TABLE 19 (CONTINUED)

SELECTED MINERAL ANALYSES OF GROUND WATERS IN VENTURA COUNTY[A]

Basin and well number	Date sampled	Conductance, (EC x 10^6 at 25°C)	Mineral constituents, in equivalents per million									Fluoride, in ppm	Boron, in ppm	Total dissolved solids, in ppm	Effective salinity, in ppm	Per cent sodium
			Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3					
East and West Las Posas																
2N/21W-11J1 (Fox Canyon)	7-21-52[B]	685	3.86	1.75	2.52	0.08	0.08	3.97	2.44	1.34	0.29	0.2	0.4	528	4.2	32
2N/21W-28A1 (Grimes Canyon)	9- 3-52	1379	5.88	3.29	4.13	0.14	0	4.80	6.78	2.13	0.03	0.6	0.1	914	7.6	32
3N/19W-28F1 (Epworth gravels)	7-18-52	356	2.10	0.57	0.70	0.02	0	2.36	0.24	0.54	0.33	0.1	Tr.	255	1.0	21
Conejo																
1N/19W- 8G1 (Volcanics)	8-21-52	1562	5.95	8.05	4.35	0.07	0	5.60	9.80	3.18	0.02	0.3	0.1	1230	12.5	24
1N/20W-15R1 (Volcanics)	7-23-52[B]	692	3.72	2.51	2.01	0.01	0	5.03	1.47	1.36	0.31	0.2	0.0	449	3.2	24
Tierra Rejada																
2N/19W-14D1 (Volcanics)	7-30-52[B]	720	2.95	3.59	1.39	0.01	0	4.13	2.10	1.50	0.13	0.4	0.1	503	3.8	18
Santa Rosa																
2N/19W-20K1 (Volcanics)	12- 8-30[C]	---	2.39	3.70	2.26	----	-	4.86	2.02	1.47	----	---	---	---	3.5	27
	7-21-52[B]	820	2.54	3.23	3.27	0.05	0	5.33	1.54	1.72	0.55	0.1	0.6	582	3.8	37
2N/20W-23A1 (Fox Canyon)	7-22-52[B]	1032	3.09	3.59	4.17	0.06	0	5.15	2.47	3.22	0.03	0.4	0.2	608	5.8	39

[A] Analysis by Division of Water Resources, unless otherwise noted.
[B] Analysis by Pacific Chemical Consultants.
[C] Analysis from Bulletin 46A. Division of Water Resources.
[D] Analysis by United States Geological Survey, Water Quality Branch; unpublished records subject to revision.
[E] Analysis by Fruit Growers Laboratory, Inc.
[F] Analysis obtained from Santa Clara Water Conservation District.
[G] Total dissolved solids reported as a sum of the constituents.
[H] Well cemented above 300 feet (date uncertain).

TABLE 20

SELECTED MINERAL ANALYSES OF DRAINAGE WATERS FROM
SEMI-PERCHED ZONE IN VICINITY OF PORT HUENEME

Number of sampling point	Number on Plate 22	Date sampled	Conductance, (EC x 10^6 at 25°C)	Mineral constituents, in equivalents per million									Boron, in ppm	Total dissolved solids, in ppm	Effective salinity, in epm	Per cent sodium
				Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3				
1N/22W- 7J	1	6- 4-52[B]	4220	20.50	17.83	18.10	----	0	5.75	47.18	3.95	0.52	1.6	3503	35.9	32
1N/22W- 7J	2	1-14-53	3774	18.5	15.3	15.2	0.17	0	6.64	39.1	4.09	0.37	2.5	3628	30.7	31
1N/22W-18A	3	1-14-53	3774	18.3	14.0	16.5	0.15	0	5.44	36.4	6.65	0.25	1.9	3428	20.6	34
1N/22W-18B	4	8- 4-52[B]	5780	18.62	22.41	35.60	0.18	0	6.72	58.90	9.60	0.46	3.6	5131	58.2	46
1N/22W-21B	5	8- 4-52[B]	1830	12.44	5.87	5.90	0.12	0	5.36	16.30	2.07	0.34	0.9	1674	11.9	25
1N/22W-21F	6	6- 6-52[B]	2150	13.55	5.37	7.03	----	0	5.41	17.61	2.40	0.30	0.8	1846	12.4	27
1N/22W-21F	7	1-14-53	2198	13.9	6.00	7.17	0.13	0	5.48	18.6	2.48	0.22	1.0	1832	13.3	27
1N/22W-21Q	8	8- 4-52[B]	2218	13.08	5.65	7.04	0.13	0	5.48	17.63	2.66	0.20	0.9	1760	12.8	28
1N/22W-27C	9	6- 6-52[B]	4110	14.00	16.60	20.62	----	0	5.45	40.20	5.74	0.80	1.8	3500	37.2	40
1N/22W-27C	10	8- 4-52	2994	16.0	12.2	16.1	0.10	0	5.28	32.8	5.08	0.91	1.9	3010	28.4	36
1N/22W-27C	11	1-14-53	4149	15.3	15.4	27.0	0.20	0	5.52	44.8	6.96	0.94	2.7	3565	42.6	47

[A] Analysis by Division of Water Resources unless otherwise noted.
[B] Analysis by Pacific Chemical Consultants.

Sources of Impairment

Sources of impairment to the quality of waters of Ventura County include natural sources, domestic sewage, irrigation return water, industrial wastes, and sea-water intrusion. There is presented hereinafter a brief discussion of each of these sources as related to its cause and character. Although not actually a source of impairment to ground water quality in themselves, improperly constructed, defective, and abandoned wells may be a factor in transmission of pollution, contamination, or degradation to usable ground waters, through the introduction of surface or drainage waters or the leachings from cesspools and septic tanks. Such wells may allow the interchange of waters between aquifers having differing quality characteristics, thus degrading good quality waters.

Natural Sources. The mineral quality of water is adversely affected by natural causes in several portions of Ventura County. In general, this natural degradation is a minor source of impairment to the quality of surface and ground waters. Sespe and Piru Creeks receive small flows of water with high boron concentration originating from abandoned mining operations. In addition, Piru Creek water is degraded by boron originating in colemanite deposits in Lockwood Valley. It is believed that the relatively high concentrations of boron noted in ground water of Piru Basin are primarily the result of percolation of the degraded Piru Creek water in the basin. In the vicinity of South Mountain and the Topatopa Mountains, natural seeps of connate brines reportedly occur, containing high concentrations of dissolved salts. These brines drain into Santa Paula Creek, the Santa Clara River, and Ojai Valley. It is reported

that there are three springs on Upper Matilija Creek from which emanate waters of high boron content, which adversely affect the quality of low flows of Matilija Creek.

Domestic Sewage. Domestic sewage returning to ground water through cesspools, septic tanks, and leach lines, or from community treatment plants, is of higher mineral content than the source water. Investigations have shown increases of 20 to 50 ppm in chlorides, 30 to 60 ppm in sodium, and 15 to 25 ppm in nitrogen* some of which may oxidize to NO_3. These increases in mineral content are so small, however, that domestic sewage in the Santa Clara River Valley, Upper Ventura River Valley, and Ojai Valley may be considered as a satisfactory source of ground water replenishment, and from this standpoint susceptible of treatment and conservation. However, as was mentioned heretofore, most waters in Ventura County are considered to be very hard. Concentrated salt wastes resulting from the regeneration of individually owned softening units could render the quality of sewage unsuitable for reuse, and cause localized pollution problems. Similar problems could be created by imprudent discharge by central regeneration plants.

Irrigation Return Water. Irrigation of agricultural crops requires an application of water in excess of the consumptive requirement for water to prevent undue build-up of salts in the root zone. This excess water, or irrigation return water, may contain from two to as many as ten times the concentration of salts found in the original water supply. In the Oxnard Plain and Mound Basins, where the pumped aquifers are confined, subsurface and open drains have been constructed to remove

*Values are from paper, "The Mineral Pickup Resulting from the Utilization of Water for Domestic Purposes", given at American Geophysical Union by Ralph Stone, February, 1952.

the irrigation return and rainfall percolate. Analyses show these drainage waters to contain from 1,800 to over 5,000 ppm of total dissolved solids. In areas where irrigation return water can percolate to the ground water, it may constitute an important source of degradation to the water supply.

Industrial Wastes. The development of natural resources and the growth of industry, including agriculture, in Ventura County have created a multitude of waste disposal problems. Whenever harmful liquid or water soluble industrial wastes are discharged into stream channels, onto the ground, or into unlined sumps, they constitute a threat of pollution to underlying ground water.

Sources of industrial wastes in Ventura County include the oil industry, citrus and walnut packing plants, refuse disposal sites, slaughter houses, and hog farms. Wastes derived from the oil industry include connate brines of high salt content pumped from the oil sands, and "contaminated" drilling muds. Wastes from citrus packing houses may include any one, or a combination of borax, soda ash, sodium hypo-chlorite, and/or soap, depending upon the individual plant operation. Wastes from walnut packing houses usually contain high concentrations of sodium chloride. Refuse disposed of in dumps will on decomposition release salts, which when dissolved by rainfall or applied water may percolate to ground water. Wastes from slaughter houses and garbage on hog farms is usually of an organic nature, which if not suitably treated or handled may produce septicity in water supplies, with accompanying foul odors.

Sea-Water Intrusion. In the Oxnard Plain Basin, it was noted that mineral analyses of water from certain wells in the vicinity of Port Hueneme during the recent drought period evidenced higher concentrations of chlorides and dissolved solids than did other water from the

Oxnard aquifer. In Table 21 there are presented complete mineral analyses of waters from wells so affected. A thorough study of this portion of the aquifer reduced the probable sources of chloride degradation in the ground water to one or more of the following:

1. Sea water intrusion through the Oxnard aquifer.
2. Percolation, or leakage through poorly constructed wells, defective casings, or abandoned wells of:
    a. Irrigation return water and other poor quality waters from the semi-perched ground water body.
    b. Sea water which had intruded into the semi-perched ground water body.

A method of differentiating between ground water degraded by sea-water and by semi-perched ground water is by comparison of the character of the two waters with that of the degraded ground water. This may be conveniently done employing a geochemical chart, by use of which the chemical character of waters can be graphically depicted.

If two waters of different character are mixed, it is logical to presume that the character of the resulting mixture will be a combination of the characters of the two waters. Thus, if the character of waters from sources of degradation are plotted on a geochemical chart, together with the character of the degraded water, the source of degradation may become apparent. Plate 22, entitled "Mineral Character of Ground Water in Vicinity of Port Hueneme and Point Mugu", shows on geochemical chart "A" the anion constituents, expressed in per cent, in the degraded water and in the two apparent sources of degradation. Also plotted on this chart are anion constituents in ground water from these wells prior to degradation. Inspection of Plate 22 will show that the indicated source of degradation of water from wells in the vicinity of Port Hueneme was sea water. The character of the anion constituents in the degraded ground water plots almost in a direct line between the character of

undegraded ground water and sea water. There was no apparent influence of the ground water found in the semi-perched body on the character of the degraded ground water. Anion constituents only were used in this chart, since cation constituents are subject to character changing influences such as cation exchange.

In an effort to distinguish between possible methods by which sea water entered the Oxnard aquifer, consideration was given to the hydrologic and geologic conditions that existed in the area of intrusion. As described previously, the Oxnard aquifer appears to outcrop in the submarine canyon near Port Hueneme. Furthermore, the semi-perched zone appears to extend under the coastal sand dunes to the ocean. Thus, from the geologic standpoint, sea water might enter either of these two water-bearing zones. Before sea water could intrude, however, a condition would have to exist whereby the hydraulic head of the sea water was greater than that prevailing in the respective aquifers. Concerning this possibility in the semi-perched zone, information obtained from studies of the Division of Irrigation and Soils of the University of California at Los Angeles was of significance. This agency determined elevations of the perched water table throughout the Oxnard Plain Basin, as a part of its study of drainage problems. These elevations indicated that throughout the basin the perched water surface sloped toward the ocean and exceeded mean sea level, thus precluding the possibility of sea water intrusion thereto.

Subsequent to 1949 with the prevailing trough in the piezometric levels in the Oxnard aquifer, conditions were conducive to the intrusion of sea water. A correlation between elevations of the piezometric surface in Oxnard aquifer and increase in chloride concentration in the ground in

the Oxnard aquifer and saline intrusion is indicated on Plate 23, entitled "Elevation of Ground Water and Chloride Ion Concentration". On this plate there is plotted the hydrograph of well number 1N/22W-20R1, together with the average weekly chloride ion concentration in water from well number 1N/22W-29A2, both of which are perforated in the Oxnard aquifer. An inspection of Plate 23, will show that during the period when the water surface elevation in well number 1N/22W-20R1 was lowest, the rate of increase in chloride concentration in the ground water was the greatest, once degradation had started. As an example, during the period from September 1st until about the 13th of December, 1951, the elevation of the water surface in well number 1N/22W-20R1 slowly increased from about minus 14 feet to about minus 2 feet, and the rate of increase in chloride concentration in water from well number 1N/22W-29A2 averaged 3.9 ppm per day. In the subsequent period, December 13, 1951 to March 15, 1952, water surface elevations averaged slightly above sea level, and the rate of increase in chloride concentration in the water was reduced to about 1.5 ppm per day. Although it appears anamalous that the chloride concentration should have increased while water surface elevations in the key well slightly exceeded sea level, consideration should be given to the fact that the top of the Oxnard aquifer in this vicinity is between 80 to 120 feet below sea level, and that the specific gravity of sea water exceeds that of fresh water. In view of this, a water surface elevation in the Oxnard aquifer of more than two feet is required in order to maintain equilibrium with the sea water. Furthermore, prior to May, 1952, the prevailing piezometric level in parts of the central portion of the basin was below sea level, so that an overall landward gradient was maintained.

In view of the lack of required hydraulic slope for intrusion

through the semi-perched zone, together with the observed correlation between water surface elevations in the Oxnard aquifer and the increase in chlorides, it appears that sea water has entered directly into the Oxnard aquifer.

The determined extent of saline intrusion in Oxnard Plain Basin has been limited to an area in the immediate vicinity of Port Hueneme, as shown on Plate 16-B, and has been apparent only in wells numbers 1N/22W-20N1, 1N/22W-20R1, 1N/22W-29A2, and 1N/22W-29C1.

Ground water in well number 1N/21W-28D1, which was perforated in the Oxnard aquifer, and was reported in Division of Water Resources Bulletin No. 46 to have been degraded by the intrusion of sea water, recovered its former quality with increase in piezometric levels above sea level and recession of sea water from the aquifer. This improvement in quality is depicted on geochemical chart B on Plate 22.

TABLE 21

SELECTED MINERAL ANALYSES OF WATERS FROM SALINE INTRUDED WELLS IN VICINITY OF PORT HUENEME

Well number	Point number on Plate 22	Date sampled	Conductance, (EC x 10^6 at 25°C)	Mineral constituents, in equivalents per million									Boron, in ppm	Total dissolved solids, in ppm	Effective salinity, in epm	Per cent sodium
				Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3				
1N/22W-20N1	N 1	4- 3-31	1180	5.94	2.55	4.56	---	----	4.05	7.87	1.21	---	0.63	923	7.1	35
	N 2	9- 4-31	----	6.09	3.54	3.82	---	----	4.13	8.05	1.27	---	----	936	7.4	28
	N 3	6- 3-32	----	6.24	3.30	4.05	---	----	4.10	8.23	1.21	---	0.68	946	7.4	30
	N 4	3- 3-33	----	5.99	3.38	4.00	---	----	4.08	8.10	1.16	---	0.60	932	7.4	30
	N 5	7-21-36	----	6.89	3.95	4.35	0.31	----	4.06	8.50	2.90	---	----	1057	8.6	30
	N 6	12-20-39	----	6.24	3.38	3.82	---	----	3.80	8.22	1.38	---	0.50	930	7.2	28
	N 7	9-27-45	----	6.14	3.30	3.87	---	0.47	3.75	7.85	1.22	---	0.63	915	7.2	29
	N 8	4-30-48	----	6.84	3.46	4.60	0.38	----	3.80	8.33	2.99	---	----	1048	8.4	33
	N 9	7-16-48	----	7.83	4.28	7.52	---	----	3.90	8.31	7.25	---	----	1286	11.8	38

TABLE 21 (CONTINUED)

SELECTED MINERAL ANALYSES OF WATERS FROM SALINE INTRUDED WELLS[A]
IN VICINITY OF PORT HUENEME

WELL NUMBER	POINT NUMBER ON PLATE 22	DATE SAMPLED	CONDUCTANCE, (EC x 10^6 AT 25°C)	MINERAL CONSTITUENTS, IN EQUIVALENTS PER MILLION									BORON, IN PPM	TOTAL DISSOLVED SOLIDS, IN PPM	EFFECTIVE SALINITY, IN EPM	PER CENT SODIUM
				CA	MG	NA	K	CO_3	HCO_3	SO_4	CL	NO_3				
1N/22W-20N1	N 10	10- 7-49	----	100.95	58.39	127.31	----	--	3.34	28.42	252.36	----	----	16176	254.9	44
	N 11	10- 8-49	----	91.22	50.00	126.31	----	--	3.41	26.57	236.29	----	----	15204	237.6	47
	N 12	3-23-50	----	50.15	12.42	60.87	0.66	--	3.49	1.42	119.14	----	----	7088	119.2	50
1N/22W-20R1	- --	9- 2-52[B]	5465	20.7	12.2	23.0	0.24	0	3.96	10.8	42.6	0.01	0.70	4070	41.4	41
	- --	12- 2-52[B]	7770	25.18	14.37	44.40	0.37	0	4.03	13.90	65.90	0.07	0.9	5675	66.4	53
1N/22W-28D1	D 1	6- 5-31[D]	8120	20.86	15.08	49.50	----	--	5.39	18.32	61.75	----	0.92	----	64.6	58
	D 2	6- 9-31[D]	6560	17.20	10.70	38.70	----	--	3.10	15.68	47.90	----	1.12	----	49.4	58
	D 3	6-26-31[DE]	8350	20.44	15.48	53.80	----	--	5.60	20.20	64.00	----	1.48	----	69.3	60
	D 4	6-26-31[DF]	8150	19.75	15.16	50.35	----	--	5.65	17.72	62.00	----	1.47	----	65.5	59
	D 5	6- 3-32[D]	----	6.09	3.62	4.70	----	--	3.83	8.50	2.03	----	0.71	----	8.3	33
	D 6	3- 3-33[D]	----	6.04	3.38	4.25	----	--	4.22	8.25	1.19	----	0.63	----	7.6	31

TABLE 21 (CONTINUED)

SELECTED MINERAL ANALYSES OF WATERS FROM SALINE INTRUDED WELLS[A]
IN VICINITY OF PORT HUENEME

WELL NUMBER	POINT NUMBER ON PLATE 22	DATE SAMPLED	CONDUCTANCE, (EC x 10^6 AT 25°C)	MINERAL CONSTITUENTS, IN EQUIVALENTS PER MILLION									BORON, IN PPM	TOTAL DISSOLVED SOLIDS, IN PPM	EFFECTIVE SALINITY, IN EPM	PER CENT SODIUM
				Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3				
1N/22W-29A2	A 1	3-31-47	----	6.20	3.38	3.87	0.18	—	4.15	8.23	1.19	0.03	0.52	954	7.4	28
	A 2	5- 5-49	----	6.20	3.28	4.13	0.10	—	4.08	8.44	1.16	0.03	----	960	7.4	30
	A 3	5-25-51	----	6.45	3.77	3.56	0.37	—	4.08	8.46	1.58	0.03	----	985	7.7	25
	A 4	7-25-51	----	6.90	3.85	3.95	----	--	4.05	8.04	2.48	0.03	----	999	7.8	27
	A 5	9- 4-51	----	7.80	4.27	4.22	0.06	0	4.01	8.19	4.12	0.03	----	1092	8.6	26
	A 6	11-27-51	----	12.10	6.31	5.04	----	0	3.69	8.21	11.34	0.01	----	1457	11.6	22
	A 7	3-28-52	----	15.45	3.36	5.52	----	0	3.65	9.02	16.47	0	----	1780	11.7	23
	A 8	6- 6-52[B]	3086	20.5	11.7	5.65	0.18	0	3.84	7.60	26.6	0.02	0.51	3200	26.6	15
1N/22W-29C1	- -	9- 2-52[B]	3817	21.2	11.4	7.18	0.22	0	3.20	6.78	30.2	0	0.48	3020	30.1	18

A ANALYSIS OBTAINED FROM SANTA CLARA WATER CONSERVATION DISTRICT, UNLESS OTHERWISE NOTED.
B ANALYSIS BY DIVISION OF WATER RESOURCES.
C ANALYSIS BY PACIFIC CHEMICAL CONSULTANTS.
D ANALYSIS FROM BULLETIN 46-A. DIVISION OF WATER RESOURCES.
E SAMPLED AT LOW TIDE.
F SAMPLED AT HIGH TIDE.

Safe Yield of Presently Developed Water Supply

An evaluation of the safe yield of existing sources of water supply in Ventura County under present conditions of development and utilization is presented in this section. As has been stated previously, surface storage developments and uncontrolled stream flow comprise only secondary sources of water supply in the County, while water stored in ground water basins presently constitutes the primary source of supply.

The term "safe yield", when used in this bulletin in connection with a surface storage development, refers to the maximum sustained rate of draft from the reservoir that could have been maintained throughout a critically deficient water supply period. When used in connection with a diversion from the unregulated flow of a surface stream, the term similarly refers to the maximum sustained rate of diversion from the stream that could have been maintained throughout a critically deficient water supply period. Water supplies as they occurred during the base period from 1936-37 through 1950-51 were utilized in determining safe yield of surface reservoirs and surface stream diversions in Ventura County. In most cases the dry seasons from 1944-45 through 1950-51 constituted the critically deficient water supply portion of this period. In general, estimates of safe yield are presented in this bulletin in terms of seasonal rate of yield.

The term "net safe yield" refers to that portion of the safe yield resulting from a proposed new water supply development and method of operation thereof that would have been wasted without the proposed works and under the present pattern of land and water utilization, and is used synonymously with the term "new water".

When used in reference to water supplies available from ground water storage, the term "safe yield" refers to the maximum rate of net extraction from the ground water basin which, if continued over an indefinitely long period of years, would result in the maintenance of certain desirable fixed conditions.

Commonly, safe ground water yield is determined by one or more of the following criteria:

1. Mean seasonal extraction of water from the ground water basin does not exceed mean seasonal replenishment to the basin.

2. Water levels are not so lowered as to cause harmful impairment of the quality of the ground water by intrusion of other water of undesirable quality, or by accumulation and concentration of degradants or pollutants.

3. Water levels are not so lowered as to imperil the economy of ground water users by excessive costs of pumping from the ground water basin or by exclusion of the users from a supply therefrom.

In the determination of the safe yield of ground water basins of Ventura County, it was found that each of these criteria applied to one or more of the basins.

Commonly, safe yield of a ground water basin is not determined until there is evidence of overdraft or use of water in excess of safe yield. Many of the basins in Ventura County are now experiencing such overdraft. On the other hand, others are not being utilized to the maximum extent possible under limitations imposed by the foregoing criteria. With increased use of these presently underdeveloped basins, ground water levels would be further lowered during drought periods, thereby providing additional space in the basins for storage of percolating surface waters that would otherwise waste to the ocean during wet periods. The effect thereof would be an increase in yield of the basins. Furthermore, in certain basins where overdraft now prevails, it appears that safe yield could be increased through modification of the present pumping patterns.

Since safe ground water yield is not a fixed value but is a function of pumping patterns and the magnitude of ground water basin utilization, together with other factors, further definition of the term is considered necessary. As used in this bulletin, therefore, the term "safe ground water yield" refers to the maximum rate of net extraction of ground water that could be maintained over

Safe Yield of Presently Developed Water Supply

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The term "net safe yield" refers to that portion of the safe yield resulting from a proposed new water supply development and method of operation thereof that would have been wasted without the proposed works and under the present pattern of land and water utilization, and is used synonymously with the term "new water".

When used in reference to water supplies available from ground water storage, the term "safe yield" refers to the maximum rate of net extraction from the ground water basin which, if continued over an indefinitely long period of years, would result in the maintenance of certain desirable fixed conditions.

Upper Ojai Subunit. The source of water supply for the Upper Ojai Subunit is ground water in Upper Ojai Basin. Since it appears that natural replenishment is satisfying the present relatively minor water requirements of the water users, the safe yield of this basin was taken as equal to the estimated average seasonal net extraction of water therefrom during the base period, or about 400 acre-feet per season. It is believed that this amount represents about the maximum rate of extraction that could be maintained from the basin.

Ojai Subunit. Since water requirements of the Ojai Subunit for both lands overlying the ground water basin and lands overlying adjacent nonwater-bearing formations are supplied by pumping from Ojai Basin, the safe yield of the water supply of the subunit was taken as equal to that estimated for the ground water basin. As stated previously, from the spring of 1944 to the fall of 1951, net retention of tributary surface runoff and of direct precipitation in Ojai Basin totaled an estimated 43,000 acre-feet. Of this amount, it was estimated that consumptive use of direct precipitation, and consumptive use of ground water by phreatophytes amounted to about 42,800 acre-feet, leaving only a negligible amount to meet extractions of water from the basin for beneficial use. However, an estimated 10,900 acre-feet of water stored in the ground water basin in the spring of 1944 could have been extracted without violating the third of the criteria governing safe ground water yield. Thus, the safe yield of Ojai Basin was estimated as the summation of the two items of supply, amounting to about 11,100 acre-feet, divided by the number of seasons in the period of analysis, or about 1,500 acre-feet per season.

Upper and Lower Ventura River Subunits. Stream flow originating in Matilija and the North Fork of Matilija Creeks, ground water in Upper Ventura River Basin and in Mound Basin underlying Lower Ventura River Basin, and ground water in low-yielding sediments east and west of the Ventura River above Foster Park comprise the sources of water supply of the Upper and Lower Ventura River

Subunits. Since 1948, runoff in Matilija Creek has been regulated by Matilija Reservoir.

It was estimated that during the drought period, if Matilija Reservoir had not been in operation, about 4,900 acre-feet per season would have been available to meet requirements of ground water users in Upper Ventura Basin and of diverters of surface flow between the confluence of Matilija and the North Fork of Matilija Creeks to and including the diversion of the City of Ventura at Foster Park. This supply was taken as the safe seasonal yield of these water sources. Of the estimated 4,900 acre-foot safe seasonal yield, it was determined that about 3,900 acre-feet would have been available for pumpage or diversion by the City, and that about 1,000 acre-feet would have been available for surface and ground water users above Foster Park.

Had Matilija Dam been in operation during the drought period, it was estimated that the reservoir would have last filled in the spring of 1947, and that with an average seasonal draft of 3,700 acre-feet during the ensuing four and one-half year period the reservoir would have been empty by the fall of 1951. It was further estimated that about 2,300 acre-feet of the average seasonal draft from the reservoir would have been put to beneficial use by users above Foster Park, including the City of Ventura, even if the reservoir had not been in operation. Thus, the net safe yield developed by Matilija Reservoir would have averaged about 1,400 acre-feet per season.

It is known that during the drought period many wells drawing from the minor ground water sources in the Upper Ventura River Subunit, and supplying lands east and west of the Ventura River above Foster Park, went dry. The average requirement for consumptive use of applied water on these lands was estimated to have been about 800 acre-feet per season. Safe yield of the minor ground water sources was estimated to have been equal to about 60 per cent of this requirement, or about 500 acre-feet per season. This estimate was based on the assumption that

these sources yielded no more water in proportion to the requirement of land served therefrom than did other ground water sources in Upper Ventura River Basin and surface flow in the Ventura River.

The portion of the safe yield of Mound Basin available to meet water requirements in the Ventura Hydrologic Unit was taken as equal to the average seasonal extraction of ground water therefrom during the base period by users in the Lower Ventura River Subunit west of the Ventura River, or an estimated 600 acre-feet per season. This amount includes an estimated 100 acre-feet of water per season extracted in this area and exported for use in the Rincon Subunit. The extraction of ground water from Mound Basin by the City of Ventura from 1947-48 through 1950-51 was considered to have been but a temporary expedient, and it was assumed that this source would not be available indefinitely to the City. This assumption was based on the fact that a pumping depression, with its center considerably below sea level, formed in the piezometric surface of the aquifer in Mound Basin when the city wells were operating. Thus, conditions were conducive to the intrusion of sea water into the pumped aquifer. It is probable that the principal source of replenishment to the aquifer is percolation of direct precipitation and of surface flow in minor watercourses in the outcrop area of the San Pedro formation north of the City, which supplies appear to be inadequate to satisfy the pumping demands on this portion of the aquifer.

Rincon Subunit. In addition to the aforementioned import from the Lower Ventura River Subunit, some water in the Rincon Subunit is obtained by pumping from small ground water basins at the mouths of several minor streams discharging to the ocean along the coastal front. The safe yield of these minor ground water basins was estimated to be about 100 acre-feet per season, which amount was taken as the safe yield of the Rincon Subunit. It is known that many wells in the subunit were dry during the latter years of the drought period. This fact, together with the prevailing poor quality of certain of the ground waters, necessitated trucked importation of drinking water for many users.

Santa Clara River Hydrologic Unit

Since water requirements of the Santa Clara River Hydrologic Unit are largely met by pumping from ground water storage, the safe yield of presently developed water supplies therein was taken as the safe yield of the ground water basins, estimated to be about 72,200 acre-feet per season. This estimate, however, includes the relatively minor yield of surface waters diverted and utilized in the hydrologic unit. No differentiation was made between yield of surface and ground water sources, since it is probable that diverted surface water would otherwise percolate and be retained in the ground water basins. Furthermore, it was assumed that in the free ground water areas the unconsumed residuum of surface waters applied to urban and irrigated lands would return to ground water storage and be available for re-use.

The total safe water supply available to meet requirements in the Santa Clara River Hydrologic Unit was estimated to be about 73,200 acre-feet per season. This supply is comprised of the foregoing safe yield of about 72,200 acre-feet per season, less an export from the Oxnard Forebay Subunit to the West Las Posas Subunit of the Calleguas-Conejo Hydrologic Unit averaging about 1,100 acre-feet per season, plus average seasonal imports of Santa Clara River water from Los Angeles County to the Eastern and Piru Subunits totaling about 2,100 acre-feet.

Table 23 summarizes the estimated safe seasonal yield of the presently developed water supply in the Santa Clara River Hydrologic Unit. The values shown for the Eastern and Piru Subunits do not include the aforementioned imports from Los Angeles County. The total value for the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits does include the cited export to the Calleguas-Conejo Hydrologic Unit.

TABLE 23

ESTIMATED SAFE SEASONAL YIELD OF PRESENTLY DEVELOPED WATER SUPPLY IN SANTA CLARA RIVER HYDROLOGIC UNIT

Subunit	Acre-feet
Eastern	0
Piru	11,100
Fillmore	10,000
Santa Paula	15,600
Mound	8,800
Oxnard Forebay, Oxnard Plain, and Pleasant Valley	26,700
TOTAL	72,200

Eastern Subunit. Water supplies for developed lands in the Eastern Subunit, so far as could be determined, are obtained entirely by importation of Santa Clara River water from Los Angeles County in the estimated average amount of about 300 acre-feet per season.

Piru, Fillmore, and Santa Paula Subunits. Derivation of the safe seasonal ground water yields of Piru, Fillmore, and Santa Paula Basins, which, as stated previously, were taken as the yields of the water supplies of the respective subunits, is shown in Table 24. The values in the table for items tending to increase and decrease yields of the basins are estimated average seasonal quantities over the base period. Derivation of values for consumptive use of precipitation was based on analyses discussed in Chapter III, and the values given include consumptive use of ground water by phreatophytes. The estimate of safe yield of Piru Basin does not include an average seasonal import of about 1,800 acre-feet of water from Los Angeles County.

TABLE 24

ESTIMATED SAFE SEASONAL YIELD OF PIRU,
FILLMORE, AND SANTA PAULA GROUND WATER BASINS

(In acre-feet)

Item	Basin		
	Piru	Fillmore	Santa Paula
Items tending to increase yield			
Surface inflow	102,000	176,900	209,700
Subsurface inflow	0	20,600	11,500
Precipitation on basin	9,600	25,800	18,500
Subtotals to be added	111,600	223,300	239,700
Items tending to decrease yield			
Surface outflow	72,900	181,300	203,200
Subsurface outflow	20,600	11,500	7,200
Consumptive use of precipitation	7,000	20,500	13,700
Subtotals to be subtracted	100,500	213,300	224,100
SAFE YIELD	11,100	10,000	15,600

It should be noted that the derived "safe yields" shown in Table 24 are not the maximum yields which could be developed in these basins. As stated in an earlier section, utility of the Piru, Fillmore, and Santa Paula Basins is limited largely by factors of economic pumping lift and mean seasonal recharge, and not by storage capacity or configuration of the basins. Therefore, it appears that their yields could be increased to the limit of mean seasonal recharge if not prohibited by economic considerations. Achievement of such increases, however, would require greater utilization of the basins than with present patterns of land use and water supply development, and greater ranges in pumping lifts, and might result in the creation of adverse salt balances in the basins.

It should be further noted in Table 24 that the safe yield indicated for a given basin is not necessarily the amount of water that is available for use in that basin. In Piru Basin, of the indicated safe yield of about 11,100

acre-feet per season, some 5,700 acre-feet per season represents an export to Fillmore Basin. The estimated safe water supply available to meet requirements in Piru Basin is comprised of the indicated safe yield less this export, plus the aforementioned import from Los Angeles County in the amount of about 1,800 acre-feet per season, or a total of about 7,200 acre-feet per season. In Fillmore Basin, of the indicated safe yield of about 10,000 acre-feet per season, approximately 1,400 acre-feet per season is exported to Santa Paula Basin. Therefore, the estimated safe water supply available to meet requirements in Fillmore Basin is comprised of the indicated safe yield less the export, plus the import from Piru Basin, or a total of about 14,300 acre-feet per season. Of the indicated safe yield in Santa Paula Basin of some 15,600 acre-feet per season, about 600 acre-feet per season is exported to Mound Basin and about 700 acre-feet to Oxnard Plain Basin. The estimated safe water supply available to meet requirements in Santa Paula Basin, therefore, is comprised of the indicated safe yield less the exports, plus the import from Fillmore Basin, or a total of approximately 15,700 acre-feet per season.

Mound Subunit. Safe yield of the Mound Subunit was taken as equal to that portion of the average seasonal extraction of ground water from Mound Basin that was utilized within the Mound Subunit during the base period, or an estimated 8,800 acre-feet per season. This estimate does not include extractions of water from Mound Basin by the City of Ventura nor by users west of the Ventura River.

Since independent evaluation of the amount of recharge to Mound Basin during the drought period could not be made with data at hand, it is possible that experience will show that the foregoing estimate of safe yield is excessive. In this connection, it appears that in the westerly portion of the basin near the ocean, where ground water levels were below sea level subsequent to 1947, a portion of the extracted ground water was obtained from aquifers in the seaward extension of the San Pedro formation. Furthermore, the observed depression in the

piezometric surface in this area indicates that transmissibility of the aquifers was inadequate to meet the pumping demands by underflow from Santa Paula Basin, the probable principal source of recharge. It is also possible that a portion of the supply to the aquifers may have come from perennial change in ground water storage in the outcrop areas of the San Pedro formation. Any of these occurrences would tend to decrease the estimated safe ground water yield of the subunit.

The estimated safe water supply available to meet requirements in the Mound Subunit is composed of the safe ground water yield of about 8,800 acre-feet per season, plus imports from Santa Paula and Oxnard Forebay Subunits of about 2,700 acre-feet per season, or a total of approximately 11,500 acre-feet per season.

Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits. The sources of water supply for these subunits are Santa Clara River water and direct precipitation that percolate in Oxnard Forebay Basin, subsurface inflow to Oxnard Forebay Basin from Santa Paula Basin, and subsurface inflow from the Calleguas-Conejo Hydrologic Unit to Oxnard Plain and Pleasant Valley Basins. In addition, water is imported to Oxnard Plain Basin from Santa Paula Basin. The total safe yield of these supplies, other than the import from Santa Paula Basin, was estimated to be about 26,700 acre-feet per season.

It has been stated that troughs formed in the piezometric surfaces in the Oxnard aquifer in Oxnard Plain Basin and in the Fox Canyon aquifer in Pleasant Valley Basin during the drought period, thus creating conditions conducive to sea-water intrusion. Furthermore, the mineral characteristics of ground water extracted from the Oxnard aquifer in the vicinity of Port Hueneme indicated that sea water had actually advanced inland to a portion of the aquifer then being pumped. Therefore, the second of the three criteria listed previously for determination of safe ground water yield was violated.

The occurrence of a trough in the piezometric surface of a confined aquifer is a function of the rate of pumping from the aquifer, the transmissibility of the aquifer, and the hydraulic head available in the forebay supplying the aquifer. With data available, it was not possible to determine independently the transmissibility of either the Oxnard or Fox Canyon aquifers. Since transmissibility is a function of the cross-sectional area and permeability of an aquifer, which factors are probably subject to little variance in a confined aquifer, it was assumed that transmissibility in the Oxnard and Fox Canyon aquifers would remain constant under various piezometric slopes and rates of pumping draft. Relationships between water level elevations in Oxnard Forebay Basin, rates of pumping draft from the Oxnard aquifer, and slopes in the piezometric surface in the Oxnard aquifer were established. Using these relationships it was determined that, with the present pattern and rate of pumping from the Oxnard aquifer, the ground water level at well number 2N/22W-23H3 in Oxnard Forebay Basin must be maintained at or above 60 feet above sea level in order to maintain a seaward gradient in the piezometric surface in the Oxnard aquifer, and to prevent formation of a trough therein. This would limit ground water storage depletion in Oxnard Forebay Basin to about 20,000 acre-feet, as compared to the actual storage depletion of about 109,500 acre-feet which prevailed in the fall of 1951.

Analyses were made for the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Basins to determine the maximum average seasonal ground water extractions that could have been made therefrom over the base period without causing formation of a trough in the piezometric surface in the Oxnard aquifer and thereby creating conditions conducive to sea-water intrusion. It was assumed that Oxnard Forebay Basin would have been full at the beginning of the drought period, and that supplies available for extraction would have been ground water in storage in the basin, together with surface and subsurface inflow retained therein, plus subsurface inflow to Pleasant Valley and Oxnard Plain Basins from the

Calleguas-Conejo Hydrologic Unit. Consideration was not given to the item of "undifferentiated supply from other sources" shown in Table 15. By a trial and error method involving monthly analyses of water supply and disposal, it was determined that a maximum of about 26,700 acre-feet of water per season could have been extracted from the three basins throughout the drought period. With this reduced pumpage, ground water storage in Oxnard Forebay Basin would have been depleted by about 87,000 acre-feet, and a seaward gradient would have been maintained in the piezometric surface in the Oxnard aquifer throughout the drought period. It was assumed, furthermore, that under these conditions a trough would not have formed in the piezometric surface in the Fox Canyon aquifer. Total safe yield of the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Basins, therefore, was estimated to be about 26,700 acre-feet per season, and was assumed to be equal to total safe yield of the corresponding subunits. Of this amount, about 4,700 acre-feet per season represents subsurface inflow from the Calleguas-Conejo Hydrologic Unit, and the remainder is comprised of supply from the Santa Clara River system.

It should be noted that possible subsurface outflow to the ocean through the Fox Canyon aquifer could not be evaluated, and was not considered in the foregoing analysis. The amount of such outflow would reduce the estimate of safe yield accordingly.

An item of water supply which would appear to increase the estimate of safe yield of the three subunits is that portion of the aforementioned "undifferentiated supply from other sources" which is comprised of inflow from fresh water stored in seaward extensions of the Oxnard and Fox Canyon aquifers. However, for purposes of the present studies this supply was not considered to be safe yield. Although the volume of this storage may be of considerable magnitude, and extractions therefrom during drought periods may be replaced by subsurface flow from Oxnard Forebay Basin during wet periods, utility of the storage appears to be

limited by the two canyons incised in the ocean floor near Port Hueneme and Point Mugu. Experience during the recent drought period showed that utilization of the storage resulted in the intrusion of sea water from Hueneme Canyon to a portion of the Oxnard aquifer then being pumped.

That portion of the "undifferentiated supply from other sources" possibly contributed to the Oxnard and Fox Canyon aquifers by percolation of direct rainfall and of the unconsumed portion of applied water would correspondingly increase the estimated safe yield. Since the magnitude of this possible supply could not be determined with data available, and since there are even uncertainties regarding its actual occurrence, it was not given consideration in the evaluation of safe yield of the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Basins.

Table 25 summarizes the derivation of safe yield of the three basins. The values given are average seasonal values for the drought period from 1944-45 through 1950-51. The value for consumptive use of precipitation in Oxnard Forebay Basin was based on analyses described in Chapter III, and includes consumptive use of water by phreatophytes. The item for subsurface outflow includes only that in the Oxnard aquifer, and as mentioned does not include possible outflow in the Fox Canyon aquifer. The indicated total safe yield of 26,700 acre-feet per season includes about 4,100 acre-feet per season exported to the Mound Subunit and to the Calleguas-Conejo Hydrologic Unit.

TABLE 25

ESTIMATED SAFE SEASONAL YIELD OF OXNARD FOREBAY, OXNARD PLAIN, AND PLEASANT VALLEY BASINS

Item	: Acre-feet
Items tending to increase yield	
Surface inflow	48,300
Subsurface inflow	
From Santa Paula Basin	7,200
From Calleguas-Conejo Hydrologic Unit	4,700
Precipitation on Oxnard Forebay Basin	5,300
Ground water storage depletion in Oxnard Forebay Basin	12,700
Subtotal to be added	78,200
Items tending to decrease yield	
Surface outflow	28,800
Subsurface outflow	15,900
Consumptive use of precipitation in Oxnard Forebay Basin	6,800
Subtotal to be subtracted	51,500
SAFE YIELD	26,700

If extractions of water from Oxnard Forebay, Oxnard Plain, and Pleasant Valley Basins were limited to the estimated safe yield of 26,700 acre-feet per season, and ground water storage depletion in Oxnard Forebay Basin was limited to 87,000 acre-feet, there would be increases in surface outflow in the Santa Clara River to the ocean and in subsurface outflow through the Oxnard aquifer. This increased outflow would result from maintenance of higher ground water levels in Oxnard Forebay Basin. Such higher levels would decrease ground water storage capacity available for storing percolating waters of the Santa Clara River, thereby increasing surface outflow, and would also increase the slope of the piezometric surface in the Oxnard aquifer to the ocean, thereby increasing the rate of subsurface outflow. Table 26 presents a comparison of estimated outflow from the Santa Clara River Hydrologic Unit during the base period and under present operating

conditions, with such outflow if the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Basins had been operated in accordance with their estimated safe yield of 26,700 acre-feet per season. The comparison does not consider possible subsurface outflow in the Fox Canyon aquifer.

TABLE 26

ESTIMATED SEASONAL OUTFLOW FROM SANTA CLARA RIVER HYDROLOGIC UNIT DURING BASE PERIOD, WITH PRESENT METHOD OF OPERATION, AND WITH OXNARD FOREBAY, OXNARD PLAIN, AND PLEASANT VALLEY BASINS OPERATED IN ACCORDANCE WITH THEIR SAFE YIELD

(In acre-feet)

Season	Surface outflow			Subsurface outflow*		
	Present operation	Safe yield operation	Increase	Present operation	Safe yield operation	Increase
1936-37	160,200	160,200	0	12,000	12,000	0
1937-38	435,600	464,700	29,100	21,600	21,600	0
1938-39	53,600	66,100	12,500	23,600	23,600	0
1939-40	27,000	27,000	0	23,100	23,100	0
1940-41	687,600	802,400	114,800	23,500	23,500	0
1941-42	70,800	87,400	16,600	23,800	23,800	0
1942-43	379,000	430,700	51,700	23,400	23,400	0
1943-44	299,500	353,400	53,900	23,500	23,500	0
1944-45	69,900	77,600	7,700	23,500	23,500	0
1945-46	59,300	70,600	11,300	9,200	23,400	14,200
1946-47	43,900	53,500	9,600	8,800	23,500	14,700
1947-48	0	0	0	3,600	20,200	16,600
1948-49	0	0	0	1,000	12,000	11,000
1949-50	0	0	0	0	6,600	6,600
1950-51	0	0	0	0	2,100	2,100
Average for base period, 1936-37 through 1950-51	152,400	172,900	20,500	14,700	19,100	4,300
Average for wet period, 1936-37 through 1943-44	264,200	299,000	34,800	21,800	21,800	0
Average for drought period, 1944-45 through 1950-51	24,700	28,800	4,100	6,600	15,900	9,300

* From Oxnard aquifer only.

It should be mentioned that of the estimated 26,700 acre-foot safe seasonal yield of the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits, it was assumed that about 2,500 acre-feet would be exported for use in the Mound Subunit, and about 1,600 acre-feet for use in the West Las Posas Subunit of the Calleguas-Conejo Hydrologic Unit, which practices actually prevailed during the drought period. It was further assumed that some 500 acre-feet per season would be imported from Santa Paula Basin during a drought period for use in the Oxnard Plain Subunit. Thus, the safe water supply available to meet requirements in the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits during a drought period would be the estimated safe ground water yield therein, less the exports to the Mound Subunit and the Calleguas-Conejo Hydrologic Unit, plus the import from Santa Paula Basin, or about 23,100 acre-feet per season. It was estimated that during a mean period of water supply and climate the exports and imports would change to about 3,200 and 700 acre-feet per season, respectively, and that the safe water supply available to the Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits would increase to about 24,200 acre-feet per season.

Calleguas-Conejo Hydrologic Unit

Since ground water is the primary source of water supply in the Calleguas-Conejo Hydrologic Unit, safe ground water yield therein was taken as equal to safe yield of the unit. As described previously in this chapter, Simi, East and West Las Posas, and Tierra Rejada Basins are experiencing perennial lowering of ground water levels, indicating a violation of the first of the three cited criteria governing determination of safe ground water yield. It is possible, also, that this perennial lowering is resulting in a condition of adverse salt balance, thereby violating the second of the criteria. Furthermore, in Conejo and Tierra Rejada Basins, prevailing low-yielding water-bearing formations and irregularities in the fracture systems in the volcanic rocks have precluded extensive utilization of ground water storage, and it appears that these basins are presently being utilized

to about the maximum practicable extent. Based on these considerations, safe ground water yield in the Calleguas-Conejo Hydrologic Unit was taken as equal to the average seasonal ground water replenishment during the base period, estimated to have been about 22,600 acre-feet.

Table 27 presents the estimated safe ground water yield of each of the subunits in the Calleguas-Conejo Hydrologic Unit. The value shown for the East and West Las Posas Subunits does not include some 1,100 acre-feet of water per season imported from Oxnard Plain Basin.

TABLE 27

ESTIMATED SAFE SEASONAL YIELD OF PRESENTLY DEVELOPED WATER SUPPLY IN CALLEGUAS-CONEJO HYDROLOGIC UNIT

Subunit	Acre-feet
Simi	6,100
East and West Las Posas	10,800
Conejo	2,600
Tierra Rejada	500
Santa Rosa	2,600
TOTAL	22,600

Simi Subunit. The derivation of the estimate of safe seasonal yield of Simi Basin is shown in Table 28. The values shown are average seasonal quantities over the base period from 1936-37 through 1950-51. The item for surface inflow does not include an average quantity of about 1,400 acre-feet of water per season imported from Tapo Canyon, a small ground water basin northeast of Simi Basin. The item for consumptive use of precipitation was based on the results of analyses described in Chapter III, and includes consumptive use of ground water by phreatophytes.

TABLE 28

ESTIMATED SAFE SEASONAL YIELD
OF SIMI GROUND WATER BASIN

Item	Acre-feet
Items tending to increase yield	
Surface inflow	3,900
Direct precipitation on ground water basin	13,300
Subtotal to be added	17,200
Items tending to decrease yield	
Surface outflow	1,100
Subsurface outflow	100
Consumptive use of precipitation	11,300
Subtotal to be subtracted	12,500
SAFE YIELD	4,700

In addition to the estimated 4,700 acre-foot safe yield of Simi Basin, importation of ground water from Tapo Canyon averaged about 1,400 acre-feet per season during the base period. It was assumed that this amount represents the safe yield of this minor basin. Thus, the safe water supply available to meet requirements in the Simi Subunit was estimated to total about 6,100 acre-feet per season.

East and West Las Posas Subunits. The average seasonal ground water replenishment of East and West Las Posas Basins during the base period, which replenishment was taken as equal to the safe yield therein, was evaluated as a differential in solution of the equation of hydrologic equilibrium. Seasonal consumptive use of applied water was estimated to have averaged about 16,900 acre-feet. Importation of water from Oxnard Plain Basin in the average amount of approximately 1,100 acre-feet per season served to meet a portion of this consumptive use. The average seasonal decrement in ground water storage, which also served to meet a

portion of the consumptive use, was estimated to have been about 5,000 acre-feet. By subtracting the sum of the estimated seasonal decrement in ground water storage and seasonal importation from the estimated seasonal consumptive use of applied water, net ground water replenishment was estimated to have averaged about 10,800 acre-feet per season. The safe water supply available to meet requirements in the East and West Las Posas Subunits was estimated to be approximately 11,900 acre-feet per season, comprised of the foregoing safe ground water yield of about 10,800 acre-feet per season, plus the importation from Oxnard Plain Basin of some 1,100 acre-feet per season.

Conejo Subunit. Since available data were insufficient to permit quantitative evaluation of the items of water supply and disposal in the Conejo Subunit during the base period, and since it appears that water requirements of the present water service area therein are being satisfied by natural replenishment of the Conejo ground water basin, safe yield of the subunit was taken as equal to the estimated average seasonal net extraction of ground water during the base period, or about 2,600 acre-feet per season.

Tierra Rejada Subunit. A few ground water level measurements available in Tierra Rejada Basin since 1930 indicate that disposal of ground water from the basin has probably exceeded replenishment thereof. It was estimated that beneficial use of ground water extracted from the basin during the base period averaged about 1,000 acre-feet per season, of which some 500 acre-feet represented consumptive use of applied water within the subunit, and the remaining 500 acre-feet represented an exportation to the Santa Rosa Subunit. Replenishment of Tierra Rejada Basin is largely from percolation of the unconsumed portion of direct precipitation Since precipitation averages less than 14 inches of depth per season over the 4,390 acres in the subunit, it is believed that the average seasonal net replenishment of the basin could be no more than about 500 acre-feet. This amount was taken as the safe seasonal yield of the Tierra Rejada Subunit.

Santa Rosa Subunit. For reasons cited in the case of the Conejo Subunit, safe yield of the Santa Rosa Subunit was taken as equal to the average seasonal net extraction of ground water therein during the base period, estimated to have been about 2,600 acre-feet. The safe water supply available to meet requirements in the Santa Rosa Subunit is comprised of this safe ground water yield plus the importation from Tierra Rejada Subunit in the amount of about 500 acre-feet per season, or a total of approximately 3,100 acre-feet per season.

Malibu Hydrologic Unit

The present water service area in the Malibu Hydrologic Unit, comprising less than 500 acres of irrigated and suburban lands, obtains its water supply by pumping ground water occurring primarily in fractured volcanic rocks. The water-using developments are largely in Hidden and Russell Valleys. Since it appears that present water requirements are being satisfied by natural replenishment, safe ground water yield in the Malibu Hydrologic Unit was taken as equal to the average seasonal consumptive use of applied water therein during the base period, estimated to have been about 800 acre-feet.

CHAPTER III. WATER UTILIZATION AND REQUIREMENTS

The nature and magnitude of water utilization and requirements in Ventura County, both at the present time and under probable ultimate conditions of development, are considered in this chapter. In connection with the discussion, the following terms are used as defined:

Water Utilization--This term is used in a broad sense to include all employments of water by nature or man, whether consumptive or non-consumptive, as well as irrecoverable losses of water incidental to such employment, and is synonymous with the term "water use".

Demands for Water--Those factors pertaining to specific rates, times, and places of delivery of water, losses of water, quality of water, etc., imposed by the control, development, and use of the water for beneficial purposes.

Water Requirement--The amount of water needed to provide for all beneficial uses of water and for irrecoverable losses incidental to such uses. As utilized in this bulletin, the term refers only to consumptive uses of applied water and attendant irrecoverable losses.

Supplemental Water Requirement--The water requirement over and above the sum of safe ground water yield and safe surface water yield.

Consumptive Use of Water--This refers to water consumed by vegetative growth in transpiration and building of plant tissue, and to water evaporated from adjacent soil, from water surfaces, and from foliage. It also refers to water similarly consumed and evaporated by urban and nonvegetative types of land use.

Applied Water--The water delivered to a farmer's headgate in the case of irrigation use, or to an individual's meter in the case of urban use, or its equivalent. It does not include direct precipitation.

Effective Precipitation--This refers to that portion of direct precipitation which is consumptively used and which does not run off or percolate to ground water.

Irrigation Efficiency--This refers to the ratio of consumptive use of applied water to the total amount of applied water, and is commonly expressed as a percentage.

Ultimate--This refers to conditions after an unspecified but long period of years in the future when land use and water supply development will be at a maximum and essentially stabilized. (It is realized that any present forecasts of the nature and extent of such ultimate development, and resultant water utilization, are inherently subject to possible large errors in detail and appreciable error in the aggregate. However, such forecasts, when based upon best available data and present judgment, are of value in establishing long-range objectives for development of water resources. They are so used herein, with full knowledge that their re-evaluation after the experience of a period of years may result in considerable revision.)

Present water requirements in Ventura County were determined by application of appropriate unit use of water factors to the present pattern of land use, from estimates of ground water extractions, and from estimated and measured diversions from surface streams to agricultural and urban entities. Probable ultimate water requirements were estimated from consideration of the probable ultimate pattern of land use and appropriate unit use of water factors. In determining the present and probable ultimate water requirements of Ventura County, due consideration was given to those natural features of the County, such as topography, geology, and soils, as they affect the use and re-use of water. As indicated by the foregoing definition, supplemental water requirements were estimated as the differences between derived values of safe yield and water requirements under present and probable ultimate conditions of development.

Certain possible non-consumptive requirements for water in Ventura County, such as those for hydroelectric power generation, flood control,

conservation of fish and wildlife, recreation, etc., may be of varying significance in the final design of works to meet supplemental consumptive requirements for water in the County. In most instances, the magnitudes of such non-consumptive requirements are relatively indeterminate, and dependent upon allocations made in design after consideration of factors of economics. For these reasons, water requirements for hydroelectric power generation, flood control, conservation of fish and wildlife, and recreation were considered to be outside the scope of the present investigation and are not evaluated in this bulletin.

Water utilization and requirements are considered and evaluated in this chapter under the general headings: "Present Water Supply Development", "Land Use", "Unit Use of Water", "Water Requirements", "Demands for Water", and "Supplemental Water Requirements".

Present Water Supply Development

As stated previously, the seasonal and cyclic vagaries of stream flow in Ventura County have precluded the dependency on unregulated surface water as a firm source of water supply. The resulting extensive utilization of ground water storage has enabled the County to achieve its present stage of development. With the exception of Matilija Dam and Reservoir, constructed in 1948 by the Ventura County Flood Control District on Matilija Creek, a tributary of the Ventura River, and of a few relatively minor additional surface storage developments, the entire regulation of the natural water supply of Ventura County is obtained from ground water storage.

Irrigated and urban lands are primarily served by pumped wells drawing from underlying ground water basins. The results of a County-wide canvass of wells conducted during the investigation indicated that there were in excess of 1,350 wells of heavy draft, equipped with pumps having motors of five

horsepower or greater, supplying water to meet irrigation requirements within the County. There were also in excess of 150 wells of heavy draft supplying water for urban and suburban uses. The irrigation wells are generally individually owned, although there are many mutual water companies in the County that obtain their water from a single well or a series of wells and distribute the water on a share basis.

In 1951, there were 92 mutual water companies in Ventura County, serving water for domestic and irrigation purposes to shareholders and members. Approximately 23,000 acres of irrigated land and more than 5,000 service connections in various portions of the County were served with water by these mutual water companies. At the same time there were four municipally owned public utilities supplying water to approximately 11,100 service connections, and seven county water districts with about 2,000 service connections. In addition, there were nine privately owned utilities supplying both domestic and irrigation water to in excess of 5,000 service connections.

Utilization of surface water in Ventura County is limited to a relatively few users along the Ventura and Santa Clara Rivers and their tributaries. Along the Santa Clara River, these users divert either the uncontrolled surface flow of Piru, Sespe, and Santa Paula Creeks or the effluent discharge from ground water storage at the lower limits of Eastern, Piru, Fillmore, and Santa Paula Basins. Since water supplies from these sources are not dependable in quantity, and in some years are accustomed to diminish completely, many lands supplied therefrom are also equipped to pump supplemental water from ground water storage.

On the Ventura River, the City of Ventura is the largest user of surface water. The City has constructed a submerged concrete diversion weir to bedrock, almost completely across the Ventura River channel immediately downstream from the mouth of Coyote Creek near Foster Park. When available, Ventura

River is diverted by gravity into the city system. When necessary, the City of Ventura also pumps ground water in Upper Ventura River Basin from a well field located a short distance upstream from the diversion weir. In 1947, when water supplies from these sources became insufficient to meet its requirements, the City pumped supplemental water from a well drilled in Mound Basin near the beach in the southeasterly portion of the City. Subsequently in 1948, three additional wells were constructed in this vicinity and were utilized until the wet season 1951-52.

Upstream from the City's Foster Park diversion weir, there are several gravity diversions supplying water to agricultural and minor urban entities adjacent to the river. Mr. Harold Conkling, Consulting Engineer, in his report entitled "Safe Yield - Matilija Reservoir", May, 1948, estimated that about 500 acres of land above Meiners Oaks were so served. During wet periods, there are some minor surface diversions effected below the Foster Park weir. Table 29 lists the major diversions of surface water in Ventura County, their sources of water supply, the general location of lands served, the points of diversion, the estimated present average seasonal diversions, and the principal use of the diverted supplies.

TABLE 29

MAJOR DIVERSIONS OF SURFACE WATER IN VENTURA COUNTY

User	Source of supply	General location of lands served	Point of diversion	Estimated present average seasonal diversion, in acre-feet	Principal use
Miscellaneous users above Meiners Oaks[a]	Ventura River	Upper Ventura River Subunit	Between confluence of Matilija and North Fork of Matilija Creeks and Meiners Oaks	1,100	Irrigation
City of Ventura	Ventura River	City of Ventura	At Foster Park	5,700[b]	Municipal
Waring Bros. Irrigation Service	Piru Creek	Piru Subunit	½ mile above railroad bridge at town of Piru	800	Irrigation
United Water Conservation District (Piru Spreading Grounds)	Piru Creek	Piru Subunit	At town of Piru	See Table 31	Ground water replenishment
Fillmore Irrigation Company	Sespe Creek	Fillmore Subunit	1 mile above U.S.G.S. gaging station near Fillmore	4,600	Irrigation
Farmer's Irrigation Company	Santa Clara River	Santa Paula and Mound Subunits	1 mile above Santa Paula bridge	1,300	Irrigation
Miscellaneous agricultural users above Santa Paula Water Works diversion	Santa Paula Creek	Santa Paula Subunit	-------	300	Irrigation
Santa Paula Water Works, Ltd.	Santa Paula Creek	City of Santa Paula	At U.S.G.S. gaging station near Santa Paula	2,800	Municipal
Santa Clara Water and Irrigation Company	Santa Clara River	Oxnard Plain Subunit	Near town of Saticoy	700	Irrigation
United Water Conservation District (Saticoy Spreading Grounds)	Santa Clara River	Oxnard Forebay Subunit	Near town of Saticoy	See Table 31	Ground water replenishment

[a]From report "Safe Yield - Matilija Reservoir", May, 1948, by Harold Conkling, Consulting Engineer.
[b]Estimated present water requirement of City of Ventura. City would divert this amount if available.

Matilija Dam is a concrete arch structure with an overpour spillway, 163 feet in height above stream bed, creating a reservoir with storage capacity of about 7,000 acre-feet. The dry seasons that followed the completion of Matilija Dam in 1948 rendered the reservoir virtually ineffective in providing water to meet the then current water supply deficiencies in the Ventura Hydrologic Unit. It was not until January, 1952, that Matilija Reservoir first filled and spilled. During 1952, about 3,200 acre-feet of water from the reservoir were delivered through a pipe line with a 12-inch terminal diameter and spread on grounds constructed by the Ventura County Flood Control District in Ojai Basin. In addition, about 3,700 acre-feet of the stored water were released in that year directly down the Ventura River, for diversion by the City of Ventura and other users and for replenishment of Upper Ventura River Basin. A minor amount of water from Matilija Reservoir was delivered directly to users in Ojai Basin for irrigation purposes.

In addition to Matilija Dam, there are nine other impounding structures in Ventura County which, because of their height or reservoir storage capacity, are considered "dams" under the provisions of the State Water Code pertaining to safety of dams. By definition in the code, any such structure across a natural drainage channel that is greater than 25 feet in height or capable of storing more than 50 acre-feet of water is considered a dam, excepting that such structures that are less than six feet in height regardless of storage capacity, and structures that are not capable of storing 15 acre-feet of water regardless of height, are not considered dams and are exempt from State jurisdiction. Table 30 presents a list of eight of the dams in Ventura County which were within the jurisdiction of the State of California as of 1953, and which were utilized for stream flow regulation, together with pertinent information for each. Two other dams in the County, under jurisdiction of the State of California but not listed in Table 30, are utilized to impound wastes from oil field operations.

TABLE 30

DAMS AND RESERVOIRS IN VENTURA COUNTY

Name	Owner	Stream	Type	Height of dam from stream bed to crest, in feet	Reservoir area, in acres	Storage capacity, in acre-feet	Drainage area, in square miles	Date constructed	Purpose
Round Mountain	Camarillo State Hospital	Long Canyon Creek	Earthfill	10	---	92	.16	1927	Flood control
Matilija	Ventura County Flood Control District	Matilija Creek	Concrete arch	163	124.0	7,000	55	1949*	Municipal and irrigation
Runkle	Ventura County Flood Control District	Tributary of Arroyo Simi	Earthfill	40	7.1	100	1.57	1949	Ground water replenishment and soil conservation
Dennison	Dennison Ranch Company	Lion Canyon Creek	Concrete slab and buttress	32	---	60	6.8	1929	Irrigation
Anola	Otto G. Wilhelm	Tributary of Santa Ana Creek	Earthfill	38	2.0	30	.05	1924	Irrigation
Lake Sherwood	Lake Sherwood Country Club	Triunfo Creek	Constant radius concrete arch	43	184.0	2,694	16.0	1904	Recreation
Lake Eleanor	Southern Counties Land Company	Eleanor Creek	Constant radius concrete arch	37	9.0	104	1.2	1881	Recreation
El Rancho Cola	Elizabeth Winthrop Alison	Coyote Creek	Earthfill	53	17.2	335	15.0	1951	Irrigation and domestic water supply

* Storage began March 14, 1948.

Artificial regulation of surface waters of the Santa Clara River system is provided by their diversion to and percolation in the Piru and Saticoy spreading grounds, constructed by the Santa Clara Water Conservation District and now operated by the United Water Conservation District. Excess flows are diverted from Piru Creek to the Piru spreading grounds, located immediately south of the town of Piru, through an unlined ditch having a capacity of about 75 second-feet. Water is diverted from the Santa Clara River to the Saticoy spreading grounds, located about one mile southeast of the town of Saticoy on the southeast side of the river, through an unlined ditch with a capacity of about 145 second-feet. During the wet season of 1951-52, about 11,800 acre-feet of water were diverted and percolated in the Piru spreading grounds. During the same season, about 25,400 acre-feet were similarly percolated in the Saticoy spreading grounds. As mentioned previously, spreading grounds were formerly operated by the Santa Clara Water Conservation District near the City of Santa Paula, wherein surface flow in Santa Paula Creek was spread. Operation of the Santa Paula spreading grounds was abandoned subsequent to the season of 1940-41 because of prevailing high ground water levels in Santa Paula Basin. Measured seasonal diversions to the three spreading grounds during the base period are shown in Table 31.

TABLE 31

MEASURED DIVERSIONS OF SURFACE FLOW TO SPREADING GROUNDS IN SANTA CLARA RIVER HYDROLOGIC UNIT, DURING BASE PERIOD

(In acre-feet)

Season	Piru spreading grounds	Saticoy spreading grounds	Santa Paula spreading grounds	Totals
1936-37	8,194	20,137	3,121	31,452
1937-38	6,664	13,652	750	21,066
1938-39	6,768	13,545	1,889	22,202
1939-40	5,103	16,790	900	22,793
1940-41	5,672	396	1,306	7,374
1941-42	0	0	0	0
1942-43	3,226	0	0	3,226
1943-44	0	1,956	0	1,956
1944-45	8,912	4,738	0	13,650
1945-46	7,067	17,243	0	24,310
1946-47	10,045	22,758	0	32,803
1947-48	1,318	7,804	0	9,122
1948-49	1,840	5,530	0	7,370
1949-50	3,780	9,700	0	13,480
1950-51	0	0	0	0
TOTALS	68,589	134,249	7,966	210,804

Land Use

As a first step in estimating the water requirements of Ventura County, survey determinations were made of the nature and extent of present land use as related to water utilization. Similarly, the probable nature and extent of ultimate land use were forecast on the basis of land classification and habitable area survey data, which segregated lands of the County in accordance with their suitability for irrigated agriculture and possible development to urban and suburban types of land use.

Past and Present Patterns of Land Use

In connection with the preparation of State Water Resources Board Bulletin No. 2, a detailed land use survey was conducted throughout the southerly developed portion of Ventura County during the season of 1949-50. During 1950-51, a resurvey was made in connection with the present investigation to ascertain changes in land use subsequent to the original survey. It was determined that such changes were minor. The 1949-50 survey, therefore, was adopted as representative of present conditions of development in Ventura County.

In the 1949-50 survey, the entire area shown on Plate 3, entitled "Hydrologic Units" was field mapped, and from the resulting maps the areal extent of each class and type of land use, including both those requiring water service and native vegetation and other types not requiring water service, was determined. A determination was also made of the areal extent of each class and type of land use overlying the major ground water basins. In agricultural areas, results of the survey were reduced by the estimated percentages of non-productive land, such as county and state highways, farm access roads, and lots; and the net irrigated area of each crop was estimated. Similarly, the gross areas of various types of urban development were determined and were then reduced by appropriate percentages of streets and walks, etc., to obtain the net water-using area. Table 32 summarizes, by hydrologic unit and subunit, the nature and extent of lands in Ventura County presently requiring water service. The areal extent of urban and irrigated lands in Ventura County during 1949-50 is delineated on Plates 24-A, 24-B, and 24-C, entitled "Present and Probable Ultimate Land Use". Table 33 presents a summary of present land use in the four hydrologic units, indicating the location of various classes of land use with respect to the major ground water basins.

TABLE 32

PRESENT WATER SERVICE AREAS IN VENTURA COUNTY

(In acres)

Class and type of land use	Ventura Hydrologic Unit					
	Upper Ojai Subunit	Ojai Subunit	Upper Ventura River Subunit	Lower Ventura River Subunit	Rincon Subunit	Subtotals
Urban and Suburban Lands						
Residential, single	20	231	321	722	38	1,332
Residential, multiple	0	10	11	51	10	82
Residential, estate	0	122	28	28	9	187
Residential, rural	8	48	266	13	13	348
Commercial	0	31	21	197	12	261
Industrial, manufacturing	22	6	2	327	0	357
Schools	2	40	17	71	0	130
Dairies	0	1	8	10	0	19
Livestock and poultry ranches	1	0	9	36	3	49
Net urban and suburban area	53	489	683	1,455	85	2,765
Military reservations*	0	0	0	0	0	0
Industrial, extractive	53	0	0	1,692	844	2,589
Subdivided, not occupied	0	174	16	0	0	190
Airoorts	0	0	14	0	0	14
Vacant	0	176	135	285	0	596
Streets and roads	18	178	206	909	77	1,388
Gross urban and suburban area	124	1,017	1,054	4,341	1,006	7,542
Irrigated Lands						
Alfalfa	0	14	208	2	0	224
Pasture	0	134	39	143	9	325
Nuts	146	107	229	103	0	585
Deciduous	10	30	46	53	0	139
Citrus	9	1,412	438	556	119	2,534
Truck	0	19	81	44	1	145
Beans	0	0	23	11	0	34
Hay and grain	0	0	0	0	0	0
Nursery	0	0	13	1	0	14
Net irrigated area	165	1,716	1,077	914	129	4,000
Streets and roads	9	79	50	52	6	196
Gross irrigated area	174	1,795	1,127	965	135	4,196
GROSS AREA REQUIRING WATER SERVICE	298	2,812	2,181	5,306	1,141	11,738

TABLE 32 (Continued)

PRESENT WATER SERVICE AREAS IN VENTURA COUNTY

(In acres)

Class and type of land use	Santa Clara River Hydrologic Unit								
	Eastern Subunit	Piru Subunit	Fillmore Subunit	Santa Paula Subunit	Mound Subunit	Oxnard Forebay Subunit	Oxnard Plain Subunit	Pleasant Valley Subunit	Subtotals
Urban and suburban lands									
Residential, single	0	70	203	538	160	43	800	144	1,958
Residential, multiple	0	0	38	63	18	10	94	70	293
Residential, estate	0	12	23	60	20	2	70	30	217
Residential, rural	0	14	14	62	41	88	220	102	541
Commercial	0	8	34	67	17	24	177	20	347
Industrial, manufacturing	0	8	70	82	22	46	127	20	375
Schools	0	3	21	47	19	15	35	13	153
Dairies	0	0	0	9	0	6	18	50	83
Livestock and poultry ranches	0	23	77	47	11	11	100	110	379
Net urban and suburban area	0	138	480	975	308	245	1,641	559	4,346
Military reservations*	0	0	0	0	0	0	4,937	0	4,937
Industrial, extractive	0	1,428	1,009	813	91	0	15	0	3,356
Subdivided, not occupied	0	2	11	18	0	10	28	15	84
Airports	0	0	0	23	14	0	126	291	454
Vacant	0	7	52	178	32	61	156	38	524
Streets and roads	0	115	204	382	104	82	549	153	1,589
Gross urban and suburban area	0	1,690	1,756	2,389	549	398	7,452	1,056	15,290
Irrigated lands									
Alfalfa	45	57	147	114	83	134	1,304	1,731	3,615
Pasture	0	30	145	108	56	10	233	62	644
Nuts	64	84	330	1,993	2,929	513	1,101	2,796	9,810
Deciduous	0	19	21	24	0	0	38	0	102
Citrus	56	4,031	8,665	6,265	2,540	1,683	5,383	2,921	31,544
Truck	0	59	279	247	158	184	4,171	1,904	7,002
Beans	0	0	327	966	2,232	749	18,149	7,021	29,444
Hay and grain	0	0	7	54	72	0	561	19	713
Nursery	0	8	12	22	2	32	34	85	195
Net irrigated area	165	4,288	9,933	9,793	8,072	3,305	30,974	16,539	83,069
Streets and roads	8	225	523	515	425	174	1,631	870	4,371
Gross irrigated area	173	4,513	10,456	10,308	8,497	3,479	32,605	17,409	87,440
GROSS AREA REQUIRING WATER SERVICE	173	6,203	12,212	12,697	9,046	3,877	40,057	18,465	102,730

TABLE 32 (Continued)

PRESENT WATER SERVICE AREAS IN VENTURA COUNTY

(In acres)

Class and type of land use	Calleguas-Conejo Hydrologic Unit							Malibu Hydrologic Unit	Totals for all hydrologic units
	Simi Subunit	East Las Posas Subunit	West Las Posas Subunit	Conejo Subunit	Tierra Rejada Subunit	Santa Rosa Subunit	Subtotals		
Urban and suburban lands									
Residential, single	142	110	11	79	3	13	378	74	3,742
Residential, multiple	5	3	3	8	0	5	24	2	401
Residential, estate	16	8	6	9	0	6	45	31	480
Residential, rural	269	64	11	133	0	0	477	0	1,366
Commercial	17	13	0	40	0	0	70	4	682
Industrial, manufacturing	25	32	0	4	0	0	61	0	793
Schools	13	10	3	10	0	3	39	0	322
Dairies	0	0	0	3	0	0	3	0	105
Livestock and poultry ranches	114	107	31	53	7	12	324	26	778
Net urban and suburban area	601	347	65	359	10	39	1,421	137	8,669
Military reservations*	0	0	0	0	0	0	0	0	4,937
Industrial, extractive	190	50	0	0	0	0	240	0	6,185
Subdivided, not occupied	0	0	0	10	0	0	10	0	284
Airports	12	0	0	0	7	0	19	5	492
Vacant	14	18	0	0	0	0	32	0	1,152
Streets and roads	163	90	9	90	0	6	358	25	3,360
Gross urban and suburban area	980	505	74	459	17	45	2,080	167	25,079
Irrigated lands									
Alfalfa	102	99	19	113	0	17	350	27	4,246
Pasture	52	4	48	70	26	2	202	241	1,412
Nuts	2,871	2,257	1,315	556	56	311	7,366	24	17,785
Deciduous	12	183	0	29	0	5	229	1	471
Citrus	2,160	2,981	1,445	593	113	1,677	8,969	37	43,084
Truck	256	251	242	104	87	45	985	9	8,141
Beans	205	812	2,606	0	103	186	3,912	0	33,390
Hay and grain	0	0	0	52	0	0	52	0	765
Nursery	9	10	0	7	0	4	30	0	239
Net irrigated area	5,667	6,597	5,675	1,524	385	2,247	22,095	339	109,503
Streets and roads	297	346	299	81	20	118	1,161	18	5,746
Gross irrigated area	5,964	6,943	5,974	1,605	405	2,365	23,256	357	115,249
GROSS AREA REQUIRING WATER SERVICE	6,944	7,448	6,048	2,064	422	2,410	25,336	524	140,328

* Area of military reservations not segregated by class and type of land use. A small portion of indicated area is estimated to require water service.

TABLE 33

SUMMARY OF PRESENT LAND USE IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Class of land use	Ventura Hydrologic Unit					
	Upper Ojai Subunit	Ojai Subunit	Upper Ventura River Subunit	Lower Ventura River Subunit[a]	Rincon Subunit[a]	Subtotals
Overlying Ground Water Basins						
Gross area requiring water service	160	2,800	1,440	---	---	4,400
Dry farmed and fallow	1,150	1,320	880	---	---	3,350
Native Brush and grass	610	1,770	1,540	---	---	3,920
Phreatophytes	30	100	550	---	---	680
Waste land	0	50	580	---	---	630
Water surface	0	0	0	---	---	0
Subtotals	1,950	6,040	4,990	---	---	12,980
Remainder of hydrologic unit						
Gross area requiring water service	140	10	740	5,310	1,140	7,340
Dry farmed and fallow	850	380	5,050	2,120	1,810	10,210
Native brush and grass	6,730	4,360	15,080	23,060	11,950	61,180
Phreatophytes	0	10	110	320	0	440
Waste land	0	0	20	360	490	870
Water surface	0	0	0	0	0	0
Subtotals	7,720	4,760	21,000	31,170	15,390	80,040
TOTALS	9,670	10,800	25,990	31,170	15,390	93,020

TABLE 33 (Continued)

SUMMARY OF PRESENT LAND USE IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Class of land use	Santa Clara River Hydrologic Unit								
	Eastern Subunit	Piru Subunit	Fillmore Subunit	Santa Paula Subunit	Mound Subunit	Oxnard Forebay Subunit	Oxnard Plain Subunit	Pleasant Valley Subunit	Subtotals
Overlying ground water basins									
Gross area requiring water service	0	3,250	10,540	9,840	9,030	3,880	40,060	17,740	94,340
Dry farmed and fallow	0	160	660	1,590	340	210	930	2,530	6,420
Native brush and grass	0	1,340	2,220	650	840	910	1,690	2,860	10,510
Phreatophytes	0	390	1,430	620	300	300	860	290	4,190
Waste land	0	1,380	1,930	740	590	870	2,900	430	8,840
Water surface	0	0	90	80	0	0	20	0	190
Subtotals	0	6,520	16,870	13,520	11,100	6,170	46,460	23,850	124,490
Remainder of hydrologic unit									
Gross area requiring water service	170	2,950	1,670	2,860	10	0	0	730	8,390
Dry farmed and fallow	100	1,110	930	1,890	220	0	0	1,670	5,920
Native brush and grass	2,360	35,940	25,440	33,450	6,160	0	0	9,740	113,090
Phreatophytes	100	360	410	170	0	0	0	0	1,040
Waste land	70	430	130	140	0	0	0	20	790
Water surface	0	0	0	10	0	0	0	0	10
Subtotals	2,800	40,790	28,580	38,520	6,390	0	0	12,160	129,240
TOTALS	2,800	47,310	45,450	52,040	17,490	6,170	46,460	36,010	253,730

TABLE 33 (Continued)

SUMMARY OF PRESENT LAND USE IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Class of land use	Calleguas-Conejo Hydrologic Unit							Malibu Hydrologic Unit[a]	Totals for all hydrologic units
	Simi Subunit	East Las Posas Subunit	West Las Posas Subunit	Conejo Subunit	Tierra Rejada Subunit	Santa Rosa Subunit	Subtotals		
Overlying ground water basins									
Gross area requiring water service	6,180	4,850	5,290	2,060	420	2,040	20,840	---	119,580
Dry farmed and fallow	3,430	1,990	930	11,020	1,540	880	19,790	---	29,560
Native brush and grass	660	700	240	15,790	2,430	120	19,940	---	34,370
Phreatophytes	210	230	10	30	0	30	510	---	5,380
Waste land	270	400	0	20	0	0	690	---	10,160
Water surface	10	0	0	10	0	0	20	---	210
Subtotals	10,760	8,170	6,470	28,930	4,390	3,070	61,790	---	199,260
Remainder of Hydrologic Unit									
Gross area requiring water service	760	2,600	760	0	0	370	4,490	520	20,740
Dry farmed and fallow	4,260	10,960	2,230	0	0	470	17,920	3,340	31,390
Native brush and grass	34,140	30,520	4,700	0	0	4,120	73,480	48,510	296,260
Phreatophytes	70	100	0	0	0	0	170	90	1,740
Waste land	20	130	0	0	0	0	150	120	1,930
Water surface	0	0	0	0	0	0	0	90	100
Subtotals	39,250	44,310	7,690	0	0	4,960	96,210	52,670	358,160
TOTALS	50,010	52,480	14,160	28,930	4,390	8,030	158,000	52,670	557,420

a Lands overlying ground water basins not differentiated.

During the course of the investigation of the water resources of Ventura County conducted by the State between 1927 and 1932 and culminating in Division of Water Resources Bulletin No. 46, similar land use surveys were made. For comparative purposes, Table 34 presents the results of a survey of irrigated crops made in 1931-32 together with those of the 1949-50 survey, tabulated by the three major hydrologic units. It should be noted that the values presented in Table 34 represent gross areas and include roads, farm lots, and other nonproductive lands.

TABLE 34

GROSS AREA OF IRRIGATED CROPS IN MAJOR HYDROLOGIC UNITS OF VENTURA COUNTY, 1931-32 AND 1949-50

(In acres)

Crop	Ventura Hydrologic Unit		Santa Clara River Hydrologic Unit		Calleguas-Conejo Hydrologic Unit		Totals	
	1931-32	1949-50	1931-32	1949-50	1931-32	1949-50	1931-32	1949-50
Alfalfa	190	235	5,024	3,805	163	368	5,377	4,408
Pasture	22	341	---	678	---	213	22	1,232
Walnuts	276	618	15,430	10,324	6,702	7,753	22,408	18,695
Deciduous	442	145	849	107	2,121	240	3,412	492
Citrus	1,815	2,656	19,503	33,204	4,157	9,441	25,475	45,301
Truck	710	152	17,566	7,371	1,654	1,037	19,930	8,560
Beans	21	35	21,064	30,994	6,358	4,118	27,443	35,147
Hay and grain	164	---	1,113	751	684	55	1,961	806
Nursery	---	14	---	206	---	31	---	251
GROSS IRRIGATED AREA	3,640	4,196	80,549	87,440	21,839	23,256	106,028	114,892

Examination of Table 34 shows that there has been but a small increase in the area of irrigated crops in Ventura County during the 18-year period from 1932 to 1950, particularly in the Ventura and Calleguas-Conejo Hydrologic Units. Except as otherwise qualified, all evaluations relating to water utilization and requirements presented in this bulletin were based on the assumption that the determined present pattern of land use in the County is equivalent to the average pattern prevailing during the base period. Although the overall increase in total irrigated acreage in the County has been relatively small, there have been, however, notable changes in the crop pattern. It is believed that these changes have not materially affected the magnitude of water utilization on irrigated lands. Significant increases in harvested acreages have occurred in the coastal plain of the Santa Clara River Valley, particularly since the end of World War II, as the result of increasing double and triple cropping practices on truck and bean lands. It is estimated that in this area lands not planted to annual crops produce an average of approximately two crops per season. It is considered probable that with maintenance of current farm prices, double and even triple cropping will become increasingly prevalent.

In common with the remainder of California, Ventura County experienced a substantial growth in population during the decade from 1940 to 1950, increasing from 69,685 to 114,647. This influx of people, which appears to be continuing, has been accompanied by a change in land use, particularly in the vicinity of Ventura and Oxnard, where lands formerly occupied by irrigated crops have been and are currently being subdivided for homes and community development. Such a trend is in evidence also in the vicinity of the town of Ojai, and in the Simi and Conejo Subunits of the Calleguas-Conejo Hydrologic Unit, even though the expansion is limited by existing and increasing water supply deficiencies.

Probable Ultimate Pattern of Land Use

Two independent surveys were conducted in Ventura County to determine the nature and extent of the probable ultimate pattern of land use as related to water utilization. A land classification survey was made to ascertain the suitability of lands for irrigated agriculture. In addition, a habitable area survey was conducted to determine the extent of lands not suitable for irrigated agriculture, but susceptible to urban types of development.

The objective of the land classification survey was to delineate the lands suitable for irrigation development and the probable crop pattern that would result with such development. The classification of lands gave consideration to such factors as topography, soils, crop adaptability, and ease of irrigation. It did not consider those economic factors relating to production and marketing, which are variable among given areas and subject to considerable fluctuation over a period of years. The survey encompassed the entire County, and included presently irrigated lands. However, it did not include those areas now devoted to concentrated urban type developments, nor the inaccessible rugged mountainous terrain in the northerly portion of the County, most of which lies within the Los Padres National Forest.

Table 35 presents the standards utilized in the land classification survey.

TABLE 35

LAND CLASSIFICATION STANDARDS

Land characteristics	Irrigable valley floor lands	Irrigable gently sloping hill lands	Irrigable steeply sloping hill lands	Non-irrigable lands
Soils				
Texture	Loamy sand to permeable clay	Sandy loam to permeable clay	Sandy loam to permeable clay	(Includes all lands which do not meet the minimum requirements for the other classes)
Minimum effective depth of good, free working soil, in inches	18	30	18	
Topography				
Maximum slopes	Smooth slopes up to 6 per cent in general gradient in reasonably large sized bodies sloping in the same plane; or rougher slopes which are less than 4 per cent in general gradient.	Smooth slopes up to 15 per cent in general gradient at minimum soil depths, increasing to 20 per cent as soil depth increases; or rougher slopes which ar less than 12 per cent in general gradient.	Smooth slopes up to 30 per cent in general gradient at minimum soil depths, increasing to 45 per cent as soil depth increases; or rougher slopes which are less than 20 per cent in general gradient at minimum soil depths, increasing to 30 per cent as soil depth increases.	
Loose rocks or rock outcroppings	Causing only moderate reduction of productivity and interference with cultural practices.	Causing only slight reduction of productivity and interference with cultural practices.	Same as gently sloping hill lands, except where soils are deep. In that case, moderate reduction of productivity and interference with cultural practices is permitted.	
Erosion	Slight; may have occasional small gullies.	Slight to moderate; may have occasional gullies which are crossable by tillage implements.	Moderate; with very few gullies which are not crossable by tillage implements.	
Drainage				
Soils and topography	Farm drainage may be required.	Drainage not a factor.	Drainage not a factor.	
Salinity	Total salts not to exceed 0.5 per cent, except where reclamation appears feasible.	Salinity not a factor.	Salinity not a factor.	
Alkalinity	pH 9.0 or less, unless soil is calcareous and evidence of black alkali is absent.	Alkalinity not a factor.	Alkalinity not a factor.	

Irrigable valley floor lands of Ventura County are primarily found on alluvial deposits, and generally are of excellent quality. These alluvial soils have been derived from sediments that have undergone little or no change or internal modifications since their deposition, and are still in the process of formation. They are comprised of deposition washed from areas of sand, sandstone, conglomerate, basic igneous rocks, old valley filling deposits, and other rocks within the drainage basins. Adequate depth of soil is present throughout the areal extent of these lands. The topography is smooth and level or gently sloping, and is suitable for most types of irrigation practice. Soil textures vary from medium to heavy, with good water-holding capacity, and the soil structure permits easy penetration of roots, air, and water. Irrigable valley floor lands generally are suitable for continuous production of all climatically adapted irrigated crops.

Irrigable hill lands include those lands which fail to meet the requirements for irrigable valley floor lands in regard to topography, but which are suitable for the production of certain irrigated crops with special irrigation practices. Since these lands are characterized by steep or rolling topography, care must be exercised in their irrigation, and terracing and/or permanent cover crops may be required. Some of these lands are to be found on recent alluvial soils, but for the most part they are comprised of residual soils or old valley filling and coastal plain soil groups that occur in marine or stream terraces. Depths of the soil varies from deep to the minimum allowable, and the underlying material may either be rock, a poorly consolidated material, or a heavy compacted soil with local tendencies toward hardpan. Surface soils are principally medium in texture with a structure permitting ease of penetration of plant roots and water. Irrigable hill lands are primarily suited for crops such as orchard or permanent pasture, which can be irrigated with small heads of water, and cultivated or harvested under adverse topographical conditions. Row crops can be grown on these lands where topography

permits, but extreme care must be exercised when irrigating in order to prevent erosion. Although the development, irrigation, cultivation, and harvesting of crops on these lands will be more difficult than on valley floor lands, they are well suited for crops easily damaged by frost, such as citrus and avocados, in that good air drainage is provided by their topographic characteristics.

Lands which failed to meet the minimum requirements for irrigated agriculture in one or more of the characteristics of soil, topography, or drainage were designated "non-irrigable lands", and were considered unsuitable for irrigation development. These lands include the rugged mountainous areas in the northerly portion of the County, river wash, coastal beach and dune sands, and saline tidal marshes. Certain minor areas located in isolated portions of the County, although meeting the standards for irrigability, were not so classified and were included in the non-irrigable classification.

The term "habitable area", as used herein, refers to those presently undeveloped lands not considered irrigable, but which, by virtue of their topographic characteristics and proximity to either present urban centers or probable future urban areas, were considered susceptible to urban types of development. From the results of a survey conducted throughout the four hydrologic units of Ventura County in 1951-52, it was determined that there were about 6,300 acres of non-irrigable lands which could be considered habitable under this definition.

Results of both the land classification and habitable area surveys indicate that in the four hydrologic units there are about 235,000 acres out of a total area of about 557,000 acres susceptible to concentrated and intensive water-using developments. Plates 24-A, 24-B, and 24-C, entitled "Present and Probable Ultimate Land Use", shows the areal extent of these lands. Table 36 presents the results of the land classification and habitable area surveys conducted in the four hydrologic units.

TABLE 36

CLASSIFICATION OF LANDS IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Hydrologic unit	Lands susceptible to water service						Non-irrigable lands	
	Irrigable valley floor lands	Irrigable gently sloping hill lands	Irrigable steeply sloping hill lands	Habitable Non-irrigable lands	Present urban[a] Lands	Subtotals	Not susceptible to intensive water service	Totals
Ventura								
Upper Ojai	590	1,740	1,020	0	0	3,350	6,320	9,670
Ojai	1,760	2,650	590	0	650	5,650	5,150	10,800
Upper Ventura River	2,220	4,640	2,460	0	830	10,150	15,840	25,990
Lower Ventura River	680[b]	1,310	670	0	2,550	5,210	25,960	31,170
Rincon	800	---	---	1,610	0	2,410	12,980	15,390
Subtotals	6,050	10,340	4,740	1,610	4,030	26,770	66,250	93,020
Santa Clara River								
Eastern	70	200	40	0	0	310	2,490	2,800
Piru	3,470	4,270	1,020	0	110	8,870	38,440	47,310
Fillmore	9,560	5,730	2,730	0	440	18,460	26,990	45,450
Santa Paula	9,490	3,270	4,510	0	1,380	18,650	33,390	52,040
Mound	9,140	840	810	0	460	11,250	6,240	17,490
Oxnard Forebay	4,550	60	0	0	380	4,990	1,180	6,170
Oxnard Plain	34,640	50	50	2,340	4,760	41,840	4,620	46,460
Pleasant Valley	18,040	5,440	1,340	0	970	25,790	10,220	36,010
Subtotals	88,960	19,860	10,500	2,340	8,500	130,160	123,570	253,730
Calleguas-Conejo								
Simi	8,500	3,860	4,180	0	480	17,020	32,990	50,010
East Las Posas	5,460	8,840	9,420	0	230	23,950	28,530	52,480
West Las Posas	5,320	4,280	2,190	0	0	11,790	2,370	14,160
Conejo	1,510	7,650	3,440	0	280	12,880	16,050	28,930
Tierra Rejada	620	680	580	0	0	1,880	2,510	4,390
Santa Rosa	1,490	1,800	730	0	0	4,020	4,010	8,030
Subtotals	22,900	27,110	20,540	0	990	71,540	86,460	158,000
Malibu	2,010	2,420	70	2,310	0	6,810	45,860	52,670
TOTALS	119,920	59,730	35,850	6,260	13,520	235,280	322,140	557,420

a Concentrated Urban developments. Areas shown do not include all lands designated "urban and sugurban" in Table 32.
b Represents total irrigable lands.

It is probable that lands in the four hydrologic units of Ventura County which were not considered either irrigable or habitable, totaling about 322,000 acres, will require water service to some small degree. Although these lands are largely of a rugged topographic character, it was forecast that scattered residences would be found therein under conditions of ultimate development. It was considered that water service to these entities would not be obtained from an organized agency, but rather would be obtained locally from springs or shallow wells through individual effort, and that the effect of these relatively minor uses on the water supply of the County would be negligible.

In addition to the approximately 557,000 acres of land included within the four hydrologic units, there are about 631,000 acres in Ventura County, most of which is in the northerly mountainous region. Of this remaining area, about 620,000 acres are within the boundaries of the Los Padres and Angeles National Forests. It was estimated by the United States Forest Service that there are about 300 acres of irrigable land in the Los Padres National Forest and within the Cuyama River drainage area. In addition, it was determined that there are about 2,000 acres of irrigable land outside the national forest boundaries in the upper reaches of Piru Creek. Under conditions of ultimate development, it is probable that there also will be an increased number of suburban residences and resort-type settlements in the national forest preserves and in the remainder of the County area not included within the four hydrologic units.

Utilizing the results of the land classification and habitable area surveys, and giving consideration to present and probable future trends of development, a pattern of probable ultimate land use was forecast for Ventura County for the purpose of estimating water requirements. As has been shown previously, utilization of water in the County at the present time is predominantly for the needs of agriculture, and the urban requirement is much smaller.

It was concluded, however, that in the future the magnitude of the urban water requirement may approach that of irrigated agriculture. This conclusion was based upon the indicated susceptibility to urbanization of a substantial portion of the County, together with the recent and apparently continuing tremendous growth of population of the nearby Los Angeles Metropolitan Area and of California in general. In this connection, the current rapid change in land use in the adjacent San Fernando Valley from irrigated agriculture to urban and suburban types of community development points to the probability of such an occurrence in portions of Ventura County in the near future. As has been mentioned, a trend in this direction is presently in evidence in areas adjacent to the Cities of Oxnard and Ventura. Accordingly, each hydrologic unit and subunit was studied from a standpoint of its susceptibility to future urbanization. Estimates were made of the percentage of the gross area, classified as requiring future intensive water service, that ultimately would be devoted to urban and suburban types of development. Based on these studies, it was estimated that under ultimate conditions of development in the four hydrologic units of Ventura County, nearly one-half of the lands requiring intensive water service would be used for urban and suburban purposes, with the remainder used for irrigated agriculture.

A probable ultimate pattern of urban land use was then derived, based on percentage factors for the various types of urban development determined in extensive studies of the Los Angeles and San Diego Metropolitan Areas made in connection with preparation of State Water Resources Board Bulletin No. 2. For the probable ultimate irrigated area, a crop pattern was derived based on the results of the land classification survey, crop adaptability, and prevailing trends in irrigated agriculture. Table 37 presents the probable ultimate pattern of land use for each hydrologic unit and subunit in Ventura County.

TABLE 37

PROBABLE ULTIMATE PATTERN OF LAND USE IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Class and type of land use	Ventura Hydrologic Unit					
	Upper Ojai Subunit	Ojai Subunit	Upper Ventura River Subunit	Lower Ventura River Subunit	Rincon Subunit	Subtotals
Urban and suburban lands						
Residential, single	860	2,160	3,880	1,980	1,230	10,110
Residential, multiple	80	210	380	420	120	1,210
Residential, estate	80	210	380	100	120	890
Commercial, strip	80	210	380	260	120	1,050
Commercial, downtown	0	0	0	50	0	50
Industrial, manufacturing	20	40	80	420	20	580
Schools	30	90	150	160	50	480
Parks	0	0	0	360	0	360
Farmsteads	80	70	130	0	0	280
Net urban and suburban area	1,230	2,990	5,380	3,750	1,660	15,010
Airports	20	40	80	100	30	270
Streets and roads	510	1,280	2,280	1,360	720	6,150
Gross urban and suburban area	1,760	4,310	7,740	5,210	2,410	21,430
Irrigated lands						
Alfalfa	0	0	0	0	0	0
Pasture	170	110	490	0	0	770
Nuts	620	80	210	0	0	910
Deciduous	570	20	130	0	0	720
Citrus	40	990	1,300	0	0	2,330
Truck	0	0	0	0	0	0
Beans	0	0	0	0	0	0
Sugar beets	0	0	0	0	0	0
Miscellaneous	0	0	0	0	0	0
Net irrigated area	1,400	1,200	2,130	0	0	4,730
Streets and roads and non-productive area	190	140	280	0	0	610
Gross irigated area	1,590	1,340	2,410	0	0	5,340
Gross area requiring water service	3,350	5,650	10,150	5,210	2,410	26,770
Non-irrigable lands not susceptible to intensive water service	6,320	5,150	15,840	25,960	12,980	66,250
TOTALS	9,670	10,800	25,990	31,170	15,390	93,020

TABLE 37 (Continued)

PROBABLE ULTIMATE PATTERN OF LAND USE IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Class and type of land use	Santa Clara River Hydrologic Unit								
	Eastern Subunit	Piru Subunit	Fillmore Subunit	Santa Paula Subunit	Mound Subunit	Oxnard Forebay Subunit	Oxnard Plain Subunit	Pleasant Valley Subunit	Subtotals
Urban and suburban lands									
Residential, single	40	1,130	2,360	2,380	3,210	640	7,950	3,290	21,000
Residential, multiple	0	70	140	140	680	40	1,670	190	2,930
Residential, estate	0	90	180	190	170	50	420	260	1,360
Commercial, strip	10	110	230	230	420	60	1,050	320	2,430
Commercial, downtown	0	0	0	0	80	0	210	0	290
Industrial, manufacturing	10	180	370	370	680	100	1,670	520	3,900
Schools	0	70	140	140	250	40	630	190	1,460
Parks	0	0	0	0	590	0	1,460	0	2,050
Farmsteads	10	330	690	700	140	190	1,050	970	4,080
Net urban and suburban area	70	1,980	4,110	4,150	6,220	1,120	16,110	5,740	39,500
Airports	0	20	50	50	170	10	420	70	790
Streets and roads	20	550	1,150	1,160	2,190	310	5,440	1,610	12,430
Gross urban and suburban area	90	2,550	5,310	5,360	8,580	1,440	21,970	7,420	52,720
Irrigated lands									
Alfalfa	0	120	240	240	20	230	750	1,530	3,130
Pasture	0	60	240	120	0	70	190	0	680
Nuts	100	170	480	2,160	580	540	560	3,070	7,660
Deciduous	0	110	0	0	0	0	0	0	110
Citrus	90	4,850	10,270	8,170	940	1,480	2,450	2,050	30,300
Truck	0	230	480	480	120	230	2,820	3,580	7,940
Beans	0	0	120	600	630	740	9,790	5,800	17,680
Sugar beets	0	0	0	0	70	0	1,880	850	2,800
Miscellaneous	0	170	120	240	50	70	380	170	1,200
Net irrigated area	190	5,710	11,950	12,010	2,410	3,360	18,820	17,050	71,500
Streets and roads and non-productive area	30	610	1,200	1,280	260	190	1,050	1,320	5,940
Gross irrigated area	220	6,320	13,150	13,290	2,670	3,550	19,870	18,370	77,440
Gross area requiring water service	310	8,870	18,460	18,650	11,250	4,990	41,840	25,790	130,160
Non-irrigable lands not susceptible to intensive water service	2,490	38,440	26,990	33,390	6,240	1,180	4,620	10,220	123,570
TOTALS	2,800	47,310	45,450	52,040	17,490	6,170	46,460	36,010	253,730

TABLE 37 (Continued)

PROBABLE ULTIMATE PATTERN OF LAND USE IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acres)

Class and type of land use	Calleguas-Conejo Hydrologic Unit							Malibu Hydrologic Unit	Totals for all hydrologic units
	Simi Subunit	East Las Posas Subunit	West Las Posas Subunit	Conejo Subunit	Tierra Rejada Subunit	Santa Rosa Subunit	Subtotals		
Urban and suburban lands									
Residential, single	6,510	3,050	1,500	4,930	240	510	16,740	3,090	50,940
Residential, multiple	640	180	90	480	10	30	1,430	300	5,870
Residential, estate	640	240	120	480	20	40	1,540	300	4,090
Commercial, strip	640	300	150	480	30	50	1,650	300	5,430
Commercial, downtown	0	0	0	0	0	0	0	0	340
Industrial, manufacturing	130	480	230	100	40	80	1,060	0	5,540
Schools	250	180	90	190	10	30	750	130	2,820
Parks	0	0	0	0	0	0	0	0	2,410
Farmsteads	210	900	440	160	70	150	1,930	60	6,350
Net urban and suburban area	9,020	5,330	2,620	6,820	420	890	25,100	4180	83,790
Airports	120	60	30	100	0	10	320	60	1,440
Streets and roads	3,830	1,500	740	2,900	120	250	9,340	,820	29,740
Gross urban and suburban area	12,970	6,890	3,390	9,820	540	1,150	34,760	,060	114,970
Irrigated lands									
Alfalfa	0	0	150	0	0	20	170	30	3,330
Pasture	110	150	80	460	60	30	890	230	2,570
Nuts	1,800	4,910	1,060	1,170	120	230	9,290	20	17,880
Deciduous	0	150	80	160	60	30	480	10	1,320
Citrus	1,550	8,930	3,550	870	780	1,800	17,480	50	50,160
Truck	0	0	380	0	0	180	560	340	8,840
Beans	70	750	1,960	50	0	150	2,980	0	20,660
Sugar beets	0	0	0	0	160	0	160	0	2,960
Miscellaneous	0	0	300	0	0	130	430	0	1,630
Net irrigated area	3,530	14,890	7,560	2,710	1,180	2,570	32,440	680	109,350
Streets and roads and non-productive area	520	2,170	840	350	160	300	4,340	70	10,960
Gross irrigated area	4,050	17,060	8,400	3,060	1,340	2,870	36,780	750	120,310
Gross area requiring water service	17,020	23,950	11,790	12,880	1,880	4,020	71,540	6,810	235,280
Non-irrigable lands not susceptible to intensive water service	32,990	28,530	2,370	16,050	2,510	4,010	86,460	45,860	322,140
TOTALS	50,010	52,480	14,160	28,930	4,390	8,030	158,000	52,670	557,420

Unit Use of Water

The second step in the evaluation of present and probable ultimate water requirements of Ventura County involved determination of appropriate units of water use for each of the classes and types of land use requiring water service. In addition, certain phases of the hydrologic analyses described in Chapter II required determination of use of water by native vegetation and other lands not requiring water service. It should be mentioned that unit values of water use presented in this bulletin are used in conjunction with net areas requiring water service.

Unit Values of Consumptive Use

Unit values of monthly and seasonal consumptive use of water for both irrigated crops and lands not requiring water service were estimated, utilizing a procedure suggested by Harry F. Blaney and Wayne D. Criddle of the Soil Conservation Service, United States Department of Agriculture, in their reports entitled "A Method of Estimating Water Requirements in Irrigated Areas from Climatological Data", dated December, 1947, and "Determining Water Requirements in Irrigated Areas from Climatological Data", dated August, 1950. Use of this procedure involved correlation and adjustment of data available on unit seasonal consumptive use by irrigated crops in other localities to correspond with data and conditions prevailing in Ventura County. This included comparison and correlation of data on the basis of variations in average monthly temperatures, monthly percentages of annual daytime hours, precipitation, and length of growing season. It disregarded certain generally unmeasured factors, such as wind movement and humidity. Also utilized were data and analyses appearing in a report to the Ventura County Flood Control District by the United States Department of Agriculture, Soil Conservation Service, entitled "Ground Water Replenishment by Penetration of Rainfall, Irrigation and Water Spreading in

Zone 3, Ventura County Flood Control District, California", and dated April, 1953.

In each of the hydrologic units and subunits, seasonal consumptive use of water for each type of land use, other than urban types, was determined for climatic conditions as they prevailed during the chosen base period from 1936-37 through 1950-51. Values so determined were taken to correspond to values for the mean period. Average unit values of seasonal consumptive use were also determined for the drought period from 1944-45 through 1950-51. In addition, in order to properly analyze hydrology of the ground water basins in the Santa Clara River Hydrologic Unit, it was necessary to estimate unit values of monthly consumptive use for the base period.

Following is an outline of the procedure utilized in estimating unit values of seasonal consumptive use of water by lands requiring water service and native vegetation:

1. The unit value for each irrigated crop during its growing season was taken as the product of available heat and an appropriate coefficient of consumption, where: (a) the available heat was the summation of the products of the average monthly temperatures and the monthly percentages of annual daytime hours, and (b) the coefficient of consumption was one which had been selected as appropriate for this part of California by Harry F. Blaney as a result of his studies for the Soil Conservation Service. Certain modifications were made in the coefficients as a result of studies of consumptive use of water available from other areas.

2. The unit value for each irrigated crop during its non-growing season was taken as the amount of the precipitation available, but not exceeding one to two inches of depth per month, depending upon the crop.

3. The seasonal unit value for each irrigated crop was taken as the summation of values determined under items 1 and 2 for that type.

4. In general, the seasonal unit values for native vegetation were taken as equal to the available precipitation up to about 1.3 feet in depth.

5. The seasonal unit value for phreatophytes was estimated to be five feet of depth, from data appearing in Division of Water Resources Bulletin No. 46, and Division of Water Resources Bulletin No. 44, "Water Losses Under Natural Conditions", dated 1933.

6. Seasonal unit values for free water surfaces were estimated from available records of evaporation at reservoirs in Santa Barbara and Los Angeles Counties. Long-term records of evaporation in Ventura County were not available.

7. Seasonal unit values for remaining miscellaneous nonwater-using types of land use were estimated on the basis of available data on corresponding consumptive uses in similar localities.

8. Seasonal unit values for urban entities were based upon detailed studies conducted in the Los Angeles and San Diego Metropolitan Areas in conjunction with the preparation of State Water Resources Board Bulletin No. 2.

9. Unit values of seasonal consumptive use of applied water were estimated by deducting seasonal effective precipitation from the calculated unit values of total seasonal consumptive use. Initial fall moisture deficiencies for irrigated crops presented in Division of Water Resources Bulletin No. 46 were employed in this determination.

10. In the Santa Clara River Hydrologic Unit, unit values of monthly consumptive use for both lands requiring water service and native vegetation were estimated from the procedure described previously, modified to account for monthly climatic variations.

Table 38 presents the estimated unit values of mean seasonal consumptive use of water and consumptive use of applied water for irrigated lands in Ventura County. Table 39 presents estimates of comparable average seasonal

values for the drought period, while Table 40 presents estimated unit values of mean and drought period seasonal consumptive use of water for native vegetation and other lands not requiring water service.

TABLE 38

ESTIMATED UNIT VALUES OF MEAN SEASONAL CONSUMPTIVE USE OF WATER ON IRRIGATED LANDS IN VENTURA COUNTY

(In feet of depth)

Type of land use	Ventura Hydrologic Unit						Santa Clara River Hydrologic Unit								
	Upper Ojai, Ojai, and Upper Ventura River Subunits			Lower Ventura River and Rincon Subunits			Eastern, Piru, Fillmore, and Santa Paula Subunits			Mound, Oxnard Forebay Oxnard Plain, and Pleasant Valley Subunits			Calleguas-Conejo and Malibu Hydrologic Units		
	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use
Alfalfa	2.5	1.1	3.6	2.1	1.1	3.2	2.4	1.1	3.5	2.1	1.1	3.2	2.3	1.1	3.4
Pasture	2.5	1.1	3.6	2.1	1.1	3.2	2.4	1.1	3.5	2.1	1.1	3.2	2.3	1.1	3.4
Walnuts	1.6	1.3	2.9	1.6	1.1	2.7	1.6	1.2	2.8	1.6	1.1	2.7	1.7	1.1	2.8
Deciduous	1.5	1.2	2.7	1.3	1.3	2.6	1.4	1.2	2.6	1.3	1.3	2.6	1.5	1.2	2.7
Citrus	1.6	0.9	2.5	1.3	0.9	2.2	1.4	1.0	2.4	1.3	0.9	2.2	1.3	1.0	2.3
Truck[a]	1.2	1.0	2.2	1.0	1.1	2.1	1.2	0.9	2.1	1.0	1.1	2.1	1.0	1.1	2.1
Beans[a]	1.2	1.0	2.2	1.1	1.0	2.1	1.2	1.0	2.2	1.1	1.0	2.1	1.1	1.1	2.2
Hay and grain	---	---	---	0.6	0.9	1.5	0.8	0.8	1.6	0.6	0.9	1.5	0.6	1.0	1.6
Nursery	3.0	1.0	4.0	3.0	1.0	4.0	3.0	1.0	4.0	3.0	1.0	4.0	3.0	1.0	4.0

[a]Values shown are for average of two crops per season.

TABLE 39

ESTIMATED AVERAGE UNIT VALUES OF SEASONAL CONSUMPTIVE USE OF WATER
ON IRRIGATED LANDS DURING DROUGHT PERIOD IN VENTURA COUNTY

(In feet of depth)

Type of land use	Ventura Hydrologic Unit						Santa Clara River Hydrologic Unit						Calleguas-Conejo and Malibu Hydrologic Units		
	Upper Ojai, Ojai, and Upper Ventura River Subunits			Lower Ventura River and Rincon Subunits			Eastern, Piru, Fillmore, and Santa Paula Subunits			Mound, Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits					
	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use	Applied water	Precipitation	Total seasonal consumptive use
Alfalfa	2.6	1.0	3.6	2.4	0.7	3.1	2.6	0.8	3.4	2.4	0.7	3.1	2.7	0.6	3.3
Pasture	2.6	1.0	3.6	2.4	0.7	3.1	2.6	0.8	3.4	2.4	0.7	3.1	2.7	0.6	3.3
Walnuts	1.8	1.1	2.9	2.0	0.8	2.8	1.9	0.9	2.8	2.0	0.8	2.8	2.1	0.7	2.8
Deciduous	1.7	1.0	2.7	1.8	0.8	2.6	1.8	0.8	2.6	1.8	0.8	2.6	1.9	0.8	2.7
Citrus	1.7	0.8	2.5	1.4	0.9	2.3	1.5	0.8	2.3	1.4	0.9	2.3	1.6	0.6	2.2
Truck[a]	1.2	0.9	2.1	1.3	0.8	2.1	1.2	0.9	2.1	1.3	0.8	2.1	1.4	0.7	2.1
Beans[a]	1.3	0.7	2.0	1.3	0.8	2.1	1.2	1.0	2.2	1.3	0.8	2.1	1.5	0.7	2.2
Hay and grain	---	---	---	0.7	0.8	1.5	0.8	0.7	1.5	0.7	0.8	1.5	0.7	0.9	1.6
Nursery	3.0	1.0	4.0	3.0	1.0	4.0	3.0	1.0	4.0	3.0	1.0	4.0	3.0	1.0	4.0

[a]Values shown are for average of two crops per season.

TABLE 40

ESTIMATED UNIT VALUES OF SEASONAL CONSUMPTIVE USE OF WATER ON NON-IRRIGATED LANDS IN VENTURA COUNTY

(In feet of depth)

Type of Land use	Ventura Hydrologic Unit				Santa Clara River Hydrologic Unit					
	Upper Ojai, Ojai, and Upper Ventura River Subunits		Lower Ventura River and Rincon Subunits		Eastern, Piru, Fillmore, and Santa Paula Subunits		Mound, Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits		Calleguas-Conejo and Malibu Hydrologic Units	
	Mean	Drought period	Mean	Drought period	Mean	Drought period	Mean	Drought period	Mean	Drought period
Non-irrigated agriculture	1.3	1.1	1.3	0.8	1.3	0.9	1.3	0.8	1.2	0.8
Fallow	0.7	0.5	0.6	0.4	0.6	0.5	0.6	0.4	0.6	0.4
Abandoned crop land	1.3	1.1	1.3	0.8	1.3	0 9	1.3	0.8	1.2	0.8
Native brush and grass	1.3	1.1	1.3	0.8	1.3	0.9	1.3	0.8	1.2	0.8
Phreatophytes	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
River wash	0.7	0.5	0.6	0.4	0.6	0.5	0.6	0.4	0.6	0.4
Water surface	4.2	4.4	4.2	4.4	4.2	4.4	4.2	4.4	4.2	4.4

Presented in Table 41 are estimated mean seasonal unit values of water delivery to and consumptive use of water on urban and suburban types of land use. Drought period values for urban and suburban types of land use were not estimated, since the effect of varying climatic conditions on use of water by these types was considered insignificant in Ventura County. As mentioned previously, values presented in Table 41 were derived from detailed studies of water use by urban types of development in the Los Angeles and San Diego Metropolitan Areas. Values for unit delivery requirements shown in Table 41, although probably representative of ultimate unit delivery requirements for urban types of development, appear to be greater than present deliveries in the service area of the City of Ventura and in the Rincon Subunit, in the cases of multiple residences, strip and downtown commercial, and industry of a manufacturing nature. For present conditions of development in the portions of the County where applied water was taken as the measure of water requirement, records of historical water deliveries rather than the units presented in Table 41 were utilized in estimating water requirements. However, as described hereinafter, these units were employed in estimating probable ultimate water requirements.

TABLE 41

ESTIMATED MEAN SEASONAL UNIT DELIVERY TO AND CONSUMPTIVE USE OF WATER ON URBAN AND SUBURBAN LANDS IN VENTURA COUNTY

(In feet of depth)

Type of land use	Delivery	Consumptive use		
		Applied water	Precipitation	Total
Residential, single	2.8	1.3	0.9	2.2
Residential, multiple	5.0*	0.3	0.6	0.9
Residential, estate	2.2	1.5	1.1	2.6
Residential, rural	1.8	0.8	0.8	1.6
Commercial, strip	4.0*	0.4	0.5	0.9
Commercial, downtown	11.0*	1.1	0.5	1.6
Industrial, manufacturing	8.5*	1.4	0.6	2.0
Schools	1.1	0.4	0.7	1.1
Parks	2.2	1.7	0.9	2.6
Dairies	1.9	1.0	0.9	1.9
Livestock and poultry ranches	1.3	0.6	0.7	1.3
Industrial, extractive	0.0	0.0	0.6	0.6
Subdivided, not occupied	0.0	0.0	0.6	0.6
Airports	0.0	0.0	0.5	0.5
Vacant	0.0	0.0	0.6	0.6
Streets and roads	0.0	0.0	0.5	0.5

* Not applicable under present conditions of development in service area of City of Ventura and in Rincon Subunit.

Unit Values of Applied Water

In certain portions of Ventura County, it was necessary to determine appropriate unit values of applied water to furnish a basis for estimating water requirements, particularly for probable ultimate conditions of development. To this end, records of water applied to representative crops available from mutual water companies, ranches, private individuals, and publications of the Division of Water Resources and other agencies were analyzed. Field studies of water applied to predominant irrigated crops were also conducted during the course of the investigation. Records of historical deliveries of water to principal urbanized areas, such as Ventura and Oxnard, were obtained and analyzed. Data

regarding delivery requirements for urban entities in the Los Angeles and San Diego Metropolitan Areas were also employed, the results of which are shown in Table 41.

The results of the studies for irrigated crops indicated a definite relationship between the amount of water applied to a given crop and the amount and occurrence of rainfall in a given season. Furthermore, extreme variations were noted in the amounts of water applied to a given crop in the same season among several users. These variations resulted from differences in irrigation practice, soil types, and individual preference and skill among irrigators, and were of such an indeterminable nature that an accurate accounting thereof was impossible.

Presented in Table 42 are estimated average unit seasonal values of application of irrigation water on principal crops in Ventura County during both the drought and wet periods. Also shown are arithmetical averages of the values for these two periods, which averages were taken as being equivalent to mean seasonal irrigation applications. While it is known that many exceptions and substantial variations from the estimated values occur, they are nevertheless considered to be representative of present irrigation practices in the County.

TABLE 42

ESTIMATED UNIT VALUES OF SEASONAL APPLICATION
OF IRRIGATION WATER ON PRINCIPAL CROPS
IN VENTURA COUNTY

(In feet of depth)

Hydrologic unit and subunit	Crop	Average for drought period	Average for wet period	Mean
Ventura	Citrus	2.5	---	---
Santa Clara River				
Eastern, Piru,	Citrus	2.8	2.2	2.5
Fillmore, and Santa	Walnuts	1.0	.5	.8
Paula Subunits	Alfalfa	5.4	4.8	5.1
	Truck	3.1	2.2	2.6
Mound, Oxnard Fore-	Citrus	1.4	1.3	1.4
bay, Oxnard Plain,	Walnuts	1.7	1.5	1.6
and Pleasant Valley	Beans	1.4	1.2	1.3
Subunits	Truck	2.0	1.2	1.6
Calleguas-Conejo	Citrus	1.9	1.4	1.6
	Walnuts	1.2	.8	1.0
	Alfalfa	---	---	3.0
	Beans	---	---	1.1
	Truck	---	---	1.2

Substantiation of the values for applied water presented in Tables 41 and 42 was obtained from the Mound, Oxnard Plain, and Pleasant Valley Subunits for the drought period from 1944-45 through 1950-51. Detailed studies were made to determine ground water extractions in these subunits for each season from 1944-45 through 1951-52. This study was conducted in cooperation with the Southern California Edison Company and included analyses of power consumption by agricultural, municipal, and other major plants pumping from ground water, pumping plant efficiencies, the results of about 580 pump tests available from the Southern California Edison Company, and of data on pumping lifts obtained from analysis of measurements of depth to ground water made during the period of

study by the Ventura County Water Survey. By applying unit values of applied water considered representative of the drought period to determined irrigated crop acreages, and by making similar computations for urban and suburban lands, it was estimated that 102,000 acre-feet of water per season on the average were applied on the Mound, Oxnard Plain, and Pleasant Valley Subunits during the drought period. In these computations, an additional allowance was made for the use of the American Crystal Sugar Company's plant at Oxnard, which was estimated to be substantially in excess of the unit delivery factor of 8.5 feet of depth indicated in Table 41. The average seasonal pumpage during this period corrected for imports to and exports from the three subunits was estimated to have been about 107,500 acre-feet. In view of the nature of the basic data, the check furnished was believed to be reasonably close, and the average unit values of seasonal application of water to prevailing types of land use were considered representative for the drought period in these subunits.

Presented in the following tabulation are estimated present weighted average seasonal unit values of applied water in the Mound, Oxnard Plain, and Pleasant Valley Subunits for drought, wet, and mean periods:

	Seasonal unit values of applied water, in feet of depth		
	Urban lands	Irrigated lands	Weighted average for urban and irrigated lands
Drought period	4.3	1.7	1.8
Wet period	4.3	1.2	1.3
Mean period	4.3	1.4	1.6

Water Requirements

Estimates of present and probable ultimate water requirements in Ventura County were made by applying appropriate unit values of water use to the present and probable ultimate areas requiring water service, and by utilizing

historical records or estimates of water production. In portions of the County wherein water applied to lands in excess of consumptive use will either return to ground water storage and be available for re-use, or will drain from the area under consideration and be available for re-use downstream, the measure of water requirement was taken as the amount of consumptive use of applied water. For lands overlying confined ground water basins, wherein it was assumed that water applied in excess of consumptive use is prevented from returning to ground water storage for subsequent re-use, the measure of water requirement was taken as the amount of applied water. Similarly, for other portions of the County not overlying ground water basins, wherein the unconsumed residuum of water applied either drains directly to the ocean or is discharged thereto as sewage effluent, water requirements were measured in terms of applied water.

Water requirements in Ventura County were evaluated for the conditions of water supply and climate that would prevail with repetition of the base period, and also for conditions that would occur during a period of drought as that from 1944-45 through 1950-51, under both present and probable ultimate patterns of land use. In many water resources studies, water requirements for a given stage of development are determined only for a mean period or for a base period which is considered representative of mean conditions. In Ventura County, however, and in similar areas subject to wide extremes in seasonal water supplies and climatic conditions, with particular regard to precipitation, water requirements for irrigation are substantially increased during periods of drought when the natural supply from direct rainfall is reduced. This results in a marked increase in the demand for artificial water supplies from either surface or ground water sources. Thus, for such irrigated areas, drought period water requirements are of particular significance in planning for water supply development. As stated previously, for purposes of analysis in this bulletin, it was assumed that urban and suburban water requirements are not appreciably affected by such seasonal and cyclic climatic variations.

Present Water Requirements

The present mean seasonal water requirement of Ventura County was estimated to be about 180,000 acre-feet. It was further estimated that during drought periods this requirement would increase to about 205,000 acre-feet per season.

Determination of the present mean and drought period seasonal water requirements was based on the following assumptions:

1. That the nature and extent of land use in Ventura County determined from the land use survey of 1949-50 is representative of present conditions of development.

2. That average conditions of water supply and climate during the base period were representative of mean conditions, and that present average seasonal water requirements determined for base period conditions of water supply and climate are equivalent to present mean seasonal water requirements.

3. That present average seasonal water requirements estimated for conditions of water supply and climate prevailing during the period from 1944-45 through 1950-51 are equivalent to present seasonal water requirements during a drought period.

4. That deficiencies in the estimated seasonal water requirements for both urban and suburban and irrigated lands cannot be endured.

5. That the estimated gross production of water by the City of Ventura during the season of 1950-51 of about 5,700 acre-feet represents the present seasonal water requirement of the service area of that City.

6. That the average seasonal extractions of ground water in Mound, Oxnard Plain, and Pleasant Valley Subunits of the Santa Clara River Hydrologic Unit, during the period from 1944-45 through 1950-51, corrected for exports and imports, are equivalent to the present seasonal water requirements therein during a drought period.

7. That the average of the estimated seasonal extractions of ground water from the Mound, Oxnard Plain, and Pleasant Valley Basins for the two seasons of 1944-45 and 1951-52, corrected for exports and imports, are equivalent to the average present seasonal water requirements therein during a wet period.

8. That the arithmetical average of the seasonal water requirements during the base period for the Mound, Oxnard Plain, and Pleasant Valley Subunits, determined under the assumptions of items 6 and 7, are equivalent to the present mean seasonal water requirements therein.

In the Upper Ojai, Ojai, and Upper Ventura River Subunits of the Ventura Hydrologic Unit, wherein water applied in excess of consumptive use will either return to ground water storage and be available for re-use, or will drain to Ventura River and be susceptible to capture by ground water users in Upper Ventura River Basin or surface diverters along the Ventura River, present water requirements were estimated from unit values of consumptive use of applied water. For the Lower Ventura River and Rincon Subunits, wherein excess water is drained to the ocean or discharged thereto as sewage effluent, present water requirements were estimated and assumed to be measured by total application of water.

Present water requirements in the Eastern, Piru, Fillmore, Santa Paula, and Oxnard Forebay Subunits of the Santa Clara River Hydrologic Unit and in Calleguas-Conejo and Malibu Hydrologic Units, were taken equal to the estimated consumptive use of applied water therein, since reregulation of the unconsumed portion of applied water is obtained in prevailing free ground water basins. As mentioned previously, present water requirements for the Mound, Oxnard Plain, and Pleasant Valley Subunits of the Santa Clara River Hydrologic Unit were evaluated from estimates of total applied water. Table 43 presents the results of the evaluation of water utilization in the Mound, Oxnard Plain,

and Pleasant Valley Subunits during the period from 1944-45 through 1951-52, which data were used in determining present water requirements therein.

TABLE 43

ESTIMATED SEASONAL UTILIZATION OF WATER IN MOUND, OXNARD PLAIN, AND PLEASANT VALLEY SUBUNITS FROM 1944-45 THROUGH 1951-52

(In acre-feet)

Season	Mound Subunit			Oxnard Plain Subunit				Pleasant Valley Subunit
	1	2	3	4	5	6	7	8
	Ground water extractions	Import from Santa Paula and Oxnard Forebay Subunits	Applied water (1 + 2)	Ground water extractions	Export to Calleguas-Conejo Hydrologic Unit	Import from Santa Paula Subunit	Applied water (4 - 5 + 6)	Ground water extractions = applied water
1944-45	7,700	2,400	10,100	46,700	1,000	200	45,900	20,700
1945-46	10,900	2,800	13,700	63,000	1,500	500	62,000	28,300
1946-47	11,900	3,200	15,100	65,900	1,600	700	65,000	30,600
1947-48	14,300	3,800	18,100	64,000	2,100	600	62,500	34,900
1948-49	13,900	3,600	17,500	66,100	700	700	64,900	39,300
1949-50	11,500	2,800	14,300	57,500	1,300	400	56,600	32,100
1950-51	12,000	3,500	15,500	66,900	1,900	200	65,200	39,900
1951-52	4,700	2,100	6,800	46,800	800	300	46,300	22,700
Average for drought period, 1944-45 through 1950-51	11,800	3,100	14,900	61,400	1,600	500	60,300	32,300
Average for seasons, 1944-45 and 1951-52	6,200	2,300	8,500	46,700	900	300	46,100	21,700

It should be mentioned that examination of records of irrigation application to walnuts in the Simi Subunit of the Calleguas-Conejo Hydrologic Unit indicated that during the base period insufficient water was applied to meet the consumptive requirement of this crop. It was estimated that about 2,900 acre-feet of irrigation water per season were actually consumed during the base period by lands planted to walnuts, as compared to an estimated consumptive requirement for irrigation water by these lands of about 5,100 acre-feet per season. Thus, the present water requirement was estimated to be about 2,200 acre-feet per season greater than actual present use in the Simi Subunit.

Table 44 presents the estimated present mean and drought period seasonal water requirements for each of the hydrologic units and subunits in Ventura County, as determined from the foregoing methods and assumptions.

TABLE 44

ESTIMATED PRESENT MEAN AND DROUGHT PERIOD
SEASONAL WATER REQUIREMENTS IN VENTURA COUNTY

(In acre-feet)

Hydrologic unit and subunit	Mean			Drought period		
	Urban and suburban	Irrigated agriculture	Totals	Urban and suburban	Irrigated agriculture	Totals
Ventura						
Upper Ojai	100	300	400	100	300	400
Ojai	600	2,900	3,500	600	3,000	3,600
Upper Ventura River	800	1,900	2,700	800	2,000	2,800
Lower Ventura River	4,100	2,100	6,200	4,100	2,100	6,200
Rincon	200	300	500	200	300	500
Subtotals	5,800	7,500	13,300	5,800	7,700	13,500
Santa Clara River						
Eastern	0	300	300	0	300	300
Piru	200	7,000	7,200	200	7,400	7,600
Fillmore	500	13,800	14,300	500	14,700	15,200
Santa Paula	1,100	14,600	15,700	1,100	15,700	16,800
Mound	400	11,100	11,500	400	14,500	14,900
Oxnard Forebay	300	4,200	4,500	300	4,400	4,700
Oxnard Plain	9,700	43,000	52,700	9,700	50,600	60,300
Pleasant Valley	700	25,900	26,600	700	31,600	32,300
Subtotals	12,900	119,900	132,800	12,900	139,200	152,100
Calleguas-Conejo						
Simi	600	9,100	9,700	600	10,100	10,700
East Las Posas	400	9,400	9,800	400	11,100	11,500
West Las Posas	100	7,000	7,100	100	8,600	8,700
Conejo	300	2,300	2,600	300	2,900	3,200
Tierra Rejada	0	500	500	0	700	700
Santa Rosa	0	3,100	3,100	0	4,000	4,000
Subtotals	1,400	31,400	32,800	1,400	37,400	38,800
Malibu	200	600	800	200	700	900
TOTALS*	20,300	159,400	179,700	20,300	185,000	205,300

* Present water requirements for minor water service areas not included within hydrologic units were estimated to average less than 100 acre-feet per season.

Probable Ultimate Water Requirements

Probable ultimate mean and drought period seasonal water requirements of Ventura County were estimated to be about 389,000 acre-feet and about 420,000 acre-feet, respectively. For the probable ultimate water service areas in the four hydrologic units, water requirements were estimated by multiplying the predicted acreages of each type of land use by appropriate unit values of seasonal water use. However, the foregoing estimates of water requirements also include allowances for expected minor water-using entities, scattered throughout the four hydrologic units and the remainder of the County, and not requiring intensive water service. In general, these minor allowances were estimated on the basis of population density-water use relationships. Requirements for predicted minor irrigation developments were estimated in the same manner as for other probable ultimate irrigated lands.

For water service areas in the Upper Ojai, Ojai, and Upper Ventura River Subunits of the Ventura Hydrologic Unit, ultimate water requirements were estimated by application of appropriate unit values of consumptive use of applied water to predicted ultimate water-using lands. For the Rincon and Lower Ventura River Subunits, unit values of applied water were utilized.

In the Eastern, Piru, Fillmore, Santa Paula, and Oxnard Forebay Subunits of the Santa Clara River Hydrologic Unit, unit values of consumptive use of applied water were employed, while unit values of applied water were used in the Mound, Oxnard Plain, and Pleasant Valley Subunits. Unit values of applied water for irrigated crops in these latter subunits were estimated by applying a 70 per cent irrigation efficiency to computed values of consumptive use of applied water.

In water service areas of the Simi, East and West Las Posas, Tierra Rejada, and Santa Rosa Subunits of the Calleguas-Conejo Hydrologic Unit, ultimate water requirements were estimated by application of appropriate unit values

of consumptive use of applied water, increased by 25 per cent to allow for waste from these areas necessary to maintain a favorable salt balance in ground water basins and for possible exportation of sewage effluent, which latter occurrence could result with increased urbanization. In the Conejo Subunit, ultimate water requirements were estimated by multiplying acreages of each type of land use requiring water service by respective unit values of applied water. It is believed that the utility of ground water storage in the Conejo Basin is limited by irregularities in the fracture system in the volcanic rocks from which ground water supplies are principally obtained. It is probable that with increased development of the subunit, the uncertainties attendant upon utilization of these ground water supplies will render them of minor significance in water supply utilization and regulation, and that water service will primarily be obtained from other sources.

For reasons similar to those cited in the case of the Conejo Subunit, ultimate water requirements of the Malibu Hydrologic Unit were determined by multiplying acreages of each type of land use requiring water service by respective unit values of applied water.

For those lands in the hydrologic units not requiring intensive water service under probable ultimate conditions of development, but wherein scattered residences were forecast, an ultimate mean seasonal water requirement of about 1,100 acre-feet was estimated from population density-water use relationships. For lands in the Los Padres and Angeles National Forests not included within the hydrologic units, the United States Forest Service has estimated a probable ultimate mean seasonal water requirement of approximately 900 acre-feet, including the requirement for about 300 acres of irrigated land. Other potential water-using lands in Ventura County, not included within the federal reservation or in the four hydrologic units comprising a gross area of about 11,000 acres, including a probable ultimate net area requiring water service of about 1,700

acres in the Upper Piru Creek drainage area, were estimated to have a probable ultimate mean seasonal water requirement of about 2,800 acre-feet.

Table 45 summarizes by hydrologic unit and subunit the estimates of probable ultimate mean and drought period seasonal water requirements.

TABLE 45

ESTIMATED PROBABLE ULTIMATE MEAN AND DROUGHT PERIOD
SEASONAL WATER REQUIREMENTS IN VENTURA COUNTY

(In acre-feet)

Hydrologic unit and subunit	Mean			Drought period		
	Urban and suburban	Irrigated agriculture	Totals	Urban and suburban	Irrigated agriculture	Totals
Ventura						
Upper Ojai	1,400	2,300	3,700	1,400	2,600	4,000
Ojai	3,500	2,300	5,800	3,500	2,500	6,000
Upper Ventura River	6,100	3,900	10,000	6,100	4,100	10,200
Lower Ventura River	14,000	0	14,000	14,000	0	14,000
Rincon	5,000	0	5,000	5,000	0	5,000
Subtotals	30,000	8,500	38,500	30,000	9,200	39,200
Santa Clara River						
Eastern	100	300	400	100	300	400
Piru	2,200	9,100	11,300	2,200	9,200	11,400
Fillmore	4,600	16,100	20,700	4,600	17,400	22,000
Santa Paula	4,700	16,500	21,200	4,700	18,100	22,800
Mound	22,500	4,400	26,900	22,500	5,200	27,700
Oxnard Forebay	1,200	4,500	5,700	1,200	5,200	6,400
Oxnard Plain	59,800	31,200	91,000	59,800	37,100	96,900
Pleasant Valley	18,400	31,800	50,200	18,400	39,200	57,600
Subtotals	113,500	113,900	227,400	113,500	131,700	245,200
Calleguas-Conejo						
Simi	12,900	7,200	20,100	12,900	7,900	20,800
East Las Posas	7,500	26,300	33,800	7,500	31,200	38,700
West Las Posas	3,700	12,000	15,700	3,700	14,400	18,100
Conejo	20,500	6,100	26,600	20,500	7,800	28,300
Tierra Rejada	600	2,000	2,600	600	2,700	3,300
Santa Rosa	1,200	4,300	5,500	1,200	5,700	6,900
Subtotals	46,400	57,900	104,300	46,400	69,700	116,100
Malibu	12,300	1,400	13,700	12,300	1,800	14,100
Remainder of County*	1,800	3,000	4,800	1,800	3,500	5,300
TOTALS	204,000	184,700	388,700	204,000	215,900	419,900

* Includes scattered residences throughout County, together with about 2,000 acres of land requiring water service in Cuyama River drainage area and in upper reaches of Piru Creek drainage area.

Demands for Water

The term "demands for water", as used in this bulletin, refers to those factors pertaining to rates, times, and places of delivery of water, losses of water, quality of water, etc., imposed by the control, development, and use of water for beneficial purposes. Those demands relating to times, rates, and delivery of water, and permissible deficiencies in application of water must be given consideration in preliminary design of works to meet supplemental water requirements and are, therefore, discussed in the following sections. Demands relating to application of water to satisfy beneficial use have been discussed previously.

Monthly Demands for Water

Because of the erratic occurrence of precipitation and stream flow in Ventura County, both seasonally and monthly, there is wide variation in the monthly percentage of seasonal irrigation demand. Wide variations also prevail both in the rate and period of demand for irrigation water for different crops. Generally, most irrigation water is applied during the months from April to November. However, the increasing double and triple cropping practices in the coastal plain of the Santa Clara River Valley impose demands on artificial water supplies throughout the year. Furthermore, with diminution of winter rainfall during protracted periods of drought, perennial crops such as citrus, deciduous orchard, and irrigated pasture require winter irrigation to supplement deficiencies in natural supplies. However, during a year of subnormal rainfall, with expedient distribution, winter irrigation may not be practiced. In the aforementioned coastal plain of the Santa Clara River Valley, if there has been insufficient precipitation in the spring to achieve proper soil moisture conditions, it is common practice to pre-irrigate bean land prior to planting. With

heavy spring precipitation, beans are not usually pre-irrigated, and the requirement for ground water supplies in such a season is substantially reduced.

Studies of irrigation practice in Ventura County indicate that for certain crops the monthly percentages of seasonal demand for water have varied from zero in the minimum month to as high as 33 per cent in the maximum month. During drought periods, although monthly percentages of seasonal demand have been more uniform throughout the season, total amounts of applied water have been greater. Since use of water in urban areas is influenced only slightly by the magnitude and occurrence of precipitation, monthly percentages of seasonal demand for urban water remain rather constant seasonally, and also show a more uniform monthly distribution than do monthly irrigation demands.

Presented in Table 46 are estimates of average monthly distribution of seasonal demands for irrigation water for mean and drought periods, together with those for average monthly distribution of seasonal demand for urban water. Estimates of monthly urban demands were based on analysis of water deliveries and water production by the Cities of Ventura, Port Hueneme, and Oxnard. Irrigation demands were estimated from data obtained from representative water service agencies, mutual water companies, and individual consumers, and from analysis of records of agricultural power consumption obtained from the Southern California Edison Company.

TABLE 46

ESTIMATED AVERAGE MONTHLY DISTRIBUTION OF
DEMANDS FOR URBAN AND IRRIGATION WATER IN VENTURA COUNTY

(In per cent of seasonal total)

Month	Urban demands	Irrigation demands					
		Eastern, Piru, Fillmore, and Santa Paula Subunits, Santa Clara River Hydrologic Unit[a]		Mound, Oxnard Forebay, Oxnard Plain, and Pleasant Valley Subunits, Santa Clara River Hydrologic Unit[b]		Calleguas-Conejo Hydrologic Unit[c]	
		Mean	Drought period	Mean	Drought period	Mean	Drought period
October	8.8	10.3	10.7	8.8	10.4	9.0	8.8
November	7.7	9.2	8.2	7.3	8.4	6.6	6.6
December	6.7	6.6	6.1	5.1	6.4	3.2	3.0
January	6.3	3.0	4.3	1.8	4.5	1.7	2.2
February	6.0	1.0	1.7	0.9	3.4	1.6	2.3
March	6.9	2.3	4.4	2.7	4.3	3.5	4.6
April	7.7	3.1	4.8	6.1	7.2	5.1	7.3
May	8.9	12.0	12.3	12.2	10.0	11.5	12.8
June	10.3	12.5	10.3	13.2	10.6	14.0	12.8
July	10.6	14.6	13.1	15.4	10.7	15.2	14.4
August	10.7	13.4	13.5	14.7	11.9	14.9	13.1
September	9.4	12.0	10.6	11.8	12.2	13.7	12.1
TOTALS	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Estimated to be applicable in Upper Ojai, Ojai, and Upper Ventura River Subunits of Ventura Hydrologic Unit.
[b]Estimated to be applicable in Lower Ventura River and Rincon Subunits of Ventura Hydrologic Unit.
[c]Estimated to be applicable in Malibu Hydrologic Unit.

Irrigation Efficiency

Satisfaction of the consumptive requirements of irrigated crops requires the application of water in excess of consumptive use. The ratio of consumptive use of applied water to the total amount of applied water, expressed as a percentage, is termed "irrigation efficiency", and is useful as an indicator of prevailing irrigation practice. Irrigation efficiency varies widely between crops and among plots devoted to the same crop. These variations are accounted for in differences of root depth, soil type, topography, method of irrigation, drainage characteristics, and in the practices of the individual irrigators. During the course of this investigation, studies were made in selected areas by both the Division of Water Resources and by the United States Soil Conservation Service to ascertain approximate irrigation efficiencies. The Soil Conservation Service in their report, "Ground Water Replenishment by Penetration of Rainfall, Irrigation and Water Spreading in Zone 3, Ventura County Flood Control District, California", dated April, 1953, estimated the average irrigation efficiency during the base period for predominant crops in the Pleasant Valley Subunit of the Santa Clara River Hydrologic Unit, and for the several subunits of the Calleguas-Conejo Hydrologic Unit.

The estimates of the Soil Conservation Service were made by comparison of records of actual application of water to crops and estimated optimum values of consumptive use of applied water. These studies indicated that irrigation efficiencies of 85 to 90 per cent prevailed for citrus, 95 to 100 per cent for walnuts, 74 to 77 per cent for alfalfa and irrigated pasture, 58 to 64 per cent for beans, and 70 to 75 per cent for summer truck crops. In the case of walnuts, it appears probable that actual consumptive use of applied water was less than the computed values used in the studies, and that actual irrigation efficiency was less than the foregoing figures indicate.

It is known that even under the most favorable conditions a 100 per cent irrigation efficiency can rarely or never be achieved. Application of water sufficient to meet consumptive requirements will result in either deep penetration beyond the root zone of the crop under irrigation, or waste from the lower end of the field. Comparison of records of application of water with estimates of consumptive use of applied water in the Piru, Fillmore, and Santa Paula Subunits of the Santa Clara River Hydrologic Unit indicates that irrigation efficiencies on citrus approximate 60 per cent. Irrigation efficiencies on citrus and walnuts in excess of this value were noted in the Oxnard Plain Subunit. However, in this area, it is possible that these crops draw upon rainfall percolation and return irrigation water stored in the semi-perched ground water body, thereby reducing applied water requirements and increasing the apparent irrigation efficiencies.

In general, it is believed that, with the cited exceptions, an overall irrigation efficiency of about 70 per cent is being achieved in Ventura County at the present time.

Irrecoverable Losses

Attendant with the beneficial use of water, including the irrigation of crop land and the delivery of urban and suburban supplies, there may occur certain losses of water which cannot be recovered for further beneficial use. As used in this bulletin, the term "irrecoverable losses of water" refers to the water applied to irrigated crops in excess of beneficial consumptive use in confined ground water areas, wherein re-use cannot be effected, and to the sewage effluent from urbanized areas which is discharged to the ocean or otherwise lost for re-use, together with any transmission or delivery losses incurred, which are not susceptible to re-use. These losses comprise an additional demand on the supplies of Ventura County over and above consumptive uses. Comparison of

present consumptive use of applied water with estimated present water requirements in Ventura County indicates that present mean seasonal irrecoverable losses amount to about 22,000 acre-feet.

Permissible Deficiencies in Application of Water

Studies to determine deficiencies in the supply of irrigation water that might be endured without permanent injury to perennial crops were not made in connection with the Ventura County Investigation. However, such studies have been made for other areas in California, and indicate that a maximum deficiency of 35 per cent of the full seasonal requirement can be endured if the deficiency occurs only at relatively long intervals. It has also been determined that small deficiencies occurring at relatively frequent intervals can be endured.

In connection with the studies for this bulletin, no allowances were made for deficiencies in water supply. Even though it is known that portions of Ventura County subsisted on deficient water supplies during the latter years of the recent drought period, all estimates pertaining to water requirements were based upon the assumption that adequate water supplies would be provided to produce optimum crop yields each and every year. Similarly, estimates of requirements for urban and suburban entities did not allow for deficiencies in supply.

Supplemental Water Requirements

As has been stated, the security of existing developments and economies in Ventura County is threatened by water supply shortages which develop

during periods of drought, by perennial lowering of ground water levels, and by the intrusion of sea water into pumped aquifers. Furthermore, the growth and enhancement of the economy of portions of the County have been impeded by the lack of firm water supplies. Elimination of present water resources problems and provision for indicated increased future water requirements of the County will require the development of additional water supplies. The amounts of water so required have been designated "the present and probable ultimate supplemental water requirements". As previously defined, the term "supplemental water requirement" refers to water requirement over and above the sum of safe ground water yield and safe surface water yield. Present and probable ultimate supplemental water requirements were determined both for the mean period of water supply and climate, which conditions were taken as equivalent to those occurring during the base period, and for the drought period.

Differences in mean and drought period supplemental water requirements, presented in this section, result from the effect of seasonal and cyclic climatic variations on water requirements and water supply utilization. Consideration was not given to possible utilization of developed water supplies during wet periods in excess of established safe yields.

Present Supplemental Water Requirements

Present supplemental water requirements were estimated for each of the hydrologic units and subunits of Ventura County by deducting the estimated safe yields of presently developed water supplies, corrected for importation and exportation, from estimated present water requirements. The present mean seasonal supplemental water requirement for the County was so determined to be about 73,000 acre-feet. It was further estimated that the present requirement for supplemental water increases during drought periods to about 89,000 acre-feet per season.

Requirements for supplemental water during periods of drought are of

particular significance in the Ventura and Santa Clara River Hydrologic Units because of the limited natural and artificial water supply regulation in portions of these units, and because of the substantial increase in water requirements therein during drought periods, particularly in the latter unit. Comparison of safe yields of developed water supplies with drought period water requirements serves to establish the magnitude of the water resources problems in these hydrologic units. In the Calleguas-Conejo Hydrologic Unit the drought period requirement for supplemental water is of lesser significance, since water resources problems therein are largely manifest in perennial lowering of ground water levels, resulting from ground water utilization in excess of mean recharge, rather than in the lack of adequate natural or artificial regulatory storage capacity.

Table 47 presents the estimated present mean and drought period seasonal supplemental water requirements in Ventura County by hydrologic units and subunits. It may be noted that in some cases values for available safe water supplies in Table 47 for the drought period exceed those presented for the mean period. This results from differences between wet and drought periods in seasonal imports of water to and exports from the several hydrologic subunits, and from the variance between wet and drought periods in water supply and disposal in ground water basins. Under "safe yield operation" of those ground water basins wherein safe yield is governed by the amount of mean seasonal replenishment, rather than by basin storage capacity or configuration or by aquifer transmissibility, increased water utilization during a drought period, with attendant reduction in replenishment, would effect a depletion of ground water storage. During ensuing wet seasons, with lesser utilization and increased replenishment, ground water levels would recover to positions prevailing at the beginning of the former drought period. Thus, over a mean period of water supply and climate there would be no net change in ground water storage, and the criterion governing safe yield in such basins would not be violated. Values presented in Table 47 under columns

headed "Net effect of modified imports and exports on safe water supply" and "Net effect of changes in remaining items of water supply and disposal on safe water supply" were derived from data and by methods and procedures presented and discussed in Chapter II.

For reasons discussed hereinafter in Chapter IV, it was assumed that the net safe yield of water developed by Matilija Reservoir, in the estimated amount of about 1,400 acre-feet per season, would be entirely utilized in the Ojai Subunit.

TABLE 47

ESTIMATED PRESENT MEAN AND DROUGHT PERIOD SEASONAL SUPPLEMENTAL WATER REQUIREMENTS
IN HYDROLOGIC UNITS OF VENTURA COUNTY

(In acre-feet)

Hydrologic unit and subunit	Mean					Drought period					
	Water requirement	Safe yield	Net effect of imports and exports on safe water supply	Available safe water supply	Supplemental water requirement	Water requirement	Safe yield	Net effect of modified imports and exports on safe water supply	Net effect of changes in remaining items of water supply and disposal on safe water supply	Available safe water supply	Supplemental water requirement
Ventura											
Upper Ojai	400	400	0	400	0	400	400	0	0	400	0
Ojai	3,500	1,500	1,400	2,900	600	3,600	1,500	1,400	0	2,900	700
Upper Ventura River	8,900	7,400	-1,500	5,900	3,000	9,000	7,400	-1,500	0	5,900	3,100
Lower Ventura River											
Rincon	500	100	100	200	300	500	100	100	0	200	300
Subtotals	13,300	9,400	0	9,400	3,900	13,500	9,400	0	0	9,400	4,100
Santa Clara River											
Eastern	300	0	300	300	0	300	0	300	0	300	0
Piru	7,200	11,100	-3,900	7,200	0	7,600	11,100	-2,900	-600	7,600	0
Fillmore	14,300	10,000	4,300	14,300	0	15,200	10,000	3,300	1,900	15,200	0
Santa Paula	15,700	15,600	100	15,700	0	16,800	15,600	1,300	-100	16,800	0
Mound	11,500	8,800	2,700	11,500	0	14,900	8,800	3,100	3,000	14,900	0
Oxnard Forebay											
Oxnard Plain	83,800	26,700	-2,500	24,200	59,600	97,300	26,700	-3,600	0	23,100	74,200
Pleasant Valley											
Subtotals	132,800	72,200	1,000	73,200	59,600	152,100	72,200	1,500	4,200	77,900	74,200
Calleguas-Conejo											
Simi	9,700	6,100	0	6,100	3,600	10,700	6,100	0	500	6,600	4,100
East Las Posas	16,900	10,800	1,100	11,900	5,000	20,200	10,800	1,600	2,100	14,500	5,700
West Las Posas											
Conejo	2,600	2,600	0	2,600	0	3,200	2,600	0	600	3,200	0
Tierra Rejada	3,600	3,100	0	3,100	500	4,700	3,100	0	1,100	4,200	500
Santa Rosa											
Subtotals	32,800	22,600	1,100	23,700	9,100	38,800	22,600	1,600	4,300	28,500	10,300
Malibu	800	800	0	800	0	900	800	0	100	900	0
TOTALS	179,700	105,000	2,100	107,100	72,600	205,300	105,000	3,100	8,600	116,700	88,600

Probable Ultimate Supplemental Water Requirements

The probable ultimate mean and drought period seasonal supplemental water requirements in Ventura County were derived by comparison of probable ultimate water requirements and safe yields, and were estimated to be about 266,000 and 287,000 acre-feet, respectively. In the derivation, consideration was given to the effects of probable future increased use of the major ground water basins on previously estimated values for presently developed safe yield.

Table 48 summarizes, by hydrologic units and subunits, the estimated ultimate supplemental water requirements for mean and drought periods. The supplemental requirements presented in Table 48 are for probable ultimate areas requiring intensive water service. It was assumed that supplemental water would not be required to meet requirements of previously discussed minor water service areas throughout the County. A brief discussion of methods and assumptions employed in deriving the ultimate supplemental requirements follows:

Ventura Hydrologic Unit. It was concluded that in the Ventura Hydrologic Unit, without construction of additional regulatory works, the yield of present sources of water supply would be no greater with the probable ultimate pattern of land use and attendant water requirements than under present conditions. It was assumed, however, that ultimately the effective storage capacity of Matilija Reservoir would be entirely lost through siltation, thereby reducing the safe yield of the presently developed water supply in the Ventura Hydrologic Unit, estimated to be 9,400 acre-feet per season, to about 8,000 acre-feet per season. Probable ultimate supplemental water requirements were derived using this latter value.

Santa Clara River Hydrologic Unit. In the Santa Clara River Hydrologic Unit, consideration was given to the effect of increased development in that portion of the Santa Clara River watershed designated Eastern Basin, and included within Los Angeles County, on flow in Santa Clara River at the county line. Land

classification surveys, conducted in connection with the preparation of State Water Resources Board Bulletin No. 2, indicated that there are about 38,000 acres of land susceptible to water-using developments in this area, as compared to present water service area of about 10,000 acres. The ultimate mean seasonal water requirement was estimated to be in excess of 60,000 acre-feet, as compared to a present water requirement of about 18,000 acre-feet. Although with data at hand it was not possible to evaluate with any degree of accuracy the effect of this probable increase in development on inflow to Ventura County, for purpose of analysis it was assumed that ultimately effluent discharge at the lower limit of Eastern Basin would be entirely eliminated. The amount of this discharge was estimated to average about 15,000 acre-feet per season over the base period, with the present pattern of land use and water supply development in Eastern Basin. This assumption may be somewhat severe with respect to the reduction in the ultimate water supply of Ventura County, since it is probable that with increased use of ground water storage in Eastern Basin effluent discharge would not be entirely eliminated. Furthermore, such increased use also would effect a reduction in flood flow in Santa Clara River at the county line, a large portion of which presently wastes to the ocean. In this regard, it was assumed that a forecast increased water requirement of 100 acre-feet per season in the portion of Eastern Basin within Ventura County would be satisfied from surface or ground water supplies in Los Angeles County, tending to increase the safe water supply available to Ventura County by that amount. In addition, it was assumed that lands in the Piru Subunit now being supplied both by effluent discharge from Eastern Basin and by import from Los Angeles County would ultimately be entirely supplied by import from Los Angeles County. Under this assumption, the ultimate mean seasonal import to the Piru Subunit would be increased by about 500 acre-feet over that estimated for the present, and would average about 2,300 acre-feet.

Monthly studies of water supply and disposal were made for Piru, Fillmore,

and Santa Paula Basins over the base period, with the probable ultimate pattern of land use prevailing therein and with the foregoing assumed changes in water supply. With exception of forecast changes in land use, water requirements, and water supply, methods and assumptions employed in the studies were identical with those used in the analysis for present conditions of development, as described in Chapter II. In commencing the studies, Piru, Fillmore, and Santa Paula Basins were assumed to be full in the spring of 1944. By the fall of 1951, it was estimated that ground water storage depletion in Piru Basin would be about 140,000 acre-feet, as compared to an actual depletion in the fall of 1951 of about 94,000 acre-feet; that ground water storage in Fillmore Basin would be depleted by about 88,000 acre-feet, as compared to an actual depletion of about 61,000 acre-feet; and that ground water storage depletion in Santa Paula Basin would be about 70,000 acre-feet, as compared to an actual depletion of about 22,500 acre-feet. Assuming a ground water storage depletion in each of these three basins in the fall of 1936 equal to that which was estimated would occur in the fall of 1951 under ultimate conditions, it was found that Piru Basin would be first filled in the spring of 1941, and that Fillmore and Santa Paula Basins would be filled by the spring of 1937. It was therefore concluded that, under the assumptions of the study, there would be no ultimate requirement for supplemental water in either the Piru, Fillmore, or Santa Paula Subunits.

It was estimated that greater use of Piru, Fillmore, and Santa Paula Basins under ultimate conditions would effect an increase in mean seasonal safe yield of these subunits by about 15,500 acre-feet over the present safe yield. Conversely it was estimated that with a further lowering of ground water levels in Santa Paula Basin there would be reduction in both effluent discharge and subsurface outflow therefrom to Oxnard Forebay Basin, thereby reducing the estimated present mean seasonal safe yield of the latter basin by about 4,300 acre-feet. Thus, the ultimate net increase in safe water supply of the Santa Clara River