SANTA ANA RIVER WATERMASTER

FOR

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

CASE No. 117628 - COUNTY OF ORANGE

ANNUAL REPORT

OF THE

SANTA ANA RIVER WATERMASTER

1969-70

FEBRUARY 1, 1971

SANTA ANA RIVER WATERMASTER

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

WATERMASTER
MAX BOOKMAN
WILLIAM J. CARROLL
CLINTON HENNING
JOHN M. TOUPS
ALBERT A. WEBB

February 1, 1971

MAILING ADDRESS
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RIVERSIDE, CALIFORNIA 92506
TELEPHONE - 714-686-1070

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

Re: Watermaster Report for 1969-70

Gentlemen:

We have the honor of submitting the Annual Report of the Santa Ana River Watermaster for the water year 1969-70. The provisions in the Judgment in Case No. 117628, entered April 23, 1969, became effective October 1, 1970 and the first annual report required from the Watermaster is for the water year 1970-71. However, although not required by the Judgment, the Watermaster has prepared this report for the water year 1969-70 for the information of the Court and the Parties.

The principal Watermaster findings for the water year 1969-70 are as follows:

At Prado

(1)	Base Flow at Prado	39,074 acre-feet
(2)	Annual Weighted TDS of Total Flow	762 ppm
(3)	Annual Adjusted Base Flow	39,074 acre-feet
*(4)	Cumulative Adjusted Base Flow	39,074 acre-feet
*(5)	Cumulative Entitlement of OCWD at Prado	42,000 acre-feet
*(6)	Cumulative Debit (5)-(4)	2,926 acre-feet
*(7)	One-third of Cumulative Debit	975 acre-feet
*(8)	Minimum Required Base Flow in Following Year	37,975 acre-feet

At Riverside Narrows

(1)	Base Flow at Riverside Narrows	17,223 acre-feet
(2)	Annual Weighted TDS of Base Flow at Riverside Narrows	687 ppm
(3)	Annual Adjusted Base Flow	17,223 acre-feet

*(4)	Cumulative Adjusted Base Flow	17,223 acre-feet
*(5)	Cumulative Entitlement of CBMWD and WMWD at Riverside Narrows	15,250 acre-feet
*(6)	Cumulative Credit	1,973 acre-feet
*(7)	One-third of Cumulative Debit	0
*(8)	Minimum Required Base Flow in Following Year	13,420 acre-feet

*Note: Since the Judgment did not go into effect until October 1, 1970, the above findings for the water year 1969-70 are for illustrative purposes only.

The above findings show that there would have been, as of the end of 1969-70, a debit of 2,926 acre-feet in the obligations of Chino Basin Municipal Water District and Western Municipal Water District at Prado. At the same time, there would have been a credit of 1,973 acre-feet in the obligation of San Bernardino Valley Municipal Water District at Riverside Narrows.

The Judgment provides that the Watermaster shall include in the annual report such other items as the parties may mutually request or the Watermaster may deem appropriate. Thus far, the Watermaster has not received any request for additional items to be included in the annual report.

The Watermaster would appreciate receiving any comments and suggestions pertinent to the contents and format for improvement of future annual reports.

Sincerely yours,

Santa Ana River Watermaster

By: Max Bookman
Max Bookman

William J. Carroll
William J. Carroll

Clinton Henning*
Clinton Henning

John M. Toups
John M. Toups

Albert A. Webb
Albert A. Webb

Enclosure

*Deceased January 9, 1971

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CHAPTER I

INTRODUCTION

This annual report of the Santa Ana River Watermaster is for the water year 1969-70. The Judgment in Case No. 117628, Orange County Water District versus City of Chino, et al, entered April 17, 1969, resulted in a division of the water supply of the Santa Ana River system. The entitlements and obligations of four major public water districts overlying the Santa Ana River watershed are set forth in the Judgment. In addition, a physical solution for satisfaction of these rights and obligations is provided, as well as a requirement that a Watermaster be appointed to administer and enforce the provisions of the Judgment on behalf of the Court.

On April 23, 1969, the Court issued an order appointing the Watermaster. The Watermaster during the water year 1969-70 consisted of a committee composed of five persons, namely, William J. Carroll, nominated by Chino Basin Municipal Water District; Albert A. Webb, nominated by Western Municipal Water District; Clinton Henning, nominated by San Bernardino Valley Municipal Water District; and John M. Toups and Max Bookman, nominated by Orange County Water District.

Mr. Clinton Henning became ill the latter part of 1970 and died on January 9, 1971. During his illness and subsequently, Mr. John M. Groves of Mr. Henning's office has represented Mr. Henning at the Watermaster meetings, and although not appointed by the Court, he continued to carry out the responsibilities of Mr. Henning, including participation in preparation of this report. Although not a signatory to this report, he is in agreement with the findings and conclusions.

While the provisions of the Judgment became effective October 1, 1970 and the first annual report required from the Watermaster will be for the water year 1970-71, this report for the water year 1969-70 has been prepared for the information and comment of the Court and the Parties.

Scope of Report

Section 7(c) of the Judgment required the Watermaster to report to the Court and to each party not more than 5 months after the end of each water year starting with 1970-71. The items to be reported upon are as follow:

(a) Prado Accounting

- (1) Base Flow at Prado
- (2) Annual Weighted TDS of Total Flow at Prado
- (3) Annual Adjusted Base Flow

(4) Cumulative Adjusted Base Flow

(5) Cumulative Entitlement of OCWD at Prado

(6) Cumulative Credit or Debit

(7) One-third of Cumulative Debit

(8) Minimum Required Base Flow in Following Year

(b) Riverside Narrows Accounting

(1) Base Flow at Riverside Narrows

(2) Annual Weighted TDS of Base Flow at Riverside Narrows

(3) Annual Adjusted Base Flow

(4) Cumulative Adjusted Base Flow

(5) Cumulative Entitlement of CBMWD and WMWD at Riverside Narrows

(6) Cumulative Credit or Debit

(7) One-third of Cumulative Debit

(8) Minimum Required Base Flow in Following Year

The above listed items as determined by the Watermaster for the water year 1969-70 are hereinafter set forth. The balance of Chapter I contains a brief history of the litigation and a summary of the Judgment. This first chapter is followed by Chapter II, "Activities of Watermaster," Chapter III, "Water Supply Conditions," Chapter IV, "Base Flow at Prado," and Chapter V, "Base Flow at Riverside Narrows."

History of Litigation

The complaint in this case was filed by the Orange County Water District on October 18, 1963 seeking an adjudication of water rights against more than 2,500 water users in the area tributary to Prado Dam within the Santa Ana River Watershed. Thirteen cross-complaints were filed in 1968 extending the adjudication to include an additional 1,500 water users in the area downstream from Prado Dam. Thus, there were involved in this case some 4,000 parties. It became obvious that every effort should be made to arrive at a settlement and a physical solution in order to avoid the enormous and unwieldy litigation that would be involved.

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 further this objective. Among other things, they provided guidance for the formation and activities of an engineering committee to provide them with 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 jointly undertake the compilation of basic data. Liaison was established with the Department of Water Resources, State of California, on requests for information to be obtained from the State's studies for use by the parties. Engineers representing the parties were divided into sub-committees 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 transfers of water between subareas.

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. This list of basic information was in response to a request from the attorneys' committee at a meeting held April 17, 1964. Special assignments were made on selected items to individual engineers to provide information requested by the attorneys' committee.

The attorneys and engineers for the defendants then commenced a series of meetings separate from the representatives of the plaintiff in order to consolidate their position and to determine their 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 and the historical supply and disposal of water passing Prado Dam segregated into the components of flow and designating the amount of supply which was usable by the downstream area. On December 11, 1964, this 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 an Order of Reference be issued requesting the State Department of Water Resources to determine the physical facts. On May 9, 1968 the plaintiffs' attorney submitted motions opposing the Order of Reference and requesting that a preliminary injunction be issued. In the meantime, every effort was being made to come to an agreement on a 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 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 Settlements Documents including a Stipulation for Judgment. The Court entered the Judgment on April 17, 1969. This terminated the many years of controversy over water rights along the Santa Ana River involving the issues and parties embraced in Orange County Water District versus City of Chino, et al.

Summary of Judgment

Provisions of the Judgment became effective on October 1, 1970. The Judgment does not define the water rights of the individual claimants. Instead, it provides for a regional allocation of water supply of the Santa Ana River system and establishes entitlements and obligations among the

four existing major public water districts overlying the aggregate of substantially all of the major areas of water use in the watershed. These districts, the locations of which are shown on Plate 1, "Santa Ana River Watershed", are as follow:

(1) Orange County Water District (OCWD), representing all lower basin entities which are located within Orange County downstream from 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 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.

A physical solution under the stipulated Judgment provides, in general, that SBVMWD shall be responsible for the delivery of an average annual amount of Base Flow at Riverside Narrows and CBMWD and WMWD shall jointly be responsible for an average annual amount of Base Flow at Prado. Essential to the understanding of the provisions of the Judgment is the definition of certain important terms. The total surface flow passing a point of measurement is divided into components, which are defined in the Judgment as follow:

"(1) Storm Flow - That portion of the total surface flow passing a point of measurement, which originates from precipitation and runoff without having first percolated to ground water storage in the zone of saturation, calculated in accordance with procedures referred to in Exhibit B.

(2) Base Flow - That portion of the total surface flow passing a point of measurement which remains after deduction of storm flow.

(3) Adjusted Base Flow - Actual base flow in each year adjusted for quality as provided....."

The Judgment sets forth a declaration of rights. Briefly stated, the Judgment provides that the water users in the area downstream from Prado Dam have rights, as against the upstream users, to receive an average annual supply of 42,000 acre-feet of Base Flow at Prado Dam, together with the right to all Storm Flow reaching Prado Dam. Water users in the area upstream of Prado Dam, as against the downstream users, have the right 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.

The physical solution set forth in the Judgment requires that SBVMWD shall be responsible for an average annual Adjusted Base Flow of 15,250 acre-feet at Riverside Narrows subject each year to the following:

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

(2) After October 1, 1986, if no cumulated debit exists, the minimum quantity shall be 12,420 acre-feet.

(3) Prior to 1986, if the cumulated credit exceeds 10,000 acre-feet, the minimum quantity shall be 12,420 acre-feet.

(4) All cumulated 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 accumulated 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.

The obligations under the physical solutions for meeting the Adjusted Base Flow of 42,000 acre-feet at Prado Dam for the benefit of the downstream water users as shared by CBMWD and WMWD are as follow:

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

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

(3) Prior to 1986, if the cumulated credit exceeds 30,000 acre-feet, the minimum quantity shall be 34,000 acre-feet.

(4) Sufficient quantities of Base Flow shall be provided at Prado to discharge completely any cumulated 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 subsequent 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.

The accounting provided for under the Judgment allows credits to be earned when the average annual Adjusted Base Flow exceeds 15,250 acre-feet at Riverside Narrows and 42,000 acre-feet at Prado. Debits accrue when the average annual Adjusted Base Flow falls below the above quantities at the respective locations. The adjustment of Base Flow for water quality is to provide an incentive to maintain a better quality water as a result of implementation of the physical solution. That is, when the water quality is improved over a certain amount, the quantitative amount of the obligation is decreased; but when that water quality is impaired beyond a specified limit, the quantity of the obligation is increased. This is one of the first comprehensive adjudications in Southern California which includes provisions applicable to the quality of water in addition to the determination of quantitative rights.

CHAPTER II

ACTIVITIES OF THE WATERMASTER

On April 23, 1969, the court issued an order appointing William J. Carroll, Albert A. Webb, Clinton Henning, John M. Toups, and Max Bookman as Watermaster for the purpose of administering the provisions of the Judgment. An organizational meeting of the Watermaster was held on May 26, 1969, and the following actions were taken:

(1) The committee elected Max Bookman Chairman and Albert A. Webb Secretary.

(2) The official files of the Watermaster will be kept by the Secretary, and copies of minutes, all incoming and outgoing mail and communications between members of the Watermaster will be furnished to each committee member.

(3) The official name adopted was "Santa Ana River Watermaster" and the mailing address will be 3788 McCray Street, Riverside, California 92506.

(4) Two regular meeting dates were established. The first is to be held the second Friday of the month of February for the purpose of preparing, approving and distributing the annual report of the Watermaster. The second is to be held the second Friday of the month of May for the purpose of establishing a work program and budget for the ensuing fiscal year. All other meetings of the Watermaster will be at the call of the Chairman.

(5) In accordance with the provisions of the Judgment, the fees, compensation and expenses of each committee member serving as Watermaster will be borne by the district which nominated such person. All other Watermaster service costs and expenses, including such work as may be requested by the Watermaster of individual members, will be borne by the parties to the stipulated Judgment proportionately, with 40 percent being allocated to OCWD and each of the other three districts allocated 20 percent of the total costs.

(6) The Watermaster will require advances of operating capital as the need arises for meeting the joint expenditures.

(7) Approval was given to the Secretary to establish a bank account with Security Pacific National Bank in Riverside. Checks for payment of expenses of the Watermaster must be signed by two of its members.

The initial program of activities undertaken by the Watermaster included examination of the existing programs of data collection in order to determine whether the information being gathered will meet the needs set forth in the Judgment. The Watermaster initiated action for receiving basic data required by the Judgment for measurements and water quality analysis from the existing data of collection agencies. It was also decided to commence analyzing the data with the water year 1967-68 in order to update the findings required by the Judgment and to provide for the establishment of efficient procedures to be followed at the time the Judgment becomes effective on October 1, 1970. Since the first meeting in May 1969, there have been 17 meetings of the Watermaster in a period of about 2 years.

Stream Flow and Water Quality Measurements

The most important data required in implementing the provisions of the Judgment relate to the operation of the necessary gaging stations for measurement of discharge and to the monitoring of water quality. There previously had been a program of stream flow measurements and water quality monitoring by the U.S. Geological Survey (USGS) carried out in cooperation with the districts involved in the adjudication. The Watermaster determined that it would be best to continue this arrangement. The first task was to review with the USGS the necessary work for the fiscal year 1969-70 to provide the data required under the Judgment.

The stream flow measurements at Prado Dam and Riverside Narrows had been included for many years in the past in the cooperative program between the USGS and the State Department of Water Resources, and this arrangement will be continued.

In order to obtain necessary water quality information at Prado Dam, OCWD agreed to pay one-half of the cost of a cooperative program with the USGS.

The water quality monitoring at Riverside Narrows is being financed by SBVMWD, WMWD AND CBMWD in cooperation with the USGS. WMWD and CBMWD financed a cooperative program with USGS for gaging Temescal Creek near Corona, Cucamonga Creek near Mira Loma and Chino Creek near Chino.

The USGS installed equipment for monitoring the quantity and quality of the effluent from the Riverside Water Quality Control Plant. The City of Riverside also samples and analyzes the

effluent from the plant. CBMWD, WMWD and SBVMWD contributed towards the cost of additional laboratory equipment that was required by the City of Riverside for the purpose of making these analyses. The costs incurred for the above services by each of the parties are detailed in Table 1.

More recently, the Watermaster has concluded that two additional stations were needed on the Santa Ana River. One station is to be located just upstream of Auburndale Bridge and will be known as Prado Park gaging station. For the initial year the cost of constructing and operating the station will be $4,000. Similarly, a second station will be constructed and operated at Mission Boulevard Bridge upstream of Riverside Narrows at a cost of $3,400. One-half of the total cost of the above described stations will be paid by the USGS.

One of the difficult problems in the stream gaging program is the maintenance of a reliable gage at the Riverside Narrows at Pedley Bridge. It is necessary to construct a temporary sand dike at the Riverside Narrows station in order to divert the low flows to the gage. Because of the unstable and poor control which exists at Pedley Bridge, stream flow measurements are being made at the crossing of the Metropolitan Water District Upper Feeder in order to ascertain whether this station can be substituted for the Pedley Bridge gage.

The USGS has also established a water quality monitoring station on the Santa Ana River just upstream from the Metropolitan Water District aqueduct crossing in order to obtain better water quality information at Riverside Narrows without the complication of the introduction of Riverside Water Quality Control Plant effluent upstream from the Pedley Bridge.

Compilation of Basic Data

The Watermaster has established records for compiling the basic data necessary in order to carry out the provisions of the Judgment. These records include the following:

(1) Daily precipitation at San Bernardino.

(2) Discharge at USGS gaging station below Prado Dam.

(3) Direct deliveries and pump export at Prado.

(4) Riverside Narrows and MWD crossing discharge.

(5) Direct deliveries at Riverside Narrows.

(6) Discharge of Riverside Water Quality Control Plant.

CHAPTER II

ACTIVITIES OF THE WATERMASTER

TABLE 1

COSTS FOR USGS MEASUREMENTS USED BY SANTA ANA RIVER WATERMASTER
July 1, 1969 to June 30, 1970

San Bernardino Valley Municipal Water District			
At Riverside Narrows			
River Discharge	$666.00		
River Water Quality Monitor	366.00		
River TDS	200.00		
Sheehan Ditch Discharge	216.00		
Sheehan Water Quality	366.00		
Analysis of data	500.00	$2,314.00	
City of Riverside - Lab		555.89	$2,869.89
Western Municipal Water District			
At Riverside Narrows (Same as SBVMWD) ($4 difference due to rounding)		$2,873.89	
Temescal Creek Discharge		400.00	
Cucamonga Discharge		400.00	
Chino Creek Discharge		400.00	4,073.89
Chino Basin Municipal Water District			
Same as WMWD			4,073.89
Orange County Water District			
At Prado Dam			
Water Quality Monitor		3,000.00	
TDS Analyses		600.00	
Analysis of Data		2,500.00	6,100.00
Total for Parties			$17,117.67
United States Geological Survey			17,117.67
GRAND TOTAL			$34,235.34

(7) Specific conductance and TDS at Prado Dam.

(8) Specific conductance and TDS at MWD crossing.

(9) Operation of Prado Reservoir.
   (a) Record of regulation
   (b) Inflow to Prado Dam

Analysis of Data

The Watermaster has made analyses of the Storm Flow and the Base Flow for the water years 1967-68, 1968-69 and for the current year reported herein -- the water year 1969-70. In addition to these analyses, studies have been made of the water quality data being compiled, the relationship between specific conductance and total dissolved solids and methods of determination of the Adjusted Base Flow.

Administrative Costs

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

On June 19, 1969, the Watermaster advised the parties that the budget for the initial year would be $50,000 and requested that the parties contribute an initial amount of $5,000 to meet the expenses being incurred during the fiscal year 1969-70. The initial budget in the amount of $50,000 anticipated that the Watermaster may have to bear the cost of the cooperative USGS programs at Prado Dam and Riverside Narrows. However, these cooperative programs were accomplished by agreements among the parties and the USGS as heretofore described.

Table 2 is a statement showing the income and expenses of the Santa Ana River Watermaster for the fiscal year 1969-70.

The Watermaster, by letter dated July 6, 1970, submitted to the parties a budget for the fiscal year 1970-71 in the amount of $30,000. Table 3 shows the items and amounts included in said budget.

CHAPTER II

ACTIVITIES OF THE WATERMASTER

TABLE 2

INCOME AND EXPENSE
SANTA ANA RIVER WATERMASTER
July 1, 1969 - June 30, 1970

Income			
Orange County Water District		$2,000.00	
San Bernardino Valley Municipal Water District		1,000.00	
Western Municipal Water District		1,000.00	
Chino Basin Municipal Water District		1,000.00	$5,000.00
Expense			
Secretary - Office Expense			
8/23/69 - 10/25/69	$181.20		
10/25/69 - 12/20/69	112.26		
12/29/69 - 1/17/70	233.88		
1/17/70 - 4/25/70	228.92		
4/25/70 - 5/23/70	97.69		
5/23/70 - 6/27/70	186.52	$1,040.47	
Check Book Charge		5.85	
Bank Endorsement Stamp		1.11	
James M. Montgomery - Stationery		41.71	
Toups Engineering, Inc. - Prado Hydrograph 1967-68		220.85	
Webb - Riverside Narrows Effluent and Discharge 1967-68		512.00	
Toups Engineering, Inc. - Prado Hydrograph 1968-69		124.30	
Webb - Charts of Prado Operation	323.50	323.50	
Webb - Army Engineers' Prado Charts	429.42	429.42	2,699.21
Balance 6/30/70			$2,300.79

CHAPTER II

ACTIVITIES OF THE WATERMASTER

TABLE 3

SANTA ANA RIVER WATERMASTER
BUDGET FOR JULY 1, 1970 TO JUNE 30, 1971

Administration	$ 3,000
Supporting Engineering Services	15,000
Outside Computer Services	2,000
Additional gaging and monitoring stations, including construction, operation, and maintenance	10,000
Total	$30,000

CHAPTER III

WATER SUPPLY CONDITIONS

Increases in the quantity of Base Flow in recent years have resulted from the more abundant rainfall which has occurred in recent years. Between 1944 and 1965, the Southern California area has been experiencing one of the worst droughts in history. In fact, in the precipitation year of 1969-61, the rainfall at San Bernardino was only 6.87 inches for the year, which is less than 40 percent of the long-term mean annual and was a record low. However, from 1964-65 through 1969-70, the average annual rainfall at San Bernardino for the six-year period was 17.40 inches, which was close to the long-term mean annual rainfall of 17.21 inches. In 1966-67, the rainfall at San Bernardino amounted to 22.50 inches, and in 1968-69, the rainfall received amounted to 31.83 inches, which is 185 percent of normal.

Precipitation During 1969-70

During 1969-70, the precipitation at the San Bernardino Station amounted to only 9.64 inches, which is 56 percent of normal. Only three major storms occurred during 1969-70. The first storm commenced November 6, 1969 and continued for two days. The second major storm commenced February 9, 1970 and had a duration of about three days. The third and largest storm of the season commenced on March 1 and continued intermittently for about five days. Although the year 1969-70 was far below normal in rainfall, Base Flow continued to increase primarily because of the record-high rainfall received in the prior year.

Runoff During 1969-70

Below Prado Dam

The total discharge at Prado Dam during 1969-70 was far below the 26-year base period (1934-35 through 1959-60) annual average, amounting to only 50,480 acre-feet, as compared to the base period average of 78,780 acre-feet per year. However, the runoff during the preceding year 1968-69 amounted to a record discharge of 375,500 acre-feet and this had a material effect on the Base Flow during the ensuing year.

As discussed above, the six-year period 1964-65 through 1969-70 experienced an average annual rainfall about equal to the normal at the San Bernardino Station. During that six-year period

the discharge at Prado Dam averaged 112,010 acre-feet annually compared to the 26-year base period annual average of 78,780 acre-feet.

The Base Flow at Prado Dam had been decreasing progressively during the extended drought period and reached a low in 1960-61 of 26,190 acre-feet. Since that year, due to improved rainfall conditions, the Base Flow has been gradually increasing. During 1969-70, the Base Flow increased to 39,074 acre-feet. The average annual base flow at Prado Dam for the six-year period 1964-65 through 1969-70, amounted to 33,320 acre-feet as compared to the 26-year base period average annual amount of 47,470 acre-feet.

At Riverside Narrows

The total natural flow (excluding City of Riverside's sewage effluent) at Riverside Narrows for 1969-70 was below the 26-year base period annual average, amounting to 20,790 acre-feet as compared to the base period annual average of 43,530 acre-feet. However, the total natural runoff at Riverside Narrows for the preceding year 1968-69 was 245,030 acre-feet.

The average annual total natural flow (excluding MWD water, the City of Riverside's sewage effluent and miscellaneous water) at Riverside Narrows for the 6-year period (1964-65 through 1969-70) was 68,790 acre-feet as compared to the base period annual average of 43,530 acre feet.

At Riverside Narrows the Base Flow decreased from 27,120 acre-feet in 1943-44 to 16,410 acre-feet in 1954-55, increased to 19,470 acre-feet in 1957-58, then decreased to an all-time low of 13,450 acre feet in 1965-66. Since that time, the Base Flow at Riverside Narrows has been gradually increasing. In 1969-70 the Base Flow was 17,223 acre-feet as compared to the 26-year base period annual average of 22,190 acre-feet. The average annual Base Flow at Riverside Narrows for the 6-year period 1964-65 through 1969-70 was 16,010 acre-feet.

Sewage Effluent from Riverside Water Quality Control Plants

Since prior to 1950 the sewage effluent from the Riverside sewage treatment plants, which is discharged at the Riverside Narrows, has been increasing in quantity. In 1949-50, the quantity of treated effluent from Riverside No. 1 and No. 2 plants amounted to 3,960 acre-feet. By 1959-60, the discharge from these plants had increased to 9,900 acre-feet. As of 1969-70, the discharge of sewage effluent from the combined treatment plants was 18,657 acre-feet. Thus the contribution of sewage effluent by the City of Riverside has been increasing at a rate of about 800 acre-feet per year.

CHAPTER IV

BASE FLOW AT PRADO

This chapter deals with the analysis of the flow at Prado Dam, the calculation of the amount of Base Flow at Prado credited to CBMWD and WMWD and the calculation of the Adjusted Base Flow. The adjustment of Base Flow is made on the basis of the weighted average annual TDS of the total flow at Prado.

Total Discharge at Prado

The total discharge of the Santa Ana River at Prado during the 1969-70 water year amounted to 50,480 acre-feet as measured at the USGS gaging station below Prado Dam. This can be compared to the 26-year average annual flow of 78,780 acre-feet during the base period of 1934-35 through 1959-60. During the water year 1969-70, a minimum monthly discharge of 1,570 acre-feet was recorded in September and a maximum monthly discharge of 8,280 acre-feet occurred in March.

Components of Flow

Of the total discharge at Prado during the 1969-70 water year 39,074 acre-feet was Base Flow and 11,406 acre-feet was Storm Flow. The components of flow were independently determined by each of the five members of the Watermaster using the general procedure set forth in the Work Papers of the engineers for the parties in reaching the physical solution provided for in the Judgment. The Base Flow of 39,074 acre-feet represents an average value of the computations submitted by the five members of the Watermaster. Details of the scalping procedure are described in the following section and the results are graphically shown on Plate 2. The components of flow of the Santa Ana River at Prado Dam for each month in the 1969-70 water year are listed in Table 4.

Base Flow

Base Flow separation for the 1969-70 water year was complicated by the intermittent regulation by the Army Corps of Engineers of water in storage behind Prado Dam during the period November 6, 1969 to May 18, 1970. The effect of gate operations at Prado Dam was to mask the magnitude of Base Flow normally recorded at the USGS stream gaging station downstream of Prado

TABLE 4

COMPONENTS OF FLOW AT PRADO DAM FOR WATER YEAR 1969-70 (In Acre-Feet)

Month	USGS Gaging Station	Storm Flow	Base Flow
Oct.	2,916	0	2,916
Nov.	4,407	1,284	3,123
Dec.	4,185	78	4,107
Jan.	5,780	1,487	4,293
Feb.	5,952	1,742	4,210
Mar.	8,279	3,570	4,709
Apr.	6,428	2,262	4,166
May	4,405	980	3,425
Jun.	2,771	0	2,771
Jul.	2,041	0	2,041
Aug.	1,744	0	1,744
Sept.	1,569	0	1,569
TOTAL	50,477	11,403	39,074

Dam. Generally, during storms the Corps of Engineers operated the Prado gates so that some of the storm runoff was temporarily held in storage behind the dam. As the storm ended, the Prado Reservoir storage was gradually reduced by the controlled releases to the downstream water conservation facilities operated by the Orange County Water District.

To facilitate the separation of the Storm Flow component from the Base Flow component, the daily inflow to Prado Reservoir was estimated. This was done by using reservoir stage records from the Corps of Engineers and dam outflow records from the USGS. Daily reservoir water surface elevations were converted to acre-feet of storage by use of the Corps of Engineers' relationship between the water surface elevation and the storage capacity. Daily reservoir inflow was computed by use of the equation: Inflow = Outflow $\pm$ Change in reservoir storage.

The general procedure used by the members of the Watermaster to separate the 1969-70 flow components is outlined below:

(1) The daily records of both calculated inflow to Prado Reservoir as described above and outflow at Prado Dam as measured by the USGS were plotted for the entire water year as shown on Plate 2.

(2) On this graph, the daily precipitation recorded at the San Bernardino County Hospital was plotted.

(3) On this same graph, the reciprocal of daily evaporation (in inches) at the Riverside Experimental Station was plotted.

(4) On this same graph, significant items of Prado Dam operation were noted, such as daily fluctuation of water in storage and gate operation.

(5) Using the above data, an initial determination was made of those days having no Storm Flow component. Non-storm periods exclude the time from commencement of rainfall until the end of the recession flow following each storm period. Use was made of the inflow hydrograph to determine Base Flow when discharge of stored water occurred during non-storm periods. All adjacent non-storm days were fitted with smooth curve segments to average out the day-to-day fluctuations.

(6) Utilizing the above curve segments during non-storm periods, a continuous smooth Base Flow curve was drawn and extended across the balance of the time when storms occurred. The shape of the curve throughout the year is similar to that utilized by the engineers in scalping of prior years and was developed from data on historical discharges during non-storm periods. During periods of Storm Flow when no storage change occurred in Prado reservoir, the outflow hydrograph was used to determine the components, but when changes in storage occurred in Prado reservoir, the inflow hydrograph was used. Storm Flow periods include the time not included in item (5) above.

(7) Arriving at an opinion of the location of the curve separating the two components of flow requires the exercise of judgment, taking into consideration items (1) through (6) above and, to some extent, the variation in Base Flow which occurred in the previous water year.

(8) Using the Base Flow curve for the separation of components of flow during storm intervals, the Storm Flow, including discharges of stored Storm Flow, were computed from the difference of the total measured flow at Prado less the Base Flow during that same time.

(9) The Base Flow for the water year was then determined by deducting the Storm Flow from the total measured discharge at Prado.

Water Quality

During the water year 1969-70, the weighted average total dissolved solids (TDS) for the total flow passing Prado was found to be 762 ppm. This determination of the water quality at the USGS gaging station below Prado Dam was made using measurements obtained by the USGS which operates a multiple parameter water quality monitoring recorder at this station. A continuous stream of water from the Santa Ana River is pumped to the water quality monitor. A continuous record of data recorded on a punched tape is obtained for determination of specific conductivity, temperature, chlorides, turbidity, dissolved oxygen and pH.

Personnel from the USGS make weekly inspections of the station to determine if equipment is operating satisfactorily and to secure grab samples of water from the river for laboratory analysis. These grab samples are sent to the laboratory for determinations of total dissolved solids and for specific conductance. During periods of storm runoff the USGS visits the station each day for the purpose of taking additional grab samples to provide a more detailed record of changes in water quality during periods of Storm Flow. These samples are analyzed for TDS and for specific conductance.

At the end of each month, the punched tape from the Prado monitoring unit is sent to Washington, D.C. for machine processing. A summary tabulation of data for all items is obtained. The summary also shows the maximum, minimum and the mean hourly reading each day of record. The results of the machine processing are returned to the USGS staff in Garden Grove, California for review and to eliminate inconsistent data. A corrected summary is then made available to the Watermaster.

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

(1) The USGS record of gage heights at Prado was utilized to select days when the discharge was relatively uniform. A maximum variation of 10 cfs from high to low flow conditions could be expected on such days. On these days, the mean hourly specific conductance, as computed by the USGS, was accepted as representative of the daily weighted value.

(2) During storm periods when the daily discharge varied, numerous flow measurements, together with the respective specific conductance measurement, were used to determine the weighted mean daily specific conductance value.

(3) There were 95 grab samples taken by the USGS during the 1969-70 year and the data from the analysis were used to prepare a correlation between specific conductance and the corresponding TDS. The correlation between these two water quality properties was excellent during the 1969-70 water year. The least squares method of curve fitting was used to develop an equation relating specific conductance to TDS.

(4) The resulting equation was then used to determine the mean daily TDS corresponding to the mean daily specific conductance values.

(5) The mean daily TDS values were then multiplied by the mean daily flow. These products were then summed and divided by the total flow for the year to determine the weighted average annual TDS value for the water year. This value was 762 parts per million of total dissolved solids for the 1969-70 water year.

Adjusted Base Flow

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

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

Where: Q = Base Flow actually received."

As noted above, the Base Flow of the Santa Ana River below Prado Dam determined by the Watermaster amounted to 39,074 acre-feet for water year 1969-70. The weighted average annual TDS of the total flow was 762 ppm. No adjustment to the Base Flow of 39,074 acre-feet was necessary because the value of the weighted average annual TDS lies between 700 and 800 ppm.

Entitlement and Credit or Debit

From pages 12 and 13 of the Judgment, the following description of the obligation of the CBMWD and WMWD is given: "CBMWD and WMWD shall be responsible for an average annual adjusted Base Flow of 42,000 acre-feet at Prado ... CBMWD and WMWD each year shall be responsible for not less than 37,000 acre-feet of Base Flow at Prado, plus one-third of any cumulative debit ..."

The Watermaster is required to maintain a continuing account of a list of pertinent items at Prado for each year.

A list of these items and the 1969-70 values are shown below:

(1)	Base Flow at Prado	39,074 acre-feet
(2)	Annual Weighted TDS of Total Flow	762 ppm
(3)	Annual Adjusted Base Flow	39,074 acre-feet
*(4)	Cumulative Adjusted Base Flow	39,074 acre-feet
*(5)	Cumulative Entitlement of OCWD at Prado	42,000 acre-feet
*(6)	Cumulative Debit (5)-(4)	2,926 acre-feet

*(7)	One-Third of Cumulative Debit	975 acre-feet
*(8)	Minimum Required Base Flow in Following Year	37,975 acre-feet

*Note: Since the Judgment did not go into effect until October, 1970, the above findings for the water year 1969-70 are for illustrative purposes only.

CHAPTER V

BASE FLOW AT RIVERSIDE NARROWS

As stated in Chapter I, the physical solution set forth in the Judgment requires that SBVMWD "....shall be responsible for an average annual Adjusted Base Flow of 15,250 acre feet at Riverside Narrows." This chapter deals with the analysis of the flow at Riverside Narrows, the calculation of the amount of Base Flow received and credited to SBVMWD, and the calculation of the Adjusted Base Flow, the adjustment being made on the basis of the weighted average annual TDS in the Base Flow.

Total Discharge at Riverside Narrows

The total surface discharge of the Santa Ana River at the Riverside Narrows (Pedley Bridge) for the water year 1969-70 amounted to 39,449 acre feet, of which 18,657 acre feet was sewage effluent discharged from the City of Riverside Water Quality Control Plant immediately upstream of Pedley Bridge.

Components of Flow

The components of flow of the Santa Ana River at the Riverside Narrows for the 1969-70 water year by month are listed in Table 5.

Base Flow

For this particular year, Base Flow at Riverside Narrows can be defined as that portion of the total surface flow passing the point of measurement at Pedley Bridge which remains after deduction of the sewage effluent discharged to the river by the City of Riverside above the measuring point and of Storm Flow.

The total flow was measured by the USGS at Pedley Bridge. The sewage flow contributed to the river by the City of Riverside was measured both by the USGS and the City of Riverside, each utilizing a separate metering device. In computing the sewage flow, however, the measurements of the USGS were used.

Daily flow of the river, excluding the sewage flow from the City of Riverside, was plotted, together with the daily precipitation record at San Bernardino County Hospital. This hydrograph is shown on Plate 3. Based on this hydrograph and utilizing in general the same procedures as are

TABLE 5

COMPONENTS OF FLOW AT RIVERSIDE NARROWS FOR WATER YEAR 1969-70
(Acre-Feet)

Month	Total Flow	Sewage Flow	Total Flow minus Sewage Flow	Storm Flow	Base Flow
Oct.	2,733	1,470	1,263	19	1,244
Nov.	3,338	1,406	1,932	676	1,256
Dec.	3,211	1,484	1,727	153	1,574
Jan.	3,431	1,537	1,894	465	1,429
Feb.	3,671	1,464	2,207	782	1,425
Mar.	5,026	1,648	3,378	1,457	1,921
Apr.	3,134	1,559	1,575	17	1,558
May	3,201	1,595	1,606	0	1,606
June	2,882	1,583	1,299	0	1,299
July	3,045	1,690	1,355	0	1,355
Aug.	2,937	1,648	1,289	0	1,289
Sept.	2,840	1,573	1,267	0	1,267
Total	39,449	18,656	20,792	3,569	17,223*

*The Base Flow of 17,223 acre feet represents an average value derived from the scalping conditions made by the five members of the Watermaster.

reflected in the Work Papers of the engineers (as referenced in Paragraph 2 of the Engineering Appendix of the Judgment), a separation was made between Storm Flow and Base Flow and the two components calculated. Each of the five members of the Watermaster independently made a determination of each component, based on his own judgment and his own interpretation of the method used in the previously referenced Work Papers. The value for Base Flow of 17,223 acre-feet is the mathematical average of the five determinations. Plate 3 is indicative of the scalping done by the Watermaster and is the actual work of one member of the Watermaster.

Water Quality

Under the terms of the Judgment it is necessary to determine the weighted average total dissolved solids (TDS) content of the Base Flow at Riverside Narrows.

To accomplish this the USGS has installed a specific conductance measuring device and recorder. The USGS operates and maintains it in the same manner as the more complex one located at Prado. The data collected from this monitor is augmented by periodic grab samples. Water quality data are collected and analyzed as described in Chapter IV.

During the year, 44 grab samples were collected and analyzed for total dissolved solids and specific conductance. Thirty-five of these sets of data were utilized in a regression analysis to determine the functional relationship between specific conductance and total dissolved solids. This relationship (an equation of the hyperbolic form) was used with the weighted mean daily specific conductances to generate a corresponding set of mean daily TDS values.

The major difference between the determination of the average annual TDS for the water year at Riverside Narrows as compared to the same determination at Prado is that only Base Flow is used in determining the weighted average. The Judgment provides that ".....during periods of Storm Flow, the TDS of Base Flow shall be estimated." Based on discussions among the engineers during the period the Judgment was being formulated, it was generally agreed that the specific conductance and, hence, the TDS, would be the average of the values of these quality indicators that were recorded immediately before Storm Flow commenced and immediately after Storm Flow ended. For the analysis for 1969-70, the values for the day before and the day after a Storm Flow period were used.

In the computation, the mean daily TDS values were multiplied by the mean daily Base Flow. The 365 resultant products were then summed and divided by the total Base Flow for the year to yield the average annual TDS for the water year. This value was 687 parts per million for the water year 1969-70.

Adjusted Base Flow

Paragraph 5(b)(2) of the Judgment provides that "The amount of Base Flow at Riverside Narrows received during any year shall be subject to adjustment based upon the weighted average annual TDS in such 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 ppm	$Q - \frac{11}{15,250} Q (TDS-700)$
600 ppm - 700 ppm	Q
Less than 600 ppm	$Q + \frac{11}{15,250} Q (600-TDS)$

Where Q = Base Flow actually received."

From the previous subsection, the weighted average annual TDS in the Base Flow at Riverside Narrows for the water year 1969-70 was 687 ppm. Therefore, the Adjusted Base Flow is the same as the actual Base Flow of 17,223 acre feet.

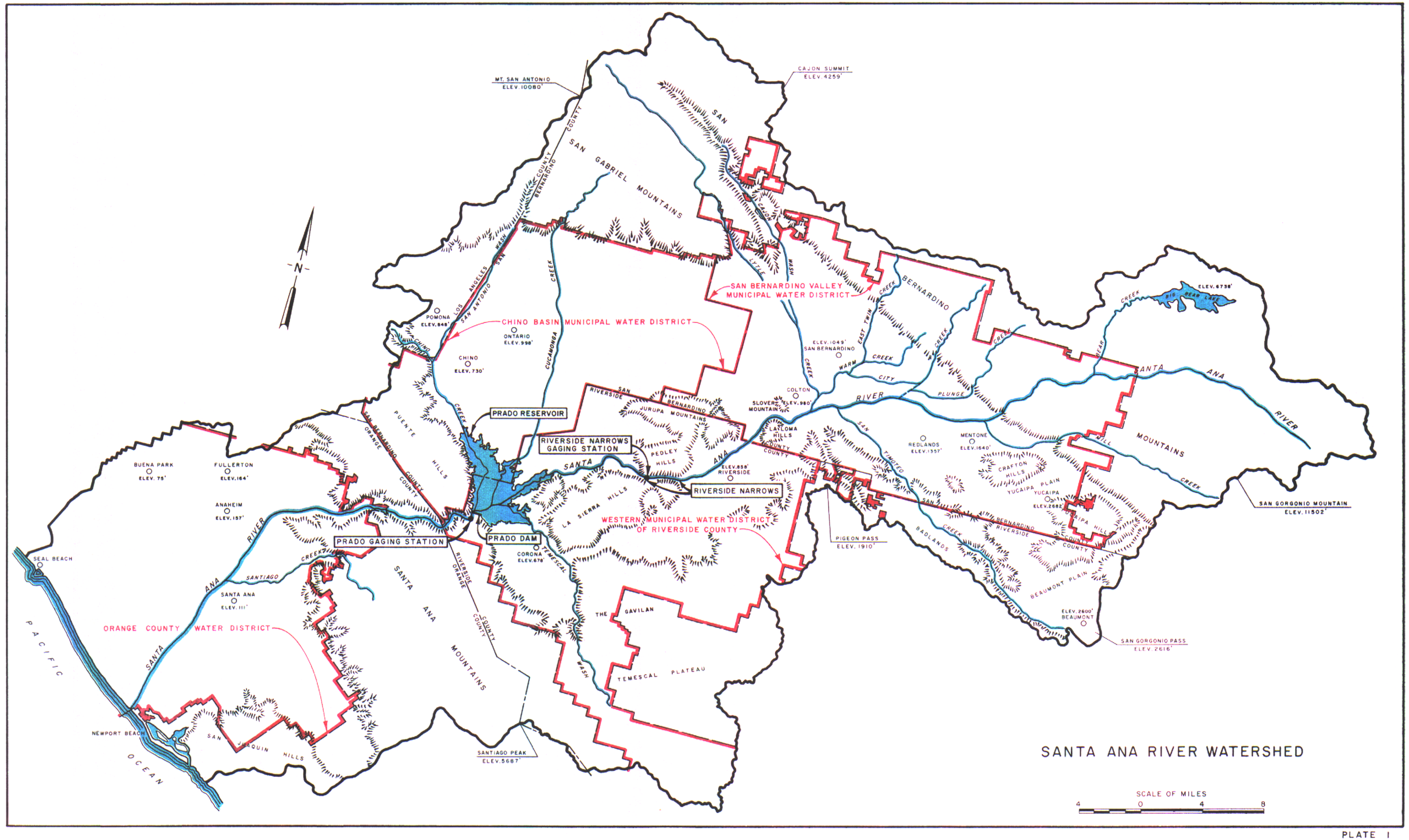
Entitlement and Credit or Debit

Paragraph 5(b) of the Judgment states that "SBVMWD shall be responsible for an average annual Adjusted Base Flow of 15,250 acre feet at Riverside Narrows .....SBVMWD each year shall be responsible at Riverside Narrows for not less than 13,420 acre feet of Base Flow plus one-third of any cumulative debit....."

A list of the accounting items and the 1969-70 values for these items, as required by Paragraph 4 of the Engineering Appendix to the Judgment, is detailed below:

(1)	Base Flow at Riverside Narrows	17,223 acre-feet
(2)	Annual Weighted TDS of Base Flow at Riverside Narrows	687 ppm
(3)	Annual Adjusted Base Flow	17,223 acre-feet
*(4)	Cumulative Adjusted Base Flow	17,223 acre-feet
*(5)	Cumulative Entitlement of CBMWD and WMWD at Riverside Narrows	15,250 acre-feet
*(6)	Cumulative Credit	1,973 acre-feet
*(7)	One-third of Cumulative Debit	0
*(8)	Minimum Required Base Flow in Following Year	13,420 acre-feet

*Note: Since the Judgment did not go into effect until October 1, 1970, the findings for the water year 1969-70 are for illustrative purposes only.



SANTA ANA RIVER WATERSHED

PLATE I

SAN BERNARDINO RAINFALL
(COUNTY HOSPITAL)

INCHES

OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
0.16	1.50	0.10	1.31	2.15	3.46	0.45	0.07	0.10	0.02	0.03	0.00

CUBIC FEET PER SECOND

INFLOW TO PRADO DAM

OUTFLOW FROM PRADO DAM

RED SHADING IS SCALPED STORM FLOW

RECIPROCAL OF EVAPORATION
AT RIVERSIDE EXP. STA.

1969-70 BASE FLOW CURVE

DISCHARGE OF SANTA ANA RIVER BELOW PRADO DAM

(WATER YEAR 69-70)

PLATE 2

1969 1970

0.16 1.50 0.10 1.31 2.15 3.46 0.45 0.07 0.10 0.02 0.03 0.00

San Bernardino Rainfall

INCHES

4 3 2 1 0

249 273 306

RED SHADING INDICATES STORM FLOW

Flow of River without Sewer

CUBIC FEET PER SECOND

200 180 160 140 120 100 80 60 40 20 0

Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept.

1969 1970

DISCHARGE OF SANTA ANA RIVER AT RIVERSIDE NARROWS & SAN BERNARDINO RAINFALL

PLATE 3