REPORT OF WATERMASTER

Western Municipal Water District of Riverside County, et al
Plaintiffs

vs.

East San Bernardino County Water District, et al
Defendants

Superior Court of Riverside County
Case No. 78426

VOLUME 9

DETERMINATION OF THE NATURAL SAFE YIELD OF THE SAN BERNARDINO BASIN AREA AND ADJUSTED BASE RIGHTS OF PLAINTIFF EXPORTERS

TEXT

WATERMASTER
Albert A. Webb
James C. Hanson

JUNE 1972

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Natural Safe Yield of the
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CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

This report is made pursuant to the Stipulated Judgment in Case No. 78426, Western Municipal Water District of Riverside County et al vs. East San Bernardino County Water District et al entered in the Superior Court of the State of California in and for the County of Riverside on April 17, 1969.

The Judgment requires the Watermaster to make certain findings and determinations among which is the natural safe yield of the San Bernardino Basin Area.

The purpose of this report is to present to the court and the parties the Watermaster determination of the natural safe yield of the San Bernardino Basin Area.

Scope of Report

The Judgment contains several pertinent definitions in Paragraph IV concerning safe yield. First, under Subparagraph (g) safe yield is defined as follows:

> "Safe Yield - Safe yield is that maximum average annual amount of water that could be extracted from the surface and subsurface water resources of an area over a period of time sufficiently long to represent or approximate long-time mean climatological conditions, with a given areal pattern of extractions, under a particular set of physical conditions or structures as such affect the net recharge to the ground water body, and with a given amount of usable underground storage capacity, without resulting in long-term, progressive lowering of ground water levels or other undesirable result. In determining the operational criteria to avoid such adverse results, consideration shall be given to maintenance of adequate ground water quality, subsurface outflow, costs of pumping, and other relevant factors."
>
> "The amount of safe yield is dependent in part upon the amount of water which can be stored in and used from the ground water reservoir over a period of normal water supply under a given set of conditions. Safe yield is thus related to factors which influence or control ground water recharge, and to the amount of storage space available to carry over recharge occurring in years of above average supply to years of deficient supply. Recharge, in turn, depends on the available surface water supply and the factors influencing the percolation of that supply to the water table."

> "Safe yield shall be determined in part through the evaluation of the average net groundwater recharge which would occur if the culture of the safe yield year had existed over a period of normal native supply."

Note that the foregoing definition comments on the relationship of safe yield to the available capacity of the ground water basin to accept and carry over recharge occurring in years of above-average basin supply for extractions to meet the basin demand during periods of less than normal supply.

The definition of the natural safe yield appears in the Judgment in Paragraph IV of Definitions, Subparagraph (h), stated as follows:

> "Natural Safe Yield - That portion of the safe yield of the San Bernardino Basin Area which could be derived solely from natural precipitation in the absence of imported water and the return flows therefrom, and without contributions from new conservation. If in the future any natural runoff tributary to the San Bernardino Basin Area is diverted away from that Basin Area so that it is not included in the calculation of natural safe yield, any replacement made thereof by San Bernardino Valley or entities within it from imported water shall be included in such calculation."

Safe yield is expressed in terms of total extractions which are a significant component of the total basin water supply available for consumptive use. The definition of extractions appears in Paragraph IV(c) as follows:

> "Extractions - Any form of the verb or noun shall include pumping, diverting, taking or withdrawing water, either surface or subsurface, by any means whatsoever, except extractions for hydroelectric generation to the extent that such flows are returned to the stream, and except for diversions for replenishment."

The Judgment contains Appendix "D", Table D-1, entitled "Extractions from San Bernardino Basin Area for the Average of Five-Year period Ending with 1963 for Use Within San Bernardino County." Table D-1 lists all of the valley and mountain basins comprising the San Bernardino Basin Area and areas tributary thereto, together with the five-year average annual extractions from each basin. Said extractions were based on the summation of the recordation filings recorded with the State Water Resources Control Board by the various entities within each basin. The total extractions from the various basins is shown in Table D-1 as 260,139 acre feet annually.

Table D-1 also shows the deduction of the extractions from five of the mountain basins from the above total, which results in an adjusted total of 231,861 acre feet annually, assumed as the total production from the San Bernardino Basin Area by all entities. From this amount, the extractions by the Plaintiffs as set forth in Appendix "B", Table B-1, are subtracted and the resulting difference of 165,407 acre feet represents the extractions from the San Bernardino Basin Area by entities other than Plaintiffs. This amount is set forth in Paragraph V(b) of the Judgment and required verification by the Watermaster.

Upon verification, it was determined that the total average annual extractions for the period 1959 through 1963 was 171,342 acre feet, as compared to the unverified total of 165,407 acre feet.

A map of the San Bernardino Basin Area is shown in Appendix "A" the Judgment. This map delineates the boundary of the San Bernardino Basin Area, as defined in the Judgment and follows in part the boundary of the alluvial fill comprising the San Bernardino Basin Area adjacent to the San Bernardino Mountains and crosses the incoming streams from the mountain areas at or near the location of the U.S.G.S. stations on said streams. Surface and ground water diversions in appreciable amounts have been made from the areas lying upstream from the apparent San Bernardino Basin Area boundary line.

The Judgment in Paragraph XIII(g) requires that:

> "The Watermaster shall initially compute and report to the Court the natural safe yield of the San Bernardino Basin Area . . ." (emphasis added)

The actual safe yield computation is based on:

1) Total extractions from the San Bernardino Basin Area, plus
2) Total natural water supply to the San Bernardino Basin Area, minus
3) Total utilization of water from the San Bernardino Basin Area.

The term "safe yield of the San Bernardino Basin Area" and the inclusion within the safe yield determination of the ground and surface water extractions made outside of the San Bernardino Basin Area are not entirely consistent. The question has, therefore, been raised as to whether these extractions made outside of the San Bernardino Basin Area, though a part of the total supply to the San Bernardino Basin Area, may properly be classified as extractions for the safe yield computation.

Predicated on the inclusions in Table D-1 of the areas upstream from the boundary of the San Bernardino Basin Area and the verification

of the waters extracted therefrom for use within the San Bernardino Basin Area, the Watermaster has upon consideration of the foregoing assumed for purposes of this report and the safe yield computation that the requirement to determine the "natural safe yield of the San Bernardino Basin Area" not only attaches to the "San Bernardino Basin Area" as defined in the Judgment and delineated in Appendix "A", but also attaches to the areas tributary thereto and the water produced therefrom for use within the "San Bernardino Basin Area," and the extractions under question have, therefore, been included in the safe yield computation.

The natural safe yield of the San Bernardino Basin Area has been predicated on the foregoing and is shown in detail in Chapter III, together with the adjusted base rights of the Plaintiffs.

For ease of reference, the natural safe yield is repeated in the table immediately following.

Total Extractions for Consumptive Use From the San Bernardino Basin Area	237,796	acre feet
Plus Total Natural Water Supply	305,777	acre feet
Minus Total Water Utilization	311,495	acre feet
NATURAL SAFE YIELD	232,078	acre feet
Say,	232,100	acre feet

A summary of the basic data used in the safe yield determination is set forth in Chapter II, describing both the items of supply and items of utilization in considerable detail. The detailed computations for these items are included in Volume 9 Appendix Part 1 and Appendix Part 2.

An item of Continuing Jurisdiction of the Court is:

> "The hydrologic condition of any one or all of the separate basins described in this Judgment in order to determine from time to time the safe yield of the San Bernardino Basin Area."

During the four-year period of 1966 through 1969, the total gaged stream inflow to the San Bernardino Basin Area exceeded the basin area outflow by some 725,000 acre feet, which was estimated to have increased the ground water storage within the San Bernardino Basin Area by approximately 570,000 acre feet. This information is furnished to the Court for its consideration.

CHAPTER II

SUMMARY OF BASIC DATA

CHAPTER II

SUMMARY OF BASIC DATA

The Judgment requires that the initial determination of the natural safe yield of the San Bernardino Basin Area be based on the cultural conditions equivalent to those existing during the five calendar year period ending with 1963.

The State of California, Department of Water Resources, in cooperation with the San Bernardino Valley Municipal Water District, has compiled a vast amount of basic data pertinent to the Santa Ana River watershed above the Bunker Hill Dike. These data were published in Bulletin 104-5, Meeting Water Demands in the Bunker Hill-San Timoteo Area and were used to a large extent in the initial safe yield determination after adjustments to reflect differences in study areas and safe yield criteria. Also used were data compiled in the matter of Orange County Water District vs. City of Chino et al, Case No. 117628 in the Superior Court of the State of California in and for the County of Orange by the Joint Engineering Committee and published in Appendix "A" for Proposed Order of Reference entitled "Basic Data", Volumes I and II, dated May 14, 1968.

Land Use

Land use surveys by the State of California, Department of Water Resources, were obtained for the years 1932, 1942, 1948, 1957 and 1963. The 1932, 1942 and 1948 data were obtained as summaries of the land use within the Bunker Hill Basin developed by the Department of Water Resources in preparation of Bulletin 104-5. The 1957 and 1963 survey data were obtained in the form of overlays of 7½ minute series United States Geological Survey Quadrangles.

The boundary of the San Bernardino Basin Area as shown in Appendix "A" of the Judgment was delineated on the 1957 and 1963 land use survey maps and the area of each of the specific land use catagories was then determined by planimeter. During this work it was found that the boundaries of the State's land use maps did not coincide with the boundary of the San Bernardino Basin as shown in Appendix "A" of the Judgment, for which adjustments were made. To facilitate the land use determination and to provide a cross check against the Department of Water Resources determinations where possible, the nodal network developed by the Department in preparation of Bulletin 104-5 was utilized. Where the San Bernardino Basin Area was not included in the State's nodal

network, new nodes were developed to encompass those areas lying within the San Bernardino Basin Area but outside the State's nodal network. Plate 1 appended hereto delineates the boundary of the San Bernardino Basin Area as defined by the Judgment and used for the safe yield determination.

The land use for each of the five calendar years ending in 1963 was determined by interpolation between the 1957 and 1963 areas for each land use category and is summarized in TABLE 1. Detailed work sheets of the land use studies and adjustments are presented in Volume 9, Appendix Part I.

The total area embraced by the San Bernardino Basin Area and utilized in the safe yield determination is 91,918 acres.

Items of Supply

The items of water supply are, for the most part, predicated on the 1934-35 through 1959-60 hydrological base period adjusted to the cultural conditions which existed during the five calendar years ending with 1963. The hydrologic base period to be utilized for determination of the safe yield of the San Bernardino Basin Area is not specified in the Judgment. However, the Judgment does specifically state that if it becomes necessary to determine the safe yield of the area between the Bunker Hill Dike and Riverside Narrows, the 1934 through 1960 base period shall be used.

Limitations of the 1934-35 through 1959-60 Base Period have been noted. However, limitations of the historic inflow data, as well as other components of supply and disposal, suggest that studies to adjust the 26-year inflow to reflect more closely the long-term mean inflow are not warranted at this time. Further, essentially all of the data developed in preparation of Bulletin 104-5 and in preparation of the settlement of both the Orange County and Western suits are based on the 1934-35 through 1959-60 Base Period. Therefore, this period was utilized for this initial determination of safe yield.

The items of water supply accruing to the San Bernardino Basin Area and used for the safe yield determination are as follows.

(1) Precipitation - The basic precipitation data used in preparation of Bulletin 104-5 were obtained from the Department of Water Resources. Since the average precipitation values reported in Bulletin 104-5 include data from stations within the San Timoteo Area, it was necessary to adjust these data to reflect only the precipitation on the San Bernardino Basin Area, as defined in the Judgment. The required adjustments appear in

TABLE 1

LAND USE WITHIN SAN BERNARDINO BASIN AREA

	Safe Yield Year				
	1959	1960	1961	1962	1963
Urban and Suburban					
Residential, Single	12,056	12,480	12,905	13,329	13,753
Residential, Multiple	339	423	507	590	674
Residential, Rural	314	237	159	81	3
Commercial	1,400	1,488	1,576	1,664	1,751
Industrial	823	915	1,008	1,100	1,193
Unclassified	752	770	788	807	825
Street	6,118	6,413	6,707	7,002	7,296
Inc.Nonwater Ser.Area	1,120	1,167	1,214	1,261	1,308
Sub Total Urban and Suburban	22,922	23,893	24,864	25,834	26,803
Irrigated Agriculture					
Alfalfa	455	428	401	375	348
Pasture	2,445	2,260	2,075	1,890	1,706
Deciduous Orchard	204	160	115	71	27
Citrus	16,444	15,959	15,473	14,988	14,503
Truck Crops	1,343	1,320	1,296	1,273	1,250
Vineyards	819	735	652	569	485
Street	1,436	1,482	1,528	1,574	1,620
Sub Total Irrigated Agriculture	23,146	22,344	21,540	20,740	19,939
Nonwater Service Areas					
Native Vegetation, Barren	2,765	2,752	2,740	2,727	2,715
Native Vegetation, Light	18,244	18,043	17,842	17,641	17,441
Native Vegetation, Medium	21,110	21,216	21,322	21,426	21,530
Native Vegetation, Heavy	1,725	1,890	2,055	2,220	2,385
Riparian Vegetation	1,127	921	715	510	304
Street	879	859	840	820	801
Sub Total Nonwater Service Areas	45,850	45,681	45,514	45,344	45,176
Basin Total	91,918	91,918	91,918	91,918	91,918

Appendix "B" of Volume 9 Appendix Part 2. Table 2, Page 10, shows the Estimated Seasonal Precipitation to be 135,862 Acre Feet Annually.

(2) Surface Water Inflow From Gaged Areas - This supply item is for the most part based on data published by the U.S.G.S. and is essentially as reported in Bulletin 104-5 with the exception that Little San Gorgonio Creek near Beaumont was deleted and San Timoteo Creek near Redlands was added to reflect the differences in study areas. Table 3, Page 11, shows the surface water inflow from gaged areas to be 58,899 Acre Feet Annually.

(3) Surface Water Inflow From Ungaged Areas - The methods and unit runoff values developed by the D.W.R. in determining ungaged surface water inflow were utilized for this study. It was, however, necessary to modify the boundaries of the ungaged areas to coincide with the boundary of the San Bernardino Basin Area. The required adjustments and modifications for the surface inflow from both gaged and ungaged areas are shown in detail in Appendix "C" of Volume 9 Appendix Part 2. Table 4, Page 12, shows the estimated surface inflow from ungaged areas to be 13,823 Acre Feet Annually.

(4) Diverted Water Inflow - The component of diverted water inflow is developed from data reported in Bulletin 104-5 and comprises the canal diversion component of the combined discharges reported by the U.S.G.S. for the various streams tributary to the San Bernardino Basin Area. Little San Gorgonio Creek near Beaumont has been excluded to reflect differences in the study areas. Adjustments are shown in Appendix "D" of Volume 9 Appendix Part 2. The diverted inflow to the Basin is shown to be 77,615 Acre Feet Annually in Table 5, page 13.

(5) Fresh Water Import - As reported herein fresh water imports are those diversions and/or extractions made from areas outside of but tributary to the San Bernardino Basin Area used within the Basin Area but not measured or otherwise reported. The amounts shown were derived from annual reports filed with the State Water Resources Control Board and from the files of the various entities making the diversions (See Appendix "E" of Volume 9 Appendix Part 2). Table 6, page 14, shows Fresh Water Import to the Basin as 2,359 Acre Feet Annually.

(6) Waste Water Import - Waste water is imported to the San Bernardino Basin Area by the City of San Bernardino from that part of the City which lies within the Rialto-Colton Basin. This item is considered a direct function of cultural development and has been taken as the average for the five-year period ending with 1963. Said amount is predicated on the total deliveries to the

Colton Basin and the assumption that 80 percent of the area was sewered and that 45 percent of the water delivered to the sewered area returns as sewage flow (see Appendix "F" of Volume 9 Appendix Part 2). Table 7, page 15, shows the average annual waste water import for the five years ending in 1963 to be 319 Acre Feet Annually.

(7) Subsurface Inflow - The subsurface inflow to the San Bernardino Basin Area is based in part on the data developed by the Department of Water Resources and reported in Bulletin 104-5. The subsurface inflow from Lytle and Cajon Creeks has been discounted since the channel cross sections used by the State for estimating the underflow in these channels were located an appreciable distance downstream from the surface water gaging stations and such subsurface flow has in large part been accounted for as measured surface flow or subsurface flow which had been diverted by wells and/or tunnels and reported as diverted water inflow (Item 4).

The subsurface inflow along the San Bernardino Mountain Front exclusive of major canyons was estimated by the Department of Water Resources at 400 acre feet per mile. In view of intense shearing and width of the San Andreas Fault along the San Bernardino Mountain Front, Geologists of the Unites States Geological Survey have suggested that such amount may be as little as 200 acre feet per mile and conceivably less. For purposes of this determination, such amount has been assumed at 200 acre feet per mile. Subsurface inflow from San Timoteo Canyon has been predicated on data furnished by the U.S.G.S. and has been taken as the average for the five-year period ending with 1963. Such amount is considered indicative of the subsurface inflow from the San Timoteo Area had the 1959-63 culture in that area existed during the 26-year hydrological base period. The required adjustments for the computation of the subsurface inflow are shown in Appendix "G" of Volume 9 Appendix Part 2. Table 8, page 16, shows the subsurface inflow to be 16,900 acre feet annually.

SUMMARY OF ITEMS OF SUPPLY

The components of inflow to the San Bernardino Basin Area are set forth in TABLES 2 through 8 and are summarized in TABLE 9. Basic data used for determination of said items are presented in Appendices "B" through "G" respectively. The estimated average annual inflow to the San Bernardino Basin Area for the 26-year base period adjusted to average cultural conditions existing during the five-year period ending with 1963 is 305,777 acre feet.

TABLE 2

ESTIMATED SEASONAL
PRECIPITATION ON THE
SAN BERNARDINO BASIN AREA

Water Year[1]	Average Precipitation (inches)	Precipitation Volume[2] (acre feet)
1934-35	21.42	164,096
1935-36	15.11	115,779
1936-37	30.73	235,420
1937-38	24.70	189,239
1938-39	18.39	140,897
1939-40	15.64	119,835
1940-41	32.45	248,588
1941-42	14.96	114,574
1942-43	25.26	193,532
1943-44	21.06	161,305
1944-45	19.63	150,352
1945-46	12.55	96,167
1946-47	17.06	130,671
1947-48	10.56	80,853
1948-49	14.31	109,656
1949-50	13.36	102,373
1950-51	10.03	76,826
1951-52	26.24	200,986
1952-53	13.60	104,175
1953-54	16.99	130,130
1954-55	13.76	105,389
1955-56	13.25	101,517
1956-57	14.24	109,092
1957-58	25.68	196,699
1958-59	7.35	56,285
1959-60	12.79	97,983
26-Year Total	461.12	3,532,419
26-Year Average	17.74	135,862

[1] 12-month period from October 1 through September 30.

[2] Predicated on 91,918 acres within San Bernardino Basin Area.

TABLE 3

SURFACE WATER INFLOW TO
SAN BERNARDINO BASIN AREA FROM GAGED AREAS

(All Amounts In Acre Feet)

Water Year	Lytle Creek Near Fontana	Lone Pine Creek Near Keenbrook	Cajon Creek Near Keenbrook	Devil Canyon Creek Near San Bernardino	Waterman Canyon Creek Near Arrow-Head Springs	East Twin Creek Near Arrow-Head Springs	City Creek Near Highland	Plunge Creek Near Highland	Santa Ana River Near Mentone	Mill Creek Near Yucaipa	San Timoteo	Total
1934-35	3,510	660	6,240	470	1,490	2,530	4,760	4,210	6,120	2,530	864	33,384
1935-36	1,280	300	2,210	260	920	2,070	3,590	3,980	7,860	2,290	637	25,397
1936-37	16,200	1,050	9,730	2,450	4,140	7,080	16,860	13,910	71,090	36,590	4,600	183,700
1937-38	68,220	8,220	24,680	6,250	5,920	10,220	19,850	14,860	134,700	65,440	5,250	363,610
1938-39	1,890	640	6,150	340	2,000	4,070	3,960	2,980	8,200	4,610	241	35,081
1939-40	1,650	550	4,800	260	1,440	3,110	4,310	3,520	5,890	1,000	598	27,128
1940-41	37,180	2,550	17,660	3,120	5,110	10,010	16,140	11,360	34,930	20,660	1,790	160,510
1941-42	650	580	4,680	550	1,400	2,630	2,940	1,640	3,380	1,270	15	19,735
1942-43	31,040	3,200	21,900	2,560	4,070	7,700	13,040	8,720	24,420	10,990	4,110	131,750
1943-44	10,430	1,420	14,250	990	2,390	4,220	5,980	3,630	6,260	1,310	487	51,367
1944-45	1,550	740	6,080	930	2,760	4,310	6,890	5,260	14,300	6,040	811	49,671
1945-46	4,650	820	6,300	290	1,310	2,480	3,880	2,990	12,150	2,920	633	38,423
1946-47	6,960	790	6,620	760	1,810	2,580	3,920	1,990	8,120	720	471	34,741
1947-48	100	450	3,410	60	760	1,320	1,190	730	760	100	155	9,035
1948-49	70	490	3,710	130	1,110	1,800	2,440	1,530	1,890	300	40	13,510
1949-50	310	290	2,420	190	1,160	1,900	2,010	1,740	1,880	510	63	12,473
1950-51	30	130	1,660	0	480	940	620	250	460	170	10	4,750
1959-52	17,130	870	9,330	1,250	2,830	5,520	10,450	7,750	19,160	7,520	1,780	83,590
1952-53	2,000	500	2,680	20	820	1,650	1,640	900	1,160	480	264	12,114
1953-54	2,750	490	4,010	570	1,510	3,590	5,800	4,550	10,370	2,300	853	36,793
1954-55	320	260	2,730	800	960	2,020	1,680	850	1,500	520	123	11,763
1955-56	1,370	200	2,020	230	900	1,670	2,020	2,000	2,810	380	194	13,794
1956-57	1,230	270	3,450	320	1,010	1,680	3,790	2,280	2,150	390	66	16,636
1957-58	35,400	880	9,360	3,650	3,430	6,200	18,420	10,430	28,620	24,180	1,200	141,770
1958-59	3,660	670	3,130	370	660	1,300	1,510	770	900	710	122	13,802
1959-60	50	270	2,020	90	390	1,040	1,440	680	540	290	37	6,847
26 Year Total	249,630	27,290	181,230	26,910	50,780	93,640	159,130	113,510	409,620	194,220	25,414	1,531,374
26 Year Average	9,601	1,050	6,970	1,035	1,953	3,602	6,120	4,366	15,755	7,470	977	58,899

TABLE 4

ESTIMATED SURFACE INFLOW FROM UNGAGED AREAS
TRIBUTARY TO THE SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Water Year	Area 4 + 6	Area 7	Area 9	Area 14	Area 15	Area 19	Area 20	Total For San Bernardino Basin Area
1934-35	4,756	800	1,266	586	782	895	522	9,607
1935-36	4,674	320	506	322	469	506	314	7,111
1936-37	17,425	1,520	2,532	1,055	1,720	1,906	1,150	27,308
1937-38	32,021	1,560	1,688	674	978	1,050	606	38,577
1938-39	8,117	680	844	498	704	778	460	12,081
1939-40	6,203	400	506	322	469	506	314	8,720
1940-41	20,785	2,040	2,701	1,084	1,486	1,595	940	30,631
1941-42	7,010	440	506	293	313	389	930	9,881
1942-43	19,391	1,320	1,941	674	860	934	564	25,684
1943-44	13,775	960	1,688	498	586	661	397	18,565
1944-45	13,694	960	1,435	410	743	778	460	18,480
1945-46	7,912	400	506	117	196	272	376	9,779
1946-47	10,536	880	1,182	352	469	545	334	14,298
1947-48	5,207	240	338	29	39	39	42	5,934
1948-49	5,412	560	928	205	313	350	209	7,977
1949-50	5,780	560	760	117	196	272	167	7,852
1950-51	2,976	160	84	59	78	78	63	3,498
1951-52	13,161	1,520	2,532	791	899	972	564	20,439
1952-53	5,083	400	760	146	196	194	125	6,904
1953-54	7,866	840	1,013	293	391	428	272	11,103
1954-55	6,302	440	591	146	196	233	146	8,054
1955-56	5,780	400	506	146	196	194	125	7,347
1956-57	6,560	600	844	176	156	194	125	8,655
1957-58	21,935	1,440	3,038	527	665	739	439	28,783
1958-59	6,723	40	0	0	0	0	0	6,763
1959-60	3,703	240	675	176	196	233	146	5,369
26-Year Total	262,787	19,720	29,370	9,696	13,296	14,741	9,790	359,400
26-Year Average	10,107	758	1,130	373	511	567	377	13,823

TABLE 5

DIVERTED WATER INFLOW TO
SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Water Year	Lytle Creek Near Fontana	Devil Canyon Creek Near San Bernardino	City Creek Near East Highlands	Plunge Creek Near East Highlands	Santa Ana River Near Mentone	Mill Creek Near Yucaipa	Total Diverted Water Inflow
1934-35	24,270	690	1,200	1,000	31,800	16,570	75,530
1935-36	19,610	880	1,170	1,000	30,630	17,420	70,710
1936-37	35,150	1,800	1,810	1,000	39,910	24,600	104,270
1937-38	35,680	1,570	2,750	1,000	34,440	13,630	89,070
1938-39	24,290	1,650	1,990	1,000	53,300	20,290	102,520
1939-40	24,110	1,250	1,860	1,500	46,340	18,200	93,260
1940-41	37,000	1,950	2,560	1,500	51,590	21,240	115,840
1941-42	26,320	1,170	1,680	1,500	47,010	20,730	98,410
1942-43	34,220	2,170	2,230	820	49,220	19,910	108,570
1943-44	38,400	2,370	2,240	1,500	49,620	21,290	115,420
1944-45	30,670	2,410	2,140	1,280	44,960	20,560	102,020
1945-46	25,500	1,640	1,940	1,510	41,930	18,780	91,300
1946-47	25,770	1,810	1,960	2,150	32,890	17,280	81,860
1947-48	15,390	1,210	1,400	1,500	30,460	11,630	61,590
1948-49	11,830	1,190	1,230	1,500	33,010	11,230	59,990
1949-50	10,550	1,230	1,160	1,500	25,810	11,470	51,720
1950-51	7,730	740	870	1,500	21,770	8,200	40,810
1951-52	16,800	1,870	1,400	1,210	38,210	16,400	75,890
1952-53	15,710	1,220	1,330	1,400	28,420	15,200	63,280
1953-54	14,390	1,360	1,170	1,220	32,430	15,560	66,130
1954-55	14,480	740	1,150	1,270	26,880	12,990	57,510
1955-56	12,080	1,180	840	910	24,690	9,490	49,190
1956-57	10,830	1,280	1,080	960	24,220	10,160	48,530
1957-58	17,440	1,700	2,240	1,770	38,980	18,080	80,210
1958-59	17,330	1,280	2,200	1,250	27,830	14,620	64,510
1959-60	11,390	810	980	980	24,870	10,810	49,840
26-Year Total	556,940	37,170	42,580	33,730	931,220	416,340	2,017,980
26-Year Average	21,421	1,430	1,638	1,297	35,816	16,013	77,615

TABLE 6

FRESH WATER IMPORT TO
SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Water Year	Bear Valley Mutual Water Co.	Devore Water Co.	East Highlands Orange Co.	Lower Yucaipa Water Co.	Regina Grape Products	South Mountain Water Co.	Willard, Stewart	Thompson, Barnes, Randall Spring	Western Heights Mutual Water Co.	Yucaipa Gateway Colony	Total
1934-35	0	80	30	130	29	1,138	500	3	200	5	2,115
1935-36	0	100	30	120	29	1,561	550	3	200	5	2,598
1936-37	0	120	50	150	30	1,330	463	5	200	5	2,353
1937-38	0	120	60	150	30	1,408	490	5	200	5	2,468
1938-39	0	120	60	150	30	1,431	120	5	200	5	2,121
1939-40	0	120	60	150	30	1,581	300	5	200	5	2,451
1940-41	0	120	60	150	30	1,238	350	5	250	10	2,213
1941-42	0	110	60	140	29	1,355	350	3	250	10	2,307
1942-43	0	100	60	130	29	1,404	400	3	300	20	2,446
1943-44	0	90	50	120	29	1,354	400	3	300	20	2,366
1944-45	0	80	50	120	29	1,400	400	3	300	20	2,402
1945-46	0	80	45	120	29	1,350	400	3	250	15	2,292
1946-47	0	80	45	120	29	1,350	400	3	250	15	2,292
1947-48	0	80	45	120	29	1,300	400	3	200	15	2,192
1948-49	0	70	45	120	29	1,300	400	3	200	15	2,182
1949-50	0	57	45	120	29	1,300	400	3	200	15	2,169
1950-51	0	55	40	120	29	1,250	350	3	150	15	2,012
1951-52	0	77	50	120	29	1,250	350	3	150	15	2,044
1952-53	548	84	40	120	29	1,200	350	3	150	15	2,539
1953-54	506	98	40	120	29	1,200	350	3	150	15	2,511
1954-55	516	94	40	120	29	1,200	350	3	150	15	2,517
1955-56	607	124	30	120	29	878	350	3	160	20	2,321
1956-57	605	85	30	120	29	1,985	350	3	160	20	3,387
1957-58	247	117	60	120	29	1,127	350	3	160	20	2,233
1958-59	657	80	53	120	29	1,085	328	3	162	20	2,537
1959-60	513	63	28	120	29	990	328	3	162	20	2,256
26-Year Total	4,199	2,404	1,206	3,310	759	33,965	9,779	88	5,254	360	61,324
26-Year Average	162	92	46	127	29	1,306	376	3	202	14	2,359

TABLE 7

WASTE WATER IMPORT TO
SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Calendar Year	Diverted Water Outflow[1]	Waste Water Import[2]
1959	801.5	288
1960	853.8	307
1961	954.9	344
1962	939.9	338
1963	878.0	316
5-Year Total	4,428.1	1,593
5-Year Average	885.6	319

[1] Water extracted from the San Bernardino Basin Area by City of San Bernardino and delivered to the Rialto-Colton Basin Area.

[2] City of San Bernardino estimates that 80% of area was sewered in period 1959-1963 and that 45% of the delivered water from the sewered area returned to the San Bernardino Basin as wastewater import:

885.62 x 0.8 x 0.45% = 319 acre-feet per year average

TABLE 8

SUBSURFACE INFLOW
TO SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet/Year)

Source	Estimated Underflow
Santa Ana River	2,500[1]
Mill Creek	1,100[1]
Plunge Creek	500[1]
East Twin Creek	700[1]
Waterman Canyon	500[1]
City Creek	800[1]
Devil Canyon	700[1]
San Bernardino Mtn. Front	4,600[2]
San Timoteo Canyon	5,500[3]
Total Estimated Average Annual Subsurface Inflow	16,900

[1] Data from DWR Bulletin 104-5 Meeting Water Demands in the Bunker Hill-San Timoteo Area: Geology, Hydrology and Operation-Economics Studies, Text, February, 1971, Table 3.

[2] Predicated on 23 miles at mountain front at 200 acre-feet per mile per year.

[3] From United States Geological Survey Open-File Report - "Ground Water Outflow, San Timoteo-Smiley Heights Area Upper Santa Ana Valley, Southern California, 1927 through 1968" by L. C. Dutcher and F. W. Fenzel.

TABLE 9

SUMMARY OF INFLOW TO THE
SAN BERNARDINO BASIN AREA

(All Values In Acre Feet)

Water Year	Precipitation	Surface Inflow To San Bernardino Basin Area		Diverted Water Inflow	Fresh Water Import	Waste Water Inflow	Sub-Surface Inflow	Total Inflow
		Gaged	Ungaged					
1934-35	164,096	33,384	9,607	75,530	2,115	319	16,900	301,951
1935-36	115,779	25,397	7,111	70,710	2,598	319	16,900	238,814
1936-37	235,420	183,700	27,308	104,270	2,353	319	16,900	570,270
1937-38	189,239	363,610	38,577	89,070	2,468	319	16,900	700,183
1938-39	140,897	35,081	12,081	102,520	2,121	319	16,900	309,919
1939-40	119,835	27,128	8,720	93,260	2,451	319	16,900	268,613
1940-41	248,588	160,510	30,631	115,840	2,213	319	16,900	575,001
1941-42	114,574	19,735	9,881	98,410	2,307	319	16,900	262,126
1942-43	193,532	131,750	25,684	108,570	2,446	319	16,900	479,201
1943-44	161.305	51,367	18,565	115,420	2,366	319	16,900	366,242
1944-45	150,352	49,671	18,480	102,020	2,402	319	16,900	340,144
1945-46	96,167	38,423	9,779	91,300	2,292	319	16,900	255,180
1946-47	130,671	34,741	14,298	81,860	2,292	319	16,900	281,081
1947-48	80,853	9,035	5,934	61,590	2,192	319	16,900	176,823
1948-49	109,656	13,510	7,977	59,990	2,182	319	16,900	210,534
1949-50	102,373	12,473	7,852	51,720	2,169	319	16,900	193,806
1950-51	76,826	4,750	3,498	40,810	2,012	319	16,900	145,115
1951-52	200,986	83,590	20,439	75,890	2,044	319	16,900	400,168
1952-53	104,175	12,114	6,904	63,280	2,539	319	16,900	206,231
1953-54	130,130	36,793	11,103	66,130	2,511	319	16,900	263,886
1954-55	105,389	11,763	8,054	57,510	2,517	319	16,900	202,452
1955-56	101,517	13,794	7,347	49,190	2,321	319	16,900	191,388
1956-57	109,092	16,636	8,655	48,530	3,387	319	16,900	203,519
1957-58	196,699	141,770	28,783	80,210	2,233	319	16,900	466,914
1958-59	56,285	13,802	6,763	64,510	2,537	319	16,900	161,116
1959-60	97,983	6,847	5,369	49,840	2,256	319	16,900	179,514
26-Year Total	3,532,419	1,531,374	359,400	2,017,980	61,324	8,294	439,400	7,950,191
26-Year Average	135,862	58,899	13,823	77,615	2,359	319	16,900	305,777

Items of Water Utilization

The items of water utilization from the San Bernardino Basin Area are predicated on the cultural conditions existing during the five calendar years ending in 1963. Such items are as follows.

(1) Consumptive Use - The largest single component of water utilization and probably the most difficult to estimate is consumptive use, which comprises over 50 percent of the total water utilization within the San Bernardino Basin Area. With the exception of the "Native Vegetation" classes, the seasonal unit consumptive use values utilized for this analysis are from Appendix "A", "Basic Data", Volume II of the Joint Engineering Committee. The total consumptive use requirements for the various water services catagories are met either by precipitation and/or applied water and no attempt was made to account for these components separately since the total consumptive use remains the same. However, the consumptive use of the "Native Vegetation" classes is dependent entirely on the seasonal amounts and distribution of precipitation. For this reason, the consumptive use values utilized were adjusted to reflect the fact that the preponderance of the "Native Vegetation" within the San Bernardino Basin Area is situated in the higher than average precipitation zones. For detailed adjustments and computations (See Appendix "H" Volume 9 Appendix Part 2), Table 10, page 22, shows the annual average consumptive use for the five-year period ending in 1963 to be 166,849 Acre Feet.

(2) Fresh Water Export - The production of surface and ground water for export and use outside the San Bernardino Basin Area comprises about 25 percent of the total water utilization. Exports by Plaintiffs averaged 64,992 acre feet per annum for the five calendar year period ending with 1963 and are fixed by the Judgment. Exports by entities other than Plaintiffs are made up of diversions by Fontana Union, Cities of Rialto and San Bernardino, Mount Vernon Water Company and West San Bernardino County Water District and others, and are determined by the average production for said five-year period as verified by the Watermaster and set forth in Report of Watermaster, Volume 1, Part 3, Verification of Extractions from San Bernardino Basin Area. The exports by entities other than Plaintiffs averages 27,208 acre feet for the five-year period ending in 1963. Thus, the average annual export of water from the San Bernardino Basin Area for the five calendar years ending with 1963 by Plaintiffs and others is 92,200 acre feet as shown on Table 11, page 23 (See Appendix I, Volume 9 Appendix Part 2 for details).

(3) Waste Water Export - This item of water utilization is based on the actual discharge of the San Bernardino Water Treatment Plants into Warm Creek and the Santa Ana River and the Southern California Edison Company discharge to the Gage Canal for the five calendar years ending with 1963. The annual discharge is shown on Table 12, page 24 to be 12,820 acre feet (See Appendix "J" of Volume 9 Appendix Part 2).

(4) Storm Outflow - The storm outflow from the San Bernardino Basin Area under safe yield conditions has been estimated as the sum of the historic outflow of Santa Ana River at "E" Street Bridge, Lytle Creek West Channel and Warm Creek Storm Flow plus an estimated incremental increase in urban runoff which would have resulted had the culture of the each of the five years ending with 1963 existed during the historic years of the hydrological base period. This adjustment was assumed to vary directly with the increase in impervious areas as determined by the D.W.R. land use studies and is considered to include a reasonable allowance for increased runoff which might have occured by virtue of channelization and flood control improvements existing during the 1959 through 1963 safe yield years. Table 13 on page 25 shows the average annual storm outflow during the safe yield years to be 26,835 Acre Feet (See Appendix "K" of Volume 9 Appendix Part 2 for details of adjustments).

(5) Rising Water - Historically, surface outflow resulting from rising water in Warm Creek was a significant component of outflow from the San Bernardino Basin Area, averaging some 20,530 acre feet per annum during the 26-year Base Period. However, as a result of the declining ground water table, the occurrence of rising water ceased in about 1959 and has not recurred since. It is considered reasonable to assume that if a recurrence of the 26-year hydrological cycle were applied to the actual ground water surface elevations that existed during the 1959 through 1963 safe yield period, rising water would most probably recur. Recurring rising water has been estimated by correlation of the historical ground water elevations in the Meacham Well (1N/4W-35L) and the historical rising water above the Meeks and Daley Canal. The annual changes in the water surface elevation in the Meacham Well which occured historically were assumed to occur during a repeat of the 26-year cycle. These changes were then applied to the water surface elevations which existed during each of the five safe yield years and the resulting rising water was then determined from the curve of rising water vs. ground water surface elevations. This determination resulted in an estimated average annual rising water component of 700 acre feet (See Appendix "L", Volume 9 Appendix Part 2).

(6) Subsurface Outflow - This item of Utilization is dependent upon a number of factors which are extremely difficult to estimate or predict. Of significant importance is the ground water surface elevations in the Rialto-Colton Basin and their effect on the hydraulic gradient below the Colton Narrows. While the subsurface outflow estimated for the five calendar year period ending with 1963 has been utilized for this study, the conditions existing during this period may not be entirely indicative of subsurface outflow which would result from operation of the San Bernardino Basin Area on a safe yield basis since the five-year period represented an extreme dry period and the lowest ground water levels in the history of the Basin. In view of the substantial decline in the pumping from the San Bernardino Basin Area for export by the Riverside interests, quality considerations may indicate the desirability of maintaining a subsurface outflow appreciably greater than that presently assumed for the initial safe yield determination. However, the data presently available do not support definite conclusions at this time as to desirable subsurface outflow for optimization of safe yield and ground water quality. Future determinations of desirable quality, and subsurface outflow criterion may require reevaluations of the safe yield determination as herein after set forth. Table 14, page 26, shows the annual subsurface outflow from the Basin to be 9,580 acre feet during the five-year period ending in 1963 (See Appendix "L" of Volume 9 Appendix Part 2 for location of points of underflow).

(7) Miscellaneous Items of Consumptive Use and Outflow - This item includes a number of adjustments to the historic hydrologic conditions within the San Bernardino Basin Area to reflect the cultural conditions of the 1959-1963 period and include:

a) Estimated consumptive use of phreatophytes along the Zanja not included in D.W.R. studies;

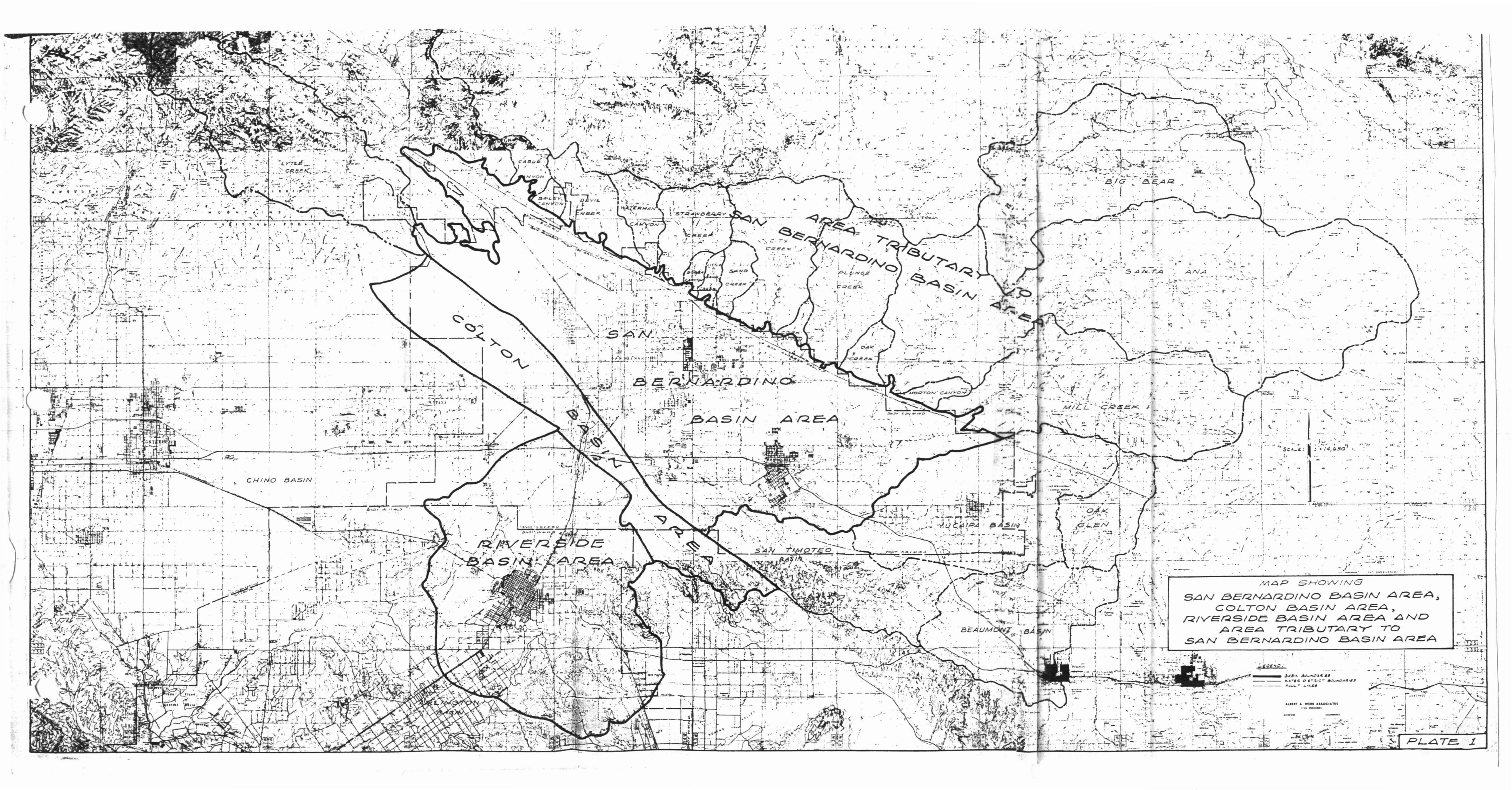
b) Deliveries to Edison Steam Plant in excess of waste discharge to Gage Canal;

c) Consumptive use of water diverted to non-water bearing areas, and not included in land use studies;

d) Estimated increase in surface outflow had diversions to Moreno Highline not been made during 1934-35 through 1959-60 base period;

e) Estimated evaporation from artificial and waste water recharge areas; and

f) Estimated increase in consusumptive use in Santa Ana River Watershed resulting from increased


SAN BERNARDINO BASIN AREA TRIBUTARY TO SAN BERNARDINO BASIN AREA
COLTON BASIN AREA
SAN BERNARDINO BASIN AREA
RIVERSIDE BASIN AREA
CHINO BASIN
BIG BEAR
SANTA ANA
MILL CREEK
OAK GLEN
YUCAIPA BASIN
SAN TIMOTEO BASIN
BEAUMONT BASIN
ELSINORE BASIN
LYTLE CREEK
CABLE CANYON
DEVIL CANYON
WATERMAN CANYON
STRAWBERRY CREEK
PLUNGE CREEK
OAK CREEK
MORTON CANYON
SCALE: 1" = 4,650'
MAP SHOWING
SAN BERNARDINO BASIN AREA,
COLTON BASIN AREA,
RIVERSIDE BASIN AREA AND
AREA TRIBUTARY TO
SAN BERNARDINO BASIN AREA
LEGEND
BASIN BOUNDARIES
WATER DISTRICT BOUNDARIES
FAULT LINES
ALBERT A. WEBB ASSOCIATES
PLATE 1

population density of the safe yield period as compared to the actual population of the historic years of the hydrological Base Period.

Table 15 on page 27 summarizes the loss to Basin from items (a) through (f) for an average annual flow of 2,511 acre feet during the five-year period ending in 1963 (See Appendix "M" of Volume 9 Appendix, Part 2 for computations and details).

SUMMARY OF ITEMS OF UTILIZATION

The items of utilization from the natural water supply accruing to the San Bernardino Basin Area are set forth in TABLE 10 through 15, and are summarized in TABLE 16. Basic data used for estimating components of outflow are presented in Appendices "H" through "M".

Predicated on the foregoing, the average annual utilization of water from the San Bernardino Basin Area based on the cultural conditions existing during the five-year period ending with 1963 is estimated at 311,495 acre feet.

TABLE 10

CONSUMPTIVE USE WITHIN SAN BERNARDINO BASIN AREA

	Unit Consumptive Use Factor [1] (AF/AC)	Safe Yield Year 1959	1960	1961	1962	1963
Urban and Suburban						
Residential, Single	2.40	28,934	29,951	30,971	31,989	33,007
Residential, Multiple	1.00	339	423	507	590	674
Residential, Rural	1.60	502	379	254	129	4
Commercial	1.00	1,400	1,488	1,576	1,664	1,751
Industrial	2.10	1,728	1,921	2,116	2,310	2,505
Unclassified	1.20	902	923	945	968	989
Street	0.63	3,854	4,040	4,225	4,411	4,596
Inc. Nonwater Ser. Area	0.72	806	840	874	907	941
Sub Total Urban and Suburban		38,467	39,968	41,471	42,970	44,470
Irrigated Agriculture						
Alfalfa	3.98	1,810	1,703	1,595	1,492	1,385
Pasture	3.97	9,706	8,972	8,237	7,503	6,772
Deciduous Orchard	3.04	620	486	349	215	82
Citrus	2.83	46,536	45,163	43,788	42,416	41,043
Truck Crops	2.36	3,169	3,115	3,058	3,004	2,950
Vineyards	2.70	2,211	1,984	1,760	1,536	1,309
Street	0.63	904	933	962	991	1,020
Sub Total Irrigated Agriculture		64,959	62,359	59,753	57,159	54,563
Nonwater Service Areas						
Native Vegetation, Barren	0.72	1,990	1,981	1,972	1,963	1,954
Native Vegetation, Light	1.40[2]	25,541	25,260	24,978	24,697	24,417
Native Vegetation, Medium	1.50[2]	31,665	31,824	31,983	32,139	32,295
Native Vegetation, Heavy	1.50[2]	2,587	2,835	3,082	3,330	3,577
Riparian Vegetation	4.30[3]	4,846	3,960	3,074	2,193	1,307
Street	0.63	553	541	529	516	504
Sub Total Nonwater Service Areas		67,184	66,402	65,620	64,839	64,056
Total Consumptive Use		170,611	168,729	166,845	164,970	163,090
		Five Year Average = 166,849				

[1] From Joint Engineering Committee, Appendix "A", Basin Data Volume II, May 14, 1968.

[2] Appendix "A", Volume II uses adjusted consumptive use values of 1.50, 1.53 & 1.51 acre feet per acre for Native vegetation. Light, medium & heavy respectively; DWR used 1.4 acre feet per acre for all Native Vegetation classes predicated on the 26 year average precipitation for the Bunker Hill - San Timoteo Area. Unit values tabulated have been adjusted to reflect areal distribution of Native Vegetation within the San Bernardino Basin Area.

[3] From DWR Bulletin 104-5, Meeting Water Demands in the Bunker Hill - San Timoteo Area: Geology, Hydrology, and Operation Economics Studies, Text, February 1971.

TABLE 11

FRESH WATER EXPORT FROM
SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Calendar Year	Plaintiffs	Other	Total
1959	67,503	35,068	102,571
1960	62,322	26,419	88,741
1961	70,483	24,782	95,265
1962	64,351	26,711	91,062
1963	60,300	23,060	83,360
5-Year Total	324,959	136,040	460,999
5-Year Average	64,992	27,208	92,200

TABLE 12

WASTE WATER EXPORT FROM
SAN BERNARDINO BASIN AREA[1]

(All Amounts In Acre Feet)

Calendar Year	City of San Bernardino SB 1	SB 2	Sub-Total	So. Calif. Edison Co. To Gage Canal	Total Waste Water Export
1959	8,845	1,736	10,581	271	10,852
1960	7,641	4,462	12,103	227	12,330
1961	7,718	6,071	13,789	315	14,104
1962	6,239	7,054	13,293	253	13,546
1963	5,577	7,438	13,015	253	13,268
5-Year Total	36,020	26,761	62,781	1,319	64,100
5-Year Average	7,204	5,352	12,556	264	12,820

[1] From San Bernardino Valley Municipal Water District Document 67-5 Survey of Waste Water Disposal Facilities in the Bunker Hill - San Timoteo Area Discharging More Than Ten Acre Feet Per Year, With Effluent Quantities, February 1967, pp. 33, 35, 39B.

TABLE 13

ESTIMATED STORM OUTFLOW FROM
SAN BERNARDINO BASIN AREA

(All Values In Acre Feet)

Water Year	Historical Storm Outflow	Estimated Increase In Runoff From Urban-Suburban Impervious Areas For Safe Yield Years					Estimated Storm Outflow From San Bernardino Basin Area For Safe Yield Years				
		1959	1960	1961	1962	1963	1959	1960	1961	1962	1963
1934-35	7,620	8,165	8,933	9,700	10,468	11,236	15,785	16,553	17,320	18,088	18,856
1935-36	9,400	6,212	6,803	7,393	7,985	8,576	15,612	16,203	16,793	17,385	17,976
1936-37	73,340	13,263	14,540	15,816	17,095	18,371	86,603	87,880	89,156	90,435	91,711
1937-38	174,600	9,129	10,019	10,908	11,799	12,689	183,729	184,619	185,508	186,399	187,289
1938-39	10,390	6,677	7,335	7,994	8,653	9,312	17,067	17,725	18,384	19,043	19,702
1939-40	8,640	4,758	5,233	5,709	6,185	6,660	13,398	13,873	14,349	14,825	15,300
1940-41	56,770	12,214	13,450	14,686	15,923	17,159	68,984	70,220	71,456	72,693	73,929
1941-42	5,720	4,041	4,455	4,870	5,284	5,699	9,761	10,175	10,590	11,004	11,419
1942-43	45,970	9,963	11,050	12,136	13,224	14,310	55,933	57,020	58,106	59,194	60,280
1943-44	17,010	6,645	7,419	8,193	8,968	9,742	23,655	24,429	25,203	25,978	26,752
1944-45	15,140	5,649	6,355	7,062	7,769	8,475	20,789	21,495	22,202	22,909	23,615
1945-46	14,610	2,970	3,371	3,771	4,172	4,573	17,580	17,981	18,381	18,782	19,183
1946-47	11,240	3,755	4,305	4,855	5,406	5,956	14,995	15,545	16,095	16,646	17,196
1947-48	4,420	2,119	2,459	2,798	3,138	3,478	6,539	6,879	7,218	7,558	7,898
1948-49	4,100	2,508	2,942	3,377	3,812	4,246	6,608	7,042	7,477	7,912	8,346
1949-50	3,930	2,555	3,037	3,519	4,002	4,484	6,485	6,967	7,449	7,932	8,414
1950-51	1,620	1,180	1,425	1,669	1,914	2,158	2,800	3,045	3,289	3,534	3,778
1951-52	24,810	4,674	5,746	6,819	7,894	8,967	29,484	30,556	31,629	32,704	33,777
1952-53	4,900	1,504	1,891	2,278	2,666	3,053	6,404	6,791	7,178	7,566	7,953
1953-54	9,310	2,389	3,088	3,787	4,488	5,187	11,699	12,398	13,097	13,798	14,497
1954-55	3,630	1,179	1,580	1,981	2,382	2,782	4,809	5,210	5,611	6,012	6,412
1955-56	6,570	1,259	1,769	2,278	2,788	3,297	7,829	8,339	8,848	9,358	9,867
1956-57	4,380	911	1,365	1,820	2,276	2,731	5,291	5,745	6,200	6,656	7,111
1957-58	27,230	904	1,807	2,711	3,615	4,518	28,134	29,037	29,941	30,845	31,748
1958-59	1,980	0	244	489	734	978	1,980	2,224	2,469	2,714	2,958
1959-60	3,360	0	0	333	666	999	3,360	3,360	3,693	4,026	4,359
26-Year Total	550,690	114,623	130,621	146,952	163,306	179,639	665,313	681,311	697,642	713,996	730,326
26-Year Average	21,180	4,409	5,024	5,652	6,281	6,909	25,589	26,204	26,832	27,461	28,089

For Safe Yield Years Five-Year Average = 26,835

TABLE 14

SUBSURFACE OUTFLOW FROM
SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Year	Segment 1	Segment 2	Segment 3	Total
1959	4,100	3,000	4,100	11,200
1960	3,600	3,000	3,900	10,500
1961	3,400	2,850	2,700	8,950
1962	3,600	2,750	2,600	8,950
1963	3,500	2,600	2,200	8,300
5-Year Total	18,200	14,200	15,500	47,900
5-Year Average	3,640	2,840	3,100	9,580

Note: Amounts tabulated for 1959 & 1960 are from Bulletin 104-5, Meeting Water Demands in the Bunker Hill - San Timoteo Area: Geology, Hydrology and Operation-Economic Studies, Text, February, 1971, Table 4.

Data for years 1961-63 from work done in connection with cooperative updating program between the Department and the San Bernardino Valley Municipal Water District.

For locations of segments see Plate 13 Location Map showing areas of underflow calculations from DWR Bulletin 104-5 included in Appendix L.

TABLE 15

MISCELLANEOUS CONSUMPTIVE USE AND OUTFLOW
FROM SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Item	1959	1960	1961	1962	1963	5-Year Average
Zanja[1]	356	308	200	412	230	301
Edison Steam Plant[2]	996	880	1,100	1,389	1,360	1,145
Consumptive Use Of Water Diverted To Non-Water Bearing Areas	30	30	30	30	30	30
Moreno Mutual[3] Adjustment To Surface Outflow	380	380	380	380	380	380
Consumptive Use By[4] Evaporation From Artificial And Waste Water Re-Charge Areas	307	307	307	307	307	307
Inflow Adjustment[5]	348	348	348	348	348	348
Totals	2,417	2,253	2,365	2,866	2,655	2,511

[1] Estimated at 6% of Crafton Mutual diversion in Zanja.

[2] Based on total water supply deliveries to Edison Company Steam Plant including Gage Canal and Edison Company Wells, less waste water discharged to Gage Canal.

[3] Estimated average increase in surface outflow from San Bernardino Basin Area assuming diversions to Moreno had not been made during 26-year base period.

[4] Estimated at 1% of 26-year average artificial and waste water recharge at 30,691 acre feet/year.

[5] Adjustment to reflect an estimated increase in consumptive use in nonwater bearing area resulting from increase in population.

TABLE 16

SUMMARY OF OUTFLOW
FROM SAN BERNARDINO BASIN AREA

(All Amounts in Acre Feet)

Component	Safe Yield Year 1959	1960	1961	1962	1963	5 Year Average
Consumptive Use	170,611	168,729	166,845	164,970	163,090	166,849
Fresh Water Export	102,571	88,741	95,265	91,062	83,360	92,200
Waste Water Export	10,852	12,330	14,104	13,546	13,268	12,820
Storm Outflow	25,589	26,204	26,832	27,461	28,089	26,835
Sub-Surface Outflow	11,200	10,500	8,950	8,950	8,300	9,580
Rising Water Outflow	700	700	700	700	700	700
Misc. Outflow & Consumptive Use	2,417	2,253	2,365	2,866	2,655	2,511
TOTAL	323,940	309,457	315,061	309,555	299,462	311,495

Extractions for Consumptive Use

Extractions for consumptive use represents withdrawals from storage to meet the total demands of the basin. Therefore, extractions for consumptive use have been classified as an item of supply.

Extractions from the surface and ground water resources of the San Bernardino Basin Area are made by Plaintiffs and Non-Plaintiffs who have recorded the amount of their annual extractions with the State Water Resources Control Board as required by law, and by Non-Plaintiffs who did not choose to record their extractions with the State Water Resources Control Board or were exempt from such filing under the provisions of the Water Code.

The Watermaster has verified the total annual extractions of the filers and non-filers for the five-year period ending with 1963 to which has been added the extractions of the Plaintiffs. The sum represents the total extractions from the San Bernardino Basin Area for consumptive use.

The summary of the extractions by the three classes of extractors for the five-year period ending in 1963 is set forth in Table 17, page 30, showing the average annual extractions for the five calendar years ending with 1963 to be 237,796 acre feet.

TABLE 17

SUMMARY OF VERIFIED WATER EXTRACTIONS
FROM SAN BERNARDINO BASIN AREA

(All Amounts In Acre Feet)

Item	Safe Yield Year 1959	1963	1961	1962	1963	1959-1963 Annual Average
Extractions by other than Plaintiffs for use within San Bernardino Basin Area.	151,478	143,639	151,657	144,304	129,591	144,134
Extractions by Plaintiffs for use within San Bernardino Basin Area.	2,870	2,545	461	751	683	1,462
Sub-Total - Extractions for use within San Bernardino Basin Area.	154,348	146,184	152,118	145,055	130,274	145,596
Extractions by other than Plaintiffs for export from San Bernardino Basin Area.	35,068	26,419	24,782	26,711	23,060	27,208
Extractions by Plaintiffs for export from San Bernardino Basin Area.	67,503	62,322	70,483	64,351	60,300	64,992
Sub-Total - Extractions for export from San Bernardino Basin Area.	102,571	88,741	95,265	91,062	83,360	92,200
Total Extractions from San Bernardino Basin Area By						
A. Other than Plaintiffs	186,546	170,058	176,439	171,015	152,651	171,342
B. Plaintiffs	70,373	64,857	70,944	65,102	60,983	66,454
C. Total	256,919	234,925	247,383	236,117	213,634	237,796

CHAPTER III

NATURAL SAFE YIELD OF THE SAN BERNARDINO BASIN AREA AND ADJUSTED BASE RIGHTS OF PLAINTIFF EXPORTERS

CHAPTER III

THE NATURAL SAFE YIELD OF THE SAN BERNARDINO BASIN AREA AND ADJUSTED BASE RIGHTS OF PLAINTIFF EXPORTERS

The natural safe yield of the San Bernardino Basin Area, based upon cultural conditions equivalent to those existing during the five calendar year period ending with 1963, has been determined by the Watermaster in accordance with the Judgment directives, as described in Chapter I.

After the determination of the safe yield, the Watermaster is directed to determine the annual adjusted right of each Plaintiff to extract water from the San Bernardino Basin Area based upon its percentage of such natural safe yield determined by methods used in Table B-2 of the Judgment.

This chapter summarizes the natural safe yield determination and the computation of the annual adjusted rights of the Plaintiffs.

Safe Yield

The safe yield of the San Bernardino Basin Area has been determined by 1) the total verified extractions for the San Bernardino Basin Area, plus 2) the total natural water supply available to the San Bernardino Basin Area, minus 3) the total use and disposal of the water from the San Bernardino Basin Area.

A summary of the estimated average annual water supply to, and the utilization from, the San Bernardino Basin Area under the cultural conditions which existed during the five calendar year period ending with 1963 are presented in Table 18. Table 18 also shows that the calculated average annual safe yield amount under 1959 through 1963 conditions is 232,078 acre feet.

TABLE NO. 18

SUMMARY OF ESTIMATED AVERAGE ANNUAL WATER SUPPLY TO AND UTILIZATION OF WATER FROM THE SAN BERNARDINO BASIN AREA UNDER CULTURAL CONDITIONS EXISTING DURING FIVE CALENDAR YEAR PERIOD ENDING WITH 1963
(All Values in Acre-Feet)

Item	Average Annual Amount Under 1959 thru 1963 Conditions
Supply	
Extractions for Consumptive Use	237,796
Precipitation	135,862
Surface Inflow, Gaged	58,899
Ungaged	13,823
Diverted Water Inflow	77,615
Freshwater Import	2,359
Waste Water Import	319
Subsurface Inflow	16,900
TOTAL SUPPLY	543,573
Use and Disposal	
Consumptive Use	166,849
Freshwater Export	92,200
Waste Water	12,820
Storm Outflow	26,835
Subsurface Outflow	9,580
Rising Water Outflow	700
Miscellaneous Outflow	2,163
Inflow Adjustment*	348
TOTAL UTILIZATION	311,495
Calculated Safe Yield	232,078

*Adjustment to historic surface inflow to reflect 1959-63 conditions during base period.

The best data available on certain of the items of supply for use by the Watermaster are subject to substantial variations, which are explained in the following paragraphs.

The component for subsurface inflow accruing along the San Andreas Fault at the base of the San Bernardino Mountain front is subject to rather wide variation. This supply item has been estimated by the Department of Water Resources (DWR) at 400 acre feet/year/mile of mountain front. Geologists of the U.S.G.S. have indicated that the amount could be as little as 200 acre feet/year/mile of mountain front and perhaps conceivably less.

The supply item of surface inflow is comprised of two components, namely: gaged and ungaged. DWR hydrologists have found that it is reasonable to expect that estimates of ungaged inflow may be subject to possible variations ranging from 10% to 200%. The gaged component has for many years been measured by the U.S.G.S. The records of surface inflow, as measured by the U.S.G.S., are the best available and have been used for many years.

Publications of the U.S.G.S. set forth the daily, monthly, and annual records of the surface flow passing the gaging stations maintained on the various streams. Each station description includes comments as to the general accuracy of data reported. "Excellent", indicates that in general the daily records have accuracy within 5%; "Good", within 10%; "Fair", within 15%; and "Poor", within 20% or more. The overall accuracy of the gaged inflow, including diverted water inflow, to the San Bernardino Basin Area is expected to range from 5% to 10%.

The largest single item of water disposal is consumptive use. The probable variation in such estimates is expected to range from 5% to 20% for municipal and industrial uses, 5% to 25% for irrigation, and 10% to 70% for native vegetation. In terms of the basin as a whole, the probable variation might range from 10% to as much as 40%.

An item of disposal subject to rather wide variation and uncertainty is the estimate of subsurface outflow. In 1963, the U.S.G.S. published Water Supply Paper 1419, setting forth the results of a study of geologic and hydrologic features of the San Bernardino Basin Area, with special reference to underflow across the San Jacinto Fault.

Following the work of the U.S.G.S., the DWR in cooperation with SBVMWD conducted an exhaustive study of subsurface outflow across the Bunker Hill Dike and as a result of this later work, published in 1971, concluded that a difference in magnitude in these two studies might be as much as 15% to 20% for comparable years.

A verification of the mathematical model for the area above Bunker Hill Dike was made, the results of which suggested that perhaps current estimates of underflow might be subject to an even wider range of probable accuracy.

The U.S.G.S., in cooperation with SBVMWD, is presently conducting a comprehensive study of the artesian zone lying immediately upstream from Bunker Hill Dike and the underflow and rising water in the area. Pending the completion of this study, the latest available data on subsurface outflow as developed by DWR in preparation of Bulletin 104-5, was used in this safe yield determination.

It is thus apparent that substantial variations in the amounts set forth in Table No. 18 are obtainable within reasonable limits of probable accuracy assignable to such amounts. However, for purposes of this initial safe yield determination and in recognition of the limitations of certain of the basic data available, these amounts are considered by the Watermaster to be reasonably indicative of the average seasonal water supply to and utilization from the San Bernardino Basin Area with the fixed conditions represented by the five calendar years ending with 1963 existing over the period of normal water supply represented by the 26-year Base Period 1934-35 through 1959-60. If in the future variations in certain of the basic data are reconciled or thought to be more reliable than the data used, it may be necessary to amend the safe yield amount accordingly.

Annual Adjusted Rights of Plaintiffs

The average annual extractions by Plaintiffs from the San Bernardino Basin Area for the five calendar years ending with 1963 are fixed by the Judgment as the "base right" of the Plaintiffs as shown in the Judgment in Appendix "B" as Table B-1, a copy of which is shown here as Table 19.

Following the completion of the verification of the entire San Bernardino Basin Area production of 237,796 acre feet, as shown in Table 17, each Plaintiff's percentage to the total verified production from the San Bernardino Basin Area was determined in accordance with methods used in Table B-2 of the Judgment. These percentages appear in Table 20.

The safe yield, as shown in Table 18, was calculated to be 232,078 acre feet annually. For purposes of determining the adjusted right of the Plaintiffs, the safe yield has been assumed to be 232,100 acre feet, and the adjusted rights for extractions by the Plaintiffs from the San Bernardino Basin Area, based on natural safe yield of 232,100 acre feet annually, is shown in Table 21.

The Judgment further states that the annual adjusted right of each Plaintiff shall include its same respective percentage of any new conservation and each Plaintiff shall pay its proportionate share of the costs thereof.

The Judgment also states that each Plaintiff shall have the right to participate in any new conservation projects under procedures to be determined by the Watermaster for notice to Plaintiffs of the planned construction of such projects. The Watermaster is not at this time aware of proposed new construction of works in which the Plaintiffs may be invited to participate, but upon receiving notice that conservation works are to be constructed, the Watermaster will then notify Plaintiffs that they may participate if they so desire.

TABLE NO. 19

EXTRACTIONS BY PLAINTIFFS FROM THE SAN BERNARDINO BASIN AREA FOR AVERAGE OF FIVE-YEAR PERIOD ENDING WITH 1963*

CLASSIFIED ACCORDING TO SERVICE AREA
(All Values in Acre-Feet)

Plaintiff	Total Extractions in San Bernardino Basin Area	Delivery to San Bernardino Basin Area	Delivery to Colton Basin Area & Riverside Basin Area in San Bernardino County	Delivery to Areas Outside San Bernardino Valley
City of Riverside (including those rights acquired as successor to the Riverside Water Co. and the Gage Canal Co.)	53,448	1,462	1,260	50,726
Riverside Highland Water Company	4,399	0	2,509	1,890
Agua Mansa Water Company, and Meeks & Daley Water Company	8,026	0	326	7,700
The Regents of the University of California	581	0	0	581
TOTAL	66,454	1,462	4,095	60,897

*From Appendix "B", Table B-1 Judgment

TABLE NO. 20

PLAINTIFF'S PERCENTAGES OF BASE RIGHT
TO TOTAL VERIFIED PRODUCTION FROM SAN
BERNARDINO BASIN AREA*
237,796 ACRE-FEET ANNUALLY,
FOR FIVE-YEAR AVERAGE ENDING WITH 1963
CLASSIFIED ACCORDING TO SERVICE AREA

Plaintiff	Delivery to San Bernardino Basin Area	Delivery to Colton Basin Area and Riverside Basin Area in San Bernardino County	Delivery to Areas Outside San Bernardino Valley
City of Riverside (including those rights acquired as successor to the Riverside Water Company and The Gage Canal Company)	.615	.530	21.332
Riverside Highland Water Company		1.055	.795
Agua Mansa Water Company, and Meeks & Daley Water Co.		.137	3.238
The Regents of the University of California			.224
TOTAL	.615	1.722	25.609

*Determined in accordance with methods used in Table B-2 of the Judgment.

TABLE NO. 21

ADJUSTED RIGHTS FOR EXTRACTIONS BY PLAINTIFFS
FROM THE SAN BERNARDINO BASIN AREA BASED ON NATURAL
SAFE YIELD OF 232,100 ACRE-FEET PER ANNUM[1]

CLASSIFIED ACCORDING TO SERVICE AREA
(All Values in Acre-Feet)

Plaintiff	Total Extractions in San Bernardino Basin Area	Delivery to San Bernardino Basin Area	Delivery to Colton Basin and Riverside Basin Area in San Bernardino County	Delivery to Areas Outside San Bernardino Valley
City of Riverside (including those rights acquired as successor to the Riverside Water Company and The Gage Canal Company)	52,169	1,427	1,230	49,512
Riverside Highland Water Company	4,294	0	2,449	1,845
Agua Mansa Water Company, and Meeks & Daley Water Company	7,833	0	318	7,515
The Regents of the University of California	566	0	0	566
TOTAL	64,862	1,427	3,997	59,438

[1] Effective January 1, 1972