EXHIBIT 12

PART 8

APPENDIX P

METHODS OF DETERMINING UNDERFLOW AT HYDROLOGIC BOUNDARIES

APPENDIX P

TABLE OF CONTENTS

TABLES

APPENDIX P

METHODS OF DETERMINING UNDERFLOW AT HYDROLOGIC BOUNDARIES

Subsurface Flow

Purpose of this appendix is to set forth methods and procedures utilized in evaluating the subsurface flow out of the Upper Los Angeles River area which has occurred historically in the vicinity of Gage F-57 through a section at the lower end of the Los Angeles Narrows and also in the vicinity of Pickens Canyon in the easterly side of La Crescenta Valley. Evaluation of subsurface flow which has occurred between Sylmar and San Fernando Hydrologic Subareas in two locations and between the Verdugo and San Fernando Hydrologic Subareas at one location, is also included. There is little or no subsurface flow from the Eagle Rock Subarea to the Los Angeles Narrows.

Methods

The quantity of subsurface flow was computed by the slope area method through use of Darcy's Law which states that the rate of discharge through a given cross section of saturated material, under laminar flow conditions, is proportional to the hydraulic gradient and may be expressed as follows:

$$Q = PIA \text{ in which}$$

Q = amount of flow in gallons per day

P = Meinzer's coefficient of permeability expressed in gallons per day per square foot under a hydraulic gradient of unity and existing ground water temperatures

I = hydraulic gradient in feet per foot at the section in a direction normal to the section

A = saturated area of the section in square feet

Subsurface flow may also be computed by the rising water method where rising water (effluent seepage) occurs perennially and where the cross-sectional area of saturated materials is unknown. The method has been noted by Tolman in Ground Water, pages 490-91, 1937. This method is also based on Darcy's Law and is dependent on the variation at different times in the amount of perennial rising water with variation in the ground water slope above the first appearance of rising water in a restricted filled channel. The formula is

$$Qu = \frac{I_1 (Qr_2) - I_2 (Qr_1)}{I_2 - I_1}$$

where Qu = subsurface flow (constant as long as rising water occurs) I_1 and I_2 the ground water slopes and Qr_1 and Qr_2 the amounts of rising water at times t_1 and t_2, respectively.

The rising water method was applied to the problem of solving for the underflow at F-57; however, the results were found to be unreliable due to the localized effects of pumping and waste discharges by the Southern Pacific Company.

Subsurface Outflow through Los Angeles Narrows at Gage F-57

Subsurface flow can take place out of the San Fernando Hydrologic Subarea in the vicinity of Gage F-57. Flow passes through a relatively thin section of water-bearing material as shown in Section L-L' on Plate 5D.

The underflow characteristics at this section are complicated by two factors. First the water table slopes away from Arroyo Seco at the eastern end of Section L-L', in the vicinity of Cypress Avenue and Huron Street, with a drop 15 feet indicating that there may be some influence on underflow at this section caused by the coalescence of Arroyo Seco detritus and flows with those of the Los Angeles River. Data with which to completely evaluate this effect are not available. Secondly, an interlocking sheet pile cutoff wall located at the beginning of the lined section (approximately 1,000 feet upstream from Gage F-57) was placed to a depth of 15 feet for the width of the lined channel in 1938 and presumably is still in place. The presence of this cutoff wall, approximately 3,900 square feet in area, may cause an unnatural rising water condition at this point. The underflow at Gage F-57 has previously been estimated by Homer Hamlin in U.S.G.S. Water Supply and Irrigation Paper No. 112 (1905). His estimate of 2.27 cfs was based on a total cross-sectional area of 107,700 square feet (1896) and an elaborate electrical velocity measuring device invented by C. S. Slichter. Review of this estimate indicates that the value determined is high because the results were based on permeability measurements in the more porous portions of the channel.

The data necessary to apply the slope area method were determined to be:

1. The weighted average permeability for the total cross-sectional area was calculated to be 1,132 gallons per day per square foot under 100 percent hydraulic gradient. This determination was made by constructing a geologic section from well and test hole logs and assigning the following permeability values to the materials designated in the logs.

Gravel	2,000 gpd	Silt	100 gpd
Sand and gravel	1,500 gpd	Clay	50 gpd
Sand	1,000 gpd	Cemented gravel	100 gpd

These values have been established in Southern California by means of pump tests performed by State and Federal agencies. These are generalized values; however, it should be noted that the weighted mean permeability determined by the panel method with the assigned values compared favorably with the results obtained at the Pollock well field (Los Angeles Department of Water and Power) by time-recovery methods.

The pump test performed by the Referee on May 5 to 11, 1959, in the Pollock well field utilized Pollock No. 3 (3949B) as the pumping well and Pollock Nos. 1 and 2 (3949 and 3949A) as observation wells. The discharge of the pumping well was metered at 3.7 cfs or 1,661 gpm.

Drawdown and recovery measurements were made on all three wells. Inasmuch as boundary conditions (bedrock outcrops about 1,000 feet from the pumping well) probably caused the erratic variation in the drawdown curves, the recovery curves which were more uniform were used to calculate an approximate permeability.

Due to the 6-day period of pumping and the relatively long interval of time before start of the drawdown test, time was plotted directly against recovery in feet on semilog paper rather than time divided by total elapsed time against recovery. The values thus obtained were used in Wenzel's nonequilibrium equation:*

$T = \frac{2.303\,Q}{4\pi\Delta s}$ where T = transmissibility, Q = discharge of well prior to shut down in cfs

Δs = the distance in feet as measured from the tangent to the straightest part of the recovery curve. This measurement is expressed as the difference in feet per log cycle of time

A time recovery method was utilized in that it provides an easy check on pumping tests and also implies a constant Q which is difficult to control accurately in the field. A sample computation for Pollock well No. 3 (3949B) follows:

$Q = 3.7, \Delta s = 1.39$

$$T = \frac{2.303 \times 3.7}{4 \times 3.14 \times 1.39} = 0.488 \text{ cfs or } = 315{,}000 \text{ gpd}$$

The well was perforated from 40 to 205 feet. The static water level prior to turning on pump was 44.05 feet. This would give 160.95 feet of saturated alluvium:

$$P = \frac{T}{\text{Saturated thickness}} = \frac{315{,}000}{160.95} = 1{,}956 \text{ gpd/square foot}$$

The log of well 3949B indicates that the majority of materials penetrated are gravels. The pump test results and the assigned value of 2,000 gallons per day per square foot for gravel are in substantial agreement.

* U. S. G. S. Water Supply Paper 887.

Each log in the section was assumed to be characteristic of the area halfway to the next log. The section is shown on Plate 5D as Section L-L'.

2. The maximum hydraulic gradient above the section is limited by the slope of the bottom of the channel (s = 0.0034). Annual gradient values were obtained from water level measurements of wells between the section and a point 4,900 feet upstream. All large amounts of pumpage and discharge are made above the reach of channel used in the computations.

3. The section has a total cross-sectional area of 312,600 square feet; 105,080 square feet of saturated cross-sectional area under high water surface conditions; and 76,590 square feet of saturated cross-sectional area under low water surface conditions. The saturated area was determined year by year by using water level measurements along the line of section.

Annual values of subsurface flow at Gage F-57 are shown in Table P-1. The average variations during each year amount to 0.015 to 0.030 cfs above or below the tabulated November values.

Subsurface Outflow at Pickens Canyon

From geologic studies it appears that a bedrock ridge, the westerly bank of an ancestral Pickens Wash cut into bedrock, exists within the area defined as the Verdugo Hydrologic Subarea. This bedrock ridge begins at the mouth of the first canyon westerly of Pickens Canyon and extends southerly to the granitic outcrop located near the intersection of Foothill Boulevard and Pickens Canyon Wash. The location is shown on Figure Q-1, Appendix Q, as the western boundary of storage unit V-2, while a portion of its profile is shown in Section P-P on Plate 5F.

TABLE P-1

SUBSURFACE OUTFLOW AT GAGE F-57

(Based on Measurements in November of Each Water Year)

Year	Gradient	Saturated area, in square feet	Underflow[b] Cubic feet per second	Underflow[b] Acre-feet per year
1928-29	0.0026	102,550	0.47	340
29-30	0.0020	102,550	0.36	260
1930-31	0.0016	102,550	0.29	210
31-32	0.0026	102,550	0.47	340
32-33	0.0034[a]	104,420	0.62	450
33-34	0.0034[a]	104,200	0.62	450
34-35	0.0034[a]	105,080	0.69	500
1935-36	0.0034[a]	102,440	0.61	440
36-37	0.0034[a]	100,570	0.60	430
37-38	0.0032	100,570	0.56	410
38-39	0.0034[a]	100,570	0.60	430
39-40	0.0034[a]	91,990	0.55	400
1940-41	0.0034[a]	80,880	0.48	350
41-42	0.0034[a]	84,510	0.50	360
42-43	0.0034	76,590	0.46	330
43-44	0.0034[a]	80,330	0.47	340
44-45	0.0034[a]	81,210	0.48	350
1945-46	0.0034[a]	77,690	0.46	330
46-47	0.0034[a]	76,630	0.46	330
47-48	0.0033	78,130	0.45	330
48-49	0.0030	77,250	0.41	300
49-50	0.0029	77,030	0.39	280
1950-51	0.0032	78,240	0.44	320
51-52	0.0028	78,570	0.38	280
52-53	0.0027	85,500	0.40	290
53-54	0.0025	82,090	0.36	260
54-55	0.0029	81,980	0.42	300
1955-56	0.0032	81,320	0.46	330
56-57	0.0018	82,970	0.26	190
57-58	0.0011	86,160	0.21	160
29-Year Average 1929-1957				340

a. Gradient adjusted downwards to grade of Los Angeles River channel = 0.0034.

b. Based on weighted average permeability = 1,132 gallons per day (100% hydraulic gradient) and rounded off to nearest 10 acre-feet.

A series of cross sections and bedrock contours (Plate 6) drawn through the subarea indicate that the bedrock is lower in the La Canada-Pickens Canyon area and that the area east of the bedrock ridge slopes to the Monk Hill Basin. Available ground water levels indicate that the ridge obstructs the flow of ground water and acts as a ground water barrier under low water table conditions such as in the fall of 1958, but not in high water table years such as 1944 when the water is above the ridge.

The amount of underflow from the Verdugo Subarea to Monk Hill Basin and the amount leaving the area of investigation were calculated at the narrowest section of the valley fill east of the boundary between Verdugo and Monk Hill. This section crosses Foothill Boulevard approximately halfway between the boundary of the area of investigation and Pickens Canyon Wash. These calculations indicate that the amount of underflow was approximately 250 acre-feet during 1928-29 and 400 acre-feet for 1943-44. Values for individual years were estimated by correlation to water levels in the area and are listed in Table P-2.

Subsurface Flow Between Sylmar and San Fernando Hydrologic Subareas

Subsurface flow can take place between the Sylmar and San Fernando Hydrologic Subareas at the Pacoima Notch in the Pacoima Wash, and at the Sylmar Notch near the intersection of San Fernando Road and Bleeker Street in San Fernando (see Plate 5 for location). In both cases flow is in a southerly direction out of the Sylmar Hydrologic Subarea.

TABLE P-2

ESTIMATED UNDERFLOW FROM
VERDUGO HYDROLOGIC SUBAREA TO MONK HILL BASIN[a]

In Acre-Feet

Year	Underflow[b]	Year	Underflow[b]
1928-29	250	1945-46	400
29-30	250	46-47	400
		47-48	300
1930-31	250	48-49	300
31-32	250	49-50	300
32-33	250		
33-34	250	1950-51	250
34-35	250	51-52	250
		52-53	300
1935-36	300	53-54	250
36-37	300	54-55	250
37-38	300		
38-39	400	1955-56	250
39-40	400	56-57	250
		57-58	250
1940-41	400		
41-42	400	29-Year Average	
42-43	400	1928-29 to	
43-44	400	1956-57	300
44-45	400		

a. Based on hydrographs of wells 5077B and 5078.
b. Values rounded off to nearest 50 acre-feet.

A third possibility for subsurface underflow out of Sylmar Subarea exists in the vicinity of and through a gap immediately northwest of the West Cienega. No data as to the depth of alluvial fill or character of materials are available in this locale. Study of aerial photographs of the area and subsequent field investigation indicates the possible existence of a north northwesterly trending fault which crosses the West Cienega. If this fault acts as a barrier or partial barrier to the subsurface outflow a marshy condition would exist. The West Cienega was in existence before the construction of Lower San Fernando Reservoir; however, the surface water levels and ground water levels now vary with the levels in the reservoir which is located to the west of the West Cienega.

On the basis of the aforementioned, subsurface outflow in the vicinity of the West Cienega and the gap immediately northwest thereof is of small magnitude and therefore not significant.

Pacoima Notch

The Pacoima Notch is located in the Pacoima Wash where the ancestral stream has eroded a notch to a maximum depth of 55 feet in the nonwater-bearing Repetto formation (see Plate 5H). The Pacoima Notch has an area of approximately 35,000 square feet as interpreted from the drawing in Reservoirs for Irrigation, Eighteenth Annual Report of U.S.G.S., Part IV, d, by James Dix Schuyler, dated 1897. The calculation of underflow at this point is somewhat complicated by the fact that the lower portion of an old submerged dam is still in place and its effect on flow through the porous Pacoima Wash deposits is not known.

The submerged dam was built by the Maclay Rancho Water Company in 1888 and was reported to be the only submerged dam in the world at that time. It was constructed of rubble masonry using Portland cement and sand mortar. It was three feet thick at the base and two feet thick at the surface. The maximum height of the structure was 52 feet with a crest length of 550 feet. Two gathering wells were provided in the line of the dam, each four feet in diameter. The structure was founded on the relatively impervious sandstone of the Repetto formation. Schuyler states:

> "The dimensions and capacity of this novel reservoir have not been definitely determined, but in round numbers it covers an area of 300 acres and has a mean depth of 15 to 20 feet, and, although it lies on a slope of 100 feet per mile, the water passes down through the gravel so slowly that it is believed the yield is equivalent to the volume of the voids in this area to the depth mentioned. As the gravel appears to be loose and rather coarse, the voids may be considered as about one-fourth of the volume and the resultant capacity about 1,300 acre-feet of water."

This storage was in the voids of the porous channel deposits upstream from the dam. Due to leakage problems in the structure the dam was abandoned as a gravity source of water in 1915 by the Maclay Rancho Water Company. In 1917 the San Fernando Water Company installed a pump in one of the masonry gathering wells of the dam and pumped water for use in their system until 1927.

A study of the water level measurements at the submerged dam in one of the old gathering wells (5989A) indicates that during the base period 1928-57 the water levels have fluctuated between the elevation of 1,199.08 feet (January 27, 1931) and 1,224.17 feet (March 19, 1938).

The annual underflow through the Pacoima Notch as shown in Table P-3 has been calculated on the basis that the old submerged dam is still intact below 1,200 feet and that subsurface flow would occur only between the 1,200 foot elevation and the static water level above that elevation. The permeability was assumed to be 1,000 gallons per day per square foot, which compares favorably with permeabilities of similar materials below Hansen Dam which were determined by pumped well methods.

An estimate of the underflow through the Pacoima Notch under unimpaired flow conditions, i.e., without the submerged dam acting as a partial barrier was made. Utilizing an assumed permeability, as interpreted from well log 5989A, of 1,000 Meinzer Units, which does not discount for the effect of the portion of the submerged dam which is still in place, the following computations of the underflow for the high and low water surface conditions were made using the formula Q = PIA:

High water surface condition (March 18, 1938)

P = 1,000, I = 0.0125, A = 34,500 square feet wetted area

Q = 431,250 gallons per day

= 1.32 acre-feet per day or 482 acre-feet per year

Low water surface condition (January 27, 1931)

P = 1,000, I = 0.0107, A = 20,200 square feet wetted area

Q = 216,140 gallons per day

= 0.66 acre-feet per day or 241 acre-feet per year

These calculations indicate that for unimpaired flow conditions the annual flow through the Pacoima Notch varies between 241 and 482 acre-feet per year and that a mean flow for the base period would be approximately 350 acre-feet per year.

Sylmar Notch

The results of the exploratory drilling performed by the City of San Fernando, the City of Los Angeles and the Referee indicate that a notch, hereinafter called the Sylmar Notch, exists from which subsurface flow can escape the subarea, (see Plate 5H). This notch has been incised in the Saugus formation to a depth of approximately 45 feet and back-filled with Upper Pleistocene and Recent alluvial detritus. It is located between the Mission well field and the intersection of Fourth and Hubbard Streets, (see Plate 5).

The total cross-sectional area, as determined by the interpretation of the test hole logs, is on the order of 96,000 square feet. The wetted cross-sectional area, as of May 26, 1959, was planimetered to be 22,300 square feet. The gradient computed between test holes SF-1 and SF-4 (Figure A-1), is 18 feet in 600 feet or 0.030 feet per foot. Based on the average permeability values listed on page P-6 and an interpretation of the logs of test holes SF-4, SF-5 and WR-6, an average permeability of 400 Meinzer Units was selected for use in the formula Q = PIA:

TABLE P-3

ESTIMATED ANNUAL UNDERFLOW THROUGH PACOIMA NOTCH[a]

Year	Gradient	Saturated area, in square feet	Underflow[c] in acre-feet per year
1928-29	b	b	(160)[d]
29-30	b	b	(160 [d]
1930-31	b	b	(160)[d]
31-32	b	10,394	(160)[d]
32-33	0.021	6,429	150
33-34	0.020	6,311	140
34-35	0.020	8,854	200
1935-36	0.021	5,270	120
36-37	0.022	12,908	320
37-38	0.024	9,234	250
38-39	0.022	7,039	180
39-40	0.021	6,524	150
1940-41	0.024	11,122	300
41-42	0.023	8,176	210
42-43	0.023	11,060	290
43-44	0.023	9,464	250
44-45	0.023	7,599	200
1945-46	0.025	7,123	200
46-47	0.025	6,149	170
47-48	0.025	4,104	110
48-49	0.027	1,865	60
49-50	0.027	1,198	40
1950-51	0.028	62	20
51-52	0.026	6,692	190
52-53	0.030	2,666	90
53-54	0.028	1,921	60
54-55	0.028	2,498	80
1955-56	0.025	3,002	80
56-57	0.024	2,005	60
57-58	0.025	5,309	150
25-Year Average 1933-1957			160

a. Assuming submerged dam impervious below elevation 1,200 feet.
b. No water level measurements available.
c. Based on assumed permeability of 1,000 gallons per square foot per day (100% hydraulic gradient).
d. 25-year average utilized for hydrologic inventory.

P = 400 Meinzer Units, I = 0.030, A = 22,300 square feet

then Q = 267,600 gallons per day

= 0.82 acre-foot per day or 300 acre-feet per year

The 300 acre-feet computed as underflow in the Sylmar Notch is based on low ground water surface conditions in 1959. Underflow for high ground water surface conditions is estimated to be approximately 500 acre-feet per year. An average value for the base period 1928-29 through 1956-57 is thus estimated to be about 400 acre-feet per year and was utilized for purposes of hydrologic inventories.

Pumping of the Mission well field of the City of Los Angeles in June and July of 1960 has apparently resulted in the lowering of water levels (0.5, 0.39 and 0.19 feet in test holes SF-1, SF-3 and SF-4, respectively). This lowering of water levels effects a reduction in ground water slope at the section thus reducing the subsurface flow from the Sylmar Subarea through Sylmar Notch.

Subsurface Flow Between Verdugo and San Fernando Hydrologic Subareas

In 1894 the damming of the underflow of Verdugo Creek was first initiated by the Verdugo Canyon Water Company. The first dam extended only 6 feet below the surface, was 50 feet long and extended across the west branch of Verdugo Creek. In the summer of 1895, work was begun on a submerged dam that was founded on bedrock and connected to the western rock wall of the canyon. This structure extended 245 feet to the northeast.

Beyond the dam, 260 feet of cribs extended which reached a maximum depth of 29.4 feet. A 225-foot tunnel was driven in the east bank of the channel and connected to the crib by a 50-foot long cut. The total yield of these works was approximately 26 miners inches (234 gpm).

The present day submerged dam, situated approximately in the same location, was built by the City of Glendale in 1935. This structure intercepts a substantial amount of the underflow of Verdugo Canyon; however, it extends only part way across the canyon. Approximately 23,000 square feet of water-bearing material in the most easterly portion of the section (see Plate 5H) east of the east manhole of the dam is not cut off by the structure. A profile which accompanied the report of James D. Schuyler and Samuel Starrow, dated March 31, 1903, entitled "Report of Verdugo Canyon Water Company", indicated an inferred deep on the east side of the canyon which is not traversed by the present dam. A shaft 48 feet deep sunk near the portal of the 1899 Verdugo Canyon Water Company tunnel in this vicinity did not intercept bedrock.

Bedrock in the Verdugo well, which is also located 300 feet easterly of the submerged dam, is 54 feet from the ground surface. The submerged dam has approximately 3,400 square feet of cross-sectional area which is nearly normal to the course of the channel. The wing wall which extends southerly from the east manhole is not included in the above figure because it more or less parallels the general direction of ground water movement.

There is very little information available concerning the character of the materials which lie easterly of the east manhole of the submerged dam. There is no log of the materials penetrated by the Verdugo Well (3963A). With no data available from which to estimate the permeability a method devised by the U.S.G.S. for this type of situation was utilized. The method of determining permeability utilizes the specific capacity, yield factor and total saturated thickness and is based on complete penetration of the aquifer. This method was applied to the Verdugo Well (3963A) in the vicinity of the submerged dam.

The factors are expressed as follows:

$$\frac{\text{yield (gpm)}}{\text{drawdown (feet)}} = \text{specific capacity}$$

$$\frac{\text{specific capacity}}{\text{thickness of saturated material}} \times 100 = \text{yield factor}$$

$$\text{yield factor} \times 20 = \text{permeability (gpd)}$$

The number 20 is an empirical constant based on many pump tests performed by the U.S.G.S. in various points of the country and includes the average effect of well losses encountered in the tests. It should be understood that this method is to be used only when there is no other alternative.

Utilizing this methed, a permeability coefficient of 350 gallons per day (Meinzers units) was obtained and applied to the saturated cross-sectional area of approximately 6,900 square feet which is not effected by the submerged dam with the slope at the section determined between Verdugo Well (3963A) and test hole No. 12 (3972O) of the City of Glendale.

The underflow during 1957-58 was thus computed, by the Darcy formula, to be 78 acre-feet. Subtraction of the extractions by the Verdugo well, which amounted to 68 acre-feet during 1957-58, from the computed underflow would leave practically nothing available for subsurface flow around the submerged dam and the underflow passing the dam was considered to be nil during 1957-58. Since the diversion from the Verdugo submerged dam has fluctuated with the available supply it is deduced that the annual amounts of underflow through the base period have also been nil.

Summary of Underflow

The quantity of underflow leaving the Upper Los Angeles River area and the quantity of underflow between hydrologic subareas are summarized in Tables 31 and 32.

APPENDIX Q

CHANGE IN STORAGE

APPENDIX Q

TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX Q

CHANGE IN STORAGE

In evaluating changes in ground water storage, only changes occurring in the zone of saturation within the boundary of the valley fill area have been considered. Changes in moisture content also occur in the zone of aeration; however, such changes cannot be feasibly measured for historic periods or over large areas. The times of year when water levels are determined should be after the end of heavy pumping and before appreciable precipitation occurs in order to minimize the amount of water in transit within the zone of aeration.

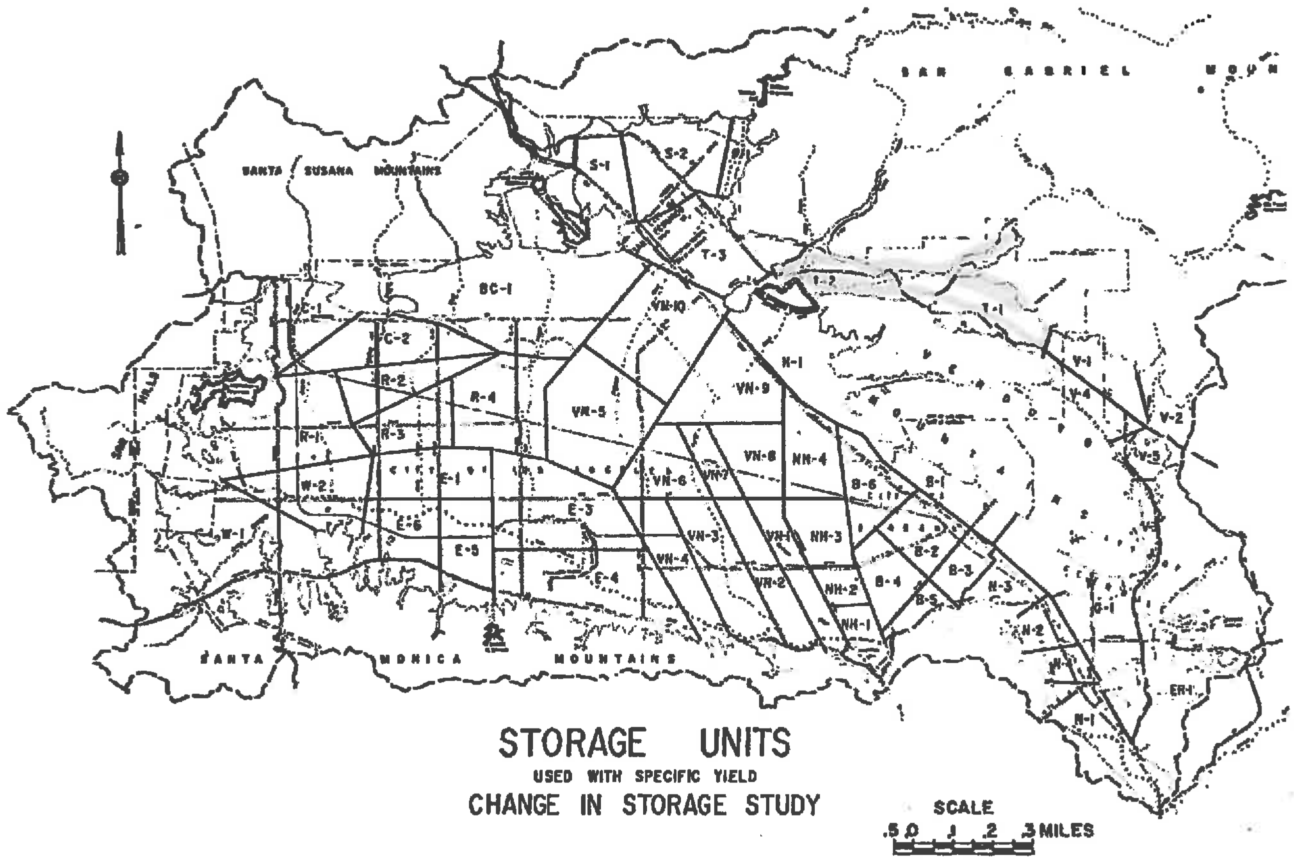
Change in storage has been computed by first multiplying the area of material which was saturated or drained by the difference in water level occurring therein, thereby to evaluate the volume of fill material dewatered or saturated. This product was then multiplied by the average specific yield of this fill material as computed from the available well logs in the area. Determination of specific yield utilized is described in Appendix D.

Free ground water conditions are generally found to exist in the major portion of the valley fill including the San Fernando and Verdugo Hydrologic Subareas. Confined conditions, however, are indicated in the Eagle Rock and Sylmar Hydrologic Subareas. Change in storage in the Eagle Rock Subarea was considered to have occurred only in the free water table or forebay portion thereof. This forebay comprises 535 acres or 69 percent of that small hydrologic subarea. Specific yields for this area were obtained by correlation of existing geologic information with specific yield data determined for the neighboring valley fill in the vicinity of the City of Glendale. A paucity of well data precluded a determination of the forebay extent in the Sylmar area and change in storage in this area was determined from water level changes and specific yields occurring throughout that subarea. It is believed that this approximation gives results which will not grossly affect the accuracy of the overall determination of change in storage in the combined subareas because of the relatively small specific yields used and the relatively moderate cyclic variation of water levels which has occurred in the Sylmar Subarea during the base period.

Storage Units

Water-bearing materials contained under the valley floor area vary greatly from place to place. The accuracy and quantity of water level and specific yield data also vary between areas. Because of these factors, the change in storage was not determined for the valley floor or hydrologic subareas as a whole but was determined for 52 separate storage units. The summation of the change in storage for a group of storage units was then equal to the change in storage of any desired larger area.

The storage units selected are shown on Figure Q-1. These units were delineated on the basis of containing similar lithologic properties throughout and having annual water level fluctuations of the same range and magnitude throughout. The area contained within each of the storage units is shown in Table Q-1.



SAN FERNANDO VALLEY REFERENCE

STORAGE UNITS

USED WITH SPECIFIC YIELD CHANGE IN STORAGE STUDY

STATE WATER RIGHTS BOARD

FIGURE Q-1

TABLE Q-1

AREAS OF STORAGE UNITS

In Acres

C-1	2,487	NH-1	617
C-2	2,741	NH-2	681
R-1	5,436	NH-3	1,537
R-2	1,824	NH-4	2,046
R-3	1,869	B-1	1,935
R-4	3,338	B-2	1,599
W-1	5,208	B-3	1,020
W-2	2,541	B-4	1,541
E-1 + E-2	2,278	B-5	787
E-3	4,458	B-6	1,841
E-4	4,895	G-1	4,310
E-5	2,287	N-1	2,376
E-6	2,593	N-2	957
BC-1	8,391	N-3	1,189
VN-1	1,861	N-4	792
VN-2	1,802	ER-1	536*
VN-3	2,905	T-1	2,097
VN-4	2,419	T-2	3,220
VN-5	4,110	T-3	3,994
VN-6	1,937	S-1	1,938
VN-7	837	S-2	3,320
VN-8	1,579	P-1	621
VN-9	3,166	V-1	1,553
VN-10	4,138	V-2	982
H-1	3,740	V-3	655
		V-4	1,151
		V-5	753

* Estimated forebay area.

Specific Yield

Selection of specific yield values is described in Appendix D. From a review of the variation of specific yield with thickness of fill material it was determined that the greatest depth interval that could be utilized and still maintain accuracy with a reasonable amount of computation was 25 feet. The depth interval utilized in the Bulletin 45[1/] study was 50 feet. It is believed that the 25-foot interval gives a more accurate relationship between the specific yield of the materials and the zone of fluctation of the water surface.

Well logs made by drillers are subject to the interpretation of the materials penetrated and the diligence of the driller. Poor logs which had obvious errors in descriptions were not used in the change in storage study. Approximately 560 well logs were utilized in the determination of the change in storage.

1/ California State Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Geology and Ground Water Storage Capacity of Valley Fill." Bulletin 45. 1934.

Water Levels

Ground water levels utilized in the computations are generally based on measurements as of October of each year. The beginning of the water year is considered as the best annual reference point because at this time the water surface has generally recovered from localized effects of heavy summer pumping and it is usually prior to any normal rainfall which might cause abnormalities in the ground water surface. In many instances where measurements in October were not available, measurements in November were utilized. Many of the wells in the San Fernando Valley are only measured twice a year. Prior to 1942 there were numerous monthly readings made from which ground water contour maps were constructed. Subsequent to 1942 semiannual readings were made, partly by the City of Los Angeles Department of Water and Power and partly by the Los Angeles County Flood Control District. In years when precipitation occurred prior to making ground water level measurements, and where water levels were measured subsequent to September 30, the computed change in storage may be in error for that hydrologic year and for the following hydrologic year. The error, however, will compensate during the two-year period involved. Table Q-2 lists the years in which precipitation occurred prior to measurement of ground water levels and the amount of precipitation occurring between the first of October and the date of water level measurement. In evaluating the change in ground water levels within a storage unit the change was determined at the center of the storage unit.

TABLE Q-2

PRECIPITATION DURING PERIODS OF FALL
WATER LEVEL MEASUREMENT, UPPER LOS ANGELES RIVER AREA

Year	Start of fall measurements	Precipitation*, in inches			
		October	November	December	Total
1942	November 10	0.96	0.08	-	1.04
1943	November 2	0.22	0	-	0.22
1944	November 22	0.11	4.66	-	4.77
1945	November 29	0.81	0.14	-	0.95
1946	October 30	0.80	-	-	0.80
1947	December 10	0.04	0.04	1.44	1.52
1948	November 8	0.13	0	-	0.13
1949	November 14	0.01	1.05	0	1.06
1950	November 1	0.36	0	-	0.36
1951	November 6	1.15	0	-	1.15
1952	November 26	0.01	3.82	-	3.83
1953	November 5	T	0	-	T
1954	November 19	T	1.37	-	1.37
1955	November 5	0.01	0	-	0.01
1956	November 23	0.51	0	-	0.51
1957	November 13	2.42	0.27	-	2.69
1958	November 12	0.02	T	-	0.02
1959	December 2	T	0.01	0	0.01

* Precipitation measured at Lockheed Airport Weather Bureau Station between the first of October and the date when the fall well measurements were started.

Sample Computation

The procedures used in the computations are a simplification of methods used in previous determinations in other areas. They were devised to permit a mechanical system and to eliminate, as far as possible, variations in interpretation.

Each of the storage units utilized specific yield values from logs of several wells. For simplicity, the sample computation for the first three years in the 1929-58 period has been made for a hypothetical storage unit containing only two wells with logs.

These logs, which were selected as being representative of those involved in the calculations, are shown in Table Q-3.

Specific Yield

The mean specific yield for each storage unit was computed on the form entitled "Well Group Computations" shown in the upper left portion of Figure Q-2, which is based on Form 136 utilized in Bulletin 45. The computations were broken into 25-foot depth intervals. Within each 25-foot interval the footage of each of the calls of the logs was entered in the appropriate square opposite the assigned specific yield value. The footages for each specific yield value from the separate logs were totaled and entered under total footage. These values were then multiplied by the specific yield and entered under product. The products in each 25-foot interval were added together and divided by the total footage of all the wells in the depth interval and the result entered under total yield in percent. The right-hand column, total yield in percent, represents

TABLE Q-3

LOGS FOR SAMPLE COMPUTATION

STORAGE UNIT X

Sample Log A (3814G)

0 - 15	Sandy loam
15 - 28	Gravel
28 - 39	Clay
39 - 51	Gravel
51 - 112	Clay
112 - 119	Sand and gravel
119 - 150	Blue clay

Sample Log B (3947E)

0 - 27	Brown sandy clay
27 - 30	Dry sandy clay
30 - 53	Dry sandy clay
53 - 64	Blue sand and gravel
64 - 68	Brown clay
68 - 72	Cemented sand and gravel
72 - 74	Blue clay
74 - 110	Hard yellow clay
110 - 114	Hard brown clay
114 - 121	Hard yellow clay
121 - 122	Black clay and gravel
122 - 123	Sandstone
123 - 133	Black clay and sand
133 - 134	White sand cemented
134 - 142	Black clay
142 - 148	Decomposed granite
148 - 150	Hard granite

weighted averages for a composite log and is considered to be located in the center of the storage unit.

Water Levels

Form CS-1, shown in the upper right portion of Figure Q-2, lists the average water surface elevation existing at approximately the beginning of each water year. The elevation of the water surface was obtained from hydrographs of well measurements and ground water contour maps.

Form CS-2, shown in the lower left portion of Figure Q-2, lists the average ground surface elevation of the storage unit as well as elevations for 25-foot intervals below ground surface. The average specific yield for each 25-foot interval is repeated opposite the proper interval.

Change in Storage

The steps in computing change in storage are shown on Form CS-3, shown in the lower right portion of Figure Q-2. Column 2 is the difference in water levels between water years. Column 3 is column 2 multiplied by the number of acres within the storage unit, the number of acres in the storage unit being shown at the top of the form. Column 5 is column 3 multiplied by average specific yield for the 25-foot interval (column 4). When the change in water surface occurs in more than one of the 25-foot intervals, as in 1930-31, a separate computation is made for the change in each different 25-foot interval. Column 6 is a summation of the change in the various 25-foot intervals shown in column 5.

SAMPLE FORMS USED IN CHANGE IN STORAGE COMPUTATIONS

Form 198 — STATE OF CALIFORNIA

INVESTIGATION **WELL GROUP COMPUTATIONS** SHEET 1 of 1

SAN FERNANDO VALLEY — BASIN San Fernando

REFERENCES — GROUP DESIGNATION X

Depth	Yield value	Total footage "A"	Total footage "B"	Group total footage	Group product		Total yield
0-25	2-5		25	25	125	485/50	9.70
	10-14	15		15	150		
	16-19						
	21-26	10		10	210		
25-50	2-5	11	25	11	33 175	452/50	9.04
	10-14						
	15-19						
	21-26	14		14	294		
50-75	2-5	24	7 3	31	15	370/50	7.36
	10-14		4	4	40		
	16-19		11	11	209		
	21-26	1		1	21		
75-100	2-5	25	25	50	150	150/50	3.00
	10-15						
	16-19						
	21-26						
100-125	2-5	18	21 6	39 6	117 20	270/50	5.40
	10-14						
	16-19	7		7	133		
	21-26						
125-150	2-5	33	8 15	33 15	99 75	174/48	3.63
	10-14						
	15-19						
	21-26						

Wt.-148 feet

Form CS-1 — Sheet 1 of __

EXAMPLE

Entered By RHB — Date 7/15/59
Checked By GAB — Date 7/15/59

Storage Unit X

October of year	Water surface elevation of composite well in feet
1928	498.3
29	500.6
1930	501.7
31	496.2
32	
33	
34	
1935	
36	
37	
38	
39	
1940	
41	
42	
43	
44	
1945	
46	
47	
48	
49	
1950	
51	
52	
53	
54	
1955	
56	
57	
58	

Form CS-2

EXAMPLE

Computed By RHB — Date 7/15/59
Checked By GAB — Date 7/15/59

Storage Unit X

Ground surface elevation of composite well in feet	Depths of interval below ground surface in feet	Elevations of interval in feet	Average specific yield of interval
573	0-25	573-548	9.7
	25-50	548-523	9.0
	50-75	523-498	7.4
	75-100	498-473	3.0
	100-125	473-448	5.4
	125-150	448-423	3.6

Form CS-3 — Sheet 1 of __

EXAMPLE

Computed By RHB — Date 7/15/59
Checked By GAB — Date 7/15/59

Storage Unit X - 10,000 Acres

October of year	(1)* Water surface elevation in feet	(2) Difference in elevation (+ or -) in feet	(3)=(2)x10,000 acres Volume of increment (+ or -) in acre-feet	(4)** Average specific yield of respective interval in per cent	(5)=(3)x(4) Change in storage within increment (+ or -) in acre-feet	(6)= sum of column (5) Total change in storage (+ or -) in acre-feet
1928	498.3	+ 2.3	+ 23,000	7.6	+ 1,748	+ 1,748
1929	500.6					
1929	500.6	+ 1.1	+ 11,000	7.6	+ 836	+ 836
1930	501.7					
1930	501.7	- 3.7	- 37,000	7.6	- 2,812	- 3,352
	498.0	- 1.8	- 18,000	3.0	- 540	
1931	496.2					

* From Form CS-1
** From Form CS-2

The change in storage for each of the storage units shown on Figure Q-1 is listed in Table Q-4. These results, summarized by hydrologic subareas in the area of investigation, are also shown in Table Q-4.

The data indicates that heavy pumping continued in the eastern portion of the San Fernando Subarea through the fall of 1956 until the end of January 1957, whereas the heavy pumping stopped by the end of November in other years. Computations showed that cones of depression resulted in an apparent excess of water removed from storage and is reflected by the large change in storage for the year 1955-56 as shown in Table Q-4. Adjustment of change in storage for 1955-56 is difficult due to a lack of water level measurements for January through February 1957. A straight line correction for the years 1955-56 and 1956-57 may be applied to obtain an estimate of change in storage for the year 1955-56 and would result in a modified cumulative change in storage for 1955-56 of minus 308,870 acre-feet.

TABLE Q-4

CHANGE IN STORAGE, BASED ON SPECIFIC YIELD AND WATER LEVELS

In Acre-Feet

Year	San Fernando plus Eagle Rock Hydrologic Subareas														
	C-1	D-2	R-1	R-2	R-3	R-4	V-1	V-2	E-1+E-2	E-3	E-4	E-5	E-6	BC-1	VN-1
1928-29	- 373	-1,579	- 587	- 89	+179	- 371	- 318	-264	- 91	- 571	- 925	+ 190	0	-2,389	- 856
29-30	0	+ 592	0	- 89	- 90	- 742	0	0	+ 182	-1,427	-1,542	+ 380	+1,411	-2,389	- 642
1930-31	+ 746	- 197	+ 587	+ 89	- 90	+ 371	- 318	-264	- 182	- 571	0	-1,139	- 882	-2,389	- 661
31-32	+ 746	- 789	+ 587	0	+179	-1,112	+ 318	+264	+ 91	-3,134	0	+1,329	0	+1,593	+ 875
32-33	0	+1,184	-1,174	+ 89	0	+2,225	+ 318	0	- 91	- 379	- 308	+ 380	+ 176	+2,389	+1,070
33-34	- 373	- 395	0	- 89	0	0	0	0	+ 91	- 379	- 308	-1,708	- 176	0	- 428
34-35	- 373	+ 197	- 549	0	0	- 371	0	+132	- 91	- 758	-4,420	+1,139	+ 882	+1,593	+ 856
1935-36	0	-1,184	- 549	-268	-179	-1,112	- 635	-132	+ 273	+2,653	+4,420	+ 190	+ 353	+ 796	- 214
36-37	+2,427	+ 197	+1,098	+179	+179	-2,225	+ 635	0	- 273	+1,712	+ 617	- 190	-1,234	+1,593	+1,498
37-38	+ 420	+ 987	+1,761	+ 89	- 90	+5,192	0	0	+ 91	+1,997	+1,234	+ 380	+1,411	+3,604	+1,926
38-39	- 841	+1,184	+ 587	+536	- 90	- 744	- 318	+132	0	-1,427	-1,234	- 380	-1,411	+ 608	+ 214
39-40	- 841	- 592	- 587	- 89	+179	+1,112	- 318	-132	+ 182	+ 285	- 308	+ 380	0	- 608	- 642
1940-41	+2,942	+1,184	+3,523	+358	+449	+ 371	+1,906	+529	+ 91	+1,427	+2,467	+1,329	+1,587	+5,468	+1,848
41-42	-1,681	+ 592	+ 587	+ 89	-359	+ 371	0	-132	+ 91	- 285	+2,467	- 380	-1,763	+1,215	- 452
42-43	+1,261	0	+1,761	+ 89	+179	+ 742	+ 318	+132	- 182	+1,427	+ 617	-1,329	+ 176	+3,645	+ 452
43-44	+ 420	+ 789	+1,761	+830	+269	+ 742	+ 500	+132	+ 182	+ 856	-5,243	+3,705	+2,292	+3,645	+ 301
44-45	- 841	+ 197	+1,761	-383	-269	+ 371	- 818	-529	- 182	- 285	+2,159	-3,895	-2,469	+1,108	- 904
1945-46	0	+1,423	-1,174	+383	+179	+ 742	0	0	+ 364	0	- 617	0	- 529	-4,753	- 817
46-47	- 420	- 685	0	-383	0	- 742	- 635	0	- 182	- 856	+ 617	- 380	+ 529	-1,822	-1,284
47-48	- 841	+ 343	- 587	+383	+359	- 742	- 318	-132	0	-1,141	0	+ 190	+ 882	-3,038	-2,140
48-49	+ 420	+ 343	- 587	0	-179	- 371	- 635	0	- 364	+ 571	+ 308	+ 759	- 882	-3,645	-2,605
49-50	- 420	- 343	+1,174	+115	-628	0	- 318	-132	+ 91	-2,853	-1,542	- 380	+ 353	-1,822	- 447
1950-51	+ 420	+1,028	0	+689	+449	+ 371	- 318	-132	0	+1,141	+1,234	+ 569	+ 353	-2,808	-2,233
51-52	+ 841	+2,056	+1,761	+230	+269	-4,079	+ 635	+132	- 182	-1,141	- 308	-2,088	+ 705	+1,593	-1,117
52-53	- 841	- 343	-1,174	0	-449	0	0	0	+ 182	-3,322	+1,234	+3,417	- 529	-1,593	-1,224
53-54	- 420	0	- 587	-919	+359	+ 371	0	0	- 638	-4,547	- 617	-3,037	- 705	-3,185	-1,656
54-55	- 420	-1,028	- 587	+575	-538	-1,483	+ 318	-132	0	+ 758	-2,159	+ 380	- 705	-4,778	-1,325
1955-56	- 420	- 343	-2,935	-804	-179	- 371	+ 953	0	- 456	-5,002	+3,392	+ 380	+1,234	-3,185	-1,202
56-57	0	- 685	+1,761	+345	+ 90	-1,483	+ 635	-396	+1,002	+ 303	- 617	+2,639	+ 529	-3,185	+ 125
57-58	+ 420	+1,028	- 587	+689	0	+ 742	+1,250	+132	- 638	-3,031	- 925	-1,310	0	+ 796	-1,247

CHANGE IN STORAGE, BASED ON SPECIFIC YIELD AND WATER LEVELS
(continued)

In Acre-Feet

Year	San Fernando plus Eagle Rock Hydrologic Subareas														
	VN-2	VN-3	VN-4	VN-5	VN-6	VN-7	VN-8	VN-9	VN-10	H-1	MH-1	MH-2	MH-3	MH-4	B-1
1928-29	- 476	0	+ 215	-2,137	-2,708	- 733	- 1,003	- 2,508	- 8,714	- 1,819	- 89	- 188	-1,314	-2,488	- 387
29-30	- 634	- 241	0	- 164	+ 225	- 105	- 549	- 2,280	- 8,566	- 910	- 74	- 188	- 262	+ 622	- 194
1930-31	- 159	- 723	- 431	-1,972	-1,123	- 523	- 742	- 1,140	- 3,186	- 910	- 74	- 376	-1,314	-1,244	- 97
31-32	+ 193	+ 964	+ 646	+1,315	+2,247	+1,464	+ 2,495	+ 6,839	+11,752	+ 4,995	+ 74	+ 282	+1,840	+3,732	+ 290
32-33	+ 476	+ 723	+ 431	+ 822	+1,130	+ 523	+ 1,003	+ 3,191	+ 571	+ 1,788	+ 341	+ 470	+1,840	+2,205	+ 290
33-34	0	+ 282	+ 968	0	-1,130	- 523	- 1,404	- 912	- 6,281	- 1,788	- 267	- 376	-1,840	-2,828	+ 290
34-35	+ 317	+1,127	0	- 493	+1,360	+ 837	+ 2,005	+ 3,191	+16,213	+ 4,469	+ 133	+ 94	+2,103	+3,847	0
1935-36	- 476	+ 282	+ 358	+ 493	+ 461	- 209	- 602	- 912	+ 2,383	- 2,682	- 44	+ 188	- 262	-1,981	+ 677
36-37	+1,427	+1,972	+1,432	+ 493	+ 461	+ 523	+ 1,805	+ 3,191	- 2,383	+ 3,575	+ 89	+ 460	+1,314	+4,018	- 290
37-38	+1,768	+ 564	+ 716	+2,030	+3,227	+1,435	+ 3,144	+ 6,595	+13,300	+ 5,363	+ 89	+ 634	+3,578	+4,076	+ 509
38-39	+ 196	0	+1,969	- 193	- 231	- 201	- 1,017	- 1,608	- 3,766	- 4,022	- 44	+ 91	- 286	-2,038	+ 488
39-40	- 982	- 564	-1,611	0	-1,153	- 711	- 1,926	- 5,443	- 2,383	- 1,788	0	- 272	-2,766	-3,736	- 244
1940-41	+2,750	+3,100	+1,790	+2,125	+2,914	+2,117	+ 5,740	+12,348	+10,667	+10,581	+ 133	+ 634	+5,625	+8,491	+ 488
41-42	- 982	-1,409	0	- 580	- 227	- 703	- 2,288	- 472	- 4,519	- 6,558	- 133	0	-1,715	-3,057	0
42-43	+ 589	+1,691	- 358	+1,932	+ 680	+1,004	+ 2,796	+ 1,415	+ 3,766	+ 5,498	- 89	- 181	-1,715	+3,736	+ 366
43-44	+ 393	+ 282	0	+ 773	+ 302	+ 301	+ 508	+ 1,887	+17,851	+ 3,180	+ 222	+ 543	+ 572	+ 340	+ 731
44-45	- 589	-1,409	- 537	- 773	- 755	-1,205	- 3,559	- 4,106	-24,630	- 9,570	- 44	- 272	-3,431	-5,434	-1,219
1945-46	-1,375	- 564	- 537	- 773	-1,070	- 904	- 2,796	- 4,021	- 3,136	+ 1,341	- 89	- 543	-2,241	-1,359	- 610
46-47	-1,375	-1,127	0	0	- 231	- 100	- 201	- 1,608	- 5,959	- 4,022	- 89	- 453	-1,051	-2,717	- 993
47-48	+ 196	-1,409	- 716	-1,545	-1,614	-1,033	- 2,807	- 4,987	+ 1,192	- 3,128	- 281	- 829	-4,205	-3,253	-1,355
48-49	-2,175	-2,536	-1,074	- 386	-2,536	-1,465	- 2,302	- 5,471	- 7,746	- 3,137	- 444	-1,034	-2,731	-5,598	+ 387
49-50	- 634	-1,488	-1,183	-1,788	-1,815	- 628	- 742	- 4,103	- 2,284	- 2,274	- 666	- 940	-1,214	-1,232	-2,322
1950-51	-1,427	-1,447	-1,722	- 822	-1,348	-1,151	- 1,781	- 5,015	-10,279	- 2,274	- 913	- 746	-2,914	-4,268	- 677
51-52	0	- 723	0	- 329	- 899	- 105	+ 594	+ 3,419	+ 2,284	+13,048	- 481	- 373	0	+2,439	- 342
52-53	- 503	- 964	-1,292	- 986	-1,123	- 314	- 1,484	- 4,559	- 8,574	- 6,257	-1,427	- 840	-1,992	-5,183	- 799
53-54	-2,042	-2,394	-1,722	-1,644	-1,326	-1,262	- 2,136	- 4,559	- 5,230	- 3,152	- 896	-1,294	-2,988	- 319	- 913
54-55	+ 742	-2,118	- 718	- 329	- 746	-1,169	- 2,136	- 4,511	- 7,248	- 3,638	- 299	- 754	-4,158	-2,873	- 963
1955-56	-3,930	-3,530	-3,592	-1,644	- 678	-1,164	- 3,223	- 5,224	- 6,368	- 1,364	-1,066	- 462	-1,214	+5,504	-3,290
56-57	+6,366	-1,177	- 958	- 164	-1,075	- 203	+ 1,200	- 4,702	- 4,246	- 1,819	+ 168	- 129	+ 729	-1,074	+ 658
57-58	-7,141	- 706	- 999	+ 493	-1,612	-1,215	- 2,400	+ 522	+ 5,661	+11,314	- 898	- 386	-2,186	+ 358	+1,809

TABLE Q-4

CHANGE IN STORAGE, BASED ON SPECIFIC YIELD AND WATER LEVELS
(continued)

In Acre-Feet

Year	San Fernando plus Eagle Rock Hydrologic Subareas														
	B-2	B-3	B-4	B-5	B-6	0-1	N-1	N-2	N-3	N-4	ER-1	T-1	T-2	T-3	Total
1928-29	- 812	-1,357	- 456	- 634	-1,245	-1,043	- 542	- 352	- 352	- 266	- 93	0	-1,555	- 503	- 41,603
29-30	- 812	0	- 456	+ 91	- 583	- 862	+1,083	+1,409	+2,611	+ 521	- 93	0	-1,020	0	- 15,787
1930-31	- 0	0	- 912	+ 181	-1,635	-2,155	- 271	- 176	- 499	- 122	- 93	+ 214	-1,530	- 503	- 26,415
31-32	+1,015	+ 228	+ 456	+ 272	+2,218	+3,017	+1,896	+2,770	+1,498	+1,220	+278	+ 428	+7,314	+4,026	+ 67,311
32-33	+1,218	+ 528	+ 912	0	+1,556	+2,086	+ 813	+ 388	+ 125	+ 122	- 93	- 214	-1,070	-3,510	+ 26,544
33-34	0	- 150	- 684	- 362	-1,556	-1,043	- 542	-1,045	-1,498	0	- 93	0	-1,601	- 503	- 28,651
34-35	- 203	+ 300	+ 228	+ 272	+2,178	+ 522	0	- 352	- 301	- 122	0	0	+1,070	+1,006	+ 38,038
1935-36	+ 812	- 300	0	0	- 622	+ 522	0	+ 528	+ 925	+ 122	- 93	- 428	-2,649	0	+ 903
36-37	- 203	- 150	+ 912	- 91	+1,867	0	+ 271	- 528	+ 125	- 244	+185	+ 214	+3,184	+1,006	+ 30,848
37-38	+1,285	- 343	+2,053	0	+3,111	0	-3,521	-1,057	-2,282	- 610	+185	+ 642	+ 535	+2,013	+ 66,609
38-39	- 473	+ 643	- 684	0	- 311	+ 522	+ 271	+1,409	+1,783	+ 122	-185	0	+ 535	-2,516	- 12,730
39-40	+ 237	0	0	- 91	-2,489	- 522	0	- 528	-1,255	- 122	-185	- 214	-1,605	- 503	- 32,835
1940-41	+1,420	+ 600	+ 912	+ 181	+4,986	+1,043	0	+ 704	+1,629	+ 122	+ 93	+2,567	+2,674	+5,032	+116,945
41-42	- 473	- 300	+ 684	+ 181	-1,563	+ 522	0	- 352	0	- 122	+ 93	- 856	-2,139	-4,529	- 31,137
42-43	+ 473	+ 300	-1,140	+ 181	+ 937	- 522	- 542	0	- 499	0	+ 93	+ 856	+1,070	- 503	+ 31,122
43-44	+ 237	-1,014	+ 684	- 181	+ 940	- 522	+ 271	-1,233	-1,306	0	+ 93	+1,560	+1,070	+7,633	+ 47,298
44-45	- 947	+ 264	- 456	- 91	-3,434	-1,043	+ 271	- 528	- 352	0	0	-1,774	+ 535	-4,110	- 74,177
1945-46	-1,556	- 150	- 684	0	-2,489	-1,996	0	-1,409	- 880	- 122	-185	-1,069	+ 535	0	- 33,481
46-47	-1,218	- 685	-1,596	- 453	-1,556	-1,293	0	- 352	- 528	- 122	+ 93	-1,497	-2,674	-3,019	- 41,069
47-48	-1,856	- 914	-1,368	-1,177	-4,318	-1,724	- 542	- 344	- 880	- 244	-185	-2,661	-2,674	-1,510	- 52,953
48-49	-2,000	- 228	-1,825	+ 362	-2,995	- 862	+ 271	- 168	-1,182	0	-464	-1,566	-1,555	+ 503	- 56,824
49-50	-1,298	- 343	-2,053	- 930	-1,688	-1,293	- 271	- 337	-1,753	- 399	0	-1,044	- 510	-1,006	- 43,390
1950-51	-1,113	-2,798	-2,743	-1,546	-3,908	-1,724	0	-1,347	-2,074	0	+185	0	-1,020	+1,006	- 53,103
51-52	-1,917	+ 755	0	+ 412	0	- 431	+ 271	- 168	+ 480	- 133	+278	+4,630	+8,968	+3,019	+ 34,003
52-53	- 496	-2,264	-4,592	-1,941	-3,257	0	- 594	-2,672	-3,048	- 665	- 93	+2,139	-6,928	-3,019	- 68,369
53-54	-2,478	+1,057	- 902	- 938	-2,124	-3,017	- 323	-1,139	-1,602	- 532	+185	+2,617	+1,580	-1,510	- 56,584
54-55	-1,487	- 453	-1,848	-1,055	-2,942	-1,332	+ 646	0	+ 319	+ 399	- 93	0	-1,070	- 503	- 51,461
1955-56	-4,213	-4,623	-1,939	- 806	-4,177	- 888	- 323	- 325	-1,434	0	- 93	-1,975	0	+ 503	- 71,484
56-57	+ 496	+ 645	- 129	- 95	-1,235	-1,332	+ 323	- 163	- 159	- 399	+ 93	+ 642	-1,020	+1,510	- 6,186
57-58	-1,735	-1,877	-2,201	-1,333	+1,852	-1,332	0	-1,139	-4,580	- 133	+ 93	-1,283	+3,159	+1,510	- 9,066

CHANGE IN STORAGE, BASED ON SPECIFIC YIELD AND WATER LEVELS
(continued)

In Acre-Feet

Year	Sylmar Hydrologic Subarea				Verdugo Hydrologic Subarea*						Total Valley Fill Area	
	S-1	S-2	P-1	Total	V-1	V-2	V-3	V-4	V-5	Total	Total	Cumulative total
1928-29	0	0	- 65	- 65	- 511	-344	- 101	- 147	- 267	-1,370	- 43,038	- 43,038
29-30	+ 169	+ 315	-190	+ 294	- 511	-344	- 101	- 147	- 267	-1,370	- 16,863	- 59,901
1930-31	0	+1,262	-243	+1,019	- 292	-196	- 101	- 442	- 400	-1,431	- 26,827	- 86,728
31-32	+1,195	+ 830	+433	+2,458	+ 73	+ 49	- 202	+ 147	0	+ 67	+ 69,836	- 16,892
32-33	+ 180	- 514	-190	- 524	+ 292	+196	- 202	- 147	- 400	- 261	+ 25,759	+ 6,867
33-34	- 529	+ 514	- 61	- 76	+ 584	+393	+ 101	0	+ 533	+1,611	- 27,116	- 18,249
34-35	- 169	-1,145	+187	-1,127	+ 219	+147	+ 504	0	+ 800	+1,670	+ 38,581	+ 20,332
1935-36	- 169	- 315	-248	- 732	+ 146	+ 98	+ 511	- 147	- 267	+ 341	+ 512	+ 20,844
36-37	+ 169	+ 315	+893	+1,377	+ 469	+246	+ 817	+1,284	+1,200	+4,016	+ 36,241	+ 57,085
37-38	+ 518	+1,544	-194	+1,868	+ 969	+687	+1,877	+2,279	+2,132	+7,944	+ 76,421	+133,506
38-39	0	+ 598	-452	+ 146	+1,025	- 49	- 186	+1,241	+ 449	+2,480	- 10,104	+123,402
39-40	-1,703	-1,826	-126	-3,655	- 75	- 49	- 93	-1,114	- 785	-2,116	- 38,606	+ 84,796
1940-41	+2,782	+2,424	+836	+6,042	+ 820	+737	+ 372	+1,721	+1,380	+5,030	+128,017	+212,813
41-42	- 360	- 797	-452	-1,609	0	+ 98	- 372	- 203	- 731	-1,408	- 34,154	+178,659
42-43	- 901	+ 598	+323	+ 20	+ 224	0	+ 558	+ 608	0	+1,390	+ 32,532	+211,191
43-44	+1,622	0	-129	+1,493	+ 149	- 49	+ 186	- 405	+ 449	+ 330	+ 49,121	+260,312
44-45	+ 360	- 398	-258	- 296	- 373	-393	- 186	-1,721	0	-2,673	- 77,146	+183,166
1945-46	+ 901	0	+ 65	+ 966	- 373	-344	-2,361	-1,139	-1,459	-5,676	- 38,191	+144,975
46-47	-1,262	- 197	- 65	-1,526	- 224	-295	-1,427	-1,814	-1,501	-5,261	- 47,856	+ 97,119
47-48	-1,622	- 598	-258	-2,478	- 298	-344	0	-3,241	-2,799	-6,682	- 62,113	+ 35,006
48-49	-1,353	-2,921	0	-4,274	- 230	-295	-1,009	-2,319	-4,367	-8,220	- 69,318	- 34,312
49-50	- 169	+ 315	-122	+ 24	+ 81	- 98	- 605	- 511	-1,118	-2,251	- 45,617	- 79,929
1950-51	- 338	- 315	- 61	- 714	- 646	- 98	+1,412	- 632	- 373	- 337	- 54,154	-134,083
51-52	+2,041	+1,262	+635	+3,938	+ 81	-196	+2,650	+2,165	+4,721	+9,421	+ 47,362	- 86,721
52-53	- 857	-1,577	-129	-2,563	+ 81	+638	- 307	- 767	-1,242	-1,597	- 72,529	-159,250
53-54	- 330	- 315	-129	- 782	- 81	-196	- 613	-1,761	- 497	-3,148	- 60,514	-219,764
54-55	- 846	+ 315	- 65	- 596	- 81	-196	- 920	+2,527	- 745	+ 585	- 51,472	-271,236
1955-56	- 508	-1,577	-190	-2,275	+ 323	- 49	+ 204	0	+1,864	+2,342	- 71,417	-342,653
56-57	0	-1,262	-243	-1,505	0	+442	+ 409	+1,592	+1,491	+3,934	- 3,757	-346,410
57-58	+ 677	- 946	+498	+ 229	- 162	- 49	+1,226	+ 884	+2,666	+4,565	- 4,272	-350,682

* Includes the portion of the Monk Hill Basin within the Upper Los Angeles River area.

APPENDIX R

GROUND WATER RECHARGE AND SAFE YIELD

APPENDIX R

TABLE OF CONTENTS

TABLES

APPENDIX R

GROUND WATER RECHARGE AND SAFE YIELD

Contained herein are tables and computations which support and elaborate on determinations made in Chapters VI and VII.

Ground Water Recharge

The ground water recharge is determined in this report as supply less the consumptive use and outflows of that supply. The consumptive use adopted by the Referee is based on the unit consumptive use values listed in Tables L-13, L-14 and L-15, the land use shown in Table K-6, and the adjustments to consumptive use determined in Chapter VI. The annual adjustment to the consumptive use of rain is expressed as 30 percent of the difference between annual precipitation on the pervious valley fill area in acre-feet and the 29-year average precipitation thereon. In years when precipitation is above normal, the adjusted consumptive use of rain is greater than the unadjusted value and in years of below normal precipitation the adjusted value is less than the unadjusted value. The consumptive use of delivered water is adjusted by reducing its annual amount by an amount equal to five percent of the sum of consumptive use and deep percolation for residential land use areas. For convenience, the adjustment of the consumptive use of delivered water may be made by adjusting the unit value of consumptive use for residential land use areas. The adjusted unit values for consumptive use of delivered water on residential land use areas are shown in Table R-1.

TABLE R-1

FINAL ADJUSTED UNIT DEPTHS OF CONSUMPTIVE USE OF RESIDENTIAL DELIVERED WATER

In Acre-Feet Per Gross Acre

Year	Consumptive use		
	San Fernando and Eagle Rock Subareas	Sylmar Subarea	Verdugo Subarea
1928-29	0.77	0.74	0.57
29-30	0.76	0.71	0.62
1930-31	0.67	0.66	0.60
31-32	0.39	0.38	0.53
32-33	0.37	0.37	0.61
33-34	0.41	0.40	0.77
34-35	0.31	0.30	0.66
1935-36	0.39	0.36	0.66
36-37	0.35	0.32	0.72
37-38	0.34	0.34	0.67
38-39	0.49	0.47	0.77
39-40	0.45	0.45	0.84
1940-41	0.33	0.33	0.62
41-42	0.50	0.49	0.89
42-43	0.56	0.55	0.74
43-44	0.56	0.56	0.73
44-45	0.69	0.67	0.73
1945-46	0.75	0.79	0.83
46-47	0.91	0.90	0.84
47-48	1.05	1.04	0.99
48-49	1.11	1.10	0.87
49-50	1.07	1.04	0.82
1950-51	1.14	1.12	0.93
51-52	0.95	0.93	0.77
52-53	1.18	1.15	0.98
53-54	1.12	1.11	0.92
54-55	1.10	1.10	0.92
1955-56	1.06	1.05	0.98
56-57	1.21	1.22	0.98
57-58	1.01	1.00	0.97
29-Year Average 1929-57	0.72	0.71	0.78

Safe Yield

The method for determining safe yield is discussed in Chapter VII. The safe yield for any year is computed by superimposing the land use in existence during the safe yield year over a normal period of precipitation. The magnitude and regimen of occurrence of annual precipitation during the 29-year base period, 1928-29 through 1956-57, have been taken as equivalent to a long-time mean or normal precipitation. The varying land use trends and economic conditions occurring during the 29-year base period have been considered in the determination of safe yield. The variation in the composition of residential land use areas has been compensated for by adjusting the weighted unit values for residential areas to reflect the composition existing during each of the safe yield years (see Appendix L). The change between economic conditions existing during the earlier years of the base period and those existing in the latter years was significant; therefore, the mean for the 29-year base period could not be used to determine averages for items influenced by economics. The 9-year subperiod of normal precipitation on the valley floor was utilized as being representative of economic conditions extant during the safe yield years.

Adjustment of Weighted Unit Values Under Safe Yield Conditions

The weighted unit values for consumptive use and deep percolation shown in Tables L-13, L-14 and L-15 are weighted according to the percent impervious and types of land use within each classification. Under safe yield culture conditions, all of the land use classes with the exception of residential have a constant percent of the area impervious during the base period. As discussed in Appendix L, percentages of residential lot areas containing deciduous trees, lawns, gardens, native vegetation and impervious areas have varied during the 29-year base period. The adjusted unit values for residential land use classes were therefore reweighted to correspond to the percentages which existed in each safe yield year. The mean weighted unit depths of consumptive use and deep percolation for the 9-year subperiod for each land use class and hydrologic subarea are shown in Table R-2.

Average Consumptive Use and Deep Percolation of Delivered Water and Average Consumptive Use of Precipitation for Safe Yield Computation

The average amounts of consumptive use and deep percolation of delivered water for the various land use classes within each subarea for the three safe yield years are shown in Table R-3. With the exception of water surface and commercial and industrial land use, which are discussed and derived in Chapter VII of this report, these average amounts are the product of the 9-year average weighted depths of consumptive use and deep percolation (Table R-2) and the acreage of each type of land use (Table K-6) in each subarea.

Table R-4 itemizes the average consumptive use of precipitation under safe yield culture. These amounts were computed utilizing the 9-year average weighted depths of consumptive use of precipitation (Table R-2) and the acreage of each land use class (Table K-6).

TABLE R-2

MEAN WEIGHTED DEPTHS OF CONSUMPTIVE USE AND DEEP PERCOLATION, 9-YEAR SUBPERIOD 1949-50 THROUGH 1957-58

In Acre-Feet Per Gross Acre

Culture class	Consumptive use			Deep percolation		
	Rain	Delivered: water	Total	Rain	Delivered: water	Total
San Fernando Subarea						
Deciduous	1.12	1.40	2.52	0.17	0.20	0.37
Citrus	1.04	1.54	2.58	0.25	0.36	0.61
Walnuts	1.10	1.44	2.54	0.19	0.25	0.44
Truck	1.07	1.62	2.69	0.22	0.54	0.76
Alfalfa and pasture	1.11	1.84	2.95	0.18	0.27	0.45
Vineyard	1.12	1.09	2.21	0.17	0.23	0.40
Lawn grass	1.04	2.63	3.67	0.29	0.57	0.86
Dry farm and native vegetation	1.16	--	1.16	0.13	--	0.13
Miscellaneous	0.81	--	0.81	0.07	--	0.07
Commercial and industrial	0.43	--	--	--	--	--
Residential[a]						
1949-50	0.72	1.09	1.81	0.22	0.23	0.45
1954-55	0.68	1.09	1.77	0.21	0.23	0.44
1957-58	0.66	1.09	1.76	0.21	0.22	0.43
Sylmar Subarea						
Deciduous	1.20	1.33	2.53	0.25	0.23	0.48
Citrus	1.11	1.47	2.58	0.33	0.36	0.69
Walnuts	1.17	1.39	2.56	0.27	0.26	0.53
Truck	1.15	1.43	2.58	0.29	0.56	0.85
Alfalfa and pasture	1.21	1.77	2.98	0.24	0.29	0.53
Vineyard	1.21	1.05	2.26	0.24	0.23	0.47
Lawn grass	1.15	2.52	3.67	0.39	0.69	1.08
Dry farm and native vegetation	1.28	--	1.28	0.16	--	0.16
Miscellaneous	0.93	--	0.93	0.09	--	0.09
Commercial and industrial	0.50	--	--	--	--	--
Residential[a]						
1949-50	0.89	1.07	1.96	0.27	0.24	0.51
1954-55	0.86	1.07	1.93	0.27	0.24	0.51
1957-58	0.82	1.08	1.90	0.28	0.23	0.51

TABLE R-2

MEAN WEIGHTED DEPTHS OF CONSUMPTIVE USE AND DEEP PERCOLATION, 9-YEAR SUBPERIOD 1949-50 THROUGH 1957-58 (continued)

In Acre-Feet Per Gross Acre

Culture class	Consumptive use			Deep percolation		
	Rain	Delivered water	Total	Rain	Delivered water	Total
Verdugo Subarea						
Deciduous	1.28	1.30	2.58	0.43	0.26	0.69
Citrus	1.18	1.43	2.61	0.51	0.42	0.93
Truck	1.23	1.51	2.74	0.46	0.60	1.06
Lawn grass	1.28	2.39	3.67	0.55	0.81	1.36
Dry farm and native vegetation	1.40	--	1.40	0.29	--	0.29
Miscellaneous	1.00	--	1.00	0.16	--	0.16
Commercial and industrial	0.49	--	--	--	--	--
Residential[a]						
1949-50	0.95	0.92	1.87	0.44	0.23	0.67
1954-55	0.95	0.92	1.87	0.44	0.23	0.67
1957-58	0.87	0.93	1.80	0.45	0.22	0.67

a. Adjusted to percentages of residential lot impervious for each safe yield year.

TABLE R-3

CONSUMPTIVE USE AND DEEP PERCOLATION OF DELIVERED WATER UNDER SAFE YIELD CULTURE

Land use class	Safe yield year 1949-50 Acreage In acres	1949-50 Consumptive use In acre-feet	1949-50 Deep percolation In acre-feet	1954-55 Acreage In acres	1954-55 Consumptive use In acre-feet	1954-55 Deep percolation In acre-feet	1957-58 Acreage In acres	1957-58 Consumptive use In acre-feet	1957-58 Deep percolation In acre-feet
San Fernando and Eagle Rock Subareas									
Deciduous	420	590	80	510	710	100	380	530	80
Citrus	10,480	16,140	3,770	7,780	11,980	2,800	4,440	6,840	1,600
Walnuts	4,230	6,090	1,060	2,910	4,190	730	1,160	1,670	290
Truck	4,870	7,890	2,630	4,350	7,050	2,350	3,730	6,040	2,010
Alfalfa	8,770	16,140	2,370	4,320	7,950	1,170	2,720	5,000	730
Vineyard	190	210	40	100	110	20	60	70	10
Lawn grass	1,780	4,680	1,010	1,860	4,890	1,060	2,090	5,500	1,190
Residential	42,060	45,850	9,670	49,840	54,330	11,460	56,900	62,590	12,520
Water surface*		3,560	0		3,560	0		3,560	0
Commercial and industrial*		5,750	0		9,660	970		12,100	2,000
Subtotal		106,900	20,630		104,430	20,660		103,900	20,430
Sylmar Subarea									
Deciduous	570	760	130	780	1,040	180	590	780	140
Citrus	590	870	210	580	850	210	430	630	150
Walnuts	20	30	10	10	10	0	0	0	0
Truck	1,060	1,520	590	260	370	150	240	340	130
Alfalfa	30	50	10	80	140	20	40	70	10
Vineyard	20	20	0	30	30	10	20	20	0
Lawn grass	40	100	30	40	100	30	40	100	30
Residential	900	960	220	1,310	1,400	310	1,560	1,680	360
Commercial and industrial*		40	0		90	0		140	0
Subtotal		4,350	1,200		4,030	910		3,760	820
Verdugo Subarea**									
Deciduous	30	40	10	10	10	0	10	10	0
Citrus	10	10	0	10	10	0	10	10	0
Truck	10	20	10	20	30	10	60	90	40
Lawn grass	110	260	90	120	290	100	150	360	120
Residential	2,030	1,870	470	2,750	2,530	630	3,200	2,980	700
Commercial and industrial*		140	0		190	0		210	0
Subtotal		2,340	580		3,060	740		3,660	860
Total for three subareas		113,590	22,410		111,520	22,310		111,320	22,110
Delivered water retention (Sum of consumptive use and deep percolation) in acre-feet.		136,000			133,830			133,430	

* See Chapter VII for source and derivation of the values for this land use class.

** Includes portion of Monk Hill Basin within Upper Los Angeles River area.

TABLE R-4

CONSUMPTIVE USE OF PRECIPITATION UNDER SAFE YIELD CULTURE

Land use class	Safe yield year					
	1949-50		1954-55		1957-58	
	Acreage In acres	Consumptive use In acre-feet	Acreage In acres	Consumptive use In acre-feet	Acreage In acres	Consumptive use In acre-feet
	San Fernando Subarea					
Deciduous	420	470	510	570	380	430
Citrus	10,480	10,900	7,780	8,090	4,440	4,620
Walnuts	4,230	4,650	2,910	3,210	1,160	1,280
Truck	4,870	5,210	4,350	4,650	3,730	3,990
Alfalfa	8,770	9,730	4,320	4,800	2,720	3,020
Vineyard	190	210	100	110	60	70
Lawn grass	1,780	1,850	1,860	1,930	2,090	2,170
Dry farm and native	24,630	28,570	24,870	28,850	24,090	27,940
Miscellaneous	1,770	1,430	1,900	1,540	2,720	2,200
Water surface	960	1,320	960	1,320	960	1,320
Riparian	300	410	260	360	200	280
Commercial and industrial	12,340	5,310	13,140	5,650	13,350	5,740
Residential	42,060	30,280	49,840	33,890	56,900	37,550
Subtotal		100,340		94,970		90,610
	Sylmar Subarea					
Deciduous	570	680	780	940	590	710
Citrus	590	650	580	640	430	470
Walnuts	20	20	10	10	0	0
Truck	1,060	1,220	260	300	240	280
Alfalfa	30	40	80	100	40	50
Vineyard	20	20	30	40	20	20
Lawn grass	40	50	40	50	40	50
Dry farm and native	2,170	2,780	2,270	2,910	2,430	3,110
Miscellaneous	150	140	130	120	80	70
Commercial and industrial	50	30	110	60	170	90
Residential	900	800	1,310	1,130	1,560	1,280
Subtotal		6,430		6,300		6,130
	Verdugo Subarea					
Deciduous	30	40	10	10	10	10
Citrus	10	10	10	10	10	10
Truck	10	10	20	20	60	70
Lawn grass	110	140	120	150	150	190
Dry farm	2,300	3,220	1,590	2,230	1,220	1,710
Miscellaneous	320	320	260	260	80	80
Riparian	30	60	20	40	20	40
Commercial and industrial	160	80	220	110	250	120
Residential	2,030	1,930	2,750	2,610	3,200	2,780
Subtotal		5,810		5,440		5,010
Total for three subareas		112,580		106,710		101,750

Modifications of Runoff Items to Suit Safe Yield Conditions

Items of runoff, which are modified to reflect safe yield conditions in the stream system, consist of residual rain, additional hill and mountain runoff due to residential development, runoff to reservoirs and native spread water. Native spread water has been discussed and derived in Chapter VII and the estimated amounts apread under safe yield conditions are shown in Table 49.

The calculations for residual rain and additional hill and mountain runoff due to residential development are shown in Tables R-5 and R-6 respectively. The source and derivations of the tables are described therein.

Ground Water Reservoir Operations Under Safe Yield Conditions

The theoretical operation of the ground water reservoir under safe yield conditions was made for the safe yield years 1949-50 and 1957-58. The safe yield years for which the study was made represented the maximum and minimum safe yield pumpage for which safe yield was determined under the Order of Reference.

By definition, the safe yield of the ground water reservoir of the Upper Los Angeles River area is the maximum average annual pumping draft which can be continually withdrawn for useful purposes under a given set of conditions without causing an undesired result. The conditions imposed upon the ground water reservoir are:

1. A period of normal precipitation was taken as the 29-year base period from 1928-29 through 1956-57.

TABLE R-5

RESIDUAL RAIN FOR SAFE YIELD COMPUTATION

Year	San Fernando and Eagle Rock Subareas: Depth of residual rain, in feet	Residual rain in acre-feet, Safe yield year: 1949-50	1954-55	1957-58	Sylmar Subarea: Depth of residual rain, in feet	Residual rain in acre-feet, Safe yield year: 1949-50	1954-55	1957-58	Verdugo Subarea: Depth of residual rain, in feet	Residual rain in acre-feet, Safe yield year: 1949-50	1954-55	1957-58	Total residual rain, in acre-feet, Safe yield year: 1949-50	1954-55	1957-58
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1928-29	0.56	15,970	18,920	22,010	0.67	570	700	800	0.99	1,160	1,470	1,680	17,700	21,090	24,490
29-30	0.73	20,810	24,660	28,700	0.96	820	1,000	1,150	0.97	1,130	1,440	1,650	22,760	27,100	31,500
1930-31	0.91	25,940	30,740	35,770	1.02	870	1,060	1,220	1.02	1,190	1,510	1,730	28,000	33,310	38,720
31-32	1.22	34,780	41,210	47,960	1.31	1,110	1,360	1,570	1.67	1,950	2,470	2,840	37,840	45,040	52,370
32-33	0.86	24,520	29,050	33,810	0.84	710	870	1,010	1.17	1,370	1,730	1,990	26,600	31,650	36,810
33-34	0.97	27,650	32,770	38,130	1.02	870	1,060	1,220	1.77	2,070	2,620	3,010	30,590	36,450	42,360
34-35	1.09	31,080	36,820	42,850	1.21	1,030	1,260	1,450	1.82	2,130	2,690	3,090	34,240	40,770	47,400
1935-36	0.65	18,530	21,960	25,550	0.92	780	960	1,100	1.17	1,370	1,730	1,990	20,680	24,650	28,640
36-37	1.43	40,770	48,310	56,210	1.62	1,380	1,680	1,940	2.20	2,570	3,260	3,740	44,720	53,250	61,890
37-38	1.62	46,190	54,720	63,680	1.76	1,500	1,830	2,110	2.81	3,290	4,160	4,780	50,980	60,710	70,570
38-39	1.40	39,910	47,290	55,030	1.48	1,260	1,540	1,780	1.77	2,070	2,620	3,010	43,240	51,450	59,820
39-40	0.97	27,650	32,770	38,130	1.02	870	1,060	1,220	1.26	1,470	1,860	2,140	29,990	35,690	41,490
1940-41	2.77	78,970	93,570	108,890	2.68	2,280	2,790	3,220	3.33	3,900	4,930	5,660	85,150	101,290	117,770
41-42	0.60	17,110	20,270	23,590	0.51	430	530	610	0.91	1,060	1,350	1,550	18,600	22,150	25,750
42-43	1.64	46,760	55,400	64,470	1.82	1,550	1,890	2,180	2.94	3,440	4,350	5,000	51,750	61,640	71,650
43-44	1.64	46,760	55,400	64,470	1.65	1,400	1,720	1,980	1.95	2,280	2,890	3,320	50,440	60,010	69,770
44-45	0.78	22,240	26,350	30,660	0.90	770	940	1,080	1.44	1,680	2,130	2,450	24,690	29,420	34,190
1945-46	0.75	21,380	25,340	29,480	0.89	760	930	1,070	1.25	1,460	1,850	2,130	23,600	28,120	32,680
46-47	0.81	23,090	27,360	31,840	0.99	840	1,030	1,190	1.38	1,610	2,040	2,350	25,540	30,430	35,380
47-48	0.35	9,980	11,820	13,760	0.36	310	370	430	0.54	630	800	920	10,920	12,990	15,110
48-49	0.29	8,270	9,800	11,400	0.45	380	470	540	0.62	730	920	1,050	9,380	11,190	12,990
49-50	0.50	14,260	16,890	19,660	0.73	620	760	880	1.03	1,210	1,520	1,750	16,090	19,170	22,290
1950-51	0.33	9,410	11,150	12,970	0.46	390	480	550	0.49	570	730	830	10,370	12,360	14,350
51-52	1.93	55,020	65,200	75,870	2.30	1,960	2,390	2,760	2.83	3,310	4,190	4,810	60,290	71,780	83,440
52-53	0.53	15,110	17,900	20,830	0.68	580	710	820	0.65	760	960	1,110	16,450	19,570	22,760
53-54	0.76	21,670	25,670	29,880	0.90	770	940	1,080	1.43	1,670	2,120	2,430	24,110	28,730	33,390
54-55	0.62	17,680	20,940	24,370	0.62	530	640	740	0.83	970	1,230	1,410	19,180	22,810	26,520
1955-56	0.96	27,370	32,430	37,740	1.16	990	1,210	1,390	1.38	1,610	2,040	2,350	29,970	35,680	41,480
56-57	0.75	21,380	25,340	29,480	0.69	590	720	830	1.03	1,210	1,520	1,750	23,180	27,580	32,060
29-Year Average 1929-57													30,590	36,420	42,330

Source and derivation of values by column number:

Column number

1, 5 and 9. Depth of residual rain on 100 percent impervious areas, Table L-13 through L-15, Appendix L.

2, 3 and 4. Column 1 multiplied by the acreage of impervious areas in San Fernando and Eagle Rock Subareas for each safe yield year: 1949-50 = 28,510 acres; 1954-55 = 33,780 acres; and 1957-58 = 39,310 acres.

6, 7 and 8. Column 5 multiplied by the acreage of impervious areas in Sylmar Subarea for each safe yield year: 1949-50 = 850 acres; 1954-55 = 1,040 acres; and 1957-58 = 1,200 acres.

10, 11 and 12. Column 9 multiplied by the acreage of impervious area in Verdugo Subarea for each safe yield year: 1949-50 = 1,170 acres; 1954-55 = 1,480 acres; and 1957-58 = 1,700 acres.

13. Sum of Columns 2, 6 and 10.

14. Sum of Columns 3, 7 and 11.

15. Sum of Columns 4, 8 and 12.

TABLE R-6

ADDITIONAL RUNOFF TRIBUTARY TO THE VALLEY FILL FROM
HILL AREAS DUE TO RESIDENTIAL DEVELOPMENT FOR SAFE YIELD CONDITIONS

Year	Additional runoff in inches		Additional runoff in acre-feet								
			Safe yield year								
			1949-50			1954-55			1957-58		
	San Fernando Subarea[a] (1)	Verdugo Subarea (2)	San Fernando Subarea[a] (3)	Verdugo Subarea (4)	Valley fill (5)	San Fernando Subarea[a] (6)	Verdugo Subarea (7)	Valley fill (8)	San Fernando Subarea[a] (9)	Verdugo Subarea (10)	Valley fill (11)
1928-29	9.5	11.9	1,000	30	1,030	2,040	110	2,150	3,300	190	3,490
29-30	8.7	11.8	910	30	940	1,870	110	1,980	3,020	190	3,210
1930-31	11.3	12.3	1,190	30	1,220	2,430	110	2,540	3,920	190	4,110
31-32	13.1	17.0	1,380	40	1,420	2,820	160	2,980	4,550	270	4,820
32-33	10.7	13.9	1,120	30	1,150	2,300	130	2,430	3,710	220	3,930
33-34	16.1	20.3	1,690	50	1,740	3,460	190	3,650	5,590	320	5,910
34-35	14.4	22.4	1,510	60	1,570	3,100	210	3,310	5,000	350	5,350
1935-36	9.6	13.5	1,010	30	1,040	2,060	120	2,180	3,330	210	3,540
36-37	15.0	22.0	1,580	60	1,640	3,230	200	3,430	5,210	350	5,560
37-38	15.5	26.0	1,630	70	1,700	3,330	240	3,570	5,380	410	5,790
38-39	14.9	20.3	1,560	50	1,610	3,200	190	3,390	5,170	320	5,490
39-40	9.5	14.8	1,000	40	1,040	2,040	140	2,180	3,300	230	3,530
1940-41	25.3	29.5	2,660	70	2,730	5,440	270	5,710	8,780	470	9,250
41-42	6.0	10.3	630	30	660	1,290	90	1,380	2,080	160	2,240
42-43	14.2	26.9	1,490	70	1,560	3,050	250	3,300	4,930	430	5,360
43-44	13.8	18.3	1,450	50	1,500	2,970	170	3,140	4,790	290	5,080
44-45	9.4	16.3	990	40	1,030	2,020	150	2,170	3,260	260	3,520
1945-46	10.0	14.7	1,050	40	1,090	2,150	140	2,290	3,470	230	3,700
46-47	16.5	16.1	1,730	40	1,770	3,550	150	3,700	5,730	250	5,980
47-48	5.0	6.5	530	20	550	1,080	60	1,140	1,740	100	1,840
48-49	4.9	7.6	510	20	530	1,050	70	1,120	1,700	120	1,820
49-50	7.4	12.7	780	30	810	1,590	120	1,710	2,570	200	2,770
1950-51	3.9	5.8	410	10	420	840	50	890	1,350	90	1,440
51-52	20.7	26.1	2,170	70	2,240	4,450	240	4,690	7,180	410	7,590
52-53	5.5	7.8	580	20	600	1,180	70	1,250	1,910	120	2,030
53-54	9.8	17.2	1,030	40	1,070	2,110	160	2,270	3,400	270	3,670
54-55	7.3	9.7	770	20	790	1,570	90	1,660	2,530	150	2,680
1955-56	11.8	16.7	1,240	40	1,280	2,540	150	2,690	4,090	260	4,350
56-57	9.7	12.0	1,020	30	1,050	2,090	110	2,200	3,370	190	3,560
29-Year Average 1929-57					1,230			2,590			4,180

a. Includes Eagle Rock and Sylmar Subareas.

Source and derivation of values by column number:

Column Number

1. Table F-8, Column 5, tributary to San Fernando and Sylmar Hydrologic Subareas.
2. Extension of values shown in Table F-8, Column 5, tributary to Verdugo Hydrologic Subarea.

3,4,6,7 9 and 10. Column 1 or 2 converted to feet multiplied by the residential acreages and percent impervious (Table F-8, Columns 6 and 7) for the respective safe yield year and subarea.

5,8 and 11. Sum of the additional runoff for the subareas for the safe yield year.

2. Cyclic trends of precipitation correspond to the 29-year base period; i.e., beginning and ending in a dry cycle.

3. The average amounts of import, export, safe yield pumpage and natural depletion prevailed during each year of the 29-year base period of normal precipitation.

4. Ground water levels for purpose of these studies were assumed to be equal to the ground water levels as they existed in 1957-58 and the available storage in the ground water reservoir above the 1957-58 ground water levels is equal to that which has existed historically; maximum ground water levels occurred in 1943-44. The difference between the amount dewatered from the high in 1943-44 to the low in 1957-58 is equal to 611,000 acre-feet.

The theoretical operation of the ground water reservoir with safe yield culture imposed over the 29-year base period utilized the basic hydrologic equation: supply minus disposal equals change in storage. Computations for the gross recharge of native water for the safe yield year 1949-50, shown in Table R-7, include the recharge from land use areas, stream system and the spreading grounds. A small difference (five percent) occurred between the 29-year average gross recharge computed for the ground water reservoir operational study and the 9-year average gross recharge determined for safe yield. The annual amounts of the gross recharge of native water were adjusted so that the 29-year average would be equal to the computed safe yield gross recharge of native water (Table 55). The values thus derived for the purpose of this study are called the adjusted gross recharge of native water.

TABLE R-7

COMPUTATION OF GROSS RECHARGE OF NATIVE WATER FOR THEORETICAL GROUND WATER RESERVOIR OPERATION STUDY BASED ON 1949-50 SAFE YIELD CULTURE CONDITIONS ON THE VALLEY FILL AREA

In 1,000 Acre-Feet

Year	Precipitation (1)	Integrated consumptive use of rain (2)	Consumptive use of rain adjustment (3)	Residual rain (4)	Recharge: Land use areas (5)	Recharge: Stream system (6)	Recharge: Native spread water (7)	Gross recharge (8)	Adjustment factor (9)	Adjusted gross recharge (10)
1928-29	122.4	103.5	-11.4	17.7	12.6	13.9	1.1	27.6	0.96	26.6
29-30	125.7	97.2	-10.7	22.8	16.4	15.6	1.2	33.2	0.96	32.0
1930-31	155.8	116.2	- 3.9	28.0	15.5	17.4	1.1	34.0	0.96	32.7
31-32	207.4	132.5	7.7	37.8	29.4	39.6	10.2	79.2	0.96	76.3
32-33	133.5	87.3	- 8.9	26.6	28.5	21.4	0	49.9	0.96	48.0
33-34	150.0	99.2	- 5.2	30.6	25.4	25.7	0.7	51.8	0.96	49.9
34-35	207.1	157.1	7.6	34.2	8.2	27.6	3.7	39.5	0.96	38.0
1935-36	131.0	96.7	- 9.5	20.7	23.1	18.3	6.2	47.6	0.96	45.8
36-37	242.2	148.1	15.5	44.7	33.9	53.1	14.5	101.5	0.96	97.7
37-38	258.6	135.4	19.2	51.0	53.0	84.5	11.9	149.4	0.96	143.8
38-39	219.1	147.8	10.4	43.2	17.7	34.0	1.1	52.8	0.96	50.8
39-40	172.0	124.5	- 0.2	30.0	17.7	24.4	2.8	44.9	0.96	43.2
1940-41	409.8	173.7	53.3	85.2	97.6	94.5	30.2	222.3	0.96	214.0
41-42	137.7	113.7	- 8.0	18.6	13.4	21.3	0.1	34.8	0.96	33.5
42-43	259.0	132.7	19.3	51.8	55.2	81.5	11.6	148.3	0.96	142.7
43-44	254.3	134.5	18.3	50.4	51.1	63.5	22.2	136.8	0.96	131.7
44-45	148.5	115.3	- 5.5	24.7	14.0	26.7	9.1	49.8	0.96	47.9
1945-46	141.3	107.6	- 7.2	23.6	17.3	23.9	2.8	44.0	0.96	42.4
46-47	156.0	115.8	- 3.8	25.5	18.5	23.6	12.5	54.6	0.96	52.6
47-48	80.1	67.8	-20.9	10.9	22.3	10.4	0	32.7	0.96	31.5
48-49	86.6	75.2	-19.5	9.4	21.5	8.1	0	29.6	0.96	28.9
49-50	111.2	87.3	-13.9	16.1	21.7	12.5	0.3	34.5	0.96	33.2
1950-51	89.9	76.1	-18.7	10.4	22.1	8.3	0	30.4	0.96	29.3
51-52	315.0	157.6	31.9	60.3	65.2	63.5	22.9	151.6	0.96	146.0
52-53	118.9	95.3	-12.2	16.5	19.3	16.1	2.9	38.3	0.96	36.9
53-54	138.4	98.9	- 7.8	24.1	23.2	20.0	2.9	46.1	0.96	44.4
54-55	142.9	116.3	- 6.8	19.2	14.2	15.6	0.2	30.0	0.96	28.9
1955-56	171.2	123.0	- 0.4	30.0	18.6	21.6	0.6	40.8	0.96	39.3
56-57	134.0	99.6	- 8.8	23.2	20.0	16.7	0.5	37.2	0.96	35.8
57-58	278.6	161.2	23.7	52.9	40.8	60.5	29.6	130.9	0.96	126.0
29-Year Average 1929-57	173.1	115.0	0	30.6	27.5	31.2	6.0	64.5		62.2

Source and derivation of values by column number:

Column No.

1. Table 1.
2. Weighted unit consumptive use of rain, Tables L-13, 14 and 15, times the acreage for 1949-50, Table K-6.
3. Consumptive use of rain adjustment = 30 percent times percent pervious times (annual rain minus 29-year average rain).
4. Table R-5, Column 13.
5. Column 1 minus Columns 2, 3 and 4.
6. Table 51, Column 9, for safe yield year 1949-50.
7. Table 51, Column 6, for safe yield year 1949-50.
8. Sum of Columns 5, 6 and 7.
9. Adjustment to make the 29-year average gross recharge equal to average gross recharge under safe yield conditions (Table 53). Adjustment factor is equal to the average gross recharge of native water, Table 53, divided by the 29-year average gross recharge, Column 8.
10. Column 8 multiplied by Column 9.

Under the conditions heretofore set forth, the average import, safe yield pumpage and export are assumed to be constant during each year of the operational study. Since the annual import is a constant, the gross recharge of import would also be a constant. With a constant safe yield pumpage and export, the pumpage available for delivered water on the valley fill area would also be a constant as would the recharge of delivered water.

The theoretical annual changes in storage in the ground water reservoir study for the 1949-50 safe yield year are shown in Table R-8. Using the ground water levels as they existed in 1957-58 as the levels at the start of the period of operation, 150,000 acre-feet of storage below and 210,000 acre-feet of storage above the beginning ground water levels would be required to operate the ground water reservoir through the base period.

TABLE R-8

THEORETICAL OPERATION OF GROUND WATER RESERVOIR UNDER CONDITIONS OF SAFE YIELD CULTURE, AVERAGE IMPORT AND EXPORT AND SAFE YIELD PUMPAGE*

In 1,000 Acre-Feet

Year	Adjusted gross recharge (1)	Gross recharge of average import (2)	Average natural depletion (3)	Return of pumped water on valley fill area (4)	Net recharge (5)	Safe yield pumpage (6)	Theoretical net annual change in storage (7)	Theoretical amount of water in ground water reservoir, Safe yield year 1949-50 (8)	Theoretical amount of water in ground water reservoir, Safe yield year 1957-58 (9)
1928-29	26.6	38.0	4.6	5.5	65.5	100.8	- 35.3	- 35.3	- 30.8
29-30	32.0	38.0	4.6	5.5	70.9	100.8	- 29.9	- 65.2	- 55.4
1930-31	32.7	38.0	4.6	5.5	71.6	100.8	- 29.2	- 94.4	- 78.2
31-32	76.3	38.0	4.6	5.5	115.2	100.8	14.4	- 80.0	- 63.8
32-33	48.0	38.0	4.6	5.5	86.9	100.8	- 13.9	- 93.9	- 74.5
33-34	49.9	38.0	4.6	5.5	88.8	100.8	- 12.0	-105.9	- 80.7
34-35	38.0	38.0	4.6	5.5	76.9	100.8	- 23.9	-129.8	- 98.0
1935-36	45.8	38.0	4.6	5.5	84.7	100.8	- 16.1	-145.9	-112.1
36-37	97.7	38.0	4.6	5.5	136.6	100.8	35.8	-110.1	- 80.4
37-38	143.8	38.0	4.6	5.5	182.7	100.8	81.9	- 28.2	- 18.5
38-39	50.8	38.0	4.6	5.5	89.7	100.8	- 11.1	- 39.2	- 28.0
39-40	43.2	38.0	4.6	5.5	82.1	100.8	- 18.7	- 57.9	- 42.5
1940-41	214.0	38.0	4.6	5.5	252.9	100.8	152.1	94.2	84.2
41-42	33.5	38.0	4.6	5.5	72.4	100.8	- 28.4	55.8	58.6
42-43	142.7	38.0	4.6	5.5	181.6	100.8	80.8	136.6	119.0
43-44	131.7	38.0	4.6	5.5	170.6	100.8	69.8	206.4	176.8
44-45	47.9	38.0	4.6	5.5	86.8	100.8	- 14.0	192.4	166.0
1945-46	42.4	38.0	4.6	5.5	81.3	100.8	- 19.5	172.9	149.5
46-47	52.6	38.0	4.6	5.5	91.5	100.8	- 9.3	163.6	144.7
47-48	31.5	38.0	4.6	5.5	70.4	100.8	- 30.4	133.2	117.9
48-49	28.9	38.0	4.6	5.5	67.8	100.8	- 33.0	100.2	87.1
49-50	33.2	38.0	4.6	5.5	72.1	100.8	- 28.7	71.5	61.6
1950-51	29.3	38.0	4.6	5.5	68.2	100.8	- 32.6	38.9	30.9
51-52	146.0	38.0	4.6	5.5	184.9	100.8	84.1	123.0	102.8
52-53	36.9	38.0	4.6	5.5	75.8	100.8	- 25.0	98.0	80.7
53-54	44.4	38.0	4.6	5.5	83.3	100.8	- 17.5	80.5	67.1
54-55	28.9	38.0	4.6	5.5	67.8	100.8	- 33.0	47.5	37.8
1955-56	39.3	38.0	4.6	5.5	78.2	100.8	- 22.6	24.9	21.1
56-57	35.8	38.0	4.6	5.5	74.7	100.8	- 26.1	- 1.2	- 1.4
57-58	126.0	38.0	4.6	5.5	164.9	100.8	64.1	62.9	43.6

* Calculations for the theoretical operation of ground water reservoir are shown for only 1949-50. The results of the operational studies for 1957-58 are shown in Column 9.

Source and derivation of values by column number:

Column No.

1. Table R-7, Column 10.
2. Table 55, Item 1.
3. Table 52, Item 7.
4. Table 56, Item 2, minus Table 55, Item 10, times (1.0 minus Table 56, Item 11).
5. Sum of Columns 1, 2 and 4, minus Column 3.
6. Table 55, Item 10.
7. Column 5 minus Column 6.
8. Cumulation of Column 7.

APPENDIX S

ORDERS OF REFERENCE

APPENDIX S

TABLE OF CONTENTS

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

THE CITY OF LOS ANGELES, a Municipal Corporation, Plaintiff, vs. CITY OF SAN FERNANDO, a Municipal Corporation, CITY OF GLENDALE, a Municipal Corporation, CITY OF BURBANK, a Municipal Corporation, et al, Defendants.	No. 650079 INTERIM ORDER OF REFERENCE To STATE WATER RIGHTS BOARD (To Investigate And Report Upon The Physical Facts Under Section 2001, Water Code)

The Motion of certain defendants for an Order of Reference to the State Water Rights Board to investigate and report upon the physical facts herein involved having come on regularly for hearing on Tuesday, March 18, 1958, after having been previously continued from time to time to said date, before the above-entitled Court, the Honorable Virgil M. Airola, Judge (assigned), Presiding, the Court having heard argument, written and oral, and considered the same, and good cause appearing therefor;

NOW, THEREFORE, IT IS HEREBY ORDERED, pursuant to Section 2001 of the Water Code of California:

I

That the State Water Rights Board of the State of California be and it is hereby appointed in the above-entitled action to study the availability and extent of any and all public and private records, documents, reports and data relating to the matters and things contained and set forth in Appendix B (Proposed Order of Reference) attached to the Order to Show Cause of the above-entitled Court, dated March 10, 1958, and to approximate the time required for, and to estimate the cost of obtaining, correlating and reporting upon, such records, documents, reports and data, and to report the results of its investigation and study to this Court on June 9, 1958.

II

The cost of this interim investigation and report shall be apportioned, and shall be paid by, the parties hereto at such time and in such proportions as shall hereafter be determined by the Court.

III

This interim investigation and report shall be made without prejudice to the right of any party hereto to hereafter object to any further Order of Reference herein and/or to object to the method and manner of the allocation of any costs of reference herein.

IV

It is recommended: (1) to the parties to this action that they co-operate with the Board by and through engineers appointed jointly or severally by them; and (2) to the Board that it seek the advice and counsel of such engineers in its investigation and in the preparation of its report.

DONE IN OPEN COURT THIS 19th day of March, 1958.

Virgil M. Airola
Virgil M. Airola
Judge (assigned) of the Superior Court

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

THE CITY OF LOS ANGELES, A Municipal Corporation, Plaintiff	No. 650079
vs.	ORDER OF REFERENCE
CITY OF SAN FERNANDO, a Municipal Corporation, CITY OF GLENDALE, a Municipal Corporation, CITY OF BURBANK, a Municipal Corporation, et al., Defendants.	To STATE WATER RIGHTS BOARD To Investigate And Report Upon The Physical Facts. (Section 2001, Water Code)

The Motions of certain defendants for an Order of Reference to the State Water Rights Board to investigate and report upon the physical facts herein involved, and the Order of the Court to the parties herein to show cause why such Order of Reference should not be made, having come on regularly for hearing on Wednesday, June 11th, 1958 (after having been previously continued from time to time to said date), before the above entitled Court, the Honorable Virgil M. Airola, Judge Presiding, the Court having heard argument, written and oral, and considered the same, and good cause appearing therefor;

NOW, THEREFORE, IT IS HEREBY ORDERED, pursuant to Section 2001 of the Water Code of the State of California, that the State Water Rights Board of said State shall be, and it is hereby, appointed in the above entitled action to investigate the following physical facts which are involved in the above entitled action and report thereon to the above entitled Court on or before two (2) years from and after the date of this Order, or within such additional time as shall be reasonably required and as shall hereafter be fixed and allowed by the Court, namely:

I

The Board is requested to investigate, find, provide data and report upon the following physical facts in accordance with the authorization of Section 2001 Water Code:

1. The geographic and hydrologic (surface and ground water) boundaries of the watershed of the Los Angeles River and its tributaries above the junction of the surface channels of the Los Angeles River and the Arroyo Seco at a point now designated as Los Angeles County Flood Control District Gauging Station No. F57. (Note: If said boundary differs from that depicted on and described in Appendixes "A" and "B" attached to plaintiff's Amended Complaint, then the areas included within both boundaries shall be studied and shall be included in the term "said area" as hereinafter used.)

2. The complete geology, insofar as it affects the occurrence and movement of ground water, and the surface and ground water hydrology of said area, including basins and sub-basins therein, including but not limited to:

A. The topography and soils.

B. The surface location of the bed and banks of the channels of the Los Angeles River and its tributaries.

C. The areas, limits and direction of flow of all ground water in said area, including, but not limited to, any and all waters percolating therein.

D. The area, location, nature, characteristics and limits of any and all basins and sub-basins and the interconnection or interdependence thereof, within said area.

E. The quality of all waters within said area, and the effect thereon of the importation of Owens Valley water.

F. The source and quantity of all waters, and the places of application and use of foreign waters, entering said area each water year for the period covered by available records and information.

G. The nature and quantity of all water loss and diminution within and from said area, each water year for the period covered by available records and information.

H. The safe yield, and the effect thereon of the importation of foreign waters, shall be determined for the water year immediately preceding the filing of the report for which data is available, and for the water years ending 1950 and 1955.

3. The geographic and hydrologic (surface and ground water) boundaries of all watersheds supplying the Los Angeles River below Los Angeles County Flood Control District Gauging Station No. F57 and above the southern boundary of the original pueblo.

4. As to each party to the within action for the period of available records and information:

(a) The location and capacity of his or its diversion works;

(b) The character of his or its use or uses of water; and

(c) The amount of his or its taking and use of water.

5. The use of water by The City of Los Angeles and its inhabitants:

(a) Since 1948 within the territory of the original pueblo; and

(b) For the period of available records within the expanded boundaries of said city as the same existed from time to time up to the date of the Report herein.

6. The amount of water distributed by plaintiff, for the period of available records and information to and including the date of the report, for use outside its boundaries as such boundaries have existed from time to time.

7. All sources of water supply of plaintiff and defendants, and the quantity thereof for the period of available records and information to and including the date of the report:

(a) Diverted and used; and

(b) Available for diversion and use.

II

The Board shall investigate, and, on the 17th day of November, 1958, or as soon thereafter as is reasonably practicable and convenient to Court and counsel, shall report to the Court and counsel upon, the following:

1. With respect to water years from and including that ending 1900 to and including that ending immediately preceding the filing of the Board's report hereunder (other than the water years specified in Paragraphs I, 2H hereof), the nature, extent and availability of any and all records and data reasonably necessary for the study by the Board of

the safe yield of the area referred to in Paragraphs I, 1 hereof and the approximate time required for, and the estimated cost of, obtaining, correlating, supplying, producing, supplementing and reporting upon such records; and

2. With respect to the water years from and including that ending 1900 to and including that ending immediately preceding the filing of the Board's report, the nature, extent, and availability of any and all of the records and data specified in Paragraphs I, 4, 5, 6 and 7 hereof, and the approximate time required for, and the estimated cost of, obtaining, correlating, supplying, producing, supplementing, and reporting upon such records and data;

3. The necessity or desirability of the Board's obtaining, correlating and reporting upon physical facts other than, and in addition to, those specified in this Order.

III

The Board is requested to retain in its Los Angeles office and have available to the parties the basic data upon which the Board bases its findings with respect to the foregoing items until thirty (30) days after the date of mailing of notice of filing its Final Report and thereupon to file a copy thereof with the Court.

IV

The parties are directed to make available to the Board such records and data as they may have which are pertinent to the subject matter of this reference.

V

It is recommended: (1) to the parties to this action that they co-operate with the Board by and through engineers appointed jointly or severally by them; and (2) to the Board that it seek the advice and counsel of such engineers in its investigation and in the preparation of its report.

DATED this 11th day of June, 1958.

s/ VIRGIL M. AIROLA
Judge of the Superior Court

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

THE CITY OF LOS ANGELES, a Municipal Corporation, Plaintiff, vs. CITY OF SAN FERNANDO, a Municipal Corporation et al., Defendants.	No. 650,079 INTERIM ORDER RECEIVING AND FILING "FIRST REPORT OF STATE WATER RIGHTS BOARD PURSUANT TO PARAGRAPH II OF REFERENCE ORDER DATED JUNE 11, 1958" AND DIRECTING NO FURTHER STUDIES OR PROCEEDINGS OR REPORTS UNDER SAID PARAGRAPH II OF SAID REFERENCE ORDER UNTIL AND UNLESS FURTHER ORDERED AND DIRECTED ON MOTION AND AFTER NOTICE PREVIOUSLY GIVEN TO ALL PARTIES, AND REQUIRING PROGRESS REPORTS FROM STATE WATER RIGHTS BOARD AT FUTURE PRE-TRIAL SESSIONS.

The State Water Rights Board having rendered and presented herein a report entitled "First Report of State Water Rights Board Pursuant to Paragraph II of Reference Order dated June 11, 1958", and good cause appearing therefor;

IT IS ORDERED:

1. That said First Report be accepted and filed herein as the report required by Paragraph II of the Reference Order of June 11, 1958;

2. That, with respect to the matters required to be investigated and reported upon as directed and outlined in paragraphs 1, 2 and 3 of said paragraph numbered II of said Order of Reference dated June 11, 1958, no further investigations, studies, proceedings or reports be made thereunder by said State Water Rights Board until and unless further ordered and directed hereafter on motion made and after notice has been previously given to all parties; and

3. That said State Water Rights Board, however, continue to be and appear by and through its attorneys and/or representatives at all future sessions of the pre-trial conference herein to make and render progress reports, oral or written, to the Court on the matters required to be reported under said Order of Reference dated June 11, 1958, except as hereinabove otherwise provided.

Dated on November 19, 1958.

VIRGIL M. AIROLA
Judge (assigned) of the Above-Entitled Court

APPENDIX T

AVAILABLE INFORMATION ON HYDROLOGIC SUBAREAS

APPENDIX T

TABLE OF CONTENTS

TABLES

APPENDIX T

AVAILABLE INFORMATION ON HYDROLOGIC SUBAREAS

The chapters in this report dealing with historic water supply and ground water recharge treat the entire valley fill area of the Upper Los Angeles River area as a unit. In view of the objections by various parties this appendix has been prepared to summarize the data available throughout the report with respect to each of the four hydrologic subareas. Particular information concerning the consumptive use of delivered water and amounts of import served to the service areas of the Crescenta Valley County Water District and La Canada Irrigation District within the Upper Los Angeles River area is also included.

The data collected in the course of this investigation were not always conducive to dividing the values into the four hydrologic subareas. Various studies were made in an attempt to separate these items into their respective subareas. The values thus determined should be considered solely as estimates of the amounts occurring in the subareas where there are no actual measurements corresponding to the exact hydrologic boundaries of the subareas.

Values presented for Verdugo Hydrologic Subarea in Tables T-2 through T-11 of this appendix exclude the amounts of water supply and disposal derived from the portion of Monk Hill Basin within the Upper Los Angeles River area.

Summary of Available Hydrologic Information

A summary of the hydrologic information available by subareas is shown in Table T-1. This table lists items of the hydrologic inventory for each subarea. Where a certain item of the inventory is not pertinent to the particular subarea, it is designated as "none". Data needed to complete items of the inventory are the surface runoff between subareas, and areal culture and gross delivered water of Eagle Rock Subarea.

Numerous items can be determined for the combined areas of San Fernando and Eagle Rock Subareas but difficulties arise in an attempt to separate the quantities derived from within the respective subareas. These quantities were therefore combined as shown in Table T-1.

Surface Runoff Between Subareas

Surface runoff occurs between Eagle Rock, Sylmar and Verdugo Subareas and San Fernando Subarea. The only stream gage measurement available in proximity to a subarea boundary is the Los Angeles County Flood Control District Stream Gaging Station No. 252. This gage, located approximately 2.8 miles below the boundary of Verdugo Subarea on Verdugo Wash, has a period of record from 1936 through 1958 (Table 27). Tributary areas between this gage and the boundary of Verdugo Subarea are areas of residential and commercial acreages and portions of the Verdugo Mountains and San Rafael Hills.

Areal Culture and Gross Delivered Water for Eagle Rock Subarea

The major difficulty encountered in a separate evaluation of the items of hydrologic information for the Eagle Rock Subarea is the determination of the areal culture and gross delivered water. There are land use data

TABLE T-1

SUMMARY OF HYDROLOGIC INFORMATION AVAILABLE ON SUBAREAS

Item	Hydrologic Subareas			
	San Fernando	Eagle Rock	Sylmar	Verdugo
1. Precipitation on subareas	Table T-2	Table T-2	Table T-2	Table T-2
2. Residual rain in subareas	Table T-3[a]	Table T-3[a]	Table T-3	Table T-3
3. Surface inflow to subareas				
a. From hill and mountain areas under conditions of native culture	Table T-4	Table T-4	Table T-4	Table T-4
b. Additional runoff from hill and mountain areas due to residential development	b	b	c	b
c. From tributary subareas	b	None	None	b
4. Runoff into reservoirs	Table F-7[d]	None	None	None
5. Native water spread in subareas	Table 30[d]	None	None	None
6. Surface outflow from subareas	Table 28	e	e	e
7. Subsurface inflow to subareas	Table 32	None	None	None
8. Subsurface outflow from subareas	Table 31	Table 32	Table 32	Table 32
9. Import to subareas				
a. Ground water originating in Upper Los Angeles River area	Table M-4[f]	Table M-4[f]	None	Table T-5
b. Water originating in Colorado and/or Mono-Owens Basin areas	Table 21[f]	Table 21[f]	Table 21	Table T-5
c. Total	f	f		

TABLE T-1

SUMMARY OF HYDROLOGIC INFORMATION AVAILABLE
ON SUBAREAS
(continued)

Item	Hydrologic Subareas			
	San Fernando	Eagle Rock	Sylmar	Verdugo
10. Import spread in subareas	Table 23[d]	None	None	None
11. Ground water extractions				
a. Extracted in subareas	Table T-6	Table T-6	Table T-6	Table T-6
b. Exported from subareas	Table T-7[a]	Table T-7[a]	Table T-7	Table T-7
12. Surface water diversions				
a. Diverted in subareas	Table 21	None	Table 21	Table T-8
b. Exported from subareas	None	None	None	Table T-8
13. Gross delivered water	Table 21[f]	Table 21[f]	Table 21	Table T-5
14. Water system loss	Table J-3[f]	Table J-3[f]	Table J-4	Table J-5
15. Sewage export	Table T-9[g]	Table T-9[g]	Table T-9	Table T-9
16. Sewer infiltration	h	h	h	h
17. Sewage import	g	None	None	None
18. Areal culture	Table K-6[a]	Table K-6[a]	Table K-6	Table T-10
19. Adjusted consumptive use	Table T-11[a]	Table T-11[a]	Table T-11	Table T-11
20. Cesspool Recharge	Table N-4[a]	c	Table N-4	Table N-4

TABLE T-1

SUMMARY OF HYDROLOGIC INFORMATION AVAILABLE
ON SUBAREAS
(continued)

Footnotes

a. Information available for combined subareas. Split cannot be made until breakdown of culture for each subarea is determined.
b. Data incomplete.
c. Data incomplete; however, the amount can be assumed to be equal to zero for practical purposes.
d. Occurs only in this subarea.
e. Amounts for Verdugo can be estimated based on short period of record from a gage 2.8 miles downstream from subarea boundary. No data are available for Sylmar and Eagle Rock.
f. Information available for combined subareas. Data incomplete for separate evaluation.
g. An estimate of this item would require additional separate information concerning Eagle Rock Subarea.
h. Estimate available for Upper Los Angeles River area but data incomplete for breakdown by subareas.

Note: Values for Verdugo Subarea are exclusive of amounts occurring or derived from the portion of Monk Hill Basin within the Upper Los Angeles River area.

available for 1949, 1955 and 1958. However, prior to these years the lack of data would necessitate the extrapolation of the land use acreages back 20 years to 1928-29.

Eagle Rock Subarea is located within the Narrows Service area of the City of Los Angeles. The determination of the gross delivered water would necessitate a study of the city's "Read Book" for the subarea, as discussed in Appendix M. Due to the continuous changing of the Read Books, the cost of determining the amount of gross delivered water from 1928-29 through 1957-58 would be prohibitive.

TABLE T-2

ANNUAL PRECIPITATION ON VALLEY FILL AREA

In Acre-Feet

Year	Hydrologic Subareas			
	San Fernando (1)	Eagle Rock (2)	Verdugo (3)	Sylmar (4)
1928-29	108,070	900	6,370	6,190
29-30	111,390	740	5,690	7,090
1930-31	139,460	950	6,380	8,070
31-32	184,740	1,290	9,690	10,350
32-33	118,910	840	6,460	6,360
33-34	131,470	1,210	8,920	7,170
34-35	182,980	1,280	10,850	10,430
1935-36	114,540	920	6,960	7,580
36-37	214,230	1,480	12,220	12,470
37-38	227,360	1,630	14,580	12,870
38-39	196,650	1,260	9,510	10,350
39-40	154,310	920	7,470	8,230
1940-41	369,020	2,560	17,510	18,250
41-42	123,420	780	6,280	6,360
42-43	227,710	1,510	14,920	12,710
43-44	228,870	1,380	10,520	11,980
44-45	130,070	950	8,560	7,660
1945-46	125,090	900	7,050	7,250
46-47	136,610	1,080	8,660	8,390
47-48	71,210	520	3,820	3,990
48-49	75,100	580	5,180	4,970
49-50	96,740	740	6,450	6,360
1950-51	79,170	530	4,250	5,300
51-52	279,750	2,050	15,130	15,890
52-53	106,530	670	4,840	6,190
53-54	121,390	870	7,970	7,010
54-55	128,310	870	6,190	6,600
1955-56	152,220	1,050	7,890	8,960
56-57	119,150	850	6,370	6,760
57-58	248,140	1,560	12,810	14,260
29-Year Average 1929-57	153,600	1,080	8,510	8,680

TABLE T-3

RESIDUAL RAIN BY SUBAREAS

In Acre-Feet

Year	Hydrologic Subareas		
	San Fernando plus Eagle Rock (1)	Sylmar (2)	Verdugo (3)
1928-29	5,950	420	340
29-30	7,670	580	510
1930-31	11,830	650	550
31-32	18,760	880	980
32-33	12,190	580	710
33-34	17,720	630	1,140
34-35	21,330	680	1,070
1935-36	12,410	580	690
36-37	26,150	1,130	2,510
37-38	30,400	1,260	2,080
38-39	27,040	1,040	1,140
39-40	20,170	680	740
1940-41	62,410	1,950	2,560
41-42	15,230	380	660
42-43	38,220	1,320	2,370
43-44	39,990	1,270	1,530
44-45	19,910	620	1,120
1945-46	20,270	590	1,760
46-47	22,670	970	1,370
47-48	11,170	230	480
48-49	9,420	220	500
49-50	14,520	690	1,010
1950-51	9,650	340	330
51-52	65,090	2,140	3,640
52-53	17,010	550	730
53-54	25,380	840	1,910
54-55	20,080	610	990
1955-56	38,660	1,300	1,900
56-57	29,580	730	1,110
57-58	68,030	2,250	4,070
29-Year Average 1929-57	23,130	820	1,260

Source and derivation by column number:

Column No.

1, 2 and 3. Annual precipitation (Table T-2) minus the summation of the weighted unit values of consumptive use and deep percolation of rain for each land use classification and respective subarea (Tables L-13, L-14 and L-15) multiplied by the respective acreage (Table K-6 and Table T-10).

TABLE T-4

HILL AND MOUNTAIN RUNOFF TO VALLEY FILL
UNDER CONDITIONS OF NATIVE CULTURE

In Acre-Feet

Year	Tributary to:			
	San Fernando Subarea (1)	Eagle Rock Subarea (2)	Verdugo Subarea (3)	Sylmar Subarea (4)
1928-29	5,120	420	100	930
29-30	4,350	0	0	960
1930-31	3,070	0	0	860
31-32	40,490	5,040	1,790	10,350
32-33	9,720	1,050	250	1,990
33-34	12,210	3,570	610	2,970
34-35	17,710	0	260	5,530
1935-36	13,040	1,470	460	3,530
36-37	64,430	5,880	2,420	17,320
37-38	128,180	11,130	4,310	31,600
38-39	21,570	1,890	640	3,890
39-40	15,040	1,050	210	3,470
1940-41	133,980	19,530	5,640	28,960
41-42	16,870	1,680	530	2,520
42-43	124,470	10,080	4,690	24,790
43-44	94,900	6,510	2,740	18,620
44-45	27,670	2,520	870	5,740
1945-46	20,030	840	250	3,090
46-47	22,890	1,260	490	6,410
47-48	5,320	210	50	390
48-49	2,460	0	0	740
49-50	3,810	210	40	1,120
1950-51	2,470	210	50	170
51-52	77,150	12,390	4,420	18,220
52-53	10,110	840	220	3,750
53-54	11,060	840	210	3,140
54-55	6,250	840	200	940
1955-56	8,260	1,050	180	1,540
56-57	4,750	840	210	970
57-58	66,920	630	1,200	17,540
29-Year Average 1929-57	31,290	3,150	1,100	7,050

TABLE T-5

IMPORT AND GROSS DELIVERED WATER
TO VERDUGO SUBAREA

In Acre-Feet

Year	Import		Gross delivered water (3)
	Ground water[a] (1)	Colorado and/or Mono-Owens Basin water[b] (2)	
1928-29	100	0	1,280
29-30	100	0	1,360
1930-31	100	0	1,430
31-32	100	0	1,450
32-33	100	0	1,540
33-34	100	0	1,940
34-35	90	0	1,680
1935-36	100	0	1,790
36-37	110	0	1,930
37-38	110	0	2,060
38-39	110	0	2,190
39-40	120	0	2,420
1940-41	120	0	2,260
41-42	140	0	2,660
42-43	170	0	2,850
43-44	170	0	3,030
44-45	180	0	3,060
1945-46	220	0	3,710
46-47	220	0	4,080
47-48	270	0	4,660
48-49	280	0	4,390
49-50	290	0	4,560
1950-51	1,490	150	4,940
51-52	1,040	130	4,700
52-53	1,360	300	6,110
53-54	1,720	330	6,810
54-55	1,390	700	6,640
1955-56	2,770	1,340	7,670
56-57	3,350	1,510	8,180
57-58	3,870	1,060	8,690
29-Year Average 1929-57	570	150	3,500

a. Ground water originating in Upper Los Angeles River area outside of Verdugo.

b. Water originating in Colorado and/or Mono-Owens Basin areas.

Source and derivation by column number:

Column No. 1- Table M-4.

Column No. 2- Sum of Columns 4 and 7, Table M-3 plus Column 7, Table M-2.

Column No. 3- Table 21, total for Verdugo Subarea minus gross delivered for La Canada Irrigation District from Tables J-5 and J-13.

TABLE T-6

GROUND WATER EXTRACTIONS AND SURFACE DIVERSIONS FROM VALLEY FILL AREA BY HYDROLOGIC SUBAREAS

In Acre-Feet

Year	San Fernando Subarea (1)	Eagle Rock Subarea (2)	Sylmar Subarea (3)	Verdugo Subarea (4)
1928-29	82,100	24	4,830	2,890
29-30	85,680	24	4,560	3,100
1930-31	89,020	24	4,020	3,440
31-32	62,720	24	3,700	3,100
32-33	61,600	24	3,050	2,740
33-34	85,090	24	4,010	2,900
34-35	71,870	24	4,410	2,670
1935-36	80,680	24	4,730	2,980
36-37	76,240	24	4,670	3,030
37-38	73,430	24	5,540	3,580
38-39	74,000	24	5,540	5,030
39-40	76,200	25	5,420	5,040
1940-41	76,820	25	5,980	5,580
41-42	74,660	25	6,020	6,150
42-43	87,760	25	5,890	6,190
43-44	92,480	35	6,070	6,590
44-45	110,080	35	6,160	6,310
1945-46	120,220	35	6,640	6,600
46-47	122,880	45	6,770	7,750
47-48	124,560	45	6,980	6,490
48-49	125,770	50	6,810	5,530
49-50	129,700	50	6,570	4,900
1950-51	124,880	50	6,240	3,850
51-52	119,950	110	5,960	4,280
52-53	144,510	120	5,490	5,250
53-54	144,610	120	5,160	5,600
54-55	140,250	120	5,630	5,280
1955-56	143,560	130	5,980	4,480
56-57	151,960	140	6,020	4,400
57-58	136,120	150	5,470	4,910
29-Year Average 1929-57	101,840	50	5,480	4,680

TABLE T-7

EXPORT OF GROUND WATER BY SUBAREAS AND TRIBUTARY AREAS

In Acre-Feet

Year	San Fernando plus Eagle Rock (1)	Sylmar (2)	Verdugo[a] (3)
1928-29	54,910	3,610	1,960
29-30	57,290	3,230	2,030
1930-31	59,490	2,650	2,060
31-32	34,320	2,340	1,760
32-33	32,010	1,720	1,300
33-34	54,170	2,470	1,000
34-35	42,910	3,130	1,120
1935-36	49,610	3,560	1,290
36-37	44,380	3,320	1,240
37-38	38,660	3,660	1,710
38-39	36,380	3,670	3,030
39-40	37,980	3,600	2,790
1940-41	40,820	4,080	3,570
41-42	33,470	4,010	3,650
42-43	44,100	3,930	3,610
43-44	47,470	4,130	3,890
44-45	62,080	4,240	3,510
1945-46	68,250	4,700	3,130
46-47	73,390	4,880	3,970
47-48	68,080	5,060	2,130
48-49	67,170	4,830	1,420
49-50	73,030	4,700	550
1950-51	67,870	4,590	470
51-52	64,080	4,340	540
52-53	83,340	4,450	610
53-54	85,230	4,590	630
54-55	81,560	4,450	450
1955-56	86,770	4,050	280
56-57	94,100	4,590	440
57-58	87,150	4,220	350
29-Year Average 1929-57	58,030	3,880	1,870

a. Includes surface diversions exported out of subarea (Table T-8).

Source and derivation by column number:

Column No. 1 - Column 3, Table M-6 plus Column 7, Table M-4.
Column No. 2 - Column 3, Table M-4.
Column No. 3 - Column 4, Table M-4 plus Column 3, Table M-7.

TABLE T-8

DIVERSIONS AND EXPORT OF SURFACE WATER
FROM TRIBUTARY HILL AREAS TO VERDUGO SUBAREA

In Acre-Feet

Year	Diverted (1)	Exported (2)
1928-29	130	70
29-30	120	70
1930-31	100	80
31-32	130	130
32-33	100	110
33-34	80	70
34-35	130	140
1935-36	170	150
36-37	310	280
37-38	400	360
38-39	390	340
39-40	360	280
1940-41	480	390
41-42	450	360
42-43	620	440
43-44	740	500
44-45	490	340
1945-46	370	270
46-47	420	240
47-48	400	120
48-49	320	120
49-50	300	110
1950-51	260	90
51-52	360	170
52-53	390	90
53-54	360	120
54-55	190	100
1955-56	150	70
56-57	140	60
57-58	190	90
29-Year Average 1929-57	300	190

Source and derivation by column number:

Column No. 1 - Table 21, surface diversion for Verdugo Subarea minus surface water diverted from Snover Canyon by La Canada Irrigation District.

Column No. 2 - Surface diversion for Pickens Canyon by La Canada Irrigation District.

TABLE T-9

SEWAGE EXPORTED BY SUBAREAS[a]

In Acre-Feet

Year	San Fernando[b] (1)	Sylmar (2)	Verdugo (3)
1928-29	6,320	170	80
29-30	7,100	180	100
1930-31	8,490	200	120
31-32	9,900	190	110
32-33	9,970	210	140
33-34	10,340	190	230
34-35	11,850	200	240
1935-36	12,450	190	260
36-37	13,230	200	330
37-38	14,360	210	350
38-39	16,470	250	380
39-40	17,440	260	450
1940-41	21,630	240	410
41-42	21,910	230	500
42-43	22,470	210	570
43-44	23,470	260	580
44-45	23,780	240	600
1945-46	24,030	280	700
46-47	27,080	300	710
47-48	28,880	320	670
48-49	30,340	360	670
49-50	31,950	380	750
1950-51	35,660	390	850
51-52	39,950	430	790
52-53	41,590	540	950
53-54	47,670	410	1,160
54-55	45,670	390	1,070
1955-56	51,860	380	1,360
56-57	60,060	400	1,440
57-58	63,960	460	1,890
29-Year Average 1929-57	24,670	280	570

a. Includes tributary drainage area and sewer infiltration.
b. Includes Sylmar, Verdugo and Eagle Rock Subareas.

Source and derivation by column number:

Column No.

1. Column 1, Table 26.
2. Sum of Columns 4 and 23, Table N-7, and sum of Columns 1 and 12, Table N-8.
3. Sum of Columns 7 and 8, Table N-8.

TABLE T-10

AREAL CULTURE WITHIN BOUNDARY OF THE
VALLEY FILL IN VERDUGO HYDROLOGIC SUBAREA

In Acres

Year	Irrigated crops: Decid-uous	Irrigated crops: Truck	Irrigated crops: Lawn grass	Irrigated crops: Total	Resi-dential	Commercial and industrial	Miscel-laneous	Riparian vege-tation	Dry farm and native vegetation
1928-29	110	0	100	210	450	30	320	20	3,360
29-30	90	0	100	190	470	30	320	20	3,360
1930-31	60	0	100	160	500	40	320	20	3,350
31-32	70	0	100	170	520	40	320	20	3,320
32-33	60	0	100	160	540	40	320	20	3,310
33-34	60	0	100	160	570	40	320	20	3,280
34-35	60	0	100	160	590	40	320	20	3,260
1935-36	60	0	100	160	610	50	320	20	3,230
36-37	60	0	100	160	660	50	320	20	3,180
37-38	50	0	100	150	710	60	320	20	3,130
38-39	40	0	100	140	750	60	320	20	3,100
39-40	30	0	100	130	800	70	320	20	3,050
1940-41	60	0	110	170	900	70	320	20	2,910
41-42	40	0	110	150	940	80	320	20	2,880
42-43	30	0	110	140	1,040	90	320	20	2,780
43-44	30	0	110	140	1,140	90	320	20	2,680
44-45	30	0	110	140	1,220	100	320	20	2,590
1945-46	40	0	110	150	1,320	110	320	20	2,470
46-47	30	0	110	140	1,440	120	320	20	2,350
47-48	30	0	110	140	1,560	130	320	20	2,220
48-49	30	0	110	140	1,650	140	320	20	2,120
49-50	20	0	110	130	1,780	150	320	20	1,990
1950-51	20	0	110	130	1,890	160	320	20	1,870
51-52	30	0	120	150	2,030	170	320	20	1,700
52-53	30	0	120	150	2,130	180	320	20	1,590
53-54	30	0	120	150	2,270	200	320	20	1,430
54-55	10	10	120	140	2,410	210	260	10	1,360
1955-56	10	20	120	150	2,500	220	200	10	1,310
56-57	10	30	150	190	2,640	230	140	10	1,180
57-58	10	50	150	210	2,800	240	80	10	1,050

TABLE T-11

ADJUSTED INTEGRATED CONSUMPTIVE USE ON LAND USE AREAS BY SUBAREAS

In Acre-Feet

Year	San Fernando plus Eagle Rock Subareas				Sylmar Subarea			Verdugo Subarea			
	Rain (1)	Delivered water (2)	Other sources (3)	Total (4)	Rain (5)	Delivered water (6)	Total (7)	Rain (8)	Delivered water (9)	Other sources (10)	Total (11)
1928-29	90,330	92,790	5,860	188,980	5,100	4,190	9,290	5,300	640	60	6,000
29-30	89,420	95,560	5,110	190,090	5,770	3,630	9,400	4,290	670	50	5,010
1930-31	116,390	90,880	4,280	211,550	6,730	3,470	10,200	5,050	650	50	5,750
31-32	147,600	67,350	5,490	220,440	8,300	2,850	11,150	6,680	590	40	7,310
32-33	82,550	72,060	4,560	159,170	4,750	3,550	8,300	4,900	670	50	5,620
33-34	95,060	77,900	4,470	177,430	5,150	3,350	8,500	4,730	740	40	5,510
34-35	164,000	70,120	5,570	239,690	9,630	3,210	12,840	8,940	570	40	9,550
1935-36	86,840	89,520	6,510	182,870	5,960	3,920	9,880	5,000	770	50	5,820
36-37	162,750	76,500	5,070	244,320	9,490	3,370	12,860	7,210	760	30	8,000
37-38	154,010	69,590	6,100	229,700	8,740	3,040	11,780	7,920	740	20	8,680
38-39	156,260	78,320	4,480	239,060	7,920	3,470	11,390	7,750	900	40	8,690
39-40	122,810	73,380	3,850	200,040	6,850	3,200	10,050	5,620	1,000	50	6,670
1940-41	221,840	59,340	5,510	286,690	11,860	3,140	15,000	10,520	830	10	11,360
41-42	100,000	90,100	9,620	199,720	5,360	4,260	9,620	4,860	1,220	60	6,140
42-43	144,610	88,270	11,830	244,710	8,330	4,210	12,540	7,730	1,050	20	8,800
43-44	145,090	86,100	12,920	244,110	8,150	4,220	12,370	6,540	1,160	40	7,740
44-45	101,040	100,850	4,060	205,950	6,480	4,760	11,240	6,210	1,260	50	7,520
1945-46	90,700	104,810	4,070	199,580	5,650	4,940	10,590	3,950	1,600	50	5,600
46-47	100,370	106,830	3,020	210,220	6,660	5,520	12,180	5,990	1,580	50	7,620
47-48	41,400	122,080	3,260	166,740	2,590	6,070	8,660	2,010	2,040	70	4,120
48-49	47,690	122,800	3,090	173,580	3,750	5,830	9,580	3,660	1,870	70	5,600
49-50	66,670	112,550	3,260	182,480	4,730	4,790	9,520	4,520	1,890	50	6,460
1950-51	52,940	124,990	3,310	181,240	4,090	4,480	8,570	2,670	2,210	70	4,950
51-52	113,880	93,790	3,240	210,910	10,110	3,730	13,840	8,230	1,920	20	10,170
52-53	75,450	119,220	3,580	198,250	4,820	4,590	9,410	2,950	2,610	60	5,620
53-54	79,740	106,710	2,520	188,970	5,190	3,750	8,940	4,200	2,550	50	6,800
54-55	99,150	103,010	2,390	204,550	5,340	4,000	9,340	4,280	2,700	30	7,010
1955-56	100,390	96,310	1,950	198,650	6,980	3,520	10,500	4,770	2,930	30	7,730
56-57	74,560	110,980	1,870	187,410	5,190	4,160	9,350	3,980	3,180	30	7,190
57-58	151,660	93,950	1,610	247,220	8,880	3,400	12,280	6,530	3,560	10	10,100
29-Year Average 1929-57	107,710	93,200	4,860	205,760	6,540	4,040	10,580	5,530	1,420	40	7,000

Source and derivation by column number:

Column Nos.

1, 5 and 8. Summation of the weighted unit values for precipitation for each land use classification and respective subarea (Tables L-13, L-14 and L-15) multiplied by the respective acreage (Table K-6 for San Fernando plus Eagle Rock and Sylmar Subareas and Table T-10 for Verdugo Subarea) except for water surface evaporation (water surface evaporation computed as per Appendix L) plus 30 percent of annual precipitation above and below 29-year average falling on pervious areas for each subarea.

2, 6 and 9. Summation of the weighted unit values for delivered water for each land use classification and respective subarea (Tables L-13, L-14 and L-15) multiplied by the respective acreage (Table K-6 for San Fernando plus Eagle Rock and Sylmar Subareas and Table T-10 for Verdugo Subarea) plus 5 percent of residential delivered water applied to land use areas (excluding sewage) for each subarea.

3. Column 17, Table 35, minus consumptive use, weighted unit value for riparian (ground water) vegetation (Table L-15), multiplied by the riparian acreage in Verdugo and Monk Hill (Table K-6).

4. Sum of Columns 1, 2 and 3.

7. Sum of Columns 5 and 6.

10. Weighted unit value for riparian (ground water) vegetation (Table L-15) multiplied by the riparian acreage for Verdugo Subarea (Table T-10).

11. Sum of Columns 8, 9 and 10.

Supplemental Information for Crescenta Valley County Water District and La Canada Irrigation District Service Areas

Gross delivered water to Crescenta Valley County Water District and La Canada Irrigation District Service areas is derived from ground water extractions and import. Disposal of gross delivered water is through consumptive use on land use areas and water system losses. The residual amounts of gross delivered water become recharge to the ground water reservoir as deep percolation on land use areas and cesspool recharge due to the lack of sewers within these service areas.

The consumptive use of delivered water from land use areas, including consumption of water system losses for these service areas, is shown in Table T-12. The values computed in Table T-12 are derived from average unit values for the consumptive use of delivered water (Table L-15, Appendix L, excepting residential classifications from Table R-1, Appendix R) for Verdugo Subarea. As heretofore discussed in Chapter VI, the integrated consumptive use computed from unit values is the average unit value representative of the subarea. Variations may occur in the amount of water delivered to each land use classification for different water service areas. Since the combined service areas of Crescenta Valley County Water District and La Canada Irrigation District are equal to approximately 50 percent of the total valley fill area of Verdugo Subarea and Monk Hill Basin within the Upper Los Angeles River area, it is believed that the average unit values for consumptive use of delivered water are applicable.

Since the average unit values of consumptive use of delivered water are dependent on the gross water delivered to Verdugo Subarea, the gross amounts imported from the Colorado River and delivered to the valley fill area by Crescenta Valley County Water District and La Canada Irrigation District are also shown in Table T-12.

TABLE T-12

ESTIMATED CONSUMPTIVE USE OF DELIVERED WATER AND AMOUNTS OF IMPORTED WATER FOR CRESCENTA VALLEY COUNTY WATER DISTRICT AND LA CANADA IRRIGATION DISTRICT SERVICE AREAS, VALLEY FILL AREA

In Acre-Feet

Year	Consumptive use of delivered water[a] Service Areas		Import Service Areas	
	Crescenta Valley (1)	La Canada (2)	Crescenta Valley (3)	La Canada (4)
1928-29	380	150	0	0
29-30	360	140	0	0
1930-31	340	140	0	0
31-32	310	130	0	0
32-33	340	140	0	0
33-34	430	130	0	0
34-35	380	130	0	0
1935-36	400	150	0	0
36-37	440	150	0	0
37-38	420	140	0	0
38-39	490	150	0	0
39-40	550	170	0	0
1940-41	470	140	0	0
41-42	690	210	0	0
42-43	620	210	0	0
43-44	660	200	0	0
44-45	720	220	0	0
1945-46	890	260	0	0
46-47	960	280	0	0
47-48	1,260	330	0	0
48-49	1,170	290	0	0
49-50	1,140	280	0	0
1950-51	1,380	340	0	0
51-52	1,250	300	0	30[c]
52-53	1,630	380	0	110
53-54	1,630	390	0	120
54-55	1,670	380	480[b]	260
1955-56	1,880	420	880	480
56-57	2,010	450	1,000	380
57-58	2,130	450	600	420
29-Year Average 1929-57	860	230		

a. Based on acreages for the water service areas (Table K-7, Appendix K) and the average unit values for consumptive use of delivered water in Verdugo Subarea (Table L-15, Appendix L, excepting residential which are from Table R-1, Appendix R) plus consumptive use of water system losses computed in the same manner as in Table 36.

b. Purchase of Colorado River water commenced June 1955 (Table M-3, Appendix M, Column 7) minus import delivered to hill areas (Table J-13, Appendix J).

c. Purchase of Colorado River water commenced February 1952 (Table M-3, Appendix M, Column 6) minus import delivered to hill areas (Table J-3, Appendix J).