGHTED TDS OF
OC-59 RELEASES
WATER YEAR 1996-97

Month	Calculated Flow at Prado (acre-feet)	Average TDS (mg/L)(1)	Flow x TDS
1996			
October	0	-	0
November	0	-	0
December	0	-	0
1997			
January	0	-	0
February	0	-	0
March	0	-	0
April	1,311	236	309,500
May	5,934	237	1,406,430
June	5,894	237	1,396,975
July	6,220	230	1,430,636
August	11,397	218	2,484,477
September	11,565	224	2,590,612
Total	42,322		9,618,631

Unadjusted Yearly Flow-weighted TDS $= \frac{9,618,631}{42,322} =$ 227 mg/L

Notes:

(1) TDS values for OC-59 releases arriving at Prado were adjusted based on mass balance using known flow and quality components, as described in Table E-5.

TABLE E-5
TDS ADJUSTMENT OF OC-59 DISCHARGE
WATER YEAR 1996-97

The TDS of the OC-59 water reaching Prado Dam was estimated using the two methods described below. The second method provided a more representative estimate.

Method 1 (Based on Annualized Values)

Method 1 is essentially the same as that described in Appendix C of the Twelfth Annual Report. It uses the following equation which depends on assumed *annual average* TDS concentrations of Base Flow and Storm Flow at Prado, which are not measured values:

$$Q_p q_p = Q_{bf} q_{bf} + Q_{sf} q_{sf} + Q_{ex} q_{ex} + Q_{ad} q_{ad} + Q_{59} q_{59}$$

where:			
	Q_p	= total flow at Prado	= 249,694 af
	q_p	= total flow TDS at Prado	= 464 mg/L
	Q_{bf}	= base flow at Prado	= 136,676 af
	q_{bf}	= base flow TDS at Prado	= 600 mg/L*
	Q_{sf}	= storm flow at Prado	= 61,783 af
	q_{sf}	= storm flow TDS at Prado	= 350 mg/L*
	Q_{ex}	= exchange flow	= 2,762 af
	q_{ex}	= exchange flow TDS	= 522 mg/L
	Q_{ad}	= Arlington Desalter flow	= 6,151 af
	q_{ad}	= Arlington Desalter TDS	= 414 mg/L
	Q_{59}	= OC-59 flow reaching Prado	= 42,322 af
	q_{59}	= OC-59 flow TDS reaching Prado	

Note: All values are annualized.

*Assumed value

Solving for q_{59}:

$$q_{59} = \frac{Q_p q_p - Q_{bf} q_{bf} - Q_{sf} q_{sf} - Q_{ex} q_{ex} - Q_{ad} q_{ad}}{Q_{59}}$$

$$= \mathbf{195\ mg/L}$$

The value of q_{59} is very sensitive to the assumed values of Prado base flow and storm flow TDS. For example, when *calculated* Prado base flow TDS was used (617 mg/L) the resultant q_{59} equaled 141mg/L. Therefore, since very small changes in assumed or calculated figures cause significant differences in estimated q_{59} values, the following method was developed to reduce this uncertainty.

Calculation of Prado Base Flow TDS (Based on March, 1997)

The TDS of Base Flow water reaching Prado Dam is a key element for the second method of calculating q_{59}. This year there was no month when water purchases and/or storm flow were not part of the total flow at Prado. Therefore, q_{bf} had to be calculated before calculating q_{59}. The month of March was chosen to calculate q_{bf} because it had the *least* amount of storm flow (only 1.5% of the total flow at Prado) for which an assumed TDS value was used. The following equation was used to calculate the TDS of base flow water reaching Prado Dam:

$$Q_p q_p = Q_{bf} q_{bf} + Q_{sf} q_{sf} + Q_{ex} q_{ex} + Q_{ad} q_{ad}$$

where:

Q_p	= total flow at Prado[1]	= 14,984 af
q_p	= total flow TDS at Prado[2]	= 606 mg/L
Q_{sf}	= storm flow at Prado[1]	= 228 af
q_{sf}	= storm flow TDS at Prado[3]	= 350 mg/L
Q_{ex}	= exchange flow[1]	= 284 af
q_{ex}	= exchange flow TDS[4]	= 553 mg/L
Q_{ad}	= Arlington Desalter flow[1]	= 519 af
q_{ad}	= Arlington Desalter TDS[2]	= 464 mg/L
Q_{bf}	= base flow at Prado[1]	= 13,953 af
q_{bf}	= base flow TDS at Prado	

[1]For March 1997.
[2]Flow-weighted average TDS for March 1997.
[3]Assumed value.
[4]Based on flow-weighted TDS for well discharge to the Riverside Canal during March 1997.

Solving for q_{bf}

$$q_{bf} = \frac{Q_p q_p - Q_{sf} q_{sf} - Q_{ex} q_{ex} - Q_{ad} q_{ad}}{Q_{bf}}$$

$$\mathbf{q_{bf} = 617\ mg/L}$$

Method 2 (Based on data from August, 1997)

Method 2 uses essentially the same equation as Method 1, except the time period of flow measurements is based on one "representative month" (August) which eliminates the storm flow terms (Q_{sf} and q_{sf}). It also uses flow-weighted TDS concentrations at Prado observed before and during purchases of OC-59 water, as graphed on Plate 5. A reduction of TDS of approximately 100 mg/L is clearly shown in late April when OC-59 releases began, as well as a similar magnitude decrease in early August when the releases increased from approximately 100 cfs to 200 cfs.

Using the month of August as a representative period of relatively stable TDS concentrations, the following equation was used to estimate the TDS of OC-59 water reaching Prado Dam:

$$Q_p q_p = Q_{bf} q_{bf} + Q_{ex} q_{ex} + Q_{ad} q_{ad} + Q_{59} q_{59}$$

where:

Q_p	= total flow at Prado[1]	= 20,505 af
q_p	= total flow TDS at Prado[2]	= 397 mg/L
Q_{bf}	= base flow at Prado[1]	= 8,479 af
q_{bf}	= base flow TDS at Prado[3]	= 617 mg/L
Q_{ex}	= exchange flow[1]	= 120 af
q_{ex}	= exchange flow TDS[4]	= 560 mg/L
Q_{ad}	= Arlington Desalter flow[1]	= 510 af
q_{ad}	= Arlington Desalter TDS[2]	= 385 mg/L
Q_{59}	= OC-59 flow reaching Prado[1]	= 11,397 af
q_{59}	= OC-59 flow TDS reaching Prado	

[1]For August 1997.
[2]Flow-weighted average TDS.
[3]As calculated above for the month of March 1997.
[4]Average TDS of three grab samples collected from the Riverside canal during August 1997.

Solving for q_{59}:

$$q_{59} = \frac{Q_p q_p - Q_{bf} q_{bf} - Q_{ex} q_{ex} - Q_{ad} q_{ad}}{Q_{59}}$$

$$= \mathbf{232\ mg/L}$$

By eliminating the uncertainty of assumed storm flow TDS concentrations, this method more accurately reflects the TDS concentration of the OC-59 water reaching Prado Dam. *Because the measured TDS of the OC-59 water remained essentially constant during the 5-month release period, the 232 mg/L value would similarly not be expected to fluctuate. Therefore, this value was used to calculate annual base and storm flow TDS at Prado in the report.*

APPENDIX F

WATER QUALITY AND DISCHARGE FROM THE ARLINGTON DESALTER TO THE ARLINGTON VALLEY DRAIN

WATER YEAR 1996-97

PREPARED BY

WILLIAM R. MILLS, JR.

TABLE F-1

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

OCTOBER 1996

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	8	17	602	385	3,262
2	8	17	601	385	3,257
3	8	17	603	386	3,267
4	8	17	602	385	3,262
5	8	17	602	385	3,262
6	8	17	603	386	3,267
7	8	17	603	386	3,261
8	8	17	602	385	3,256
9	8	17	603	386	3,261
10	8	17	603	386	3,261
11	8	17	604	387	3,267
12	8	17	604	387	3,267
13	8	17	604	387	3,267
14	8	17	603	386	3,261
15	8	17	604	387	3,267
16	8	17	604	387	3,267
17	8	17	604	387	3,267
18	8	16	600	384	3,043
19	8	16	559	358	2,913
20	8	16	558	357	2,902
21	8	15	573	367	2,844
22	8	16	560	358	2,901
23	8	16	560	358	2,901
24	8	16	555	355	2,875
25	8	16	556	356	2,875
26	8	16	555	355	2,875
27	8	16	557	356	2,886
28	8	16	560	358	2,901
29	8	16	559	358	2,891
30	6	12	559	358	2,132
31	8	16	587	376	3,082
Total	255	505			95,500
Monthly Flow Weighted TDS				375	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

NOVEMBER 1996

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	8	16	589	377	3,092
2	8	16	587	376	3,082
3	8	16	587	376	3,076
4	8	16	577	369	3,035
5	8	17	576	369	3,070
6	8	16	581	372	3,085
7	9	18	645	413	3,667
8	9	18	680	435	4,021
9	9	18	680	435	4,021
10	9	18	680	435	4,015
11	9	18	680	435	4,015
12	9	18	681	436	4,027
13	9	18	682	436	4,033
14	9	18	682	436	4,033
15	9	18	677	433	3,977
16	9	18	681	436	4,021
17	9	18	686	439	4,064
18	9	18	693	444	4,126
19	9	18	694	444	4,132
20	9	18	695	445	4,131
21	9	18	696	445	4,137
22	9	18	696	445	4,137
23	9	18	696	445	4,137
24	9	18	695	445	4,131
25	9	18	696	445	4,137
26	8	17	655	419	3,562
27	9	18	681	436	4,000
28	9	18	692	443	4,106
29	9	18	692	443	4,099
30	9	18	694	444	4,118
Total	270	536			115,285
Monthly Flow Weighted TDS				426	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

DECEMBER 1996

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	9	18	694	444	4,118
2	9	18	695	445	4,124
3	9	18	695	445	4,124
4	9	18	695	445	4,117
5	9	18	712	456	4,119
6	9	18	696	445	4,130
7	9	18	696	445	4,130
8	9	18	696	445	4,130
9	9	18	697	446	4,136
10	9	18	698	447	4,135
11	9	18	699	447	4,141
12	9	18	699	447	4,141
13	9	18	699	447	4,141
14	9	18	721	461	4,128
15	9	18	699	447	4,141
16	9	18	698	447	4,135
17	9	18	699	447	4,134
18	9	18	698	447	4,128
19	9	18	700	448	4,140
20	9	18	698	447	4,121
21	9	18	698	447	4,128
22	9	18	700	448	4,140
23	9	18	699	447	4,127
24	9	18	699	447	4,127
25	9	18	699	447	4,127
26	9	18	700	448	4,133
27	9	18	700	448	4,133
28	8	16	700	448	3,613
29	9	18	702	449	4,131
30	9	18	703	450	4,143
31	9	18	703	450	4,143
Total	285	565			127,553
Monthly Flow Weighted TDS				448	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

JANUARY 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	9	18	703	450	4,143
2	9	18	704	451	4,149
3	9	18	704	451	4,142
4	9	18	703	450	4,137
5	9	18	703	450	4,130
6	7	15	735	470	3,466
7	9	18	707	452	4,167
8	9	18	703	450	4,137
9	9	18	703	450	4,137
10	9	18	703	450	4,137
11	9	18	704	451	4,142
12	9	18	704	451	4,142
13	9	18	704	451	4,135
14	9	18	705	451	4,141
15	9	18	704	451	4,135
16	9	18	704	451	4,135
17	9	18	705	451	4,134
18	9	18	704	451	4,128
19	9	18	706	452	4,140
20	9	18	705	451	4,134
21	9	18	705	451	4,134
22	9	18	707	452	4,146
23	9	18	707	452	4,146
24	9	18	707	452	4,146
25	9	18	707	452	4,146
26	9	18	708	453	4,145
27	9	18	709	454	4,151
28	9	18	707	452	4,139
29	9	18	708	453	4,145
30	9	18	707	452	4,139
31	9	18	707	452	4,139
Total	283	561			127,689
Monthly Flow Weighted TDS				452	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

FEBRUARY 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	9	18	707	452	4,132
2	9	18	707	452	4,132
3	9	18	708	453	4,138
4	9	18	709	454	4,144
5	9	18	708	453	4,131
6	9	18	708	453	4,131
7	9	18	708	453	4,138
8	9	18	709	454	4,144
9	9	18	709	454	4,137
10	9	18	709	454	4,137
11	9	18	709	454	4,137
12	9	18	710	454	4,143
13	9	18	710	454	4,136
14	9	18	710	454	4,136
15	9	18	710	454	4,136
16	9	18	710	454	4,136
17	9	18	710	454	4,136
18	9	18	711	455	4,141
19	9	18	710	454	4,136
20	9	18	710	454	4,136
21	9	18	710	454	4,128
22	9	18	711	455	4,134
23	9	18	711	455	4,134
24	9	18	727	465	4,191
25	9	18	735	470	4,318
26	9	18	730	467	4,288
27	9	18	734	470	4,304
28	9	18	733	469	4,299
Total	255	506			116,528
Monthly Flow Weighted TDS				457	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

MARCH 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	9	18	734	470	4,297
2	9	18	731	468	4,272
3	9	18	728	466	4,262
4	9	17	745	477	4,155
5	9	18	730	467	4,266
6	9	18	729	467	4,253
7	9	18	728	466	4,248
8	9	18	727	465	4,242
9	9	18	726	465	4,236
10	9	18	726	465	4,236
11	9	18	728	466	4,240
12	9	18	726	465	4,236
13	9	18	725	464	4,216
14	9	18	727	465	4,227
15	9	18	724	463	4,210
16	9	18	724	463	4,210
17	9	18	725	464	4,216
18	9	18	726	465	4,222
19	9	18	727	465	4,227
20	9	18	727	465	4,220
21	9	18	728	466	4,226
22	9	18	726	465	4,214
23	3	7	740	474	1,642
24	3	7	740	474	1,657
25	9	17	663	424	3,632
26	5	11	715	458	2,500
27	5	9	695	445	2,072
28	9	18	728	466	4,255
29	9	18	728	466	4,240
30	9	18	728	466	4,233
31	9	17	736	471	4,134
Total	262	519			121,496
Monthly Flow Weighted TDS				464	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

APRIL 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	9	18	737	472	4,278
2	9	18	743	476	4,306
3	8	17	744	476	3,995
4	9	18	734	470	4,253
5	9	18	732	468	4,242
6	9	18	735	470	4,252
7	9	18	737	472	4,264
8	9	18	713	456	4,188
9	8	15	746	477	3,651
10	9	17	666	426	3,727
11	9	17	664	425	3,716
12	9	17	664	425	3,710
13	9	17	664	425	3,710
14	9	17	664	425	3,710
15	9	17	665	426	3,715
16	9	17	662	424	3,712
17	9	17	660	422	3,720
18	9	17	660	422	3,720
19	9	17	660	422	3,720
20	9	17	661	423	3,719
21	9	17	661	423	3,719
22	9	17	661	423	3,719
23	9	17	661	423	3,719
24	9	17	661	423	3,713
25	9	17	661	423	3,713
26	9	17	661	423	3,713
27	9	17	661	423	3,713
28	9	17	662	424	3,718
29	8	15	674	431	3,305
30	8	15	422	270	2,040
Total	261	518			113,378
Monthly Flow Weighted TDS				434	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

MAY 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	7	14	304	195	1,355
2	8	16	559	358	2,974
3	9	17	598	383	3,276
4	9	17	598	383	3,276
5	7	14	611	391	2,766
6	9	17	611	391	3,377
7	9	17	610	390	3,372
8	9	17	610	390	3,372
9	9	17	611	391	3,377
10	9	17	610	390	3,372
11	9	17	610	390	3,372
12	7	14	610	390	2,852
13	8	17	598	383	3,252
14	8	17	597	382	3,247
15	8	17	597	382	3,247
16	8	17	597	382	3,247
17	8	16	597	382	3,158
18	8	17	593	380	3,207
19	8	17	592	379	3,202
20	8	17	592	379	3,202
21	8	17	592	379	3,202
22	8	17	591	378	3,191
23	7	14	591	378	2,617
24	4	8	131	84	346
25	7	14	448	287	1,975
26	8	17	599	383	3,240
27	8	17	600	384	3,245
28	8	17	598	383	3,234
29	8	17	599	383	3,234
30	8	17	599	383	3,234
31	8	17	599	383	3,234
Total	252	499			93,253
Monthly Flow Weighted TDS				371	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

JUNE 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	8	17	598	383	3,228
2	8	17	598	383	3,228
3	8	17	599	383	3,234
4	8	17	599	383	3,228
5	8	16	542	347	2,819
6	8	16	530	339	2,735
7	6	12	136	87	523
8	7	14	295	189	1,292
9	9	17	613	392	3,340
10	9	17	612	392	3,334
11	9	17	612	392	3,334
12	8	16	581	372	3,039
13	8	17	607	388	3,289
14	8	17	607	388	3,289
15	8	17	607	388	3,289
16	8	17	606	388	3,284
17	8	17	606	388	3,284
18	8	17	606	388	3,284
19	8	17	609	390	3,294
20	8	17	607	388	3,283
21	8	17	607	388	3,283
22	8	17	607	388	3,283
23	8	17	608	389	3,288
24	8	17	607	388	3,277
25	8	17	608	389	3,282
26	8	17	608	389	3,282
27	8	17	607	388	3,277
28	8	17	607	388	3,277
29	8	17	607	388	3,301
30	8	17	607	388	3,271
Total	249	493			92,451
Monthly Flow Weighted TDS				372	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

JULY 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	8	16	582	372	3,079
2	8	17	595	381	3,177
3	8	17	595	381	3,177
4	8	17	595	381	3,171
5	8	17	596	381	3,176
6	8	17	595	381	3,171
7	8	17	595	381	3,171
8	8	16	637	408	3,206
9	8	17	573	367	3,054
10	8	17	573	367	3,054
11	8	17	572	366	3,048
12	8	17	572	366	3,048
13	8	17	572	366	3,048
14	8	16	572	366	3,043
15	3	6	596	381	1,110
16	3	7	722	462	1,516
17	5	11	785	502	2,745
18	3	6	741	474	1,380
19	8	17	586	375	3,187
20	8	15	615	394	3,064
21	8	17	591	378	3,179
22	8	15	626	401	3,063
23	8	17	584	374	3,159
24	8	17	584	374	3,159
25	8	17	583	373	3,153
26	8	17	584	374	3,159
27	8	17	583	373	3,153
28	8	17	582	372	3,148
29	8	17	584	374	3,159
30	8	17	583	373	3,153
31	8	17	583	373	3,153
Total	239	474			91,262
Monthly Flow Weighted TDS				382	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

AUGUST 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	8	17	583	373	3,153
2	8	17	582	372	3,148
3	8	17	583	373	3,153
4	8	17	583	373	3,153
5	7	14	675	432	3,076
6	7	15	851	545	4,013
7	7	14	711	455	3,113
8	8	17	593	380	3,219
9	8	17	593	380	3,219
10	8	17	592	379	3,214
11	8	17	592	379	3,214
12	8	17	592	379	3,214
13	8	17	592	379	3,214
14	8	17	592	379	3,214
15	8	17	592	379	3,214
16	8	17	593	380	3,219
17	8	17	592	379	3,214
18	7	15	601	385	2,846
19	8	17	589	377	3,180
20	8	17	589	377	3,186
21	8	17	588	376	3,180
22	8	17	588	376	3,174
23	8	17	587	376	3,169
24	8	17	588	376	3,174
25	8	17	587	376	3,175
26	8	17	586	375	3,169
27	8	17	587	376	3,169
28	8	17	587	376	3,169
29	8	17	586	375	3,164
30	8	17	586	375	3,164
31	8	17	586	375	3,164
Total	257	510			99,044
Monthly Flow Weighted TDS				385	

1. TDS = EC x 0.64

TABLE F-1 (continued)

SUMMARY OF DISCHARGE AND WEIGHTED TDS
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

SEPTEMBER 1997

Day	Arlington Discharge (cfs)	Arlington Discharge (acre-feet)	Daily Mean EC (microsiemens/cm)	Computed TDS (mg/L)(1)	Outflow X TDS
1	8	17	586	375	3,152
2	8	17	586	375	3,152
3	8	17	586	375	3,164
4	8	17	586	375	3,158
5	8	17	586	375	3,158
6	8	17	578	370	3,098
7	8	17	569	364	3,032
8	8	15	665	426	3,221
9	7	14	752	481	3,352
10	8	16	612	392	3,092
11	8	16	568	364	3,010
12	8	16	568	364	3,016
13	8	16	568	364	3,016
14	8	16	566	362	3,005
15	8	16	566	362	2,994
16	8	16	572	366	3,026
17	8	17	577	369	3,075
18	8	17	576	369	3,070
19	8	17	576	369	3,075
20	8	17	575	368	3,070
21	8	17	575	368	3,070
22	8	17	575	368	3,064
23	8	16	572	366	3,043
24	8	16	575	368	3,059
25	4	8	582	372	1,476
26	4	7	682	436	1,561
27	7	13	747	478	3,137
28	7	13	746	477	3,126
29	7	14	673	431	3,127
30	8	16	570	365	3,032
Total	234	464			89,630
Monthly Flow Weighted TDS				383	

1. TDS = EC x 0.64

TABLE F-2

QUALITY OF WATER DISCHARGED
FROM THE ARLINGTON DESALTER
TO THE ARLINGTON VALLEY DRAIN
WATER YEAR 1996-97

Month	Discharge (acre-feet)	Weighted TDS (mg/L)	Discharge X TDS
1996			
October	505	375	189,421
November	536	426	228,665
December	565	448	252,997
1997			
January	561	452	253,268
February	506	457	231,131
March	519	464	240,984
April	518	434	224,882
May	499	371	184,964
June	493	372	183,374
July	474	382	181,016
August	510	385	196,451
September	464	383	177,778
Total	6,151		2,544,932

Yearly Flow Weighted TDS = $\frac{2,544,932}{6,151}$ = 414 mg/L

APPENDIX G

WATER QUALITY AND DISCHARGE FROM LAKE ELSINORE

WATER YEAR 1996-97

PREPARED BY

WILLIAM R. MILLS, JR.

No discharges into the Santa Ana River watershed from Lake Elsinore occurred during the 1996-97 water year.

APPENDIX H

WATER QUALITY AND DISCHARGE OF THE SANTA ANA RIVER BELOW PRADO DAM

WATER YEAR 1996-97

PREPARED BY

WILLIAM R. MILLS, JR.

TABLE H-1

WATER QUALITY SAMPLES BELOW PRADO DAM
FOR WATER YEAR 1996-97

Date	EC (microsiemens/cm)	TDS (mg/L)	Source
10/08/96	939	586	USGS
10/15/96	925	514	OCWD
10/30/96	939	600	USGS
11/19/96	908	562	USGS
11/20/96	930	530	OCWD
11/26/96	500	304	USGS
12/11/96	539	320	USGS
12/18/96	804	472	OCWD
12/31/96	956	590	USGS
01/21/97	711	422	OCWD
01/22/97	789	464	USGS
01/30/97	476	278	USGS
02/06/97	854	518	USGS
02/12/97	938	568	USGS
02/19/97	981	600	OCWD
02/27/97	1020	630	USGS
03/07/97	1020	633	USGS
03/18/97	988	630	OCWD
03/25/97	969	607	USGS
04/08/97	958	596	USGS
04/16/97	967	608	USGS
04/21/97	941	594	OCWD
04/30/97	813	495	USGS
05/19/97	773	430	OCWD
05/29/97	775	461	USGS
06/06/97	768	466	USGS
06/16/97	770	458	OCWD
06/26/97	798	488	USGS
07/09/97	766	467	USGS
07/14/97	735	424	OCWD
07/23/97	754	460	USGS
07/28/97	717	442	OCWD
08/05/97	688	434	OCWD
08/07/97	662	410	USGS
08/13/97	655	396	OCWD
08/19/97	606	386	OCWD
08/21/97	644	383	USGS
08/25/97	584	408	OCWD
09/11/97	643	383	USGS
09/17/97	629	382	OCWD
09/23/97	628	384	OCWD
09/29/97	724	459	USGS

TABLE H-2

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

OCTOBER 1996

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	186	926	565	105,138
2	198	931	568	112,526
3	194	928	566	109,897
4	192	928	566	108,764
5	194	930	568	110,134
6	199	929	567	112,851
7	201	925	565	113,494
8	191	937	572	109,247
9	186	947	578	107,522
10	183	955	583	106,682
11	186	963	588	109,339
12	185	966	590	109,090
13	186	963	588	109,339
14	197	959	585	115,324
15	207	951	581	120,168
16	191	974	595	113,561
17	195	977	596	116,296
18	190	976	596	113,198
19	202	975	595	120,224
20	200	974	595	118,912
21	191	973	594	113,444
22	185	972	593	109,768
23	189	971	593	112,026
24	194	970	592	114,871
25	198	969	592	117,118
26	198	965	589	116,635
27	198	970	592	117,239
28	209	952	581	121,456
29	213	946	577	123,001
30	155	918	560	86,858
31	302	758	463	139,737
Total	6,095			3,513,860
Monthly Flow Weighted TDS			577	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

NOVEMBER 1996

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	398	780	476	189,502
2	385	894	546	210,104
3	363	922	563	204,303
4	318	940	574	182,470
5	243	944	576	140,028
6	233	948	579	134,834
7	215	951	581	124,812
8	213	949	579	123,391
9	210	952	581	122,037
10	207	949	579	119,915
11	206	945	577	118,833
12	207	941	574	118,904
13	210	944	576	121,012
14	219	943	576	126,064
15	223	931	568	126,733
16	220	929	567	124,760
17	218	932	569	124,025
18	222	931	568	126,165
19	227	928	566	128,591
20	231	942	575	132,831
21	167	857	523	87,364
22	399	514	314	125,191
23	531	511	312	165,635
24	530	543	331	175,676
25	524	578	353	184,882
26	520	555	339	176,170
27	514	607	371	190,453
28	511	651	397	203,066
29	503	647	395	198,659
30	491	676	413	202,612
Total	9,658			4,509,021
Monthly Flow Weighted TDS			467	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

DECEMBER 1996

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	481	698	426	204,945
2	484	734	448	216,859
3	484	799	488	236,063
4	481	827	505	242,821
5	474	874	534	252,887
6	443	831	507	224,720
7	332	929	567	188,274
8	272	959	585	159,230
9	248	861	526	130,344
10	322	488	298	95,921
11	326	530	324	105,470
12	445	557	340	151,304
13	545	552	337	183,642
14	548	719	439	240,517
15	534	655	400	213,510
16	542	686	419	226,965
17	534	704	430	229,483
18	522	826	504	263,201
19	508	897	548	278,159
20	486	932	569	276,496
21	434	1,010	617	267,576
22	367	702	429	157,268
23	476	589	360	171,143
24	457	815	498	227,358
25	402	996	608	244,411
26	285	1,010	617	175,712
27	260	930	568	147,602
28	337	680	415	139,886
29	344	735	449	154,341
30	368	878	536	197,233
31	435	973	594	258,368
Total	13,176			6,261,708
Monthly Flow Weighted TDS			475	

1. TDS = EC x0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

JANUARY 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	416	998	609	253,431
2	366	824	503	184,096
3	390	578	353	137,603
4	393	553	338	132,664
5	393	682	416	163,611
6	452	767	468	211,626
7	482	872	532	256,566
8	472	955	583	275,158
9	339	1,010	617	209,005
10	231	1,010	617	142,420
11	217	1,020	623	135,113
12	241	896	547	131,814
13	407	400	244	99,378
14	868	429	262	227,307
15	928	434	265	245,852
16	1,080	492	300	324,358
17	575	501	306	175,850
18	498	595	363	180,877
19	492	639	390	191,912
20	449	671	410	183,910
21	447	743	454	202,737
22	461	783	478	220,343
23	616	780	476	293,300
24	702	697	425	298,680
25	695	691	422	293,156
26	4,820	552	337	1,624,136
27	3,700	402	245	907,954
28	847	418	255	216,120
29	577	439	268	154,624
30	545	503	307	167,340
31	487	633	386	188,178
Total	23,586			8,429,120
Monthly Flow Weighted TDS			357	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

FEBRUARY 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	487	688	420	204,528
2	487	723	441	214,933
3	464	787	480	222,910
4	442	840	513	226,641
5	439	878	536	235,286
6	435	884	540	234,735
7	432	924	564	243,664
8	428	951	581	248,462
9	421	958	585	246,198
10	364	960	586	213,309
11	336	965	589	197,926
12	333	961	586	195,278
13	325	956	584	189,727
14	328	952	581	190,611
15	326	957	584	190,443
16	327	962	587	192,026
17	327	965	589	192,624
18	396	971	593	234,720
19	432	975	595	257,113
20	427	980	598	255,441
21	421	987	602	253,650
22	417	989	604	251,749
23	412	992	606	249,485
24	403	996	608	245,019
25	395	1,000	610	241,120
26	387	1,010	617	238,599
27	342	1,010	617	210,855
28	317	1,020	623	197,377
Total	11,050			6,274,430
Monthly Flow Weighted TDS			568	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

MARCH 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	312	1,020	623	194,263
2	304	1,020	623	189,282
3	322	1,020	623	200,490
4	331	1,020	623	206,094
5	301	1,020	623	187,414
6	272	1,020	623	169,358
7	250	1,020	623	155,660
8	243	1,010	617	149,818
9	246	1,000	610	150,166
10	245	1,000	610	149,555
11	248	999	610	151,235
12	230	997	609	139,978
13	232	993	606	140,629
14	237	992	606	143,515
15	239	991	605	144,580
16	245	990	604	148,060
17	244	988	603	147,158
18	245	984	601	147,163
19	234	983	600	140,412
20	233	978	597	139,101
21	240	977	596	143,134
22	243	974	595	144,478
23	248	974	595	147,451
24	252	969	592	149,060
25	247	970	592	146,253
26	252	974	595	149,829
27	239	974	595	142,100
28	245	972	593	145,368
29	239	972	593	141,808
30	238	969	592	140,779
31	240	968	591	141,815
Total	7,896			4,786,004
Monthly Flow Weighted TDS			606	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

APRIL 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	242	967	590	142,849
2	235	963	588	138,143
3	227	965	589	133,718
4	236	964	588	138,875
5	227	963	588	133,441
6	229	963	588	134,616
7	234	962	587	137,413
8	219	961	587	128,471
9	209	962	587	122,732
10	213	963	588	125,211
11	215	966	590	126,780
12	217	965	589	127,827
13	222	967	590	131,044
14	224	968	591	132,361
15	219	968	591	129,406
16	211	968	591	124,679
17	219	961	587	128,471
18	214	951	581	124,231
19	212	941	574	121,776
20	221	930	568	125,462
21	222	919	561	124,539
22	215	909	555	119,299
23	216	900	549	118,668
24	281	880	537	150,947
25	295	867	529	156,127
26	295	855	522	153,966
27	302	845	516	155,776
28	308	834	509	156,803
29	310	824	503	155,928
30	313	814	497	155,527
Total	7,202			4,055,086
Monthly Flow Weighted TDS			563	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

MAY 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	315	807	493	155,174
2	285	810	494	140,918
3	281	808	493	138,597
4	303	806	492	149,078
5	313	805	491	153,807
6	298	805	491	146,436
7	248	801	489	121,261
8	263	807	493	129,558
9	272	805	491	133,660
10	286	808	493	141,063
11	291	810	494	143,885
12	293	808	493	144,516
13	297	807	493	146,307
14	299	810	494	147,840
15	297	803	490	145,582
16	297	797	487	144,494
17	297	791	483	143,407
18	301	785	479	144,236
19	299	781	477	142,547
20	265	785	479	126,985
21	279	791	483	134,715
22	290	787	480	139,319
23	299	782	477	142,730
24	299	772	471	140,904
25	313	780	476	149,031
26	324	778	475	153,872
27	270	757	462	124,766
28	282	761	465	131,000
29	281	771	471	132,250
30	277	763	466	129,015
31	271	762	465	126,055
Total	8,985			4,343,009
Monthly Flow Weighted TDS			483	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

JUNE 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	286	764	466	133,382
2	294	760	464	136,395
3	287	755	461	132,271
4	268	750	458	122,697
5	276	750	458	126,434
6	289	751	458	132,468
7	335	751	459	153,643
8	303	752	459	139,049
9	314	752	459	144,182
10	230	753	459	105,674
11	255	753	460	117,229
12	284	754	460	130,638
13	302	754	460	139,000
14	295	754	461	135,858
15	297	755	461	136,860
16	298	755	461	137,401
17	292	756	461	134,714
18	270	756	462	124,638
19	280	757	462	129,330
20	289	757	462	133,565
21	284	758	462	131,332
22	308	758	463	142,514
23	332	758	463	153,709
24	289	759	463	133,879
25	220	759	464	101,974
26	294	760	464	136,355
27	241	760	464	111,839
28	287	761	464	133,264
29	313	761	465	145,422
30	311	762	465	144,577
Total	8,623			3,980,290
Monthly Flow Weighted TDS			462	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

JULY 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	273	762	465	126,985
2	209	762	465	97,273
3	230	763	466	107,109
4	247	763	466	115,093
5	257	764	466	119,822
6	263	764	467	122,691
7	267	765	467	124,629
8	268	765	467	125,169
9	260	766	467	121,503
10	249	766	468	116,430
11	255	755	461	117,523
12	259	754	460	119,209
13	264	754	460	121,510
14	268	757	462	123,842
15	265	754	460	121,970
16	258	752	459	118,433
17	263	755	461	121,210
18	258	745	455	117,331
19	256	744	454	116,265
20	256	739	451	115,484
21	262	740	452	118,350
22	266	742	453	120,482
23	263	748	457	120,086
24	269	740	452	121,512
25	308	729	445	137,061
26	272	737	450	122,369
27	270	715	436	117,844
28	270	707	432	116,525
29	270	705	430	116,195
30	267	701	428	114,252
31	266	699	427	113,500
Total	8,108			3,687,657
Monthly Flow Weighted TDS			455	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

AUGUST 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	258	710	433	111,819
2	252	711	434	109,372
3	249	715	436	108,678
4	254	716	437	111,015
5	304	676	413	125,446
6	346	664	405	140,243
7	340	654	399	135,735
8	343	648	396	135,677
9	348	646	394	137,230
10	353	642	392	138,339
11	356	637	389	138,429
12	353	632	386	136,185
13	352	630	385	135,369
14	351	630	385	134,984
15	350	636	388	135,882
16	353	640	391	137,908
17	359	645	394	141,348
18	355	660	403	143,024
19	345	655	400	137,942
20	344	643	393	135,022
21	344	641	391	134,602
22	346	639	390	134,963
23	346	640	391	135,174
24	340	638	389	132,415
25	341	638	389	132,804
26	342	637	389	132,985
27	334	640	391	130,486
28	337	637	389	131,041
29	353	638	389	137,477
30	352	642	392	137,948
31	336	647	395	132,703
Total	10,336			4,102,243
Monthly Flow Weighted TDS			397	

1. TDS = EC x 0.610431

TABLE H-2 (continued)

SUMMARY OF FLOW WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

SEPTEMBER 1997

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS(1)	Outflow X TDS
1	338	644	393	132,874
2	350	646	394	138,018
3	348	647	395	137,442
4	347	649	396	137,471
5	347	652	398	138,106
6	366	671	410	149,913
7	345	642	392	135,204
8	352	648	396	139,237
9	348	651	397	138,292
10	361	646	394	142,356
11	364	639	390	141,984
12	352	642	392	137,948
13	355	643	393	139,340
14	374	662	404	151,135
15	378	658	402	151,829
16	397	684	418	165,761
17	357	653	399	142,304
18	380	674	411	156,343
19	353	642	392	138,339
20	350	647	395	138,232
21	364	655	400	145,539
22	371	660	403	149,470
23	371	661	403	149,696
24	362	656	400	144,960
25	319	629	384	122,483
26	506	757	462	233,821
27	535	700	427	228,606
28	388	625	382	148,029
29	395	634	387	152,870
30	395	663	405	159,863
Total	11,168			4,487,466
Monthly Flow Weighted TDS			402	

1. TDS = EC x0.610431

TABLE H-3

ANNUAL SUMMARY OF FLOW-WEIGHTED TDS BELOW PRADO DAM

WATER YEAR 1996-97

Month	Monthly Flow (cfs-days)	Monthly Weighted TDS (mg/L)	Monthly Flow x TDS
1996			
October	6,095	577	3,513,860
November	9,658	467	4,509,021
December	13,176	475	6,261,708
1997			
January	23,586	357	8,429,120
February	11,050	568	6,274,430
March	7,896	606	4,786,004
April	7,202	563	4,055,086
May	8,985	483	4,343,009
June	8,623	462	3,980,290
July	8,108	455	3,687,657
August	10,336	397	4,102,243
September	11,168	402	4,487,466
Total	125,883		58,429,893

Yearly Flow Weighted TDS = $\frac{58,429,893}{125,883}$ = 464 mg/L

APPENDIX I

WATER QUALITY AND FLOW OF WASTEWATER FROM RUBIDOUX COMMUNITY SERVICES DISTRICT DISCHARGED BELOW THE RIVERSIDE NARROWS GAGING STATION

WATER YEAR 1996-97

PREPARED BY

DONALD L. HARRIGER

TABLE I-1

WATER QUALITY AND FLOW OF WASTEWATER
FROM RUBIDOUX COMMUNITY SERVICES DISTRICT
DISCHARGED BELOW THE
RIVERSIDE NARROWS GAGING STATION

WATER YEAR 1996-97

MONTH	Discharge (acre-feet)	TDS (mg/L)	Discharge x TDS
1996			
October	185	644	118,958
November	173	644	111,291
December	163	705	115,211
1997			
January	163	635	103,615
February	146	661	96,640
March	166	608	100,740
April	166	625	103,806
May	185	632	116,722
June	179	565	101,244
July	189	613	115,866
August	191	623	118,750
September	189	626	118,592
Total	2,095		1,321,434

$$\text{Flow weighted TDS} = \frac{1{,}321{,}434}{2{,}095} = 631 \text{ mg/L}$$

APPENDIX J

WATER QUALITY AND FLOW OF THE SANTA ANA RIVER AT RIVERSIDE NARROWS

WATER YEAR 1996-97

PREPARED BY

DONALD L. HARRIGER

TABLE J-1

WATER QUALITY AND FLOW OF THE
SANTA ANA RIVER AT RIVERSIDE NARROWS

W.Y. 1996-97

Date Sampled	E.C. (microsiemens/cm)	TDS (mg/L)	Source of data	*Monthly Average*	*Ratio*
1996					
10/01/96	964	550	C. OF R.		0.57
10/04/96	893	552	U.S.G.S.		0.62
10/07/96	938	614	C. OF R.		0.65
10/10/96	967	643	C. OF R.		0.66
10/15/96	985	669	C. OF R.		0.68
10/18/96	861	540	U.S.G.S.		0.63
10/29/96	979	623	C. OF R.	599	0.64
11/01/96	857	516 *	U.S.G.S.		0.60
11/07/96	944	607 *	C. OF R.		0.64
11/12/96	975	618 *	C. OF R.		0.63
11/20/96	845	522 *	U.S.G.S.		0.62
11/21/96	825	548 *	C. OF R.		0.66
11/26/96	914	602 *	C. OF R.	569	0.66
12/02/96	1005	617 *	C. OF R.		0.61
12/03/96	854	536 *	U.S.G.S.		0.63
12/10/96	472	296 *	U.S.G.S.		0.63
12/10/96	411	328 *	C. OF R.		0.80
12/19/96	938	628 *	C. OF R.		0.67
12/24/96	874	598 *	C. OF R.	501	0.68
1997					
01/02/97	920	630 *	C. OF R.		0.68
01/06/97	860	538 *	U.S.G.S.		0.63
01/07/97	852	615 *	C. OF R.		0.72
01/16/97	573	358 *	U.S.G.S.		0.62
01/16/97	453	458 *	C. OF R.		1.01
01/21/97	855	570 *	C. OF R.		0.67
01/30/97	652	465 *	C. OF R.	519	0.71

* Data not used in determining monthly averages, storm flow.

C of R City of Riverside
USGS U.S. Geological Survey
DWR Dept. of Water Resources

TABLE J-1

WATER QUALITY AND FLOW OF THE
SANTA ANA RIVER AT RIVERSIDE NARROWS

W.Y. 1996-97

Date Sampled	E.C. (microsiemens/cm)	TDS (mg/L)	Source of data	*Monthly Average*	*Ratio*
02/03/97	825	514 *	U.S.G.S.		0.62
02/04/97	854	555 *	C. OF R.		0.65
02/12/97	821	516 *	U.S.G.S.		0.63
02/13/97	812	627 *	C. OF R.		0.77
02/18/97	978	668 *	C. OF R.		0.68
02/27/97	992	653 *	C. OF R.	589	0.66
03/04/97	878	552 *	U.S.G.S.		0.63
03/04/97	986	634	C. OF R.		0.64
03/13/97	984	648	C. OF R.		0.66
03/18/97	988	661	C. OF R.		0.67
03/24/97	881	564	U.S.G.S.		0.64
03/27/97	989	624	C. OF R.	626	0.63
04/01/97	928	584	U.S.G.S.		0.63
04/01/97	994	612	C. OF R.		0.62
04/10/97	1031	610	C. OF R.		0.59
04/11/97	989	627	U.S.G.S.		0.63
04/15/97	1021	624	C. OF R.		0.61
04/24/97	993	628	U.S.G.S.		0.63
04/24/97	1060	622	C. OF R.		0.59
04/29/97	1022	630	C. OF R.	617	0.62
05/01/97	855	532	U.S.G.S.		0.62
05/08/97	927	580	U.S.G.S.		0.63
05/08/97	1033	624	C. OF R.		0.60
05/13/97	1043	643	C. OF R.		0.62
05/22/97	1047	674	C. OF R.		0.64
05/27/97	900	555	U.S.G.S.		0.62
05/27/97	1020	638	C. OF R.	607	0.63

* Data not used in determining monthly averages, storm flow.

C of R City of Riverside
USGS U.S. Geological Survey
DWR Dept. of Water Resources

TABLE J-1

WATER QUALITY AND FLOW OF THE
SANTA ANA RIVER AT RIVERSIDE NARROWS

W.Y. 1996-97

Date Sampled	E.C. (microsiemens/cm)	TDS (mg/L)	Source of data	*Monthly Average*	*Ratio*
06/03/97	1010	630	U.S.G.S.		0.62
06/05/97	861	558	C. OF R.		0.65
06/11/97	956	565	C. OF R.		0.59
06/18/97	1020	646	U.S.G.S.		0.63
06/18/97	1063	660	C. OF R.		0.62
06/24/97	1058	706	C. OF R.	628	0.67
07/01/97	920	578	U.S.G.S.		0.63
07/05/97	998	658	C. OF R.		0.66
07/08/97	1103	687	C. OF R.		0.62
07/11/97	877	555	U.S.G.S.		0.63
07/17/97	1025	656	C. OF R.		0.64
07/22/97	990	660	C. OF R.		0.67
07/31/97	1030	641	C. OF R.	634	0.62
08/04/97	964	599	U.S.G.S.		0.62
08/05/97	1041	661	C. OF R.		0.63
08/14/97	1022	640	C. OF R.		0.63
08/15/97	1000	630	U.S.G.S.		0.63
08/19/97	1064	681	C. OF R.		0.64
08/28/97	1053	641	C. OF R.	642	0.61
09/02/97	1062	670 *	C. OF R.		0.63
09/03/97	1020	650 *	U.S.G.S.		0.64
09/11/97	1020	633 *	C. OF R.		0.62
09/16/97	862	545 *	U.S.G.S.		0.63
09/16/97	1030	614 *	C. OF R.		0.60
09/25/97	933	602 *	C. OF R.	619	0.65

* Data not used in determining monthly averages, storm flow.
C of R City of Riverside
USGS U.S. Geological Survey
DWR Dept. of Water Resources

TABLE J-2

FLOW WEIGHTED TDS OF BASE FLOW AT RIVERSIDE NARROWS
(Including Nontributary Flow
Discharged Above the Narrows)

W.Y. 1996-97

Month	Flow [1] (acre-feet)	TDS [2] (mg/L)	Flow x TDS
1996			
October	5,601	599	3,353,399
November	6,090	605 *	3,684,450
December	5,679	610 *	3,464,190
1997			
January	5,609	615 *	3,449,535
February	5,221	620 *	3,237,020
March	6,045	626	3,785,379
April	5,970	617	3,684,236
May	5,109	607	3,098,973
June	4,830	628	3,030,825
July	4,602	634	2,915,696
August	4,300	642	2,760,600
September	4,229	640 *	2,706,560
Total	63,285		39,170,863

$$\text{Flow weighted TDS} = \frac{39,170,863}{63,285} = 619 \text{ mg/L}$$

(1) Total Flow minus Storm Flow from Table 6

(2) TDS based on water quality data from Table J - 1

* Data are straight line estimates during storm flow periods