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DIVISION OF WATER RESOURCES
EDWARD HYATT, State Engineer

Reports on State Water Plan Prepared Pursuant to Chapter 832, Statutes of 1929

BULLETIN No. 36

COST OF IRRIGATION WATER
IN
CALIFORNIA

A Cooperative Report by the Division of Agricultural Engineering of the U. S. Department of Agriculture and the College of Agriculture, University of California.

1930

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LETTER OF TRANSMITTAL

Mr. Edward Hyatt,
State Engineer,
Sacramento, California.

Dear Sir: I am pleased to transmit herewith a revision of California Division of Engineering and Irrigation Bulletin No. 8, "Cost of Water to Irrigators in California."

The report was prepared by Harry F. Blaney and Martin R. Huberty and represents the result of an intensive study of the cost to the users of securing such supplies of water as were applied in irrigation. This investigation was supported by and the report prepared under cooperative agreement of the Division of Water Resources of the California Department of Public Works, the Division of Agricultural Engineering of the U. S. Department of Agriculture, and the Division of Irrigation Investigations and Practice of the University of California.

Respectfully submitted

W. W. McLaughlin

Associate Chief,
Division of Agricultural Engineering,
U. S. Department of Agriculture.

Berkeley, California,
December 9, 1930.

ACKNOWLEDGMENT

The authors acknowledge the assistance rendered by several members of the staffs of the Division of Agricultural Engineering, United States Department of Agriculture, and the Division of Irrigation Investigations and Practice, University of California Agricultural Experiment Station, in gathering the data and preparing it for publication. Wells A. Hutchins, irrigation economist, A. Lincoln Fellows, senior irrigation engineer, and F. J. Fricke, junior irrigation engineer, all of the Division of Agricultural Engineering, United States Department of Agriculture, and C. V. Givan, junior irrigation engineer, and J. E. Christiansen, junior irrigation engineer of the Division of Irrigation Investigations and Practice, University of California, rendered assistance in obtaining data and preparation of this report.

The information relative to irrigation districts was summarized from reports of irrigation districts of January 1, 1930, filed with the State Engineer, and as published in Bulletin 21-A of the Division of Water Resources. In this connection valuable assistance was rendered by A. N. Burch and R. S. Carberry, irrigation engineers. Data for the other types of enterprises were gathered by field canvassers during the summer and fall of 1930.

ORGANIZATION

STATE DEPARTMENT OF PUBLIC WORKS

B. B. Meek ..... *Director*

Edward Hyatt ..... *State Engineer*

ORGANIZATION

UNITED STATES DEPARTMENT OF AGRICULTURE

and

UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION

Cooperating in

Water Resource Investigations

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CHAPTER 832, STATUTES OF 1929.

An act making an appropriation for work of exploration, investigation and preliminary plans in furtherance of a coordinated plan for the conservation, development, and utilization of the water resources of California including the Santa Ana river, Mojave river and all water resources of southern California.

[I object to the item of $450,000.00 in section 1 and reduce the amount to $390,000.00. With this reduction I approve the bill. Dated June 17, 1929. C. C. YOUNG, Governor.]

The people of the State of California do enact as follows:

SECTION 1. Out of any money in the state treasury not otherwise appropriated, the sum of four hundred fifty thousand dollars, or so much thereof as may be necessary, is hereby appropriated to be expended by the state department of public works in accordance with law in conducting work of exploration, investigation and preliminary plans in furtherance of a coordinated plan for the conservation, development and utilization of the water resources of California including the Santa Ana river and its tributaries, the Mojave river and its tributaries, and all other water resources of southern California.

SEC. 2. The department of public works, subject to the other provisions of this act, is empowered to expend any portion of the appropriation herein provided for the purposes of this act, in cooperation with the government of the United States of America or in cooperation with political subdivisions of the State of California; and for the purpose of such cooperation is hereby authorized to draw its claim upon said appropriation in favor of the United States of America or the appropriate agency thereof for the payment of the cost of such portion of said cooperative work as may be determined by the department of public works.

SEC. 3. Upon the sale of any bonds of this state hereafter authorized to be issued to be expended for any one or more of the purposes for which any part of the appropriation herein provided may have been expended, the amount so expended from the appropriation herein provided shall be returned into the general fund of the state treasury out of the proceeds first derived from the sale of said bonds.

FOREWORD

This report is one of a series of bulletins on the State Water Plan issued by the Division of Water Resources pursuant to the provisions of Chapter 832, Statutes of 1929, directing further investigations of the water resources of California. The series includes Bulletin Nos. 25 to 36, inclusive. Bulletin No. 25, "Report to Legislature of 1931 on State Water Plan," is a summary report of the entire investigation.

Prior to the studies carried out under this act, the water resources investigation had been in progress more or less continuously since 1921 under several statutory enactments. The results of the earlier work have been published as Bulletin Nos. 3, 4, 5, 6, 9, 11, 12, 13, 14, 19, and 20 of the former Division of Engineering and Irrigation, Nos. 5, 6, and 7 of the former Division of Water Rights, and Nos. 22 and 24 of the Division of Water Resources.

This bulletin is one of two pertaining to investigations of the water resources of the State prepared cooperatively by the Division of Agricultural Engineering, United States Department of Agriculture, the University of California Agricultural Experiment Station, and the Division of Water Resources of the State Department of Public Works. It is a revision, extension and enlargement of an earlier report, Bulletin No. 8, "Cost of Water to Irrigators in California," published in 1925 by the former Division of Engineering and Irrigation, State Department of Public Works, which set forth the costs in 1922.

Information regarding the unit prices California irrigators now are paying for water is an important factor in determining the economic feasibility of the State Water Plan. It must be recognized, however, that the present costs in some instances may be more or less than are economically justified.

The data presented herein represents the results of a study of the cost of irrigation water covering the past several years, and the year 1929 in particular, under the various types of irrigation enterprises in California, namely: public utilities, mutual water companies, irrigation districts and farm irrigation pumping plants. Varying conditions of development, methods of distribution and types of water supply are covered, based upon the data obtained from the agency furnishing or distributing the water supply, or from the water user. Every effort has been made to present the data accurately and with completeness, but judgment and proper caution should be used in comparing costs of irrigation water under the varying conditions considered in the following text.

CHAPTER I

INTRODUCTION AND SUMMARY

Each year water is becoming more valuable and dificult to obtain, consequently bankers, investors, government officials, engineers and farmers may well ask, therefore, what expenditure is justified to develop a water supply for the profitable production of the crops that can be raised on the land and what water charge such land can afford to pay. Farmers and prospective farmers, also, are in need of such cost data as will enable them to choose crops that can be grown profitably under the prevailing water charges.

Scope of Report.

In California the following types of enterprises furnish irrigation water: public utilities, contract companies, irrigation districts, mutual water companies, individuals, partnerships, associations, private companies, United States Bureau of Reclamation, United States Indian Service, State land settlements, water works districts, municipal improvement districts and reclamation districts. However, for the purpose of this investigation, most of the data collected may be grouped in four classes: public utilities, mutual water companies, irrigation districts and farm irrigation pumping plants.

For a report of this character to be useful in published form, it should give information on the type of irrigation system, locality, age, source of water supply, amount of water delivered, acreage irrigated, crops raised, capital invested, and water charges, in addition to annual cost of water to the irrigator. In this study such data were obtained by visiting the principal irrigation enterprises of the state. The tables on cost of irrigation water are based on data furnished by the agency distributing the water or by the water user. On the major and more important tables, a notation to this effect is made. It was neither feasible nor practicable to extend the investigation to include all irrigation enterprises in California. However, it is believed that the data presented are well representative of the costs throughout the state. Much information collected was so fragmentary and incomplete that its inclusion was not warranted. While the report covers the past several years, the data for the year 1929 are presented in more detail than that for other years.

Cost data presented in this report must be used with judgment in considering the varying factors entering into that cost, and caution should be exercised particularly in comparing cost under one type of enterprise with that under another type, as well as between enterprises of the same type where varying conditions apply. Methods used in distribution of water, accuracy of measurements of amounts delivered, differences in points of measurment, variations in manner of collection of tolls and methods of assessment, together with diversity in character and amounts of water supply, are factors that render difficult the placing of the cost to the user upon a strictly comparable basis for all enterprises. Data on amounts of water delivered are of varying degrees of accuracy. Some are results of careful measurements or

metering. At the other extreme are the estimates of the system engineer or superintendent, based on occasional or periodical gagings and close familiarity with the use of water under the system. Care was taken, however, to have the data present, if not exactly, at least approximately, the true use of water at the point at which the distributing agancy measures its delivery. Where a system does not have sufficient water supply or the irrigators receive water from other sources, the fact is so noted by footnotes to the tables. Wherever possible, influencing factors are noted in the tables or appended thereto as footnotes.

The factors entering into the cost of irrigation water differ for each type of enterprise; hence they are treated separately under the headings of Public Utilities, Mutual Water Companies, Irrigation Districts and Farm Irrigation Pumping Plants. In comparing costs of irrigation water it should be borne in mind that those under the various agencies are not directly comparable. One agency may include cost of lateral distribution and similar costs to the user, whereas others merely serve water at its source or from a main canal. Payment is made for irrigation water from a public utility only if it is used, whereas irrigation districts usually impose some charge on all lands in every year, even though no water is usel. Furthermore, few irrigation districts have been in operation long enough to reach full maturity on their bond issue at which time assessments need be made to meet the maintenance and operation expenses only. Fixed annual charges are less per unit of water delivered in a season of large or complete delivery than in a year of small use or water supply. This should be considered in use of all tables of cost, and particularly those for the year 1929 only.

The data have been compiled and summarized in tables, but to many readers the information would have little meaning without further explanation. Accordingly, each type of enterprise is discussed briefly, with regard to its nature and the factors comprising the annual cost of water, and an explanatory description accompanies each table. In the appendix are given similar data collected in 1922.*

Summary.

Four kinds of enterprises, public utilities, mutual water companies, irrigation districts and farm irrigation pumping plants have been considered. Cost data for these types of enterprises are not always comparable as their forms of organization are different, and comparisons between two systems of the same type of enterprise are often difficult because factors affecting the cost of water vary widely. To present this summary in tabular form may add to the difficulties unless the reader realizes that it is to be used only to give a general view of the cost situation. The following summaries give the range in cost of water for 1929, including interest on capital invested:

For public utility water companies the minimum annual cost of irrigation water per acre is 37 cents and the maximum $72.14. The cost per acre-foot varies from 30 cents to $34.85. The higher costs in the Sierra foothills, as compared with the valley areas, are, in the main, due to added expense for serving isolated tracts.

* State of California, Department of Public Works Bulletin No. 8, "Cost of Water to Irrigators in California," by Harry F. Blaney.

Under mutual water companies the lowest cost of water per acre is 72 cents and the highest $84.33. The cost per acre-foot varies from 59 cents to $41.27.

For irrigation districts the lowest cost of water per acre is 82 cents and the highest $83.90. In areas of cheap water, many of the districts do not measure the water delivered, therefore, it is not possible to give a minimum cost on an acre-foot basis. The maximum cost per acre-foot is $116.45.

The variations in annual cost of irrigation water under public utilities, mutual water companies and irrigation districts are summarized in Tables 1, 2 and 3, in groups comprising various crops and systems furnishing gravity water only and pumped water only.

Chapter V discusses the general factors entering into the cost of pumping rather than to describe the results obtained from testing individual plants.

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TABLE 1

SUMMARY OF COST OF WATER TO IRRIGATORS IN CALIFORNIA, PUBLIC UTILITIES 1929

Compiled from data furnished by the individual public utility companies

Group	Number of companies considered	Annual cost of irrigation water, including interest on capital invested[1]					
		Per acre			Per acre-foot		
		Minimum	Maximum	Weighted average	Minimum	Maximum	Weighted average
Northern California							
Citrus trees	2	$5 00	$7 56				
Deciduous trees	7	2 73	7 56		$0 78	$6 25	
Alfalfa	3	2 73	6 47		0 78	2 00	
All gravity system	6	2 73	7 56		1 50	6 25	
Total acreage considered				$5 44			$1 39
Centra California							
Deciduous trees	12	0 37	9 40		0 30	5 00	
Alfalfa	14	0 37	9 40		0 30	5 00	
Cotton	11	0 37	2 25		0 30	1 00	
All gravity system	15	0 37	9 40		0 30	5 00	
Total acreage considered				1 30			0 52
Southern California							
Citrus trees	8	5 44	72 14		3 63	34 85	
Deciduous trees	7	5 44	26 14		5 04	26 14	
Alfalfa	3	6 96	17 98		5 04	10 08	
All gravity system	6	5 00	26 14		3 63	26 14	
All pumping system	5	8 59	72 14		8 40	34 85	
Total acreage considered				7 43			13 32
State							
Total acreage considered		0 37	72 14	2 83	0 30	34 85	2 90

[1] See text pages 20 and 21 and Table 4.

TABLE 2

SUMMARY OF COST OF WATER TO IRRIGATORS IN CALIFORNIA, MUTUAL WATER COMPANIES, 1929

Compiled from data furnished by the individual mutual water companies

Group	Number of companies considered	Annual cost of irrigation water, including interest on capital invested[1]			
		Per acre		Per acre-foot	
		Minimum	Maximum	Minimum	Maximum
Northern California					
Citrus trees	2	$3 94	$5 06	$1 08	$3 16
Deciduous trees	13	2 10	10 17	1 08	4 62
Alfalfa	9	3 94	10 17	1 08	4 62
Cotton	2	3 80	5 29	2 24	2 78
Rice	6	2 10	20 60		
All gravity system	5	2 10	7 40	1 08	
All pumping system	12	3 75	10 17	1 61	4 62
Central California					
Citrus trees	2	26 33	49 48	8 78	14 14
Deciduous trees	16	0 72	7 83		
Vines	13	0 72	26 33		
Alfalfa	22	0 72	7 83		
Cotton	10	0 72	7 83		
All gravity system	20	0 72	3 25		
All pumping system	4	5 95	49 48		
Southern California					
Citrus trees	57	5 06	84 33	2 73	41 27
Deciduous trees	33	5 06	58 52	2 73	38 25
Alfalfa	11	4 77	35 13	2 39	31 45
All gravity system	6	4 77	49 05	2 39	35 04
All pumping system	29	5 32	84 33	2 73	41 27

[1] See page 28 and Tables 5 to 27.

TABLE 3

SUMMARY OF COST OF WATER TO IRRIGATORS IN CALIFORNIA, IRRIGATION DISTRICTS, 1929

Compiled from data furnished by the individual irrigation districts

Group	Number of districts considered	Annual cost of irrigation water, including interest on retired bonds[1]				
		Per acre			Per acre-foot	
		Minimum	Maximum	Weighted average	Minimum	Maximum
Northern California						
Citrus trees	7	$1 33	$11 05		(2)	$6 46
Deciduous trees	16	1 33	11 05		(2)	6 65
Vines	13	1 33	13 72		(2)	8 69
Alfalfa	17	1 33	13 72		(2)	8 69
Rice	5	4 11	13 72		(2)	8 69
All gravity system	16	1 33	11 05		0 72	6 65
All pumping system	9	4 11	13 72		(2)	8 69
Total acreage considered				$5 13		
Central California						
Citrus trees	5	1 03	31 29		0 73	19 42
Deciduous trees	13	0 82	26 85		0 68	17 99
Vines	14	0 82	31 29		0 68	19 42
Alfalfa	22	0 82	13 88		0 68	8 50
Cotton	13	1 03	9 64		0 73	6 41
All gravity system	10	0 82	5 07		0 73	2 88
All pumping system	13	3 55	31 29		1 63	19 42
Total acreage considered				3 72		
Southern California						
Citrus trees	9	4 60	46 58		1 19	116 45
Deciduous trees	9	4 60	36 97		1 19	35 75
Vines	4	4 60	36 97		1 19	26 80
Alfalfa	6	4 60	32 83		1 19	16 93
Miscellaneous	4	4 60	83 90		1 19	36 46
All gravity system	5	4 60	36 97		1 19	32 20
All pumping system	12	8 63	83 90		1 95	116 45
Total acreage considered				6 25		
State						
Total acreage considered		0 82	83 90	4 60		

[1] See text page 93 and Table 28

[2] Minimum occurs in districts that do not measure the water diverted

CHAPTER II

PUBLIC UTILITIES

A public utility water company is defined by Chapter 80, Statutes of 1913, as amended by Chapter 172, Statutes of 1923 (Statutes of California) as follows:

> "Section 1. Whenever any person, firm or private corporation, their lessees, trustees, receivers or trustees appointed by any court whatsoever, owning, controlling, operating or managing any water system within this state, sells, leases, rents or delivers water to any person, firm, private corporation, municipality, or any other political subdivision of the state whatsoever, except as limited by section 2, hereof, whether under contract or otherwise, such person, firm or private corporation is a public utility, and subject to the provisions of the public utilities act of this state and the jurisdiction, control and regulation of the railroad commission of the State of California; provided, however, that whenever the owner of a water supply not otherwise dedicated to public use and primarily used for domestic purposes by such owner or for the irrigation of such owner's lands, shall sell or deliver the surplus of such water for domestic purposes or for the irrigation of adjoining lands, or whenever such owner shall, in an emergency water shortage sell or deliver water from such supply to others for a limited period not to exceed one irrigation season, or whenever such owner shall sell or deliver a portion of such water supply as a matter of accommodation to neighbors to whom no other supply of water for domestic or irrigation purposes is equally available then such owner shall not be subject to the jurisdiction, control and regulation of the railroad commission of the State of California; provided, further, however, that for the purpose of determining the status of any person, firm or private corporation, their lessees, trustees, receivers or trustees appointed by any court whatsoever, owning, controlling, operating or managing any water system or water supply within the state, the railroad commission may hold hearings and issue process and orders in like manner and to the same extent as provided in the public utilities act of the State of California and the findings and conclusions of the railroad commission on questions of fact arising under this act shall be final and not subject to review, except as provided in said public utilities act.
>
> "Section 2. Whenever any private corporation or association is organized for the purpose solely of delivering water to its stockholders or members at cost, and delivers water to no one except its stockholders or members at cost, such private corporation or association is not a public utility, and is not subject to the jurisdiction, control or regulation of the railroad commission of the State of California."

Contract water companies selling water to noncontract holders have been classified by the commission as public utilities to that extent, as have mutual water companies delivering water for compensation to others than their members or stockholders.

Method of Financing.

Most public utility water companies have been financed by private capital. Theoretically the capital stock represents the investment, or the cost of water rights, development of a water supply, and irrigation works.

The original irrigation enterprises of this type were generally of two classes—those under which water rights were sold for a fixed sum, with the addition of an annual charge for maintenance and operation of the irrigation system, and those under which water was furnished for an annual rental.

Under the Public Utilities Act of 1911 the State Railroad Commission was given the power not only to fix the rates charged by water corporations, but practically to regulate their entire business, including manner of service, measurement of water, incurrence of indebtedness, accounting, profits, etc. Each company is required to file its rates with the commission and to give a yearly report, on special forms provided, showing details of its operations.

Factors in Cost of Water Under Public Utilities.

The factors that determine the annual cost of water to irrigators under public utilities are water rates and the amount of water delivered.

Water Rates.—Under the public utilities the water rate represents the entire cost to the user and the interest on investment is a matter of concern for the corporation only. Rates established by the California Railroad Commission allow a reasonable profit to the utilities on the valuation, if practicable. In fixing rates the commission considers three items of expense—"fair return on valuation of plant," "depreciation" and "maintenance and operation."

Eight per cent interest is the maximum allowed on invested capital, which is determined by an appraisal of physical property on original cost basis. The company's records of cost are not depended upon unless they are complete and accurate. In some cases full cash was not paid in for stock, and money to build the plant came from sale of bonds. If the company is paying interest on bonds, then that interest must come out of the allowance for return on valuation, but if interest on the bonds is less than this amount the stockholder gets part of the profit and the bond holder gets only the part represented by his bond interest. No profit over that set by the commission is allowed. This would be liberal if it could be obtained in full, considering that the utility, under regulation by the State, would then be practically assured of that return, but in practice public utility irrigation companies have seldom been able to obtain the maximum return.*

The valuation having been determined, depreciation is computed, generally by the sinking fund method. It is usually relatively easy to determine the maintenance and operation expenses as, in compliance with the law, the companies keep fairly accurate records of these items.

Many types of enterprises levy taxes against the land within their boundaries, or assessments are made, even though water is not used. Public utilities, on the other hand, must stand ready to serve, yet if water is not requested no charges are made. This is an item that is often overlooked in comparing water costs under the various institutions.

Indirect benefit may accrue to the land within the area served by the public utility, yet the company has no means of gaining a revenue. These benefits may be in the form of the existence of a favorable water table in the district or a high value of vacant land due to the fact that water may be had for it whenever desired.

Public utility water rates are not uniform in their units of measurements. About 25 per cent of the companies use the flat rate per year—a fixed amount either per acre per year or per miner's inch per year. In many cases the acre-unit is used, doubtless because, when the original rates were established, water was so cheap and plentiful that companies did not feel justified in making the expenditures necessary to measure it. Obviously under this system an irrigator must pay the same whether he uses one acre-foot or four acre-feet per acre, and there is, therefore, no incentive to conserve water. A few companies have endeavored to make the flat rate more uniform by varying the rate per acre according to the crops grown.

* U. S. Department of Agriculture Technical Bulletin No. 177, "Commercial Irrigation Companies," by Wells A. Hutchins, shows that an average of 61 irrigation utilities reporting to the California Railroad Commission had an average annual net return of 0.38 per cent on their nominal capitalization for the years 1913–26, inclusive.

Other units used are the acre-foot, cubic foot, cubic foot per second for 24 hours, an irrigation, miner's inch per hour, and miner's inch per 24 hours. The value of the miner's inch also varies in different localities, in most cases being considered as either one-fiftieth or one-fortieth of a second-foot.

Amount of Water Delivered.—When the flat rate is used, the amount of water used by the irrigator is a factor in computing the annual cost of water per acre-foot. It is also a factor in determining the annual cost per acre when the rate is based on some unit of measurement. The amounts given in this report represent the average amounts of water delivered to irrigators by the company, *i.e.*, the amounts of water paid for. In many cases this may be considered as the net water requirement for the system.

Cost of Water to Irrigators.

Table 4 shows annual costs of water to irrigators under public utilities, the data being grouped as related to northern, central and southern California. In addition to the cost of water to irrigators, factors which affect the cost of water and other useful data are shown. Most of the column headings are self-explanatory, but a few require more detailed descriptions.

Column 4, "Year organized," may or may not indicate the age of the water rights, as some companies have reorganized or bought early rights to water.

Columns 10 and 11, "Average amount of water delivered, acre-feet per acre," show the average depth of water applied. With companies having sufficient water supplies the amount given indicates the net duty of water for the system.

Column 13, giving the water charges per acre-foot for 1929, is a reduction of column 12, "Rate schedule," to an acre-foot basis in such cases as permit such reduction.

Column 15 shows annual costs of water per acre for the average amounts used in 1929 and is obtained by multiplying the amounts given in column 13 by the corresponding amounts in column 11, except where the water rate is on an acre basis.

Column 17 gives the annual cost of water per acre-foot for the average amount used and the amounts given are either equal to those in column 13 or obtained by dividing the amounts given in column 15 by the corresponding amounts in column 11, "Average amount of water delivered, acre-feet per acre, 1929."

Columns 14, 15, 16 and 17 indicate the cost of water. Public utility water rates include interest on capital invested and represent the entire charges to irrigator.

While the data in Table 4 represents the cost of water to irrigators, they may not in some instances indicate what it actually costs the companies to deliver the water, primarily because some companies have had rate-hearings before the State Railroad Commission and have been granted increased rates, while other companies, perhaps because they were unwilling to antagonize the farmers, have never pressed their cases before the commission and in some instances are either operating at a loss or are not earning interest on the capital invested.

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TABLE 4

COST OF WATER TO IRRIGATORS, PUBLIC UTILITY COMPANIES IN NORTHERN, CENTRAL AND SOUTHERN CALIFORNIA. AVERAGES FOR YEARS 1925-1929, INCLUSIVE, AND YEAR 1929, PARTICULARLY

Compiled from data furnished by the individual public utility companies

Name of company	Address	County	Year organized	Source of water supply	Percentage of water pumped	Lift, feet	Area irrigated, 1929: Crops, acreage if available	Area irrigated, 1929: Total acreage	Average amount of water delivered, acre-feet per acre: 1925-1929	Average amount of water delivered, acre-feet per acre: 1929	Water charges, 1929: Rate schedule	Water charges, 1929: Per acre-foot	Annual cost of water including interest on capital invested[a]: Per acre for average amount used: Average, 1925-1929	Per acre for average amount used: 1929	Per acre-foot for average amount used: Average, 1925-1929	Per acre-foot for average amount used: 1929
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Northern California																
Clear Lake Water Company	Woodland	Yolo	[b]1927	Cache Creek	0	0	Alfalfa, 7,404; miscellaneous, 2,951, deciduous trees and vines, 1,803[c]	11,258	3.23	1.82	$3.00 per cubic foot per second for 24 hours	$1.50	$4.84	$2.73	$1.50	$1.50
Cottonwood Irrigation and Mining Company	Hornbrook	Siskiyou	1904	Cottonwood and Grouse creeks	0	0	Alfalfa, 380, deciduous trees, 10; truck, 10	400	1.40	1.89	$0.10 per miner's inch for 24 hours[d]	2.00	2.80	3.78	2.00	2.00
Diamond Ridge Water Company	Diamond Springs	El Dorado	1916	Camp Creek, Park Creek, North Fork Cosumnes River	0	0	Pears, 500; miscellaneous, 100	600	[e]3	[e]4	Continuous flow, one miner's inch for 24 hours, $0.30[f]	6.00	7.00	6.00	...	...
											Cumulative flow, one miner's inch for 24 hours, $0.35	7.00	...	...	...	...
Happy Valley Water Company	Ohada	Shasta	1925	Eagle Creek, Anderson Creek, South Fork Clear Creek and North Fork Cottonwood Creek	0	0	Olives, 1,222, grapes, 100; lemons, 80, deciduous, 50, truck, 25, field crops, 25	1,502	1.25	1.25	Water not ordered in advance, $0.45[g]	9.00	...	...	...	...
Natomas Water Company	Folsom	Sacramento	1912	South Fork American River	0	0	Deciduous trees and vines, citrus	1,800	...	...	$5.00 per acre ($4.00 per acre-foot for outsiders)	...	5.00	5.00	4.00	4.00
											Metered—$0.08 per 24 hour-inch, unmetered, $5.00 per acre	2.00	5.00	5.00	...	...
North Fork Ditch Company	Orangevale	Sacramento	1909	North Fork American River	0	0	Deciduous trees and vines, citrus	[h]1,980	[i]1.25	[i]1.21	One miner's inch continuous flow, retail $36, one miner's inch continuous flow, wholesale $30, domestic (300,000 gallons) $12[j]	[k]6.25	[k]8.00	[k]7.56	[k]6.25	[k]6.25
Sutter-Butte Canal Company	Gridley	Butte, Sutter	1911	Feather River	(*)	(*)	Rice, 16,355; alfalfa, 2,044, deciduous trees, 5,469; grapes, 248, field crops, 2,053, grain, 1,245; pasture, 841, garden, 96	[l]27,410	7.34	8.34	Rice—$8.50 per acre gravity, $0.80 pumped; general crops—$3.25 per acre gravity, $4.05 pumped[m]	...	6.67	9.47	0.91	0.78
Central California																
Buena Vista Canal, Incorporated	Bakersfield	Kern	1878	Kern River	0	0	Alfalfa, cotton, grain[n]	[o]3,958	[p]2.12	2.57	$0.38 per acre-foot[q]	0.38	0.81	0.98	0.38	0.38
Central Canal Company	Bakersfield	Kern	1908	Kern River	0	0	Alfalfa, cotton, grain, deciduous trees, vines[r]	1632	[s]3.17	1.58	$0.38 per acre-foot[q]	0.38	1.20	0.60	0.38	0.38
East Side Canal Company	Bakersfield	Kern	1892	Kern River	0	0	Cotton, alfalfa, deciduous trees, vines, field crops, truck[t]	[o]6,053	[p]2.10	1.05	$0.38 per acre-foot[q]	0.38	0.80	0.74	0.38	0.38
Farmers Canal Company	Bakersfield	Kern	1890	Kern River	0	0	Alfalfa, cotton, grain, deciduous trees, vines[r]	[o]2,800	[p]1.67	1.30	$0.38 per acre-foot[q]	0.38	0.63	0.49	0.38	0.38
Stine Canal Company	Bakersfield	Kern	1878	Kern River	0	0	Alfalfa, cotton, grain, deciduous trees, vines[r]	[o]6,571	...	...	...	...	...	...	...	...
Kern Island Canal Company	Bakersfield	Kern	1870	Kern River	0	0	Alfalfa, cotton, grain, deciduous trees, vines[r]	40,610	[p]1.82	2.07	$0.38 per acre-foot[q]	0.38	0.69	0.79	0.38	0.3
Kern River Canal and Irrigation Company	Bakersfield	Kern	1892	Kern River	0	0	Alfalfa, cotton, grain, deciduous trees, vines[r]	[o]2,276	[p]2.43	1.23	$0.30 per acre-foot[q]	0.30	0.73	0.37	0.30	0.30
Pioneer Canal, Incorporated	Bakersfield	Kern	1878	Kern River	0	0	Alfalfa, cotton, field crops[r]	[u]1,569	[p]1.27	1.32	$0.38 per acre-foot[q]	0.38	0.48	0.50	0.38	0.38
Madera Canal and Irrigation Company[v]	Madera	Madera	1888	Fresno, Merced and San Joaquin rivers	0	0	Alfalfa, deciduous trees and vines, miscellaneous	6,322	[w]1.00	[w]1.00	$0.50 to $1.25 per acre-foot	[w]1.00	[w]1.00	[w]1.00	[w]1.00	[w]1.00
San Joaquin and Kings River Canal and Irrigation Company[x]	Los Banos	Fresno, Merced, Stanislaus	1905	San Joaquin River	0	0	Alfalfa, 58,544; cotton, 16,633, grain, 9,605, pasture, 9,174; rice, 3,891; truck, 800; deciduous trees, 46[illegible], total, 99,419	[o]32,560 [o]50,773	[y]7.00 [y]2.60	...	Fresno, $1.25 per acre per season[z] Merced, $1.75 per acre per season[z]	...	1.25 1.75	1.25 1.75	...	...
								[o]16,080			Stanislaus, $2.25 per acre per season[z]	...	2.25	2.25		
East Side Canal and Irrigation Company	Newman	Stanislaus	1887	San Joaquin River and Merced Irrigation District	0	0	Alfalfa, 4,000; beans, 1,000, rice, 550; cotton, 50	6,590	...	...	$2.00 per acre	...	2.00	2.00	...	...
Bohart Estate Company and Emma Rose[a]	Angels Camp	Calaveras	1852[b]	Stanislaus River	0	0	Mainly alfalfa and deciduous trees	466	1.56	2.36	$0.20 per miner's inch for 24 hours and $0.15 per miner's inch for spilled water[a]	...	3.66	5.70	3.66	3.66
Pacific Gas and Electric Company	Sonora	Tuolumne	1905	Stanislaus River	0	0	Mainly alfalfa and deciduous trees	1,050	...	1.66	$0.25 per miner's inch for 24 hours[c]	5.00	...	0.40	5.00	...
Monterey County Water Company[d]	Soledad	Monterey	1901	Arroyo Seco River	0	0	Alfalfa, 184, deciduous trees, 102; beans, 59, grain, 6	541	[e]1.00	[e]1.00	$2.00 per acre per irrigation	...	[e]2.00	[e]2.00	2.00	2.00
San Benito County Land and Water Company[f]	Hollister	San Benito	1908	San Benito Creek	0	0	Deciduous trees, 36	36	[g]1.00	[g]1.00	$5.00 per hour for two irrigations (majority)[h]	...	5.00	5.00	5.00	5.00
Southern California																
East Gardena Water Company	Gardena	Los Angeles	1902	Wells	100	60	Truck, 220, alfalfa, 20	240	2.20	2.14	$1.25 per hour for all water used	8.40	18.48	17.98	8.40	8.40
Farmers Irrigation Company	Santa Paula	Ventura	1917	Santa Clara River, wells	94	40-135	Citrus, 2,052, walnuts, 1,540, beans, 632, apricots, 154, alfalfa, 107, truck, 107	5,548	1.67	2.08	$0.20 per miner's inch for 24 hours (majority)[i]	[j]5.04	8.42	10.48	5.04	5.04
George R. Bliss	Carpinteria	Santa Barbara	1925	Wells	100	101	Deciduous trees, 8[illegible], beans, 60, citrus, 59, avocados, 11	218	0.93	0.81	$0.0025 per 100 cubic feet (majority)[k]	...	14.15	11.40	14.15	14.15
Hesperia Water Company	Hesperia	San Bernardino	1915	Streams	0	0	Miscellaneous, 40	40	...	...	$5.00 per acre (minimum)[l]	...	5.00	5.00	...	...
Hugh Warring[m]	Piru	Ventura	[n]1882	Piru Creek	0	0	Citrus, 322	322	2.33	1.70	$0.006 per miner's inch per hour[o]	3.63	8.46	6.17	3.63	3.63
Lake Henet Water Company	Henet	Riverside	1885	Lake Henet, streams, artesian wells	0	0	Deciduous trees, 3,550; alfalfa, 3,300, citrus, 850	7,600	[p]0.82	[p]0.49	$0.40 per miner's inch per 24 hours (majority)[p]	10.08	[p]8.27	[p]6.96	10.08	10.08
Moorpark Farmers Water Company	Moorpark	Ventura	1919	Wells	100	45	Apricots, 290, walnuts, 275, beans, 80; tomatoes, 60	695	...	0.71	$0.02 per miner's inch per hour (majority)[q]	12.10	...	8.59	...	12.10
Santa Clara Water and Irrigation Company	Oxnard	Ventura	1871	Santa Clara River	0	0	Beans, 935, walnuts, 700; truck, 125, citrus, 40	1,800	[r]1.38	1.08	$0.20 per miner's inch per 24 hours (majority)[s]	5.04	6.96	5.44	5.04	5.04
San Gabriel Valley Water Company	Alhambra	Los Angeles	1907	Wells	100	105-241	Miscellaneous, 172, citrus, 50	222	1.38	2.07	$0.06 per 100 cubic feet (majority)	34.65	80.85	72.18	32.19	34.65
Sweetwater Water Corporation	National City	San Diego	[t]1902	Sweetwater River	0	0	Citrus, miscellaneous, truck, deciduous trees[u]	5,000	[v]1.00	[v]1.00	$0.06 per 100 cubic feet (majority)	26.14	22.65	26.14	22.65	26.14
West Riverside Canal Company	Riverside	Riverside	1916	Santa Ana Basin, wells	0	0	Truck, 4,000, citrus, 2,500, alfalfa, 1,500	8,000	[w]1.39	[w]1.48	$0.08 per miner's inch per year[w]	...	[w]2.33	[w]2.28	[w]1.68	[w]1.61
Whittier Water Company	Whittier	Los Angeles	1907	Wells	100	56	Citrus, 1,600, deciduous trees, 400	2,000	[x]1.43	1.08	$0.04 per miner's inch per hour (majority)[y]	24.20	34.61	26.14	24.20	24.20

[a] Estimated.
[b] Approximate.
[c] Formerly Yolo Water and Power Company, incorporated in 1911.
[d] In years of normal or greater than normal rainfall there is usually a large planting of rice.
[e] Water not available for irrigation in latter part of season.
[f] About 5 per cent of the water diverted is boosted about ten feet.
[g] Average where water is retailed to the farmers, the company wholesales much of the water.
[h] Of this acreage 1,011 acres were double cropped.
[i] Rates changed in 1930 to $9 and $10.40 for rice and $3.85 and $4.65 for general crops.
[j] Average not known; crops listed in order of magnitude. Information secured by ditch tenders and areas may be slightly in excess of net area irrigated.
[k] Average of four years, 1926-1929.
[l] Not a complete supply, augments pumping.
[m] Included under the San Joaquin and Kings River Canal and Irrigation Company is Poso Canal Company (a mutual company). The averages for the latter company are included herein. The Poso Canal Company pays the rates of the serving public utility company and in addition pays assessments as indicated in Tables 23, 24 and 27. Rates in effect in 1930 uniform for all counties: rice, $7.50 per acre per season, general crops, $2.75, winter irrigation of grain and pasture, $1.50; or measured rate of $1.15 per acre-foot.
[n] One miner's inch equals one-fifteenth of a cubic foot per second.
[o] One miner's inch equals one-fortieth of a cubic foot per second.
[p] Company applied in 1930 for increase in rates, application pending.
[q] Raised to $0.04 per 100 cubic feet in 1930.
[r] Extra water $0.015 per hour-inch.
[s] Formerly Piru Water Company.
[t] The area served by this company is also served extensively by private pumping plants, therefore the data given for amount of water delivered and cost per acre are subnormal.
[u] Latest incorporation in 1926.
[v] The area served by this company, which is a carrier company owned by six mutual companies, has other sources of supply, therefore data on amount of water delivered and cost per acre are subnormal.
[w] Fresno County.
[x] Merced County.
[y] Stanislaus County.
[z] Rice.
[a] General crops.
[b] Union Water Company water right purchased.
[c] Storage water $4.00 per acre-foot in 1930.
[d] The records of deliveries are at the points where the water leaves the companies' canals and do not give actual deliveries to the land. Rate raised to $0.85 per acre-foot in 1931 (interim rate.)
[e] See text pages 20 and 21.

CHAPTER III

MUTUAL WATER COMPANIES

A mutual water company is defined by the California statutes as "any private corporation or association . . . organized for the purpose solely of delivering water to its stockholders or members at cost."* This type of enterprise also is known under the name "cooperative water company." A mutual company may be considered a special form of private company in which the stock represents water rights and is entirely owned by those to be served.

Organization and Financing.

Mutual water companies are incorporated under the general statute regulating the organization of private companies. Many of the mutual companies have been organized by enterprises engaged in the subdivision and sale of land in connection with the sales program. Usually the land companies built the irrigation systems, either wholly or in part, in advance of settlement, and organized the mutual companies on paper, shares of stock being issued to settlers when the land was sold. In most cases the settlers obtain control of the irrigation system after 50 per cent of the stock has been issued.

Some mutual companies have been organized by the landowners directly, working together for the development of a water supply and the construction of an irrigation system. Usually, in such cases, the works were built little by little and were not completed for several years, the length of the period depending upon how construction funds were obtained. Funds have been raised by subscriptions to capital, by direct assessment of the capital stock, by bonds, and by small loans. In a few cases settlers have cooperated in building works by their own labor.

The affairs of mutual companies are controlled by a board of directors elected annually by the stockholders. The president is elected by the directors from one of their own number. As a rule the secretary keeps the books and records and computes and collects water charges. A superintendent usually is placed in charge of water delivery, operation and maintenance. The number of ditch tenders assisting him in delivering the water depends upon the size of the company.

Water Stock.

Shares of stock in mutual water companies are generally issued on the basis of the area to be irrigated. One share of stock per acre is usual, although in one case as many as 100 shares per acre were issued and in other instances one share covers 640 acres. In many cases, however, a share of stock does not represent any unit area of land, but only a pro rata share of the available water supply, and is not appurtenant to the individual holding. Under this plan the irrigator may purchase or rent as many shares of stock for his land as he

* California Statutes 1913, Chapter 80, page 84.

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* California Statutes 1913, Chapter 80, page 84.

chooses. Each share of stock may represent a right to a specified amount of water, usually stated in terms of continuous flow.

A company may or may not make the stock appurtenant to the land. If the stock is appurtenant to the land it is so stated in the by-laws or articles of incorporation of the company. A provision of the California law authorizes mutual companies to make their stock appurtenant by enacting a by-law to that effect, having the same recorded in the office of the county recorder and describing the lands in the stock certificates.* When this provision of the law is exercised to the full extent, the shares and the water can not be sold separately from the land. Although the stock may have a stated high par value, it has no independent market value, but nevertheless, such a value does exist under cover of the land prices. Several methods are used to fix the price of unsold shares of stock after the first year. One method is to require the subsequent purchaser to pay the par value, plus all assessments to date, plus simple interest. Another method is to add assessments, but no interest to the par value, while some companies fix stated prices independent of the assessments that have been levied.

In some instances the stock is made appurtenant only to the tract of land to be subdivided and to adjoining lands, allowing transfers of stock to be made between individual landowners within this area, necessarily requiring, however, that such transfers be made through the company's office. Under this plan an irrigator may invest in as many shares as he needs, depending upon the crops grown.

In a number of companies, especially in central California, the stock is not appurtenant to the land. The stock may be transferred at will by sale or lease to any lands that are susceptible of irrigation from the system. Under this arrangement it is usual to find a number of independent lateral ditches distributing water beyond the area originally served by the company's system. A very complicated situation, resulting from the organization of the independent distributing ditches into mutual companies, sometimes exists. In many cases these sublateral companies are organized solely to distribute water to holders of stock in the parent company and to enforce a fair distribution of the costs to those benefited. When this is the case the stock of these sublateral companies usually has no market value and the ditches belonging to these companies are locally called "dry ditches." In some cases, however, the sublateral company owns the stock in the parent company and its stock has a market value, usually dependent upon the value of stock in the parent company.

The principal advantage of not having the stock appurtenant to the land is that an irrigator need not have any more stock than he requires for the irrigation of his crops, making it possible for him to adjust his water supply to the crops grown and the methods of irrigation practiced. Here there is an incentive for more economical use of water, but the advantages are offset in some sections by practical disadvantages. For example, where unlimited transfers are permitted during the irrigation season, it is very difficult for the company to distribute its water supply uniformly on the basis of the number of shares owned, especially where the supply is not entirely adequate. In many cases in central California where the stockholders are

* California Civil Code, section 324.

dependent upon private pumping for a supplemental supply, the water stock in the ditch companies is being gradually purchased by outside areas, resulting in a smaller replenishment and a greater draft on the underground supply and a rapidly receding water table, but this alienation of stock is not usual in southern California.

A few companies which make the water appurtenant to the land allow one stockholder to rent shares to another for periods not exceeding four years. This limitation is to safeguard the owner of the shares against any claim of a prescriptive right being set up by the renter of the shares by using the water five years or more.

When the stock is not appurtenant and can be transferred separately from the land, it acquires a market value which, with few exceptions, is higher than the par value. This market value is influenced primarily by the agricultural values producible by the use of water, the current state of company's water supply and character of water right and the demand for water stock by adjacent outside areas susceptible of irrigation from the system; likewise by the cost of developing other water supplies, usually from wells, financial condition of the company, annual cost of operation and maintenance and other minor factors.*

Factors in the Annual Cost of Water Under Mutual Water Companies.

The principal factors in the annual cost of water considered in this report are annual assessments, water charges, interest on capital stock or capital investment, and amount of water used.

Assessments and Water Charges.—Companies differ to some extent in their finances. Revenue for operation and maintenance may be obtained from either assessments on the stock or water charges. Assessments are one effective means of raising funds as they are a lien against the stock. Collections on account of delinquent assessments are usually enforced by selling the stock at public auction. When water charges are made, collections are usually enforced by refusing to deliver water unless the charges are paid in advance of a certain date. All stock in mutual water companies is assessable, although some companies do not use this method for raising revenue.

One general method is to raise all revenue for permanent improvements or capital expenditures by assessments and to collect operating funds by water charges. Some companies collect funds for both maintenance and improvements by assessments, but use water charges for other operating expenses. In a few of the companies that are pumping water, the expenses for power only are covered by water charges and all the revenue for other operating costs and fixed charges, including the demand charge for power, are met by assessments on the stock. When all the revenue is raised by assessments there is little inducement for the stockholder to make the best use of the water and there is an incentive to use all of the water available, whether it is needed or not. When water charges are made on the basis of amount of water used, more economical use of the water generally results. If all of the revenue is derived from water charges there may be an incentive for speculation in stock if it is not appurtenant to the land.

* U. S. Department of Agriculture Technical Bulletin No. 82, "Mutual Irrigation Companies," by Wells A. Hutchins.

Many different kinds of rate schedules for water charges are used by the companies. Rates may be on a measured basis of so much per hour-inch per irrigation, per day-inch, per acre-foot, or per cubic foot, or on a flat rate basis at so much per acre or miner's inch per season, irrespective of the amount of water used. Some companies have constant rates for all water used, while others have different rates for winter and summer or different rates for each month, different rates for day and night use, or a graduated rate decreasing as the amount of water used increases. Some companies have a minimum charge, or collect water charges only on water used in excess of a certain amount per acre.

Mutual water companies that make no charge for water generally assess the stock each year, or in some cases several times each year. Companies that use a water charge to meet their running expenses may not assess the stock every year, but only when some improvements are to be made on the system, or when payments are to be made on indebtedness.

It rarely happens, however, that a company does not make at least one assessment in five years. Although some companies levy assessments each year, the rates from year to year vary considerably and the assessment for any one year may not be indicative of the average annual assessment. For these reasons, in determining the annual cost of irrigation water for this report, the average of the assessments for the five years, terminating with 1929, are given.

When any part of the revenues is applied on retiring bonds or loans, or used for new construction, this amount should be deducted in computing the total annual cost. These items can not be properly charged to the annual cost as they belong to the capital account. It happens, however, that the records of expenditures for improvements and maintenance of a large number of companies are not segregated. In such cases no deduction has been made for ordinary improvements, the assumption being that these improvements tend to balance the depreciation of the system.

Interest on Capital Stock or Capital Investment.—For the purpose of making comparisons of the total water costs it is necessary to include interest on the stock holders' capital investment. If the stock is not appurtenant to the land its market value for 1929 has been used as a basis for the interest charge. If the stock is appurtenant to the land it has no apparent market value and a different basis for the interest charge must be used. In southern California, where the par value of the stock usually represents the original investment in the irrigation system, this value has been taken. In northern and central California, however, the par value of the stock of a number of companies was set at a nominal figure, as for example, $1 or $10 per share, which does not in any way represent the actual investment in the system. In these cases the actual capital investment was used, if available from the companies' records; otherwise the original capital investment per acre was estimated.

Because of the several different methods employed in arriving at the basis for the interest charge, a definite comparison of the cost of water, including interest on the capital stock, between companies which fall into such different classifications can not be made. Usually, for the

companies where the present market value of the stock is taken as the basis, the interest charge is higher because the value of the water right is included; whereas for the companies where the original cost of the system or the par value of the stock was used as the basis, the value of the water right may possibly not be included. In many cases where the present market value of the stock was used it does not represent the cost of water to stockholders who may have purchased their stock when its value was much lower, but it does represent present value. In all cases the capital investment has been reduced to an acreage basis and the interest charge has been computed at six per cent.

Amount of Water Delivered.—The amount of water delivered to the irrigator is a factor in the annual cost of water, not only in determining the amount of the water charge, but also in determining the total cost per acre-foot. The amounts given in this report represent the average amounts, expressed in acre-feet per acre, delivered by the company to the irrigator. In most cases in southern California it is an indication of the amount of water required and may be considered the net duty of water under the system. In many cases in central California a supplemental supply from private wells may be required in the latter part of the season and the data may possibly not indicate the actual water requirement.

Cost of Water in Southern California.

The method used in arriving at the cost of water under mutual water companies in southern California, as set out in Table 5, has been to take into account the assessment on the capital stock, the charge for water delivered, and the interest on capital stock. The entire cost is included in these items, with the exception of depreciation on the plant, which has not been considered because it was not practical to include in this study the vast amount of work necessary to fairly determine depreciation under each of the many systems. No doubt in many cases repairs of a permanent nature offset this factor.

From the sum of the above three items considered should be deducted the amount put into a sinking fund to retire bonds or loans. Interest paid on the principal is properly chargeable to the annual cost of water, while funds collected to retire the principal of indebtedness are not. They should be charged to capital account. Many irrigators overlook the fact that funds invested in water stock would earn interest if loaned out and that such interest should be charged to their annual cost of irrigation water.

Of the items that make the total annual cost of water, the assessments and interest on capital stock are fixed charges because they relate to a share of stock and must be paid whether any water is used or not, but water charges or rates vary in many cases according to the amounts of water used by the stockholders. For these and other reasons, together with the fact that the duty of water per acre is not uniform, the matter of fairly comparing the annual cost of water under different mutual companies is complex.

Cost of Water to Irrigators.

The annual cost of water to irrigators under most of the important mutual water companies in southern California is shown in Table 5.

In addition to the cost of water to irrigators the table shows factors which affect the cost and other useful data. Most of the column headings are self-explanatory, but a few require more detailed descriptions.

Column 3, "Year organized," in many instances will give some idea of the age of water rights or system.

Column 17, "Value of stock per acre," is obtained by multiplying amounts given in column 15, "Market value of stock per share," by the corresponding amounts in column 16, "Average number shares per acre." Where market value is not available the par value is used.

Column 22, "Water charge per acre for the average amount used," is equal to the amounts given in column 21, "Water rate per acre-foot," multiplied by those in column 12, "Average duty of water, acre-feet per acre," except in a few instances where the water rate is on the basis of a flat charge per acre.

The last six columns of the table are the final results obtained from the previous columns and show the annual cost of water.

Columns 24 and 25, "Annual cost of water for use of one acre-foot only," were included in the tabulations primarily for comparison purposes. They show what the cost would be if the irrigator used only one acre-foot instead of the average amount, as indicated in column 12. Hence under companies raising all their funds by assessments an irrigator using one acre-foot pays just as much as the irrigator who uses two acre-feet. On the other hand, if the water charge is on a measured basis the water user pays according to the amount used. Column 24 is equal to the "Average annual assessment per acre" (column 19), plus the "Water rate, per acre-foot" (column 21), minus the "Average debt retired per acre" (column 23). Column 25 is equal to the amount in column 24, plus the "Interest on value of capital stock per acre at 6 per cent" (column 18).

Columns 26 and 27 give the "Annual cost of water per acre for the average amount used." Column 26 is equal to the "Average annual assessment per acre" (column 19), plus "Water charge per acre for average amount used" (column 22), minus "Average debt retired per acre" (column 23). Column 27 is equal to the amount in column 26, plus "Interest on value of capital stock per acre at 6 per cent" (column 18).

Columns 28 and 29 indicate the annual cost of water per acre-foot for the average amount used. These data are obtained by dividing the amounts in columns 26 and 27, respectively, by the "Average duty of water, acre-feet per acre" (column 12).

TABLE 5

COST OF WATER TO IRRIGATORS, MUTUAL WATER COMPANIES, SOUTHERN CALIFORNIA, 1929

Compiled from data furnished by the individual mutual water companies

Name of company	Location	Year organized	Source of water supply	Lift, feet	Percentage of water pumped	Area irrigated, acres: Citrus trees	Deciduous trees	Alfalfa	Miscellaneous	Total	Average duty of water, amount of water delivered, acre-feet per acre	Capital stock: Number of shares issued	Par value of stock, per share	Market value of stock, per share	Average number of shares, per acre	Value of stock per acre	Interest on value of capital stock, per acre at 6 per cent	Average annual assessment per acre, (1925-1929, inclusive)	Factors in annual cost of water: Water rate, 1929: Per hour-inch	Per acre-foot	Water charge per acre, for average amount used	Average debt retired per acre, (1925-1929, inclusive)	Annual cost of water: For use of one acre-foot only: Excluding interest on value of capital stock	Including interest on value of capital stock	Per acre for average amount used: Excluding interest on value of capital stock	Including interest on value of capital stock	Per acre-foot (for average) amount used: Excluding interest on value of capital stock	Including interest on value of capital stock
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)
Alta Mutual Water Company	Sanger	1912	Wells	75	100	500	1,000		300	1,800	1 20	1,800	$60 00	$175 00	1 00	$175 00	$10 50	$1 80	$ 0198	$13 37	$13 64	None	$13 17	$23 67	$15 44	$25 94	$12 87	$21 61
Anaheim Union Water Company	Anaheim	1884	Santa Ana River and wells	130-170	72	7,500	500			8,000	1 60	8,000	100 00	95 00	1 00	95 00	5 70	4 20	0125	8 44	13 17	$2 37	10 06	15 76	15 00	20 70	9 38	12 93
Arroyo Ditch and Water Company	Downey	1885	San Gabriel River and wells	450	60	*	*	(*)	(*)	2,500	0 92	3,000	5 00	4 00	1 00	4 00	0 24	2 80	0050	1 03	2 79	None	5 83	6 07	5 59	5 83	6 08	6 34
Azusa Irrigating Company	Azusa	1886	San Gabriel River and wells	300	75	2,500	400		100	4,000	1 74	11,800	15 00	100 00	3 00	300 00	18 00	6 60	0095	5 93	10 32	1 00	11 53	29 53	15 02	33 02	9 18	19 50
Banning Heights Mutual Water Company	Banning	1911	White Water River		0	600				600		14,000	15 00	15 00	10 00	150 00	9 00	4 10	None	None	None	None	4 10	13 10	4 10	13 10		
Banning Water Company	Banning	1884	Wells	80	98		3,130	20	50	3,200	1 38	3,270	50 00	125 00	1 10	137 50	8 25	8 14	None	None	None	None	8 14	16 39	8 14	16 39	5 90	11 88
Base Line Water Company	La Verne	1919	Wells	340	100	300				300	1 95	1,125	100 00	200 00	3 00	600 00	36 00	*3 60	0316	19 12	57 38	None	22 72	58 72	40 88	76 88	20 95	39 42
Beardsley Water Ditch Company	Duarte	1881	San Gabriel River and wells	175	20	500	80		20	600	*2 00	630	33 00	200 00	1 00	200 00	12 00	9 20	None	None	None	None	9 20	21 20	9 20	21 20	4 60	10 60
Bear Valley Mutual Water Company	Redlands	1906	Santa Ana River																									
Crafton Water Company	Redlands	1886	Bear Valley Mutual Water Company and wells		20	*1,900				*1,900	*2 00	3,500	100 00	250 00	1 00	250 00	15 00	8 80	None	None	None	1 10	7 70	22 70	7 70	22 70	3 85	11 35
Redlands Heights Water Company	Redlands	1891	Crafton and South Mountain Water Companies			1,000				1,000	2 01	1,412	100 00	150 00	1 50	225 00	1 50	27 30	None	None	None	None	27 30	40 80	13 58	19 70		
Lugonia Park Water Company	Redlands	1894	Bear Valley Mutual Water Company	0	0	200				200	1 40	198	100 00	125 00	1 00	125 00	7 50	17 40	None	None	None	None	5 88	11 52	19 02	11 52	8 24	11 58
East Redlands Water Company	Redlands	1887	Crafton Company			443				443	1 47	443	100 00	160 00	1 00	160 00	9 60	11 60	None	None	None	0 15	10 05	20 25	10 05	20 25	9 11	17 30
West Redlands Water Company	Redlands	1887	Bear Valley Mutual Water Company and wells	125	40	806				806	1 43	806	100 00	115 00	1 00	115 00	6 90	14 80	None	None	None	1 65	12 95	19 85	12 95	19 85	9 06	13 87
West Highlands Water Company	Highlands	1887	Bear Valley Mutual Water Company and wells	100-175	25	800				800	2 14	900	200 00	200 00	1 00	200 00	12 00	8 80	None	None	None	1 00	7 80	19 80	7 80	19 80	3 65	9 25
Redlands Water Company	Redlands	1882	Bear Valley Mutual Water Company and city			1,363				1,363	1 93	1,500	100 00	130 00	1 10	143 00	8 58	9 20	None	None	None	None	9 20	17 78	9 20	17 78	4 77	9 22
California Domestic Water Company	Whittier	1903	Wells	35	100	1,330	670			2,000	1 50	8,005	50 00	85 00	1 50	127 50	7 65	10 20	None	None	None	2 02	13 58	21 23	13 58	21 23	9 06	14 15
La Habra	La Habra	1902	California Domestic Company	175	100	3,000				3,000	1 50	4,002	50 00	137 50	1 50	206 25	12 38	22 50	None	None	None	2 02	19 86	32 36	19 86	32 36	13 25	21 60
Canyon Water Company of Pomona	Pomona	1897	San Antonio River	0	0	2,500				2,500	*1 34	18,401	10 00	15 00	7 36	110 40	6 62	0 22	None	None	None	None	0 22	6 84	0 22	6 84	0 16	5 10
Cajuenga Water Company	Cajuenga	1892	San Juan Creek and well	30	5	240	160			400	1 40	421	100 00	300 00	1 00	300 00	18 00	6 00	None	None	None	None	6 00	24 00	4 20	17 15		
Chino Water Company	Ontario	1905	Wells	185	100	1,065			200	1,265	0 85	999	100 00	75 00	1 00	75 00	4 50	None	0.60	12 10	10 75	1 38	10 52	15 02	9 07	13 57	10 30	15 42
Citizens Land and Water Company	Bloomington	1907	Wells	200	100	4,100	50	60	400	4,700	1 65	5,197	50 00	145 00	1 00	145 00	8 70	*8 40	0125	7 56	12 47	1 54	14 42	23 12	16 33	28 03	11 72	17 00
Covina Irrigation Company	Covina	1882	San Gabriel River and well	145	75	4,500				4,500	1 30	10,000	50 00	77 50	3 00	232 50	13 95	18 80	0021	1 27	1 77	4 30	16 57	30 57	17 67	31 02	12 28	22 31
Cucamonga Water Company	Cucamonga	1887	Wells	277	100	2,900	800		1,100	4,800	1 20	4,443	100 00	125 00	1 50	187 50	11 25	22 55	None	None	None	2 70	19 85	30 99	19 85	30 99	15 25	23 95
Del Monte Irrigation Company	Pomona	1887	Wells	300	100	1,800			10	1,810	2 79	22,650	10 00	18 00	12 50	225 00	13 50	28 12	None	None	None	None	28 12	41 62	28 12	41 62	10 08	14 91
Del Norte Water Company	Ventura	1910	Wells	300	100	30	70		682	782	1 16	2,317	10 00	60 00	1 00	60 00	3 60	2 60	0710	18 15	21 05	None	20 75	24 25	23 65	27 25	20 28	23 60
Domingues Water Company	Compton	1911	Wells	70	100	(*)		(*)	Major	*5,000	1 08	20,000	50 00	None	1 00	50 00	3 00	None	0724	19 00	21 17	3 40	16 20	19 20	17 77	20 77	16 45	19 23
Duarte Mutual Irrigation and Canal Company	Duarte	1890	San Gabriel River and wells			1,200				1,200	*1 55	6,295	10 00	100 00	5 00	500 00	30 00	2 00	0125	7 56	11 72	None	9 56	39 56	13 72	43 72	8 85	28 20
Escondido Mutual Water Company "A" Stock "B" Stock	Escondido	1905	San Luis Rey River	0	0	4,000				4,000	1 40	354,314	1 00	4 00	100 00	400 00	24 00	*2 40	0083	5 02	7 03	1 50	5 52	29 92	7 93	31 93	5 66	22 81
									1,000	15,000	1 40		1 00	3 00	75 00	225 00	13 50	*30 02	0093	5 02	7 03	1 50	33 64	47 04	35 55	49 05	25 39	35 04
Etiwanda Water Company	Etiwanda	1882	Canyons and well	400	70	1,500			500	2,000	1 29	2,300	100 00	400 00	1 10	440 00	26 40	9 13	None	None	None	None	9 13	35 53	9 13	35 53	7 08	27 55
Fillmore Irrigation Company	Fillmore	1888	Sespe Creek and wells	98	40	(*)	(*)	(*)	(*)	1,100	*1 79	2,000	100 00	100 00	1 00	100 00	3 00				14 00	2 50	14 50	20 50	14 50	20 50	8 10	11 45
Fontana Union Water Company	Fontana	1912	Lytle Creek and wells	250	75	5,000	3,000	100	4,500	13,000	1 30	15,000	100 00	200 00	1 00	200 00	12 00	9 00	0125	7 56	9 84	*1 10	18 26	27 26	17 53	26 53	13 48	22 72
Fruitvale Mutual Water Company	San Jacinto	1921	San Jacinto River and wells	55	84		1,215	1,979	513	3,707	2 10	4,790	100 00	75 00	1 00	75 00	4 77	4 80	0078	4 71	9 99	1 20	9 25	14 02	14 43	19 20	6 87	9 14
Gage Canal Company	Riverside	1894	Santa Ana River and wells	50	94	6,314	20		60	6,394	3 80	12,788	50 00	200 00	2 00	400 00	24 00	*15 40			0 91	0 85	*14 85	*38 85	15 71	39 71	4 13	10 45
Glendora Consolidated Mutual Irrigation Company	Glendora	1920	Wells	400	60	2,500				2,500	1 50	5,204	100 00	100 00	1 00	208 00	12 48	24 53	0400	14 00	16 30	11 40	37 53	49 83	49 41	61 91	32 95	41 22
Irrigation Company of Pomona	Pomona	1886	Wells	325	100	450	300		750	1,500	0 83	18,357	10 00	15 00	15 00	225 00	13 50	22 50	None	None	None	None	22 50	27 00	22 50	27 00	27 10	33 65
Jurupa Water Company	West Riverside	1909	Wells	100	100	160			340	500	1 87	3,000	50 00		2 40	120 00	7 20	None	0170	10 28	19 22	None	10 28	17 48	19 22	26 42	10 28	14 12
La Puente Cooperative Water Company	West Covina	1909	Wells				1,800		200	2,000	1 85	2,000	50 00	150 00	1 00	150 00	9 00	3 70	0100	6 65	11 19	2 50	7 35	16 23	12 19	21 39	6 70	11 56
La Verne Water Association	La Verne	1911	Wells	300	100	650				650	2 40	1,240	100 00	100 00	2 00	208 00	12 48	*24 40	0311	18 82	45 47	9 12	16 10	52 98	20 42	54 33	25 18	35 14
Limited Mutual Water Company	Ontario	1912	Wells	453	100	314				314	2 42	737	20 00	20 00	2 00	40 00	2 40	None	0312	18 88	43 80	None	18 88	21 28	43 80	46 20	18 88	19 91
Lugonia Water Company	Redlands	1887	Santa Ana River			1,500				1,500	2 17	3,160	100 00	135 00	2 00	270 00	16 20	5 00	None	None	None	0 51	4 49	20 69	4 49	20 69	2 07	9 53
Lytle Creek Water and Improvement Company	Rialto	1887	Lytle Creek and wells	200	57	3,200			300	3,500	3 21	3,238	50 00	250 00	1 00	250 00	15 00	18 40	None	None	None	1 24	17 16	32 16	17 16	32 16	5 35	10 02
Montalvo Mutual Water Company	Ventura	1912	Wells		100	(*)	(*)	(*)	(*)	967	1 73	932	50 00	60 00	1 00	60 00	3 60	9 00	0125	7 56	13 08	None	16 56	20 16	22 08	25 68	12 76	14 84
Montebello Land and Water Company	Montebello	1890	Wells		100		100		400	500	1 13	1,250	100 00		1 00	100 00	6 00	20 00	None	None	None	2 40	17 60	23 60	17 60	23 60	15 58	20 88
Monte Vista Irrigation Company	Ontario	1908	Wells	280	100	500		400	100	1,000	1 55	988	10 00	10 00	1 00	10 00	0 60	2 40	0190	10 89	16 88	None	13 29	19 29	13 29	19 29	12 44	18 05
Mound Water Company	Ventura	1905	Wells	64	100	40	481		280	801	0 95	829	100 00		1 00	100 00	0 00	40 00	0200	12 10	11 50	None	20 48	26 43	19 83	25 83	20 87	27 21
Mutual Land and Water Company	Rialto	1908	Wells	300	100	425				425	3 00	585	50 00	75 00	1 38	103 50	6 21	30 30	None	None	None	None	30 30	36 57	30 30	36 57	10 12	12 19
North Fork Water Company	San Bernardino	1895	Santa Ana River		25	2,000				2,000	*2 73	7,200	100 00	125 00	2 50	312 50	18 75	*4 50	None	None	None	None	4 50	23 25	4 50	23 25	1 65	8 52
Rincon Irrigation Company	Whittier	1909	Wells	35	100	120	580			700	1 95	720	10 00	None	1 00	10 00	0 60	None	0040	2 42	4 72	None	2 42	3 02	4 72	5 32	2 42	2 73
Riverside Water Company	Riverside	1895	Santa Ana River	35-100	67	1,476	1,549	2,342	2,205	7,572	3 54	18,875	10 00	200 00	2 00	400 00	24 00	None			*11 22	0 02	*9 91	*33 91	11 13	35 13	3 14	9 93
Salazar Water Company	Riverside	1905	Spring Creek	0	0	225			75	300	2 13	75	200 00	600 00	0 25	150 00	9 00	9 00	None	None	None	None	9 00	18 00	9 00	18 00	4 65	8 83
San Antonio Irrigating Company	Downey	1899	Rio Hondo River	0	0			(*)	(*)	800	*2 00	8,071	5 00	3 00	10 10	30 30	1 82	3 84	None	None	None	0 50	2 05	4 77	2 05	4 77	1 48	2 39
San Antonio Water Company	Upland	1882	San Antonio Creek and wells	330	60	4,300				4,300	2 00	6,004	100 00	300 00	1 33	399 00	23 94	22 61	None	None	*22 27	0 94	*21 67	*45 61	23 94	47 88	9 21	18 41
San Cayetano Mutual Water Company	Santa Paula	1913	Wells	328	100	420	80			500	1 53	1,600	50 00	200 00	2 00	400 00	24 00	0 26	0070	22 39	34 76	None	22 65	46 65	34 52	58 52	22 56	38 26
Santa Ana Valley Irrigation Company	Orange	1877	Santa Ana River and wells	228-290	52	(*)	(*)			16,586	2 31	16,586	5 00	191 00	1 00	191 00	*11 46		0070	4 20	9 84		4 26	15 72	9 84	21 30	4 26	9 22
Sotoyo Development Company	Satoyo	1902	Wells	250	100		200		40	240	*1 82	170	40 00	25 00	1 00	25 00	1 50	None	0167	10 10	18 38	None	10 10	11 60	18 38	19 88	10 10	10 93
South Mountain Water Company	Redlands	1886	Springs and wells	150	40	500				500	2 72	1,000	100 00	50 00	2 00	100 00	6 00	24 00	None	None	None	3 80	20 20	26 20	20 20	26 20	7 48	9 70
South Side Improvement Company	Fillmore	1887	Wells	40	100	1,300	158			1,458	2 01	2,918	10 00	30 00	2 00	60 00	3 60	2 50	0041	2 48	4 98	None	1 08	8 58	7 48	11 08	3 72	5 52
Standeer Ditch Company	Rivera	1902	San Gabriel River	65	30	1,280	500			1,780	1 70	17,858	1 00	10 00	10 00	10 00	0 60	2 40	0020	1 21	2 06	None	3 61	4 21	1 40	5 06	2 02	2 98
Temescal Water Company	Corona	1887	Streams and wells	75-100	14	4,400				4,400	2 87	18,905	100 00	120 00	1 86	241 80	14 51	35 03	None	None	None	4 18	31 75	46 26	31 75	46 26	11 34	16 52
Thermal Belt Water Company	Santa Paula	1893	Wells		100	1,500	100		53	1,288	*2 00	1,500	100 00	250 00	1 00	250 00	15 00	7 34	None	None	None	None	7 34	22 34	7 34	22 34	3 67	11 17
Trabuco Water Company	Capistrano	1892	Wells	20	90	75	340			415	1 50	360	100 00	300 00	1 00	300 00	18 00	9 50	None	None	None	None	9 50	27 50	9 50	27 50	5 97	17 30
Walnut Growers Mutual Water Company	Monrovia	1906	Wells	115	100		140	20	620	780	0 58	550	50 00	50 00	1 40	70 00	4 20	4 76	0900	18 15	10 16	1 50	21 41	25 61	13 42	17 82	23 05	31 45
West Riverside 350-Inch Company	Riverside	1887	Wells	20-94	100	600			600	1,200	2 57	360	100 00	350 00	0 25	87 50	5 25	7 50	None	None	None	None	7 50	12 75	7 50	12 75	2 92	4 96
Whittier Extension Mutual Water Company	Whittier	1913	North Whittier	178-418	100	1,925	50		125	2,100	1 10	2,500	100 00	200 00	1 00	200 00	12 00	5 00	0250	15 13	16 64	None	21 03	33 03	22 54	34 54	20 50	31 40
Yorba Linda Water Company	Yorba Linda	1909	Wells	320	100	2,500			100	2,600	1 67	2,710	100 00	75 00	1 00	75 00	4 50	27 00	None	None	None	3 69	23 21	27 81	23 31	27 81	13 93	16 65
Yucaipa Water Company No. 1	Yucaipa	1910	Wells and tunnels	175	75		3,500			3,500	1 88	3,500	100 00	75 00	1 50	112 50	6 75	14 55	0125	7 56	14 21	3 07	18 43	25 19	25 09	31 84	13 35	16 93

* Estimated.
* Average unknown.
* Assessments levied for permanent improvements.
* Does not include cost of additional water received from private pumping plants
* A water tax rather than an assessment.
* Extra water only.
* Cost of extra water not included.
* Water charge per acre for minimum use is $10 00
* Assessments levied only for capital investments
* Includes 700 shares of domestic water stock.
* Includes lands irrigated by private pumping plants.
* Includes assessments for permanent improvements, $2 00; service charge 40 cents.
* Includes assessments for permanent improvements, $1.50; service charge, 40 cents, fixed charge, $28.12.

TRENDS OF COST UNDER TYPICAL MUTUAL WATER COMPANIES IN SOUTHERN CALIFORNIA

Studies of the costs of water over periods of years were made in connection with eight of the principal mutual companies in southern California in order to bring to light the trends during the eight or ten years ending with 1929.* The results are presented in Tables 6 to 13 and Plates I to VIII, and are briefly analyzed in the following pages.

Computations of cost, including the net amount of indebtedness retired, are presented in harmony with the method followed in Table 5. However, all data in Tables 6 to 13, inclusive, refer to individual years, whereas certain columns in Table 5 show five-year averages. Likewise, in Tables 6 to 13, "Net amount of debt retired per acre," includes both funded and current indebtedness, after offsetting increases against retirements. That is, if a company retired $5,000 of bonds during a given year, but had notes or bills payable at the end of the year exceeding that outstanding at the beginning of the year by $5,000 or more, the net amount of debt retired per acre would be shown as "None."

In addition to the calculations of cost based upon debt retirements, further computations based upon the peculiar financial set-up and operations of each company are presented in most of the tables herein mentioned.

Glendora Consolidated Mutual Irrigating Company.

This company was formed in 1920 as a result of the consolidation of Glendora Mutual Water Company and Glendora Irrigating Company. The system of the latter company originated in 1887 and passed through several changes of organization before becoming a definitely mutual enterprise. The Glendora Mutual Water Company was formed in 1898 and was cooperative from the start. The consolidation in 1920 was effected in order to finance improvements in water supply with the combined resources of the two companies.

The water supply is derived almost entirely by pumping from wells. One per cent of the total water supply in 1929 was gravity water. The average pumping lift in 1922 was reported as 450 feet; in 1929, as 280 to 464 feet, with an average of about 400 feet. Water is delivered to users in rotation, mainly on schedules of 22 to 30 days, depending upon the character of soil. The area served is all in citrus groves. The average duty of water has not varied greatly during the nine years under consideration.

The authorized capitalization is $750,000, consisting of 7500 shares of par value of $100 per share. Of this number, 5204 shares were outstanding December 31, 1929. The stock is not appurtenant to the land. The market value has not changed radically since the company was organized. The market price per share was quoted at $90 in 1922, $85 in 1925, and $100 in 1929, and has been around $90 during the other years.

The company issued $500,000 of bonds shortly after organizing, and began retiring the principal in 1922. At the end of 1929 the indebtedness consisted of $353,000 of bonds, $22,100 of bills payable and

* This discussion was prepared by Wells A. Hutchins, irrigation economist, Division of Agricultural Engineering, U. S. Department of Agriculture.

$2,006.57 of accounts payable. Assets at that time were valued at $1,283,371.06.

Assessments are levied primarily for paying the interest and principal of bonds and for improvements and a charge or toll of four cents per hour-inch is made for operation and maintenance expenses. However, the line is actually not so sharply drawn, for in practice part of the assessment money is sometimes used for operating expenditures. In addition to revenue from assessments and water sales, the company has an income of several thousand dollars per year from other sources. This incidental income, however, is relatively small and has little bearing upon the cost of water to the stockholders.

The annual cost of water is shown in Table 6 and in Plate I according to two methods of computation, (1) by deducting from the sum of assessments and water charges the amount of indebtedness retired annually; (2) by deducting from the assessments and water charges the annual surplus available for capital investment, *i. e.*, the excess of assessments and charges over actual operation and maintenance expenditures.

Plate I also shows the area irrigated, the duty of the water served by the district, and the seasonal rainfall from year to year from 1921 to 1929, the years covered by this investigation.

It will be noted that, according to both methods of computation, the annual cost per acre for the average quantity of water used has decreased considerably since 1922, and that the trend in cost per acre-foot has also been downward. From that portion of Plate I showing the relation between irrigation income and operating expenditures, it will be seen that the fairly consistent decline in interest charges accounts for a considerable part of the general decrease in cost of water, and that the fluctuations in cost of pumping have an important bearing upon the fluctuations in total annual cost.

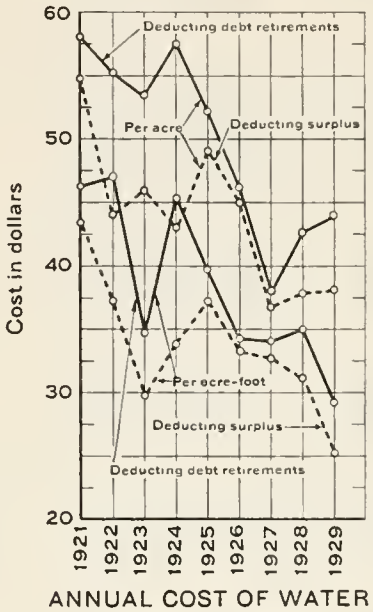
TABLE 6

ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, GLENDORA CONSOLIDATED MUTUAL IRRIGATING COMPANY, 1921-1929, INCLUSIVE

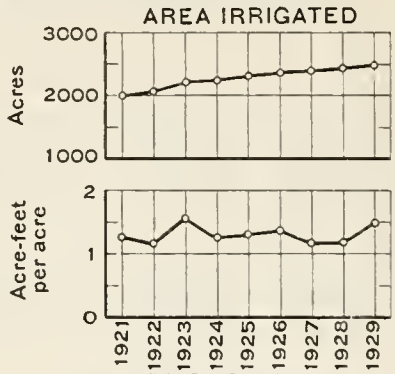
	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	2,000	2,050	2,200	2,250	2,300	2,350	2,400	2,450	2,500
Average duty of water, acre-feet per acre	1.26	1.18	1.54	1 27	1.31	1 35	1 12	1 21	1 50
Average number of shares per acre	2 52	2 46	2 29	2 24	2 19	2 20	2 15	2 11	2.08
Value of capital stock per acre	$226 80	$221 40	$206 10	$201 60	$186 15	$198 00	$193 50	$189 90	$208 00
FACTORS IN ANNUAL COST OF WATER[a]:									
Interest on value of capital stock per acre at 6 per cent	$13 61	$13 28	$12 37	$12 10	$11 17	$11 88	$11 61	$11 39	$12 48
Annual assessment per acre	27 72	27 06	29 77	29 12	28 47	28 60	23 65	23 21	18 72
Water charge per acre for average amount used	30 50	28 55	37 27	30 73	31 70	32 67	27 10	29 29	36 30
Net amount of debt retired per acre	None	None	13 51	2 22	8 05	15 10	12 67	10 00	11 20
Portion of water charge and assessment available for capital investment, per acre	3 33	11 56	21 07	16 82	11 25	16 07	14 06	14 75	17 16
ANNUAL COST OF WATER—Deducting debt requirements:									
For use of one acre-foot only—									
Excluding interest on value of capital stock	$51 92	$51 26	$40 46	$51 10	$44 62	$37 70	$35 18	$37 41	$31 72
Including interest on value of capital stock	65 53	64 54	52 83	63 20	55 79	49 58	46 79	48 80	44 20
Per acre for average amount used—									
Excluding interest on value of capital stock	58 22	55 61	53 53	57 63	52 12	46 17	38 08	42 50	43 82
Including interest on value of capital stock	71 83	68 89	65 90	69 73	63 29	58 05	49 69	53 89	56 30
Per acre-foot for average amount used—									
Excluding interest on value of capital stock	46 21	47 13	34 76	45 38	39 79	34 20	34 00	35 12	29 21
Including interest on value of capital stock	57 01	58 38	42 79	54 91	48 31	43 00	44 37	44 54	37 53
NNUAL COST OF WATER - Deducting portion of water charge and assessment available for capital investment:									
For use of one acre-foot only—									
Excluding interest on value of capital stock	$48 59	$39 70	$32 90	$36 50	$41 42	$36 73	$33 79	$32 66	$25 76
Including interest on value of capital stock	62 20	52 98	45 27	48 60	52 59	48 61	45 40	44 05	38 24
Per acre for average amount used—									
Excluding interest on value of capital stock	54 89	44 05	45 97	43 03	48 92	45 20	36 69	37 75	37 86
Including interest on value of capital stock	68 50	57 33	58 34	55 13	60 09	57 08	48 30	49 14	50 34
Per acre-foot for average amount used—									
Excluding interest on value of capital stock	43 56	37 33	29 85	33 88	37 34	33 48	32 76	31 20	25 24
Including interest on value of capital stock	54 37	48 58	37 88	43 41	45 87	42 28	43 13	40 61	33 56

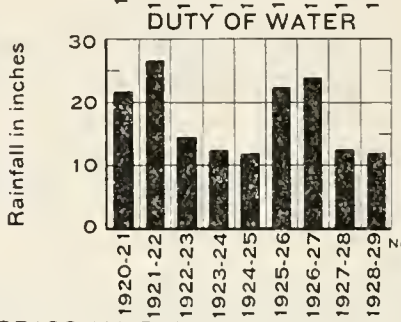
[a] Water rate, each year: Per hour-inch, $0.04; per acre-foot, $24.20.

PLATE I



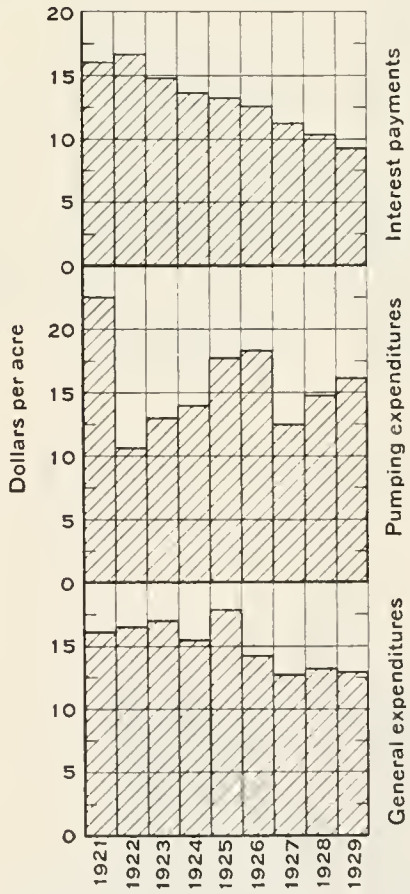
ANNUAL COST OF WATER
Excluding interest on value of capital stock



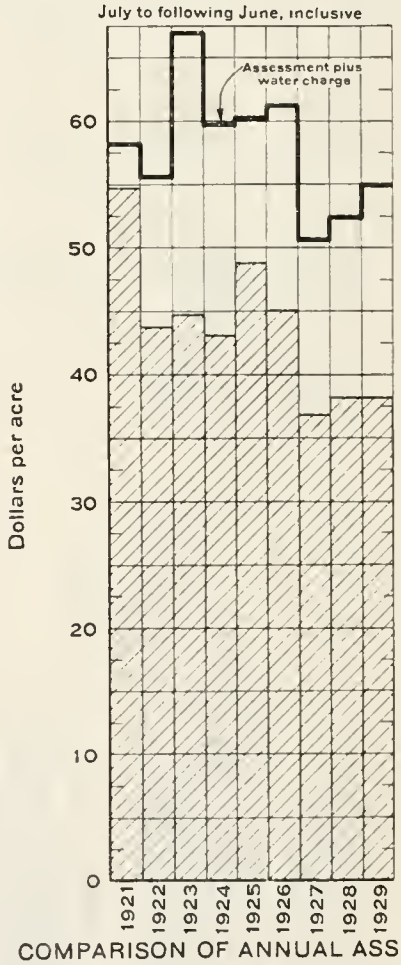


Note. Claremont record incomplete for 1924 and 1926. Upland record substituted for missing portions of these seasons

SEASONAL RAINFALL AT CLAREMONT
July to following June, inclusive



SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



COMPARISON OF ANNUAL ASSESSMENT PLUS WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

GLENDORA CONSOLIDATED MUTUAL IRRIGATING COMPANY

ANNUAL DATA, 1921-1929

San Antonio Water Company.

This company was organized in 1882 in connection with the development of Ontario Colony. Water is diverted by gravity from San Antonio Canyon and distributed to each ten-acre tract by a system of underground pipes. The gravity supply has been augmented for years by pumping from wells. As in many other sections, the pumping question has become increasingly important within the past few years. The heavy pumping, at greater depths than formerly, accounted in part for the increased assessments in 1928. In this connection the following figures published in the annual report of San Antonio Water Company for 1929 are pertinent:

	*Flow in San Antonio Canyon in miner's inches**	*Pumping lift at Sixteenth street wells in feet*
September, 1917	---	112.3
September, 1925	176	244.1
September, 1926	361	245.3
September, 1927	423	228.0
September, 1928	204	279.2
September, 1929	236	306.0
November, 1929	---	318.0

* One miner's inch is equal to one-fiftieth of a second-foot.

The company has an authorized capitalization of $1,500,000, consisting of 15,000 shares with par value of $100, of which 6064 shares are issued and outstanding. No new stock has been issued for many years. The stock is not appurtenant to the land; it has a fluctuating market value, due to supply and demand for stock, which was $350 per share in 1922 and $300 in 1929. Of the 6064 outstanding shares, 346 at the end of 1929 were owned by municipalities and the balance by orchardists. The company issued bonds in 1892 and has redeemed or refinanced the maturities from time to time. Indebtedness outstanding at the end of 1929, aside from current accounts payable, consisted of $224,000 of five per cent bonds, $115,000 of six per cent bonds, and $35,000 in notes. Fixed assets, less reserve for accrued depreciation, were valued at that time at $1,697,672.44.

The power resources of this project were controlled until 1927 by the Ontario Power Company, a subsidiary, all of the outstanding common stock of which was owned by San Antonio Water Company. In 1927 the water company disposed of this power company stock and applied the proceeds largely to reduction of indebtedness and to financing new improvements.

In 1928 the company embarked on a comprehensive program of new development designed to improve the water supply. The estimated cost of this program was about $215,000. Expenditures to the end of 1929 aggregated nearly $200,000, part of which was financed by the sale of bonds and issuance of notes.

Water is delivered to stockholders in rotation during the irrigation season extending from April 1 to November 30, and is paid for during that time entirely by stock assessments. During the winter season water may be had on application at rates for actual use varying from 30 to 50 cents per 24-hour inch, depending upon the amount of pumping required.

The irrigated area is all in citrus groves. The area served has been decreasing somewhat, due partly to subdivision into residence property and partly to acquiring water in some cases from private plants. Stock so released is acquired by other shareholders to increase the water supply for older citrus groves.

Plate II gives a segregation of operation and maintenance expenditures and compares the total with the sum of the annual assessment and water charge. The fact that the line representing assessments and water charges is so much lower than the operating expenditures during most of the years to 1927, inclusive, is due to the ownership of the subsidiary power company and resulting dividends during those years. The company has some income at present from sources other than payments by stockholders, which accounts for the more recent differences shown on the chart.

The plate also presents a graphical comparison of the cost of water per acre and per acre-foot, the area irrigated under the company's service, the duty of the water delivered, and the seasonal rainfall.

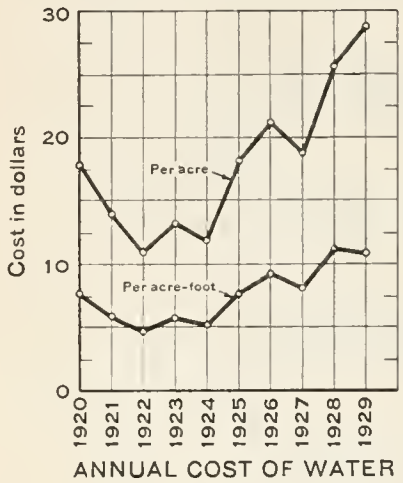
TABLE 7

ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, SAN ANTONIO WATER COMPANY, 1920-1929, INCLUSIVE

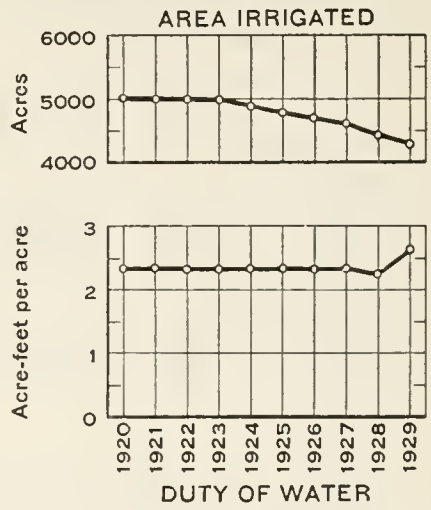
	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	5,000	5,000	5,000	5 000	4,900	4,800	4,700	4,600	4,450	4,300
Average duty of water, acre-feet per acre	*2.30	*2.30	2.30	*2.30	*2.30	*2.30	*2.30	*2 30	2.26	2 60
Average number of shares per acre	1.14	1.14	1.14	1 14	1.17	1.19	1.22	1 24	1 28	1 33
Value of capital stock per acre	$399 00	$399 00	$399 00	$399 00	$380 25	$386 75	$396 50	$372 00	$384 00	$399 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock per acre at 6 per cent	$23 94	$23 94	$23 94	$23 94	$22 82	$23 20	$23 79	$22 32	$23 04	$23 94
Annual assessment per acre	17 10	17 10	11 40	11 40	11 70	17 85	24 40	18 60	25 60	26 60
Water charge per acre for average amount used (extra water only)	0 78	0 86	1 26	1 87	0 47	0 48	1 87	0 25	0 13	2 27
Net amount of debt retired per acre	None	3 94	1 61	None	None	None	4 68	[a]None	[a]None	None
ANNUAL COST OF WATER:										
For use of one acre-foot only[b]—										
Excluding interest on value of capital stock	$17 10	$13 16	$9 79	$11 40	$11 70	$17 85	$19 72	$18 60	$25 60	$26 60
Including interest on value of capital stock	41 04	37 10	33 73	35 34	34 52	41 05	43 51	40 92	48 64	50 54
Per acre for average amount used—										
Excluding interest on value of capital stock	17 88	14 02	11 05	13 27	12 17	18 33	21 59	18 85	25 73	28 87
Including interest on value of capital stock	41 82	37 96	34 99	37 21	34 99	41 53	45 38	41 17	48 77	52 81
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	7 78	6 10	4 80	5 77	5 29	7 97	9 39	8 20	11 38	11 10
Including interest on value of capital stock	18 18	16 50	15 21	16 18	15 21	18 05	19 73	17 90	21 58	20 31

* Estimated.
[a] Debt retirements in 1927 and 1928 not chargeable to cost of water, therefore not shown.
[b] Cost of extra water not included in cost for use of one acre-foot only.

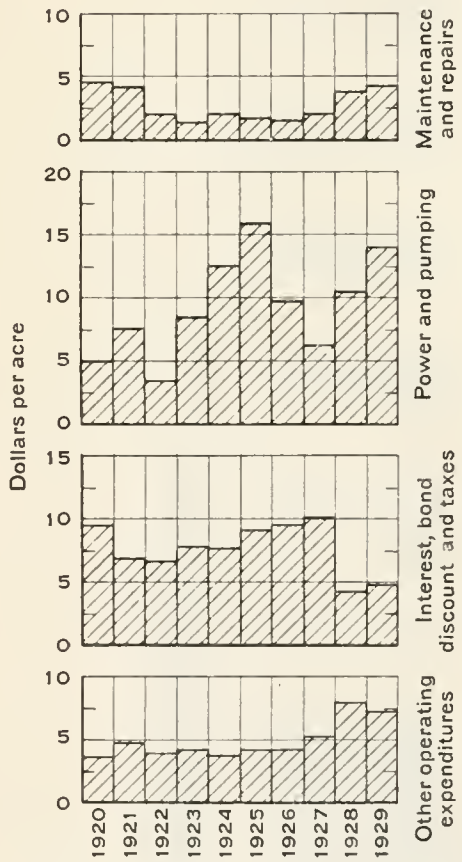
PLATE II



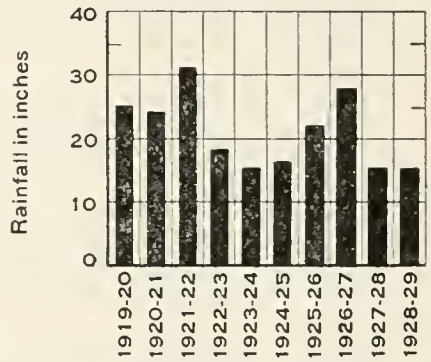
ANNUAL COST OF WATER
Excluding interest on value of capital stock



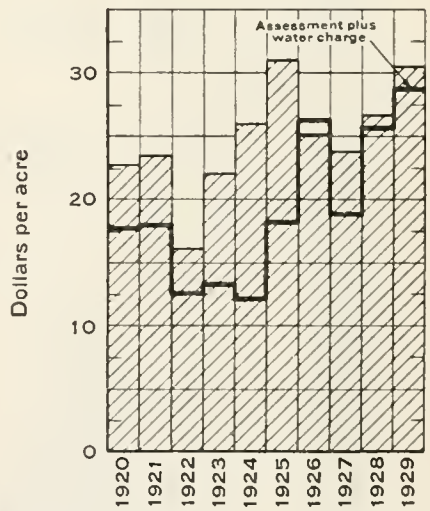
DUTY OF WATER



SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



SEASONAL RAINFALL AT UPLAND
July to following June, inclusive



COMPARISON OF ANNUAL ASSESSMENT PLUS WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

SAN ANTONIO WATER COMPANY

ANNUAL DATA, 1920-1929

Anaheim Union Water Company.

This company was organized in 1884 to effect a consolidation of several existing companies whose interests were in conflict. One of these companies, the Anaheim Water Company, was formed in 1859 in connection with the establishment of Anaheim Colony by the Los Angeles Vineyard Society. Another ditch was of even longer standing. Water is obtained by diversion from Santa Ana River and by pumping from wells.

The articles of incorporation of Anaheim Union Water Company provided for delivering water to stockholders within a defined area of 12,000 acres, and for the issuance of 12,000 shares of stock. At present the stock is made appurtenant to a prescribed area of about 14,800 acres, within which it may be transferred at will. The number of authorized shares has been reduced to 8004, which is the number now outstanding. Of this number, 20 shares are nonassessable. The par value is $100 and the market value has fluctuated from $70 to $300, but has remained close to $100 during the past ten years. In 1929 it was quoted at $95; in 1930, $110.

The usual holding of stock is at the rate of one share per acre. Approximately 9500 acres are covered by water stock, but part of this area also is supplied by individual pumping plants. The area that may be considered irrigated solely from the company system, after making allowance for the above duplication, is estimated at 8000 acres, of which 7500 acres are in citrus and 500 acres in deciduous fruits. The duty of water and cost figures are based on this estimated area of 8000 acres.

Water is delivered on demand when the available quantity permits; otherwise it is prorated and delivered in rotation. The company will not deliver water to more than two shares of stock per acre. The standard irrigation head is 100 inches, but much smaller heads are available for small tracts on the heavier soils. Delivery is usually made to the individual user at his corner, and is measured through a submerged orifice. The water charge in 1920 and 1921, per hour per 100 inches, varied from 40 cents in the winter months to $1.20 in the summer; in 1922 to 1929, inclusive, from 60 cents to $1.80, respectively.

This company has valuable oil properties, the income from which has served to decrease the cost of water to the stockholders. In fact, partly because of the availability of this oil revenue, no assessments were levied during the years 1912 to 1919, inclusive. In 1920, however, assessments were resumed, for the oil royalties were decreasing, new construction had become necessary, and the indebtedness of the company then amounted to $158,000 in bonds and $222,850 in notes, a total of $380,850, or $47.61 per acre on the basis of 8000 acres irrigated.

Over the ten-year period 1920–1929, the assessments have totaled $60 per acre and the total expenditures for new improvements $59.04 per acre. The net reduction of indebtedness over this period, after allowing for the three years in which there were net increases, was $21.82 per acre, and the net income from oil operations totaled $27.35 per acre. In other words, the assessments have taken care of new improvements and the oil income has more than taken care of the net reductions of indebtedness. The oil income is therefore an item of considerable

importance in the finances of this company and to determine the cost of water to the stockholders, the effect of this item in discharging obligations, which assessments or water charges otherwise would be called upon to discharge, should be offset against such obligations. An additional tabulation in which the annual net income from oil operations is subtracted from the sum of debt retirements and expenditures for permanent improvements is therefore presented in order to arrive at the cost of water.

The fluctuation in cost from year to year has been considerable. This has resulted from the fluctuations in assessments, debt retirements and expenditures for new improvements.

Pumping from wells has become increasingly important as a source of water supply, as will appear from the percentages of water pumped which are shown in Table 8.

Plate III shows the total cost of operation and maintenance each year for the period of the study and a segregation of the total into the more important groups. Attention is called to the general increase in cost of pumping from 1922 to 1929 and to the equally striking decline in interest on indebtedness. Also presented in the plate are the cost of water in dollars per acre and per acre-foot, the rainfall, the area irrigated, the duty of the water, together with the net income per acre from the company's oil holdings.

TABLE 8

ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, ANAHEIM UNION WATER COMPANY, 1920-1929, INCLUSIVE

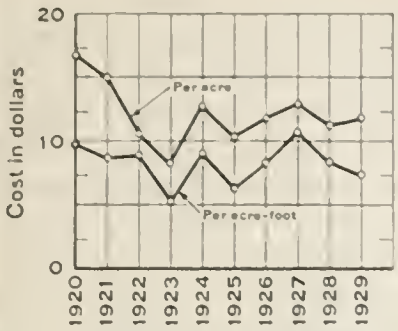
	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Percentage of water pumped	----------	----------	16 0	20 0	32 0	30.0	38.0	66.0	54 0	72.0
Average duty of water, acre-feet per acre	1.73	1.73	1.21	1.52	1.41	1 58	1 43	1 18	1.40	1 60
Average number of shares per acre	1.0	1 0	1 0	1.0	1.0	1.0	1 0	1.0	1.0	1 0
Value of capital stock per acre	$100 00	$100 00	$100 00	$100 00	$100 00	$100 00	$100 00	$100 00	$100 00	$95 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock per acre at 6 per cent	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$5 70
Annual assessment per acre	10 00	10 00	8 00	3 00	8 00	8 00	5 00	5 00	3 00	None
Water rate, per hour-inch (average)	0097	0096	0150	0135	0127	0131	0136	0157	0150	0136
Water rate per acre-foot (average)	5 87	5 81	9 08	8 17	7 68	7 93	8 23	9 50	9 08	8 23
Water charge per acre for average amount used	10 15	10 05	10 98	12 42	10 83	12 53	11 77	11 21	12 71	13 17
Net amount of debt retired per acre	None	3 24	2 29	3 16	6 36	7 74	None	71	3 38	None
Expenditures for new improvements per acre	.8 25	6 04	9 02	5 34	1 84	4 38	9 65	6 77	3 87	3 88
Net increase in indebtedness per acre	2 40	None	None	None	None	None	1 92	None	None	0 74
Portion of expenditures for improvements not accounted for by increase in indebtedness	5 85	6 04	9 02	5 34	1 84	4 38	7 73	6 77	3 87	3 14
Net income from oil operations per acre	2 58	4 18	2 97	1 26	2 03	1 77	2 70	4 13	2 92	1 81
ANNUAL COST OF WATER—Deducting debt retirements:										
For use of one acre-foot only—										
Excluding interest on value of capital stock	$15 87	$12 57	$14 79	$8 01	$9 32	$8 19	$13 23	$13 79	$8 70	$8 23
Including interest on value of capital stock	21 87	18 57	20 79	14 01	15 32	14 19	19 23	19 79	14 70	13 93
Per acre for average amount used—										
Excluding interest on value of capital stock	20 15	16 81	16 69	12 26	12 47	12 79	16 77	15 50	12 33	13 17
Including interest on value of capital stock	26 15	22 81	22 69	18 26	18 47	18 79	22 77	21 50	18 33	18 87
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	11 65	9 72	13 79	8 07	8 85	8 10	11 72	13 13	8 81	8 23
Including interest on value of capital stock	15 11	13 18	18 75	12 01	13 10	11 89	15 92	18 22	13 09	11 79
ANNUAL COST OF WATER—Deducting debt retirements and charge for new improvements:										
For use of one-acre-foot only—										
Excluding interest on value of capital stock	$10 02	$6 53	$5 77	$2 67	$7 48	$3 81	$5 50	$7 02	$4 83	$5 09
Including interest on value of capital stock	16 02	12 53	11 77	8 67	13 48	9 81	11 50	13 02	10 83	10 79
Per acre for average amount used—										
Excluding interest on value of capital stock	14 30	10 77	7 67	6 92	10 63	8 41	9 04	8 73	8 46	10 03
Including interest on value of capital stock	20 30	16 77	13 67	12 92	16 63	14 41	15 04	14 73	14 46	15 73
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	8 27	6 23	6 34	4 55	7 54	5 32	6 32	7 40	6 04	6 27
Including interest on value of capital stock	11 73	9 69	11 30	8 50	11 79	9 12	10 52	12 48	10 33	9 83

TABLE 8—Continued

ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, ANAHEIM UNION WATER COMPANY, 1920-1929, INCLUSIVE

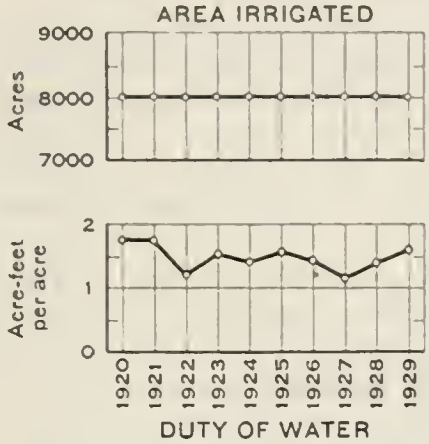
	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
ANNUAL COST OF WATER—Deducting debt retirements and charge for new improvements, minus net income from oil operations:										
For use of one acre-foot only—										
Excluding interest on value of capital stock	$12 60	$10 71	$8 74	$3 93	$9 51	$5 58	$8 20	$11 15	$7 75	$6 90
Including interest on value of capital stock	18 60	16 71	14 74	9 93	15 51	11 58	14 20	17 15	13 75	12 60
Per acre for average amount used—										
Excluding interest on value of capital stock	16 88	14 95	10 64	8 18	12 66	10 18	11 74	12 86	11 38	11 84
Including interest on value of capital stock	22 88	20 95	16 64	14 18	18 66	16 18	17 74	18 86	17 38	17 54
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	9 76	8 64	8 80	5 38	8 98	6 44	8 21	10 89	8 13	7 40
Including interest on value of capital stock	13 22	12 11	13 75	9 33	13 23	10 24	12 40	15 98	12 41	10 96

PLATE III

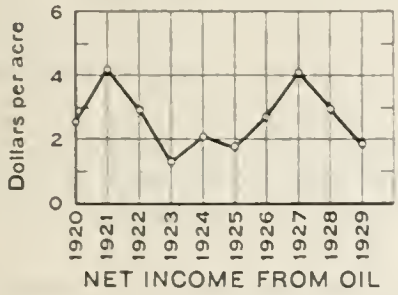


ANNUAL COST OF WATER

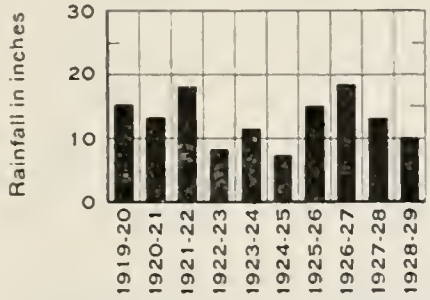
After deducting debt retirements and charge for new improvements minus annual net income from oil operations and excluding interest on value of capital stock



DUTY OF WATER

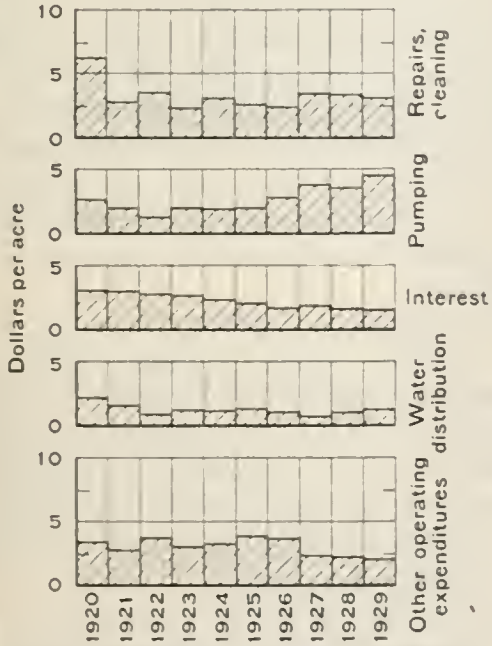


NET INCOME FROM OIL

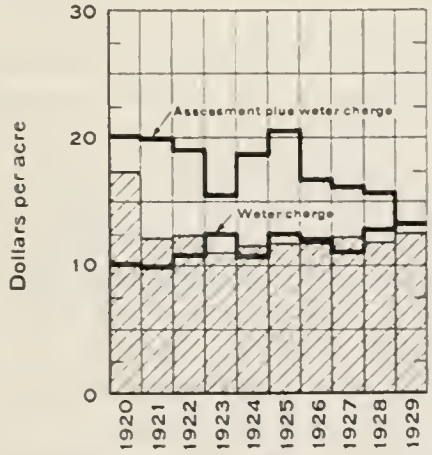


SEASONAL RAINFALL AT SANTA ANA

July to following June, inclusive



SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



COMPARISON OF ANNUAL ASSESSMENT PLUS WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

ANAHEIM UNION WATER COMPANY

ANNUAL DATA, 1920-1929

Santa Ana Valley Irrigation Company.

This system is an amalgamation and extension of old riparian ditches serving land in the Rancho Santiago de Santa Ana in Orange County. The section is intensively developed, consisting almost entirely of citrus and walnut groves. The area irrigated has decreased slowly, but steadily, from 17,416 to 16,586 acres in the ten years ending with 1929, due to subdivision of agricultural areas into residential property. However, the authorized capitalization of the company covers 20,000 shares, and the primary purpose of incorporation was to deliver water to owners of lands in the above named rancho.

Water is procured by gravity diversion from Santa Ana River and by pumping from wells, pumping to augment the gravity flow having been resorted to many years ago. The quantities pumped in 1923 and succeeding years have greatly exceeded those of preceding years.

Prior to 1922 water was delivered in rotation when it was necessary to prorate the available supply. Various individuals, however, had installed private pumping plants to insure their own supply during periods of heaviest use, and from this the practice arose of selling pumped water to others. In 1922 the company inaugurated the policy of supplementing its own gravity and pumped water supply, when necessary, by purchasing water at two cents per inch-hour from private pumping plants and delivering the aggregate to stockholders on demand.

For some years the company has been replacing private laterals with its own pipe lines, intending eventually to reach every user directly. Deliveries in most cases are now made at the user's land. The head is 100 inches, delivered through an opening 33⅓ inches wide by three inches deep, measured under a pressure of four inches above the top of the opening. Fractional heads down to one-twentieth head, or five inches, are measured through openings of the same three-inch depth under the same pressure. The inch used by this company is the outstanding exception in southern California, where the prevailing inch is equivalent to one-fiftieth second-foot.

Water is appurtenant to the land, the company having been incorporated as a delivering agency only. Capital stock is made appurtenant to the land by the articles of incorporation and by-laws. The stock therefore has no real market value. However, treasury stock sold by the company has an arbitrary sale value, computed by adding to the par value of $5 per share, the amount of each assessment levied since organization of the company, plus simple interest at ten per cent per annum on each assessment from the time when due.

Receipts and disbursements are segregated into the construction fund and the expense fund. Assessments and receipts from the sale of stock are paid into the construction fund and used only for permanent improvements and other capital investments and for litigation in defense of water rights. Receipts from water charges and other sources go into the expense fund for operation, maintenance and current expenses. Loans are charged to one fund or the other and similarly discharged.

Assessments have been levied at the rate of 55 cents per share for a number of years, there having been three assessments per annum from 1920 to 1924 and four per annum from 1925 on. Water charges

vary from year to year and during the year. In 1929, when gravity water was not all in use, the rate was 40 cents per hour per 100 inches and for one period 30 cents; when gravity water was all in use, 80 cents; when the company's pumping started, $1; when private pumping plants were employed, $1.20.

The company has never issued bonds. Its indebtedness, represented by notes payable, varies considerably from year to year. These notes are held in large part by stockholders.

The cost of water under this company shows a distinct trend upwards during the ten years ending with 1929. This is true even without considering interest on the arbitrary value of the capital stock, which increases with each assessment. The years 1920 and 1921 are not strictly comparable with the following eight years, inasmuch as the costs for 1920 and 1921 do not include water used from private pumping plants. The peak of 1927, in cost per acre-foot exclusive of interest, is due partly to the relatively low average delivery of one and one-half acre-feet per acre that year and partly to the large proportion of pumped water used. Pumped water was 57.7 per cent of the total amount used in 1927.

Considering the years 1923 and 1929, in which years the average use of water was almost identical, the cost per acre-foot, excluding interest, increased from $3.60 to $5.21, or 44.7 per cent. Eliminating assessments and debt retirements from consideration, the comparable increase was from $3.26 to $4.26, or 30.7 per cent, which is shown in Plate IV. The plate also presents a comparison of the annual water charge with the total operation and maintenance expenditures, the rainfall in the company's service area, the area irrigated and the duty of the water delivered. The influence of the cost of pumping factor may be gaged by the following comparison:

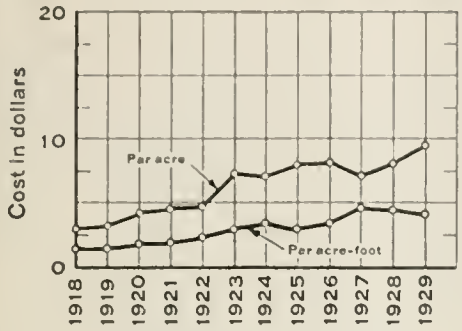
	1923	1929	Increase	
			Total	Per cent
Total disbursements, expense account	$112,774 16	$157,194 57	$44,420 41	39.4
Item of power	33,346 97	60,976 22		
Item of private pumping plants	8,369 50	22,878 25		
Sum of disbursements for pumping items	$41,716 47	$83,854 47	$42,138 00	101.0
Per cent of total disbursements represented by pumping	37.0	53.3		

TABLE 9

ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, SANTA ANA VALLEY IRRIGATION COMPANY, 1918-1929, INCLUSIVE

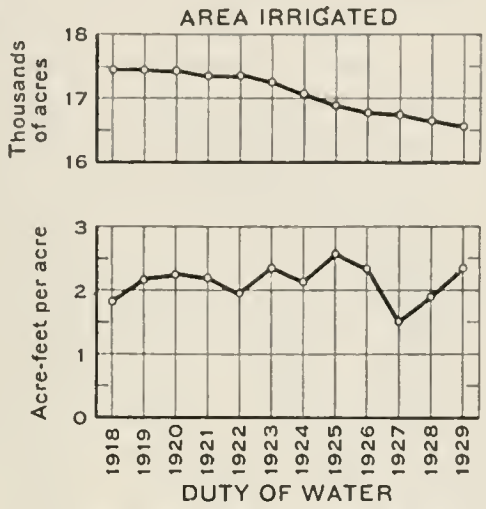
	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	17,428.	17,402.	17,416.	17,346.	17,362.	17,238.	17,045.	16,887.	16,765.	16,706.	16,638.	16,586.
Pumping lift, feet	----------	----------	----------	----------	75.	----------	----------	----------	247.	255.	262.	264.
Percentage of water pumped	18.	16.	20.	17.	17.	28.	37.	29.	40.	58.	50.	52.
Average duty of water, acre-feet per acre	1.79	2.15	2.21	2.18	1.93	2.33	2.10	2.54	2.30	1.50	1.88	2.31
Average number of shares per acre	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
Value of capital stock per acre	$117 00	$122 00	$127 00	$132 00	$137 00	$142 00	$147 00	$155 00	$164 00	$173 00	$182 00	$191 00
FACTORS IN ANNUAL COST OF WATER:												
Interest on value of capital stock per acre at 6 per cent	$7 02	$7 32	$7 62	$7 92	$8 22	$8 52	$8 82	$9 30	$9 84	$10 38	$10 92	$11 46
Annual assessment per acre	1 65	1 65	1 65	1 65	1 65	1 65	1 65	2 20	2 20	2 20	2 20	2 20
Water rate, per hour-inch	0027	0026	0032	0036	0042	0054	0058	0054	0060	0079	0075	0070
Water rate, per acre-foot	1 65	1 56	1 92	2 17	2 55	3 26	3 51	3 25	3 66	4 78	4 55	4 26
Water charge per acre for average amount used	2 95	3 35	4 24	4 73	4 92	7 60	7 37	8 26	8 42	7 17	8 56	9 84
Net amount of debt retired per acre	91	46	26	None	None	87	06	None	None	None	30	None
ANNUAL COST OF WATER—Deducting debt retirements:												
For use of one acre-foot only—												
Excluding interest on value of capital stock	$2 39	$2 75	$3 31	$3 82	$4 20	$4 04	$5 10	$5 45	$5 86	$6 98	$6 45	$6 46
Including interest on value of capital stock	9 41	10 07	10 93	11 74	12 42	12 56	13 92	14 75	15 70	17 36	17 37	17 92
Per acre for average amount used—												
Excluding interest on value of capital stock	3 69	4 54	5 63	6 38	6 57	8 38	8 96	10 46	10 62	9 37	10 46	12 04
Including interest on value of capital stock	10 71	11 86	13 25	14 30	14 79	16 90	17 78	19 76	20 46	19 75	21 38	23 50
Per acre-foot for average amount used—												
Excluding interest on value of capital stock	2 06	2 11	2 55	2 93	3 40	3 60	4 27	4 12	4 62	6 25	5 56	5 21
Including interest on value of capital stock	5 98	5 52	6 00	6 56	7 66	7 25	8 47	7 78	8 90	13 16	11 37	10 17
ANNUAL COST OF WATER—Without adding assessments or deducting debt retirements:												
For use of one acre-foot only—												
Excluding interest on value of capital stock	$1 65	$1 56	$1 92	$2 17	$2 55	$3 26	$3 51	$3 25	$3 66	$4 78	$4 55	$4 26
Including interest on value of capital stock	8 67	8 88	9 54	10 09	10 77	11 78	12 33	12 55	13 50	15 16	15 47	15 72
Per acre for average amount used—												
Excluding interest on value of capital stock	2 95	3 35	4 24	4 73	4 92	7 60	7 37	8 26	8 42	7 17	8 56	9 84
Including interest on value of capital stock	9 97	10 67	11 86	12 65	13 14	16 12	16 19	17 56	18 26	17 55	19 48	21 30
Per acre-foot for average amount used—												
Excluding interest on value of capital stock	1 65	1 56	1 92	2 17	2 55	3 26	3 51	3 25	3 66	4 78	4 55	4 26
Including interest on value of capital stock	5 57	4 96	5 37	5 80	6 81	6 92	7 71	6 91	7 94	11 70	10 36	9 22

PLATE IV

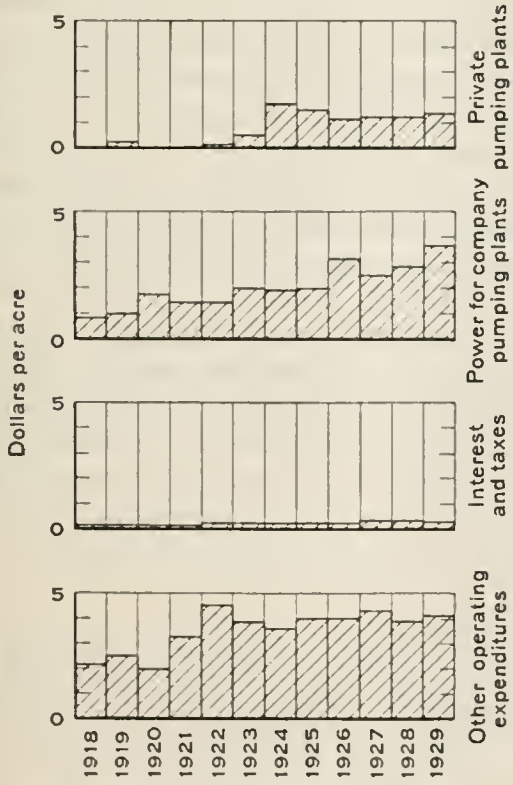


ANNUAL COST OF WATER

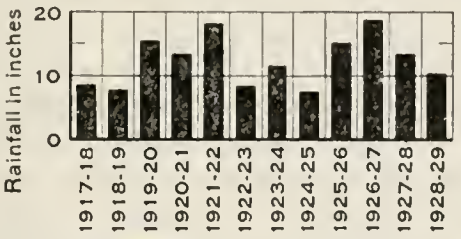
Without adding assessments or deducting debt retirements, and excluding interest on value of capital stock



DUTY OF WATER

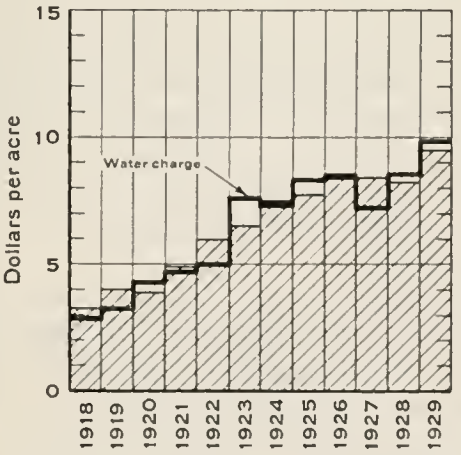


SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



SEASONAL RAINFALL AT SANTA ANA

July to following June, inclusive



COMPARISON OF ANNUAL WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

SANTA ANA VALLEY IRRIGATION COMPANY

ANNUAL DATA, 1918-1929

Temescal Water Company.

This organization grew from an undertaking by the South Riverside Land and Water Company which included subdivision of land, development of water, and sale of the lands with water rights attached. Water is obtained from several different sources by gravity and by pumping. During the past decade the company has spent considerable money in improving its water supplies, including the installation of new wells and pumps, purchase of additional water rights, purchase of carrying capacity in the Gage canal, and construction of pipe lines connecting the Gage canal and the Temescal distribution system.

Pumping has been an important feature for many years. Of the total annual water supplies, the proportion pumped during the period 1917–1929, inclusive, has ranged from 51 per cent in 1922 to 94 per cent in 1929, with a weighed average for the entire period of 84.4 per cent. This situation is shown graphically in Plate V.

Delivery of domestic water to residents of Corona was undertaken by the original promotion company. The Temescal Water Company acquired the domestic system and organized the Corona City Water Company, a public service corporation, to handle it. The Temescal Water Company owns the stock of Corona City Water Company, and the latter in turn owns 700 shares of stock of Temescal Water Company. The domestic water company is therefore entitled to a proportionate share of water delivered by Temescal Company. In the figures presented herein for cost of water, proper allowance has been made for this situation by separating the domestic shares of stock, domestic deliveries of water, and proportionate expenditures for operation and maintenance from the several totals.

Shares of stock are appurtenant to the entire tract served. Within the tract they are allocated to one of two topographic levels. Shares may be transferred from one level to the other only with consent of the company. A charge of $50 per share is made for transferring stock from the lower level to the upper level, owing to the higher capital cost of the upper level works. This charge and other factors have led to material differences in market values of stock between the two levels.

The stock is not appurtenant to individual tracts on either level. However, the company will not deliver water to one acre of land in excess of the quantity represented by three shares of stock, owing to pipe-line capacities. Water is delivered in rotation to individual tracts, usually in ten-acre units.

The revenue of Temescal Water Company is derived from annual stock assessments and from rents of lands. There is no charge for water aside from the assessment. In addition, the company from time to time has obtained funds from sales of water-bearing lands for dry-farming purposes, has floated bond issues, and borrowed money on both secured and unsecured notes. The extensive developments beginning in 1924 were financed mainly through bond issues. At the end of 1929 outstanding obligations included $725,000 of bonds, $100,000 of serial notes, $117,859.29 of secured accounts payable, and $21,392.09 of unsecured accounts payable—a total of $964,251.38. Offsetting these obligations were assets valued at $2,402,962.05.

The annual cost of water is shown for each of the years 1917 to 1929, inclusive, after deducting from the annual assessment the amount of indebtedness retired each year. This method of computation harmonizes with the general presentation in this bulletin; however, for this company, it does not represent the real cost to the water users, in view of the several sales of capital assets, sales of treasury stock, flotations of bond issues, and other important financial transactions that have taken place during the thirteen years considered. An additional presentation is therefore made of the annual cost computed after deducting from each assessment the amount available for capital investment, without considering whether such amount was actually applied upon retirement of indebtedness or expenditures for new improvements.

The amount available for capital investment has been computed by deducting from the assessment the total expenditures for operation and maintenance, where such expenditures were less than the assessment. It will be noted from Plate V that in several years these expenditures exceeded the assessment. Such cases were handled as follows: The costs for 1917 and 1918 were taken as the assessments for those years, owing to a carry-over from the 1916 assessment which more than accounts for the deficits. The costs for 1926 and 1929 are also taken as the respective assessments; the deficit from 1926 is applied on the two years following, and that from 1929 is left for future years.

The cost trend from 1917 to 1929 has been generally upward. The pronounced drop in 1922 was due principally to the relatively small quantity of water pumped that year. Reference to Plate V shows that the largest increases in expenditures in recent years have been for pumping and for interest, discount and taxes. The item of interest on the bond issues of 1924 and succeeding years accounts for a material portion of the increase.

Also shown in Plate V are the rainfall for the years of the study, a comparison of the gravity and pumped water supplies of the company for each of these years, the duty of these supplies, and the area irrigated.

TABLE 10

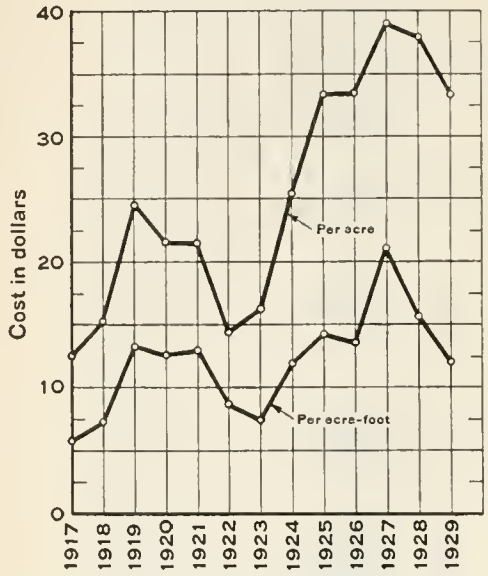
ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, TEMESCAL WATER COMPANY, 1917-1929, INCLUSIVE

	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	4,682.	4,682.	4,682.	4,682.	4,682.	4,682.	4,600.	4,550.	4,500.	4,400.	4,400.	4,400.	4,400.
Percentage of water pumped	74.	85.	93.	79.	92.	51.	80.	91.	93.	83.	80.	91.	94.
Average duty of water, acre-feet per acre	2.21	2.06	1.86	1.72	1.66	1.66	2.12	2.12	2.35	2.46	1.85	2.43	2.80
Average number of shares per acre	1 68	1.68	1.68	1.67	1.66	1.73	1.76	1.80	1.82	1.86	1.86	1.86	1.86
Value of capital stock per acre:													
Average	$147 84	$147 84	$147 84	$203 74	$202 52	$211 06	$214 72	$219 60	$222 04	$241 80	$241 80	$241 80	$241 80
Upper level	168 00	168 00	168 00	233 80	232 40	[a]242 20	246 40	252 00	[a]254 80	279 00	279 00	279 00	[a]279 00
Lower level	[a]117 60	117 60	117 60	158 65	157 70	[a]164 35	167 20	171 00	[a]172 90	186 00	186 00	186 00	[a]186 00
FACTORS IN ANNUAL COST OF WATER:													
Interest on value of capital stock per acre at 6 per cent—													
Average	$8 87	$8 87	$8 87	$12 22	$12 15	$12 66	$12 88	$13 18	$13 32	$14 51	$14 51	$14 51	$14 51
Upper level	10 08	10 08	10 08	14 03	13 94	14 53	14 78	15 12	15 29	16 74	16 74	16 74	16 74
Lower level	7 06	7 06	7 06	9 52	9 46	9 86	10 03	10 26	10 37	11 16	11 16	11 16	11 16
Annual assessment per acre	12 60	15 12	30 24	30 06	29 88	20 76	26 40	27 00	34 58	33 48	39 06	39 06	33 48
Net amount of debt retired per acre	5 34	5 34	7 05	9 08	6 09	6 51	11 52	None	None	None	None	None	20 91
Portion of assessment available for permanent improvements or retirement of indebtedness, per acre	None	None	5 60	8 56	8 43	6 51	10 17	1 52	1 25	None	None	1 10	None
ANNUAL COST OF WATER—Deducting debt retirements:													
For use of one acre-foot only—													
Excluding interest on value of capital stock	$7 26	$9 78	$23 19	$20 98	$23 79	$14 25	$14 88	$27 00	$34 58	$33 48	$39 06	$39 06	$12 57
Including interest on value of capital stock:													
Average	16 13	18 65	32 06	33 20	35 94	26 91	27 76	40 18	47 90	47 99	53 57	53 57	27 08
Upper level	17 34	19 86	33 27	35 01	37 73	28 78	29 66	42 12	49 87	50 22	55 80	55 80	29 31
Lower level	14 32	16 84	30 25	30 50	33 25	24 11	24 91	37 26	44 95	44 64	50 22	50 22	23 73
Per acre for average amount used—													
Excluding interest on value of capital stock	7 26	9 78	23 19	20 98	23 79	14 25	14 88	27 00	34 58	33 48	39 06	39 06	12 57
Including interest on value of capital stock:													
Average	16 13	18 65	32 06	33 20	35 94	26 91	27 76	40 18	47 90	47 99	53 57	53 57	27 08
Upper level	17 34	19 86	33 27	35 01	37 73	28 78	29 66	42 12	49 87	50 22	55 80	55 80	29 31
Lower level	14 32	16 84	30 25	30 50	33 25	24 11	24 91	37 26	44 95	44 64	50 22	50 22	23 73

Per acre-foot for average amount used—													
Excluding interest on value of capital stock	3 29	4 75	12 47	12 20	14 33	8 58	7 02	12 74	14 71	13 61	21 11	16 07	4 49
Including interest on value of capital stock:													
Average	7 30	9 05	17 24	19 30	21 65	16 21	13 09	18 95	20 38	19 51	28 96	22 05	9 67
Upper level	7 85	9 64	17 89	20 36	22 73	17 34	13 99	19 87	21 22	20 41	30 16	22 96	10 47
Lower level	6 48	8 17	16 26	17 73	20 03	14 52	11 75	17 58	19 13	18 15	27 15	20 67	8 48
ANNUAL COST OF WATER—Deducting portion of assessment available for improvements or debt retirements:													
For use of one acre-foot only—													
Excluding interest on value of capital stock	$12 60	$15 12	$24 64	$21 50	$21 45	$14 25	$16 23	$25 48	$33 33	$33 48	$39 06	$37 96	$33 48
Including interest on value of capital stock:													
Average	21 47	23 99	33 51	33 72	33 60	26 91	29 11	38 66	46 65	47 99	53 57	52 47	47 99
Upper level	22 68	25 20	34 72	35 53	35 39	28 78	31 01	40 60	48 62	50 22	55 80	54 70	50 22
Lower level	19 66	22 18	31 70	31 02	30 91	24 11	26 26	35 74	43 70	44 64	50 22	49 12	44 64
Per acre for average amount used—													
Excluding interest on value of capital stock	12 60	15 12	24 64	21 50	21 45	14 25	16 23	25 48	33 33	33 48	39 06	37 96	33 48
Including interest on value of capital stock:													
Average	21 47	23 99	33 51	33 72	33 60	26 91	29 11	38 66	46 65	47 99	53 57	52 47	47 99
Upper level	22 68	25 20	34 72	35 53	35 39	28 78	31 01	40 60	48 62	50 22	55 80	54 70	50 22
Lower level	19 66	22 18	31 70	31 02	30 91	24 11	26 26	35 74	43 70	44 64	50 22	49 12	44 64
Per acre-foot for average amount used—													
Excluding interest on value of capital stock	5 70	7 34	13 25	12 50	12 92	8 58	7 66	12 02	14 18	13 61	21 11	15 62	11 96
Including interest on value of capital stock:													
Average	9 71	11 65	18 02	19 60	20 24	16 21	13 73	18 24	19 85	19 51	28 96	21 59	17 14
Upper level	10 26	12 23	18 67	20 66	21 32	17 34	14 63	19 15	20 69	20 41	30 16	22 51	17 94
Lower level	8 90	10 77	17 04	18 03	18 62	14 52	12 39	16 86	18 60	18 15	27 15	20 21	15 94

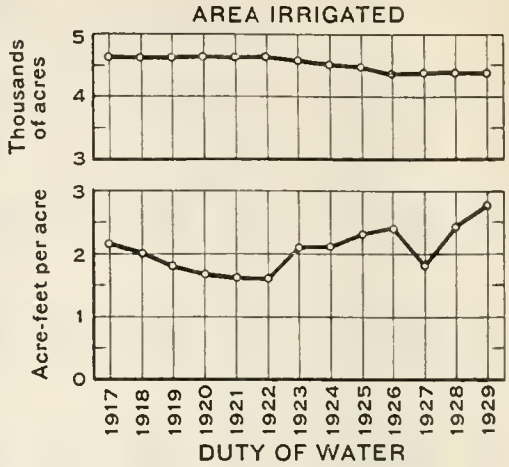
* Stock values for these years reported; others interpolated.

PLATE V

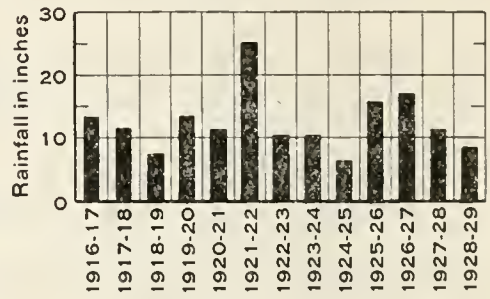


ANNUAL COST OF WATER

After deducting portion of assessment available for improvements or debt retirements, and excluding interest on value of capital stock

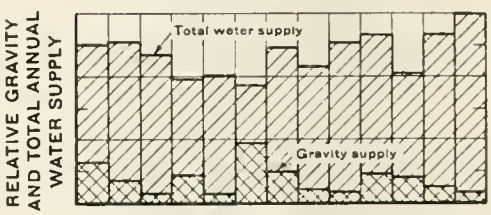


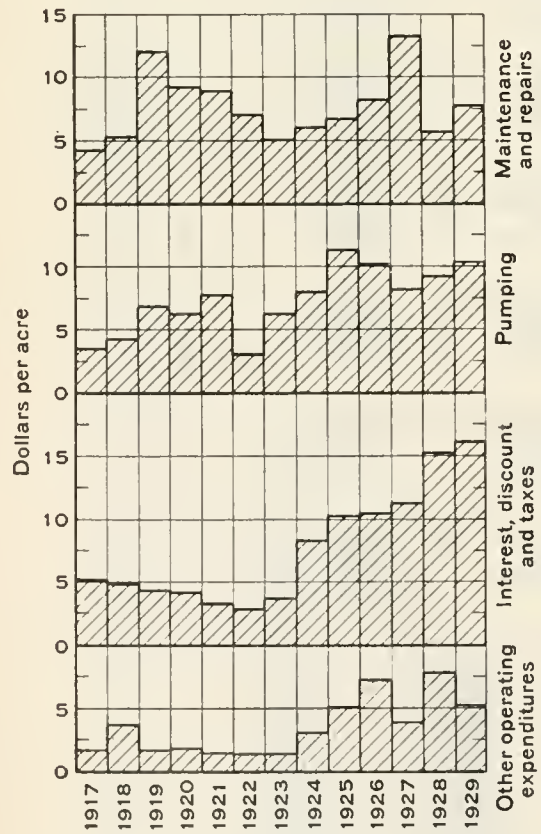
DUTY OF WATER



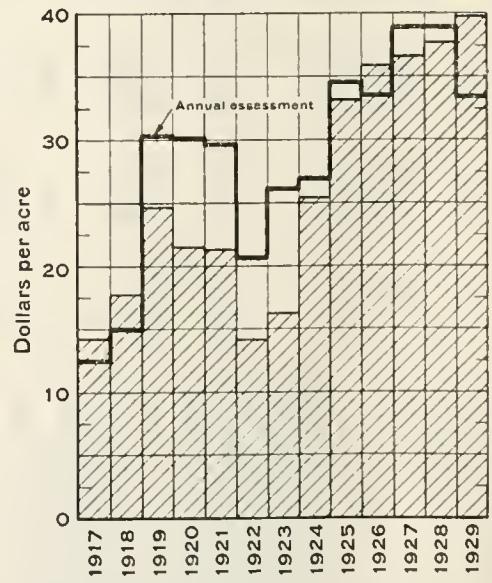
SEASONAL RAINFALL AT CORONA

July to following June, inclusive





SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



COMPARISON OF ANNUAL ASSESSMENT WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

TEMESCAL WATER COMPANY

ANNUAL DATA, 1917-1929

Riverside Water Company.

This company, which completed its organization in 1885, grew from a combined land and water enterprise having its inception in 1869. The original surveys were made by persons interested in the cultivation of mulberry trees for silk production, but the first appreciable construction work was done by their successors, the Southern California Colony Association.

The Riverside Water Company was entitled, by virtue of its articles of incorporation, to sell water to other than stockholders, and consequently was sometimes looked upon as a public utility. In fact, in the early days water was delivered to certain landowners who had acquired prescriptive rights and who refused to buy stock in the company. However, the proportion of water delivered to nonstockholders has never been large, and all consumers have been served on the same basis; hence the company in practice has always been essentially a mutual organization. Legislative authority was obtained in 1923 to issue stock to owners of appurtenant land on a showing of title to the land. To remove any further question as to mutual status, the by-laws were amended in 1925 to provide that water should be supplied to stockholders only.

The water supply is derived from Warm Creek, Santa Ana River, and wells. The gravity supply in 1929 was about one-third of the total. Pumping has become increasingly important within the past eight years.

Water is delivered on demand to individual users, within the limitations of rules governing prorating of water.

Prior to 1929, water was charged to users on one of two bases—the acre rate and the inch rate. The inch rate, which was discontinued at the end of 1928, had been utilized by growers of grain or other crops requiring only two or three irrigations. The acre rate, which was $10 per acre in 1929, entitled the user in that year to his proportion of water flowing in the canal during the winter months, and to a flow of eight miner's inches per acre during each prorating period of 35 days beginning April 22 and ending October 31. Water in excess of such prorated quantity, but not exceeding a total of 20 miner's inches per acre, could be obtained. Such additional amount over eight inches per acre was sold from April 22 to May 26 at 10 cents per 24-hour inch and thereafter to October 31 at 12½ cents. The acre rate is therefore the minimum charge for water.

No assessments were levied during the period under consideration. In fact, an assessment of $3 per share levied in April, 1930, was the first in the history of the company. The company has an operating income of several thousand dollars per year from rent and from water power, in addition to that from water sales. Indebtedness at the end of 1929 consisted of $60,000 in bills payable and $20,000 in mortgage notes. There have been no bonds since 1913. Expenditures for improvements during the twelve-year period ending with 1929 have varied from 48 cents to $4.61 per acre per annum. During the last three years of this period an aggregate of approximately $63,500 was invested in wells and pumping plants—or an average of $2.80 per acre per annum.

TABLE 11

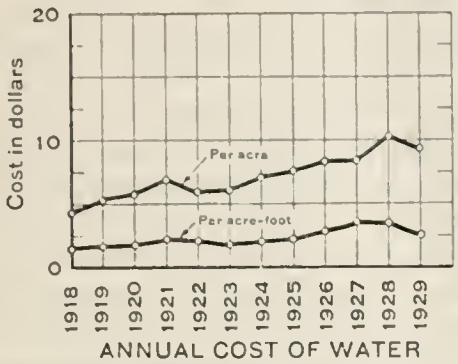
ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, RIVERSIDE WATER COMPANY, 1918-1929, INCLUSIVE

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	8,111.	8,150.	7,934.	8,093.	8,058.	8,033	7,699.	8,064.	7,688.	7,605.	7,542.	7,572.
Average duty of water, acre-feet per acre	3.05	3.14	3.07	3.02	2.67	3.32	3.59	3.44	2.96	2.40	2.89	3.54
Average number of shares per acre	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
Value of capital stock per acre	$150 00	$150 00	$150 00	$150 00	$150 00	$150 00	$150 00	$150 00	*$400 00	*$400 00	*$400 00	*$400 00
FACTORS IN ANNUAL COST OF WATER:												
Interest on value of capital stock per acre at 6 per cent	$9 00	$9 00	$9 00	$9 00	$9 00	$9 00	$9 00	$29 00	$24 00	$24 00	$24 00	$24 00
Acre rate (minimum charge)	6 00	6 00	8 00	8 00	8 00	7 00	8 00	8 00	8 00	8 00	10 00	10 00
Water charge per acre for average amount used (total charges)	6 42	6 41	8 58	8 23	8 27	7 63	9 19	8 42	8 47	8 35	10 44	11 22
Net amount of debt retired per acre	1 05	None	50	None	3 48	None	None	None	None	None	46	None
Portion of water charge available for capital investment per acre	1 96	1 05	2 82	1 26	2 47	1 51	2 15	83	23	None	30	2 07
ANNUAL COST OF WATER—Deducting debt retirements:												
For use of one acre-foot only[a]—												
Excluding interest on value of capital stock	$4 95	$6 00	$7 50	$8 00	$4 52	$7 00	$8 00	$8 00	$8 00	$8 00	$9 54	$10 00
Including interest on value of capital stock	13 95	15 00	16 50	17 00	13 52	16 00	17 00	17 00	32 00	32 00	33 54	34 00
Per acre for average amount used—												
Excluding interest on value of capital stock	5 37	6 41	8 08	8 23	4 79	7 63	9 19	8 42	8 47	8 35	9 98	11 22
Including interest on value of capital stock	14 37	15 41	17 08	17 23	13 79	16 63	18 19	17 42	32 47	32 35	33 98	35 22
Per acre-foot for average amount used—												
Excluding interest on value of capital stock	1 76	2 04	2 63	2 73	1 79	2 30	2 56	2 45	2 86	3 48	3 45	3 17
Including interest on value of capital stock	4 71	4 91	5 56	5 71	5 16	5 01	5 07	5 06	10 97	13 48	11 76	9 95
ANNUAL COST OF WATER—Deducting portion of charge available for capital investment:												
For use of one acre-foot only[a]—												
Excluding interest on value of capital stock	$4 04	$4 95	$5 18	$6 74	$5 53	$5 49	$5 85	$7 17	$7 77	$8 00	$9 70	$7 93
Including interest on value of capital stock	13 04	13 95	14 18	15 74	14 53	14 49	14 85	16 17	31 77	32 00	33 70	31 93
Per acre for average amount used—												
Excluding interest on value of capital stock	4 46	5 36	5 76	6 97	5 80	6 12	7 04	7 59	8 24	8 35	10 14	9 15
Including interest on value of capital stock	13 46	14 36	14 76	15 97	14 80	15 12	16 04	16 59	32 24	32 35	34 14	33 15
Per acre-foot for average amount used—												
Excluding interest on value of capital stock	1 46	1 71	1 88	2 31	2 17	1 84	1 96	2 21	2 78	3 48	3 51	2 58
Including interest on value of capital stock	4 41	4 57	4 81	5 29	5 54	4 55	4 47	4 82	10 89	13 48	11 81	9 36

* Estimated present value.

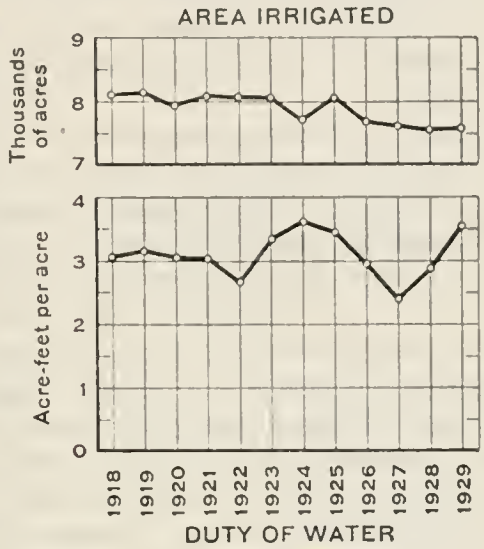
[a] Cost for use of only one acre-foot based on "acre rate."

PLATE VI

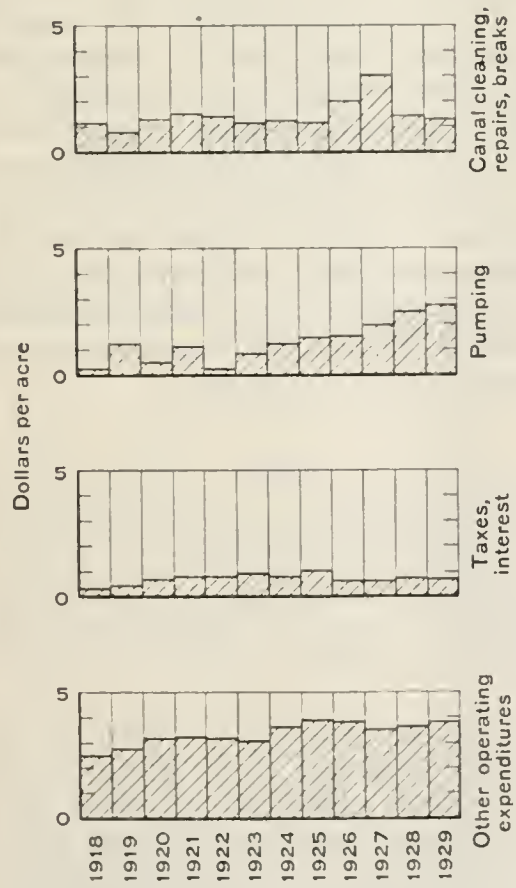


ANNUAL COST OF WATER

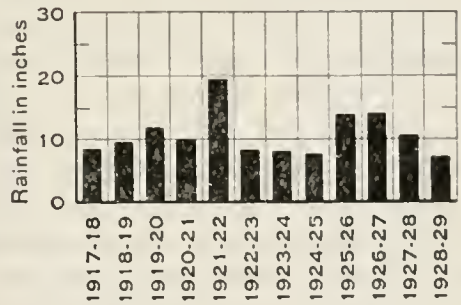
After deducting from water charge the portion available for capital investment, and excluding interest on value of capital stock



DUTY OF WATER

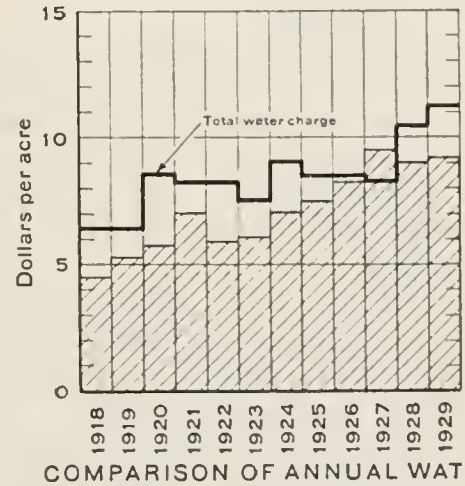


SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



SEASONAL RAINFALL AT RIVERSIDE

July to following June, inclusive



COMPARISON OF ANNUAL WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

RIVERSIDE WATER COMPANY

ANNUAL DATA, 1918-1929

Shares of stock are appurtenant to the land and have no separate market value. The value of $150 per acre, or $75 per share, shown in the accompanying Table 11 for 1918 to 1925 was determined by occasional sales of treasury stock; that of $400 per acre, or $200 per share, shown for 1926–1929 is the present value as estimated by company officials.

The cost of water per acre has about doubled during the period 1918–1929. The largest single factor affecting this increase is the cost of pumping, which was 21 cents per acre, or five per cent of the total operation and maintenance expense, in 1918, as against $2.76, or 30 per cent of the total, in 1929. This is shown graphically in Plate VI. The pumping cost fluctuated considerably during the first few years of the period, but has increased steadily since 1922—a general experience among the larger mutual companies of southern California. Exceptionally heavy expenditures due to breaks and storm damage accounted for the peak operation costs of 1927.

The table shows the cost of water computed in two ways, (1) by deducting from the water charge the amount of indebtedness retired; (2) by deducting from the charge that portion available for capital investment, such as retiring indebtedness and making permanent improvements. In most years this second deduction is simply the difference between the total operation and maintenance expenditures and the total water charges. In 1927 such expenditures exceeded the water charges and for that year the cost is taken as the total expenditures. For 1928 the deficit so occasioned in 1927 is offset against the actual difference which would otherwise have been deducted for 1928.

Plate VI also shows the cost per acre and per acre-foot, computed according to the second plan, the rainfall records, the water duty and area irrigated for each of the years covered in the study.

Gage Canal Company.

The Gage Canal Company was organized in 1890 by the Riverside Trust Company, Limited, to acquire and operate a system begun six years earlier by Matthew Gage and sold in the meantime to the trust company. Gage had financed the original construction through the sale of water rights. The water supply is derived from Santa Ana River and from wells. Of the total water used in 1929, 94 per cent was pumped.

The area served by this system is highly developed. Most of the acreage is in citrus groves. Water is delivered in rotation to the individual user, mainly to ten-acre tracts, although in some cases to tracts as small as two acres. The management has followed a consistent policy of improving the water supply and the physical system, a material portion of the work having been paid for directly from the annual water tax. The Mocking Bird Canyon Dam was financed by the sale of bonds, of which the last were redeemed in 1919. At present the company has but little indebtedness.

The Gage Canal Company not only delivers water to its own stockholders, but also carries in bulk the water supply of East Riverside Water Company and portions of the water supplies of Alta Mesa Mutual Water Company and Temescal Water Company. Costs of operation and maintenance of the Gage system are accordingly apportioned among the four organizations.

Shares of stock are appurtenant to the land, but may be transferred with consent of the company. Market values, therefore, are occasionally quoted, ranging from $100 per share in 1919 to $200 in 1928. In 1927 the company sold 500 shares of treasury stock at $150 per share. These values per acre are doubled, inasmuch as the ratio of stock to land is two shares to the acre.

The company originally levied stock assessments. The assessment was discontinued and levy of an annual water tax per share was begun in 1914, due to possible complications attending the sale of appurtenant stock in case of delinquency. Withholding delivery of water is the remedy followed in case of avoidable delinquency in payment of the water tax.

Stockholders of this company are divided into two classes; those who maintain their own pipe-line laterals, constituting about one-third of the shares, and those who contribute to maintenance of the Gage Canal Company pipe lines. Stockholders who maintain their own pipe lines are given a refund annually from the water tax. The exact proportion of shares in these classes varies somewhat from year to year, but the approximate ratio above has held for many years.

The cost of water per acre has followed a generally upward trend during the ten-year period ending with 1929. The drop in 1926 coincides with a drop in operation and maintenance expenditures that year, which in turn coincides with a decided drop in the quantity of water delivered. The cost drop in 1929, when a relatively large quantity of water was delivered, is attributable to lower expenditures for canal and pipe-line maintenance and renewals. It will be noted from Plate VII that expenditures for pumping have been increasing since 1922 with considerable regularity, constituting the most important factor in the increased cost of water. Next to pumping, the extensive pipe-line replacement program of 1928 and 1929 has had most to do with the higher costs of late years. Interest on indebtedness has been a minor factor. Legal expenses account for the recent increase in the group of "Other operating expenditures."

Plate VII also showing trends in cost per acre and per acre-foot, without interest on the value of capital stock, gives only the cost for the majority shares which pay the full water tax. Cost figures for such shares make a closer approach to actuality than do those for the minority shares, which are given a refund from the water tax, inasmuch as the refund is an offset to the minority shareholders' own cost of maintaining their own pipe lines. The total cost to such minority share holders is, therefore, greater than is indicated by computations in which the refund is deducted. To present a complete picture, the accompanying Table 12 gives both sets of costs so far as the Gage Canal Company is concerned, with an additional presentation of the average for all shares. Plate VII, which also compares the expenditures for operation and maintenance with the annual water tax, also refers to the average rather than to either group of shares, inasmuch as the average annual water tax represents the net portion of the tax collections actually available to the company for operation or investment purposes.

Presented in the plate also are rainfall records, duty of water used, and information on the area of land irrigated each year from 1918 to 1929.

TABLE 12

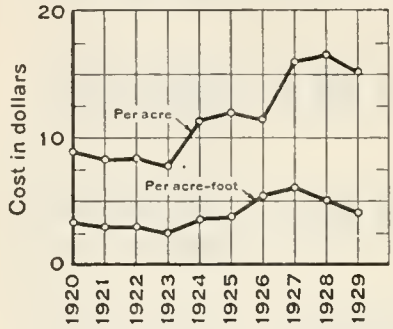
ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, GAGE CANAL COMPANY, 1920-1929, INCLUSIVE

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	6,144.	6,144.	6,144.	6,144.	6,144.	6,144.	6,144.	6,394.	6,394.	6,394.
Average duty of water, acre-feet per acre	2.86	2.70	2.76	3.03	3.06	3.20	2.21	2.64	3.23	3.80
Average number of shares per acre	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
Value of capital stock per acre	$250 00	$300 00	[a]$300 00	$300 00	$250 00	$250 00	[a]$250 00	[a]$300 00	[a]$400 00	$400 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock per acre at 6 per cent	$15 00	$18 00	$18 00	$18 00	$15 00	$15 00	$15 00	$18 00	$24 00	$24 00
Annual water tax per acre	10 00	10 00	12 00	12 00	12 00	12 00	17 00	16 00	16 00	16 00
Water charge per acre for average amount used (extra water only)	None	None	None	None	None	None	64	45	73	86
Net amount of debt retired per acre	None	None	None	1.39	59	[b]None	2 25	48	[b]None	None
Portion of water tax transferred to "Reserve capital invested in fixed assets," per acre	87	1 67	3 54	4 25	79	None	6 19	58	27	1 79
Approximately Two-thirds of Shares Pay the Full Water Tax. Cost to Such Shares:										
ANNUAL COST OF WATER—Deducting debt retirements:										
For use of one acre-foot only[c]—										
Excluding interest on value of capital stock	$10 00	$10 00	$12 00	$10 61	$11 41	$12 00	$14 75	$15 52	$16 00	$16 00
Including interest on value of capital stock	25 00	28 00	30 00	28 61	26 41	27 00	29 75	33 52	40 00	40 00
Per acre for average amount used—										
Excluding interest on value of capital stock	10 00	10 00	12 00	10 61	11 41	12 00	15 39	15 97	16 73	16 86
Including interest on value of capital stock	25 00	28 00	30 00	28 61	26 41	27 00	30 39	33 97	40 73	40 86
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	3 50	3 70	4 35	3 50	3 73	3 75	6 96	6 05	5 18	4 44
Including interest on value of capital stock	8 74	10 37	10 87	9 44	8 63	8 44	13 75	12 87	12 61	10 75
ANNUAL COST OF WATER—Deducting investment in fixed assets:										
For use of one acre-foot only[c]—										
Excluding interest on value of capital stock	$9 13	$8 33	$8 46	$7 75	$11 21	$12 00	$10 81	$15 42	$15 73	$14 21
Including interest on value of capital stock	24 13	26 33	26 46	25 75	26 21	27 00	25 81	33 42	39 73	38 21
Per acre for average amount used—										
Excluding interest on value of capital stock	9 13	8 33	8 46	7 75	11 21	12 00	11 45	15 87	16 46	15 07
Including interest on value of capital stock	24 13	26 33	26 46	25 75	26 21	27 00	26 45	33 87	40 46	39 07
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	3 19	3 08	3 07	2 56	3 66	3 75	5 18	6 01	5 10	3 97
Including interest on value of capital stock	8 44	9 75	9 59	8 50	8 57	8 44	11 97	12 83	12 52	10 28
Approximately One-third of Shares Maintain Their Own Pipe Lines and Secure Refund From Water Tax. Cost to Such Shares:										
Net annual water tax per acre	$9 74	$9 63	$11 24	$11 66	$11 63	$10 68	$16 00	$13 00	$13 00	$13 00

ANNUAL COST OF WATER—Deducting debt retirements:										
For use of one acre-foot only[c]—										
Excluding interest on value of capital stock	$9 74	$9 63	$11 24	$10 27	$11 04	$10 68	$13 75	$12 52	$13 00	$13 00
Including interest on value of capital stock	24 74	27 63	29 24	28 27	26 04	25 68	28 75	30 52	37 00	37 00
Per acre for average amount used—										
Excluding interest on value of capital stock	9 74	9 63	11 24	10 27	11 04	10 68	14 39	12 97	13 73	13 86
Including interest on value of capital stock	24 74	27 63	29 24	28 27	26 04	25 68	29 39	30 97	37 73	37 86
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	3 41	3 57	4 07	3 39	3 61	3 34	6 51	4 91	4 25	3 65
Including interest on value of capital stock	8 65	10 23	10 60	9 33	8 51	8 02	13 30	11 73	11 68	9 96
ANNUAL COST OF WATER—Deducting investment in fixed assets:										
For use of one acre-foot only[c]—										
Excluding interest on value of capital stock	$8 87	$7 96	$7 70	$7 41	$10 84	$10 68	$9 81	$12 42	$12 73	$11 21
Including interest on value of capital stock	23 87	25 96	25 70	25 41	25 84	25 68	24 81	30 42	36 73	35 21
Per acre for average amount used—										
Excluding interest on value of capital stock	8 87	7 96	7 70	7 41	10 84	10 68	10 45	12 87	13 46	12 07
Including interest on value of capital stock	23 87	25 96	25 70	25 41	25 84	25 68	25 45	30 87	37 46	36 07
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	3 10	2 95	2 79	2 44	3 54	3 34	4 73	4 88	4 17	3 18
Including interest on value of capital stock	8 34	9 61	9 31	8 39	8 44	8 02	11 52	11 69	11 60	9 49
Average Net Cost to All Shares:										
Average annual water tax, per acre	$9 91	$9 87	$11 72	$11 87	$11 86	$11 55	$16 67	$14 96	$14 98	$14 97
ANNUAL COST OF WATER—Deducting debt retirements:										
For use of one acre-foot only[c]—										
Excluding interest on value of capital stock	$9 91	$9 87	$11 72	$10 48	$11 27	$11 55	$14 42	$14 48	$14 98	$14 97
Including interest on value of capital stock	24 91	27 87	29 72	28 48	26 27	26 55	29 42	32 48	38 98	38 97
Per acre for average amount used—										
Excluding interest on value of capital stock	9 91	9 87	11 72	10 48	11 27	11 55	15 06	14 93	15 71	15 83
Including interest on value of capital stock	24 91	27 87	29 72	28 48	26 27	26 55	30 06	32 93	39 71	39 83
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	3 46	3 66	4 25	3 46	3 68	3 61	6 81	5 66	4 86	4 17
Including interest on value of capital stock	8 71	10 32	10 77	9 40	8 58	8 30	13 60	12 47	12 29	10 48
ANNUAL COST OF WATER—Deducting investment in fixed assets:										
For use of one acre-foot only[c]—										
Excluding interest on value of capital stock	$9 04	$8 20	$8 18	$7 62	$11 07	$11 55	$10 48	$14 38	$14 71	$13 18
Including interest on value of capital stock	24 04	26 20	26 18	25 62	26 07	26 55	25 48	32 38	38 71	37 18
Per acre for average amount used—										
Excluding interest on value of capital stock	9 04	8 20	8 18	7 62	11 07	11 55	11 12	14 83	15 44	14 04
Including interest on value of capital stock	24 04	26 20	26 18	25 62	26 07	26 55	26 12	32 83	39 44	38 04
Per acre-foot for average amount used—										
Excluding interest on value of capital stock	3 16	3 04	2 96	2 52	3 62	3 61	5 03	5 62	4 78	3 70
Including interest on value of capital stock	8 41	9 70	9 49	8 45	8 52	8 30	11 82	12 44	12 21	10 01

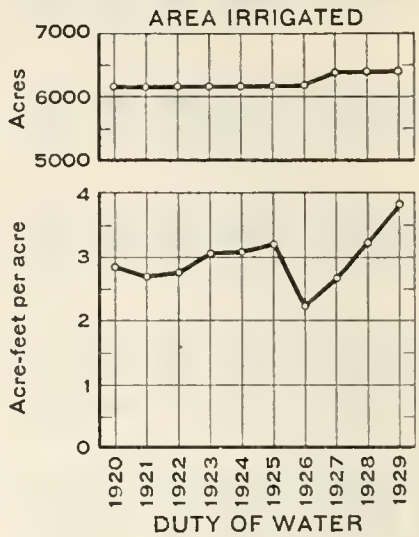
[a] These values quoted; others interpolated.
[b] Debt retirements these years not chargeable to water tax.
[c] Cost of extra water not included in cost for use of one acre-foot only.

PLATE VII

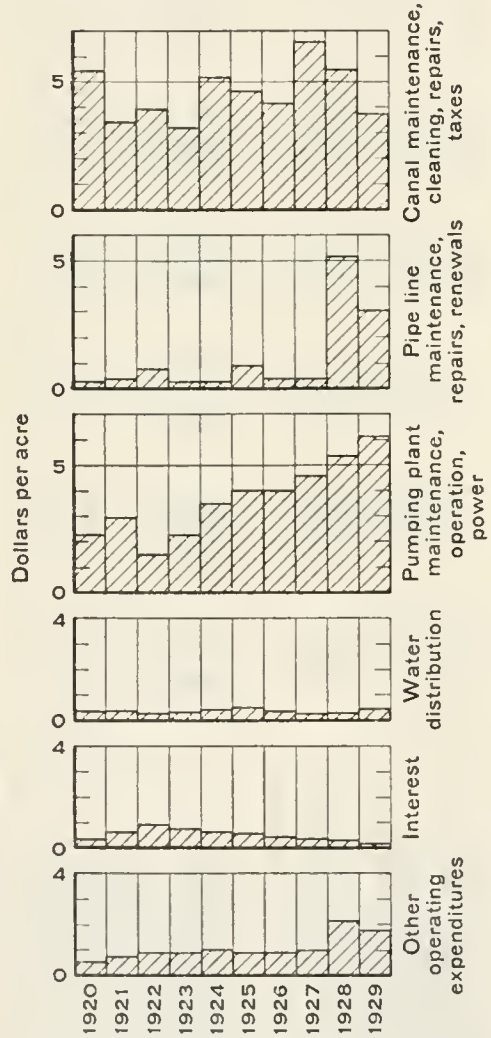


ANNUAL COST OF WATER

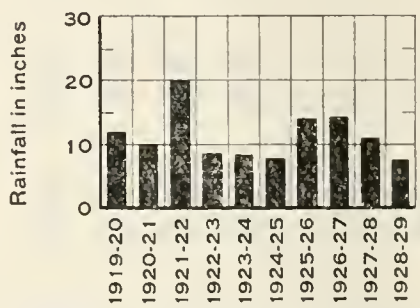
After deducting from annual water tax the portion transferred to "Reserve Capital invested in fixed assets," and excluding interest on value of capital stock. Applies to shares of stock which pay full water tax



DUTY OF WATER

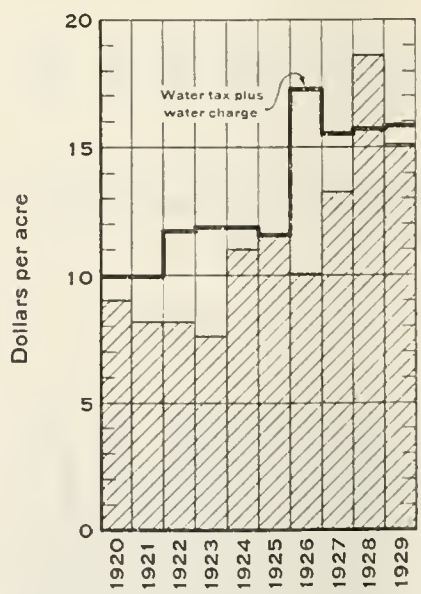


SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



SEASONAL RAINFALL AT RIVERSIDE

July to following June, inclusive



COMPARISON OF ANNUAL WATER TAX PLUS WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

GAGE CANAL COMPANY

ANNUAL DATA, 1920-1929

Fruitvale Mutual Water Company.

This company succeeded the Citizens Water Company of San Jacinto, a public utility. Several changes of organization, including the formation and abandonment of San Jacinto and Pleasant Valley Irrigation District in the early nineties, preceded the acquisition of the public utility system in 1921 by the water users organized as a mutual company. The Fruitvale Mutual Water Company, upon purchasing the works from the Citizens Company and exchanging shares of stock for water-right certificates held by consumers, was authorized by the Railroad Commission to abandon public service and acquire complete mutual status as of May 10, 1921.

The original capitalization of $400,000 was increased to $600,000 in 1923. This consists of 6000 shares of stock with par value of $100 per share. Of this number 4827 shares were outstanding October 31, 1929. Treasury stock is sold by the company for $75 per share, the proceeds being devoted to extensions and improvements. The articles of incorporation and by-laws provide that one share or less per acre shall be made appurtenant to the land; additional shares may be transferred from one tract to another.

The initial bond issue of 1920 was $260,000. Retirements of principal to 1927 aggregated $43,000. A new issue of $350,000 was then authorized, of which $300,000 was used to refund all outstanding bonds and to finance new improvements, the balance of $50,000 being held for future use. Indebtedness outstanding October 31, 1929, consisted of the $300,000 of bonds and $23,376.54 of notes and current liabilities. Assets at that date totaled $1,349,200.19.

The sources of water supply are San Jacinto River and wells. In addition to its own wells, the company has agreements with owners of a number of private wells to purchase surplus water when needed. Of the total quantity of water procured in 1929, gravity water constituted 19 per cent, water pumped by the company 73 per cent, and water purchased from private pumping plants 8 per cent. The percentage of water pumped has increased greatly since 1922, as shown on Table 13 and Plate VIII.

Assessments are levied for paying the interest and principal of bonds. Income from water sales and from nonoperating sources is devoted to operation and maintenance expenses. Water delivered to stockholders is charged for on a sliding scale, depending upon the time of year in which delivered and upon the source from which the water is being obtained. In 1929, these rates varied from 10 to 20 cents per 24-hour inch, with an average of 18.7 cents for the year. The highest rate applied to water pumped during the period May to August, inclusive.

Plate VIII also compares the sum of the annual water charge per acre for the average amount used and the annual assessment with the several items of operation and maintenance expenditures, together with rainfall records, information on the duty of water made available by the company and the area irrigated by its service. The cost of pumping is shown to be the dominant factor in determining the annual cost. The item of "Distribution" includes booster expense to 1928; during that year this operation was discontinued. The costs of repairs at the gravity source, pumping plants, and distribution lines are not segregated from the operation expenses. These figures shown in Plate VIII represent actual expenditures and do not include depreciation.

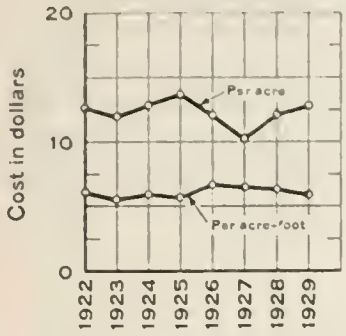
TABLE 13

ANNUAL COST OF IRRIGATION WATER TO STOCKHOLDERS, FRUITVALE MUTUAL WATER COMPANY, 1922-1929, INCLUSIVE

	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	2,924.	3,106.	3,330.	3,442.	3,437.	3,243.	3,996.	3,707.
Average lift in feet	*25.	(x)	(x)	(x)	(x)	(x)	(x)	85.
Percentage of water pumped	17.	34.	55.	72.	62.	50.	78.	81.
Average duty of water, acre-feet per acre	2 02	2.07	2.13	2.38	1.79	1.58	1.86	2.10
Average number of shares per acre	1.23	1.25	1.26	1.16	1.16	1.11	1.06	1.06
Value of capital stock per acre	$93 48	$95 42	$100 80	$87 00	$87 00	$83 25	$79 50	$79 50
FACTORS IN ANNUAL COST OF WATER:								
Interest on value of capital stock per acre at 6 per cent	$5 61	$5 73	$6 05	$5 22	$5 22	$5 00	$4 77	$4 77
Annual assessment per acre	5 97	6 06	9 14	8 70	7 54	4 44	4 24	4 24
Water rate, per hour-inch (average)	0058	0055	0068	0074	0074	0070	0071	0078
Water rate, per acre-foot (average)	3 49	3 33	4 11	4 46	4 49	4 23	4 30	4 71
Water charge per acre for average amount used	7 05	6 89	8 75	10 61	8 04	6 68	8 00	9 89
Net amount of debt retired per acre	1 65	2 31	2 11	1 94	1 94	2 59	None	None
Portion of assessment and water charge available for capital investment, per acre	28	97	4 86	5 45	3 47	55	07	1 15
ANNUAL COST OF WATER—Deducting debt retirements:								
For use of one acre-foot only—								
Excluding interest on value of capital stock	$7 81	$7 08	$11 14	$11 22	$10 09	$6 08	$8 54	$8 95
Including interest on value of capital stock	13 42	12 81	17 19	16 44	15 31	11 08	13 31	13 72
Per acre for average amount used—								
Excluding interest on value of capital stock	11 37	10 64	15 78	17 37	13 64	8 53	12 24	14 13
Including interest on value of capital stock	16 98	16 37	21 83	22 59	18 86	13 53	17 01	18 90
Per acre-foot for average amount used—								
Excluding interest on value of capital stock	5 63	5 14	7 41	7 30	7 62	5 40	6 58	6 73
Including interest on value of capital stock	8 41	7 91	10 25	9 49	10 54	8 56	9 15	9 00
ANNUAL COST OF WATER—Deducting portion of assessment and water charge available for capital investment:								
For use of one acre-foot only—								
Excluding interest on value of capital stock	$9 18	$8 42	$8 39	$7 71	$8 56	$8 12	$8 47	$7 80
Including interest on value of capital stock	14 79	14 15	14 44	12 93	13 78	13 12	13 24	12 57
Per acre for average amount used—								
Excluding interest on value of capital stock	12 74	11 98	13 03	13 86	12 11	10 57	12 17	12 98
Including interest on value of capital stock	18 35	17 71	19 08	19 08	17 33	15 57	16 94	17 75
Per acre-foot for average amount used—								
Excluding interest on value of capital stock	6 31	5 79	6 12	5 82	6 77	6 69	6 54	6 18
Including interest on value of capital stock	9 08	8 56	8 96	8 02	9 68	9 85	9 11	8 45

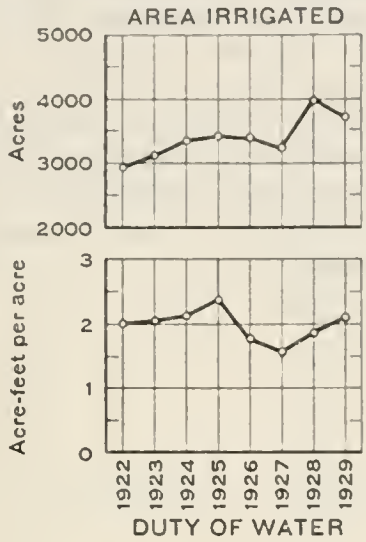
* Estimated.
x Not reported.

PLATE VIII

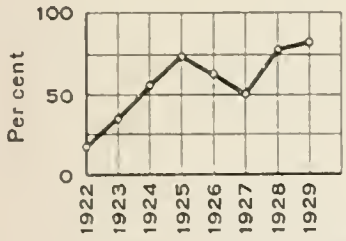


ANNUAL COST OF WATER

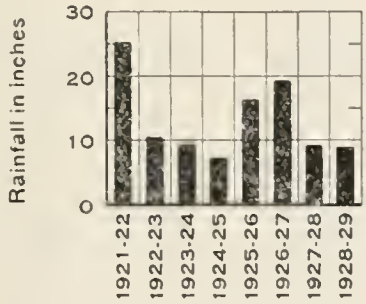
After deducting portion of assessment and water charge available for capital investment, and excluding interest on value of capital stock



DUTY OF WATER

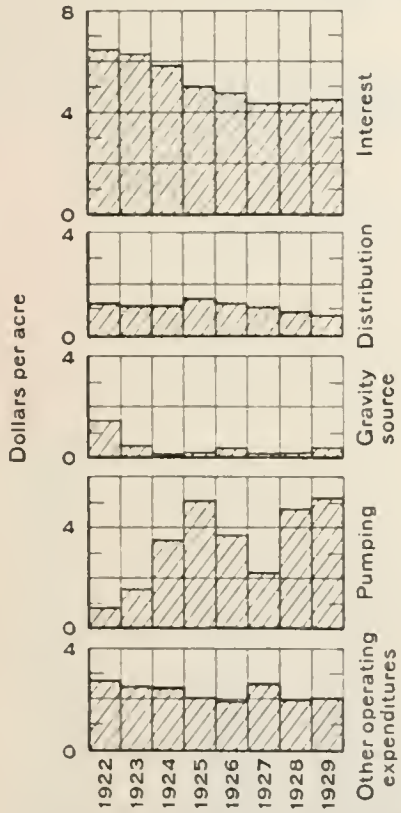


PER CENT OF WATER PUMPED

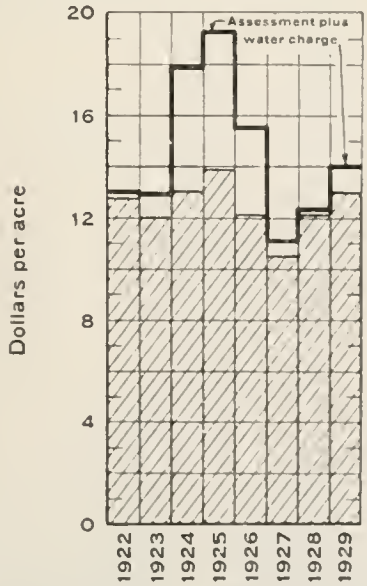


SEASONAL RAINFALL AT SAN JACINTO

July to following June, inclusive



SEGREGATION OF OPERATION AND MAINTENANCE EXPENDITURES



COMPARISON OF ANNUAL ASSESSMENT PLUS WATER CHARGE WITH TOTAL OPERATION AND MAINTENANCE EXPENDITURES

FRUITVALE MUTUAL WATER COMPANY

ANNUAL DATA, 1922-1929

Tables Showing Cost Data for Other Companies.

Information concerning the annual cost of irrigation water is shown for still other mutual companies of southern California in Tables 14 to 20, inclusive. The data are compiled in form similar to those of Table 5, with the exception that the amounts shown as "Annual assessments per acre" and "Amount of debt retired per acre" are for the year considered rather than averages for five years. Thus the annual cost of water shown in the following tables for 1929 is not the same as that of Table 5

TABLE 14

ANNUAL COST OF WATER TO IRRIGATORS, ALTA MUTUAL WATER COMPANY, SATICOY, 1923-1929, INCLUSIVE

	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Average lift in feet	----------	----------	----------	----------	----------	----------	75
Percentage of water pumped	----------	----------	----------	----------	----------	----------	100
Average duty of water, acre-feet per acre	1.43	1 38	1 32	.72	0 5	1 0	1 2
Average number of shares per acre	.1	.1	.1	1	1	1	1
Value of stock per acre[a]	$175 00	$175 00	$175 00	$175 00	$175 00	$175 00	$175 00
FACTORS IN ANNUAL COST OF WATER:							
Interest on value of capital stock, per acre	$10 50	$10 50	$10 50	$10 50	$10 50	$10 50	$10 50
Annual assessment per acre	None	None	None	6 00	None	None	3 00
Water rate, per hour-inch	0167	0167	0167	0167	0167	0167	0187
Water rate, per acre-foot	10 10	10 10	10 10	10 10	10 10	10 10	11 35
Water charge per acre for average amount used	14 43	13 93	13 33	7 27	5 05	10 10	13 62
Amount of debt retired per acre	None	None	None	None	None	None	None
Permanent improvements, cost per acre	2 33	0 18	4 05	None	None	0 44	3 33
ANNUAL COST OF WATER—Deducting debt retirements:							
For use of one acre-foot only—							
Excluding interest	$10 10	$10 10	$10 10	$16 10	$10 10	$10 10	$14 35
Including interest	20 60	20 60	20 60	26 60	20 60	20 60	24 85
Per acre for average amount used—							
Excluding interest	14 43	13 93	13 33	13 27	5 05	10 10	16 62
Including interest	24 93	24 43	23 83	23 77	15 55	20 60	27 12
Per acre-foot for average amount used—							
Excluding interest	10 92	10 09	10 10	18 43	10 10	10 10	13 85
Including interest	17 43	17 70	18 05	33 01	31 10	20 60	22 60
ANNUAL COST OF WATER—Deducting debt retirement and cost of permanent improvements:							
For use of one acre-foot only—							
Excluding interest	$7 77	$9 92	$6 05	$16 10	$10 10	$9 66	$11 02
Including interest	18 27	20 42	16 55	26 60	20 60	20 16	21 52
Per acre for average amount used—							
Excluding interest	12 10	13 75	9 28	13 27	5 05	9 66	13 29
Including interest	22 60	24 25	19 78	23 77	15 55	20 16	23 79
Per acre-foot for average amount used—							
Excluding interest	8 46	9 96	7 03	18 43	10 10	9 66	11 08
Including interest	15 84	17 50	14 98	33 01	31 10	20 16	19 82

[a] Assumed.

TABLE 15

ANNUAL COST OF WATER TO IRRIGATORS, CHINO WATER COMPANY, ONTARIO, 1920-1929, INCLUSIVE

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	----------	----------	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Average lift in feet	----------	----------	150	----------	----------	----------	----------	----------	----------	185
Percentage of water pumped	----------	----------	100	----------	----------	----------	----------	----------	----------	100
Average duty of water, acre-feet per acre	*0.70	*0.70	0.56	*0.70	0.69	0.83	0.67	0.61	0.75	0.88
Average number of shares per acre	----------	----------	1	1	1	1	1	1	1	1
Value of stock per acre	[a]$100 00	[a]$100 00	[a]$100 00	[a]$100 00	[a]$100 00	[a]$100 00	[a]$100 00	[a]$100 00	[a]$100 00	$75 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock per acre	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$4 50
Annual assessment per acre	None	None	None	None	None	None	None	None	None	None
Water rate, per hour-inch	02	02	02	02	02	02	02	02	02	02
Water rate, per acre-foot	12 10	12 10	12 10	12 10	12 10	12 10	12 10	12 10	12 10	12 10
Water charge per acre for average amount used	8 47	8 47	6 78	8 47	8 35	10 04	8 11	7 38	9 08	10 65
Amount of debt retired per acre	None	None	None	None	2 50	3 00	None	None	2 90	2 00
ANNUAL COST OF WATER:										
For use of one acre-foot only—										
Excluding interest	$12 10	$12 10	$12 10	$12 10	$9 60	$9 10	$12 10	$12 10	$9 20	$10 10
Including interest	18 10	18 10	18 10	18 10	15 60	15 10	18 10	18 10	15 20	14 60
Per acre for average amount used—										
Excluding interest	8 47	8 47	6 78	8 47	5 85	7 04	8 11	7 38	6 18	8 65
Including interest	14 47	14 47	12 78	14 47	11 85	13 04	14 11	13 38	12 18	13 15
Per acre-foot for average amount used—										
Excluding interest	12 10	12 10	12 10	12 10	8 48	8 48	12 10	12 10	8 24	9 83
Including interest	20 67	20 67	22 80	20 67	17 17	15 72	21 06	21 93	16 24	14 94

* Estimated.
[a] Par value

TABLE 16

ANNUAL COST OF WATER TO IRRIGATORS, CITIZENS LAND AND WATER COMPANY, BLOOMINGTON, 1920-1929, INCLUSIVE

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated			4,000							4,700
Average lift in feet			100							200
Percentage of water pumped			100							100
Average duty of water, acre-feet per acre	*1.8	*1.8	*1.81	*1.87	*1.81	*1.17	*1 53	*1.69	1 60	1 65
Average number of shares per acre	1	1	1	1	1	1	1	1	1	1
Value of stock per acre			$250 00							$145 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock per acre	*$12 00	*$13 50	$15 00	*$14 10	*$13 20	*$12 30	*$11 40	*$10 50	*$9 60	$8 70
Annual assessment per acre	*5 00	5 00	6 50	5 50	5 00	11 50	8 00	6 50	7 00	9 00
Water, rate, per hour-inch	01	01	01	01	01	01	01	01	0125	0125
Water rate, per acre-foot	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	7 56	7 56
Water charge per acre for average amount used	10 89	10 89	10 95	11 31	10 95	7 08	9 26	10 22	12 10	12 47
Amount of debt retired per acre	None	None	None	None	1 44	1 44	1 44	1 44	1 44	1 92
Permanent improvements, per acre				2 90	3 84	5 35	9 25	[a]8 45	[a]8 45	3 63
ANNUAL COST OF WATER—Deducting debt retirements:										
For use of one acre-foot only—										
Excluding interest	$11 05	$11 05	$12 55	$11 55	$9 61	$16 11	$12 61	$11 11	$13 12	$14 64
Including interest	23 05	24 55	27 55	25 65	22 81	28 41	24 01	21 61	22 72	23 34
Per acre for average amount used—										
Excluding interest	15 89	15 89	17 45	16 81	14 51	17 14	15 82	15 28	17 66	19 55
Including interest	27 89	29 39	32 45	30 91	27 71	29 44	27 22	25 78	27 26	28 25
Per acre-foot for average amount used—										
Excluding interest	8 83	8 83	9 64	9 00	8 02	14 65	10 34	9 05	11 04	11 85
Including interest	15 49	16 33	17 93	16 52	15 31	25 16	17 79	15 25	17 04	17 12
ANNUAL COST OF WATER—Deducting for debt retirement and cost of permanent improvements:										
For use of one acre-foot only—										
Excluding interest				$8 65	$5 77	$10 76	$3 36	$2 66	$4 67	$11 01
Including interest				22 75	18 97	23 06	14 76	13 16	14 27	19 71
Per acre for average amount used—										
Excluding interest				13 91	10 67	11 79	6 57	6 83	9 21	15 92
Including interest				28 01	23 87	24 09	17 97	17 33	18 81	24 62
Per acre-foot for average amount used—										
Excluding interest				7 44	5 90	10 08	4 29	4 04	5 76	9 65
Including interest				14 98	13 19	20 59	11 74	10 25	11 76	14 92

* Estimated.
[a] Average for 1927 and 1928.

TABLE 17

ANNUAL COST OF WATER TO IRRIGATORS, LA PUENTE COOPERATIVE WATER COMPANY, WEST COVINA, 1922-1929, INCLUSIVE

	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	2,000							2,000
Average lift in feet	70							
Percentage of water pumped	100							100
Average duty of water, acre-feet per acre	1.35	1.84	1.92	1.83	1.57	1.19	1.5	1.85
Average number of shares per acre	1	1	1	1	1	1	1	1
Value of stock per acre	$50 00	$50 00						$150 00
FACTORS IN ANNUAL COST OF WATER:								
Interest on value of capital stock per acre	$3 00	$3 00	*$4 00	*$5 00	*$6 00	*$7 00	*$8 00	$9 00
Annual assessment per acre	4 00	3 20	2 50	3 00	5 00	4 00	3 00	3 50
Water rate, per hour-inch	.0125	01	01	01	01	01	01	01
Water rate, per acre-foot	7 56	6 05	6 05	6 05	6 05	6 05	6 05	6 05
Water charge per acre for average amount used	10 21	11 13	11 62	11 07	9 50	7 20	9 08	11 19
Amount of debt retired per acre	2 50	2 50	2 50	2 50	2 50	2 50	2 50	2 50
ANNUAL COST OF WATER—Deducting debt retirements:								
For use of one acre-foot only—								
Excluding interest	$9 06	$6 75	$6 05	$6 55	$8 55	$7 55	$6 55	$7 05
Including interest	12 06	9 75	10 05	11 55	14 55	14 55	14 55	16 05
Per acre for average amount used—								
Excluding interest	11 71	11 83	11 62	11 57	12 00	8 70	9 58	12 19
Including interest	14 71	14 83	15 62	16 57	18 00	15 70	17 58	21 19
Per acre-foot for average amount used—								
Excluding interest	8 67	6 43	6 05	6 32	7 64	7 31	6 39	6 59
Including interest	10 90	8 06	8 14	9 05	11 47	13 20	11 72	11 45

* Estimated.

TABLE 18

ANNUAL COST OF WATER TO IRRIGATORS, MONTE VISTA IRRIGATION COMPANY, ONTARIO, 1920-1929, INCLUSIVE

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	950	950	950	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Average lift in feet	----------	----------	250	----------	----------	----------	----------	----------	----------	280
Percentage of water pumped	----------	----------	100	----------	----------	----------	----------	----------	----------	100
Average duty of water, acre-feet per acre	*1.00	*1 00	1.09	·1.24	1.20	1.53	1.49	1.34	1.43	1.55
Average number of shares per acre	1	1	1	1	1	1	1	1	1	1
Value of stock per acre	$100 00	$100 00	$100 00	$100 00	$100 00	$100 00	$150 00	$200 00	$100 00	$100 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock per acre	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00	$6 00
Annual assessment per acre	5 00	6 00	6 00	5 00	3 00	6 00	6 00	None	None	None
Water rate, per hour-inch	018	018	018	018	018	018	018	018	018	018
Water rate, per acre-foot	10 89	10 89	10 89	10 89	10 89	10 89	10 89	10 89	10 89	10 89
Water charge per acre for average amount used	10 89	10 89	11 87	13 50	13 07	16 66	16 22	14 60	15 57	16 88
Amount of debt retired per acre	None	None	None	None	None	None	None	None	None	None
Permanent improvements, cost per acre	5 00	6 00	6 00	0 62	2 45	14 50	None	None	None	2 62
ANNUAL COST OF WATER—Deducting debt retirements:										
For use of one acre-foot only—										
Excluding interest	$15 89	$16 89	$16 89	$15 89	$13 89	$16 89	$16 89	$10 89	$10 89	$10 89
Including interest	21 89	22 89	22 89	21 89	19 89	22 89	22 89	16 89	16 89	16 89
Per acre for average amount used—										
Excluding interest	15 89	16 89	17 87	18 50	16 07	22 66	22 22	14 60	15 57	16 88
Including interest	21 89	22 89	23 87	24 50	22 07	28 66	28 22	20 60	21 57	22 88
Per acre-foot for average amount used—										
Excluding interest	15 89	16 89	16 39	14 92	13 38	14 80	14 91	10 89	10 89	10 89
Including interest	21 89	22 89	21 90	19 76	18 39	18 73	18 94	15 37	15 08	14 76
ANNUAL COST OF WATER—Deducting debt retirement and cost of permanent improvements:										
For use of one acre-foot only—										
Excluding interest	$10 89	$10 89	$10 89	$15 27	$11 44	$ 2 39	$16 89	$10 89	$10 89	$8 27
Including interest	16 89	16 89	16 89	21 27	17 44	8 39	22 89	16 89	16 89	14 26
Per acre for average amount used—										
Excluding interest	10 89	10 89	11 87	17 88	13 62	8 16	22 22	14 60	15 57	14 26
Including interest	16 89	16 89	17 87	23 88	19 62	14 16	28 22	20 60	21 57	20 26
Per acre-foot for average amount used—										
Excluding interest	10 89	10 89	10 89	14 42	11 35	5 33	14 91	10 89	10 89	9 20
Including interest	16 89	16 89	16 39	19 25	16 35	9 26	18 94	15 37	15 08	13 07

* Estimated.

TABLE 19

ANNUAL COST OF WATER TO IRRIGATORS, SOUTHSIDE IMPROVEMENT COMPANY, FILLMORE, 1925-1929, INCLUSIVE

	1925	1926	1927	1928	1929
Acreage irrigated	1,458	1,458	1,458	1,458	1,458
Average lift in feet	----------	----------	----------	----------	*40
Percentage of water pumped	----------	----------	----------	----------	100
Average duty of water, acre-feet per acre	2.52	1.97	1.63	2.12	2.01
Average number of shares per acre	2	2	2	2	2
Value of stock per acre	$60 00	$60 00	$60 00	$60 00	$60 00
FACTORS IN ANNUAL COST OF WATER:					
Interest on value of capital stock per acre	$3 60	$3 60	$3 60	$3 60	$3 60
Annual assessment, per acre	6 50	None	3 50	2 50	None
Water rate, per hour-inch	0041	0041	0041	0041	0041
Water rate, per acre-foot	2 50	2 50	2 50	2 50	2 50
Water charge per acre for average amount used	6 30	4 93	4 08	5 30	5 03
Amount of debt retired per acre	None	None	None	None	None
Permanent improvements, cost per acre	6 22	0 31	2 46	None	0 64
ANNUAL COST OF WATER—Deducting debt retirements:					
For use of one acre-foot only—					
Excluding interest	$9 00	$2 50	$6 00	$5 00	$2 50
Including interest	12 60	6 10	9 60	8 60	6 10
Per acre for average amount used—					
Excluding interest	12 80	4 92	7 58	7 80	5 03
Including interest	16 40	8 52	11 18	11 40	8 63
Per acre-foot for average amount used—					
Excluding interest	5 08	2 50	4 65	3 68	2 50
Including interest	6 50	4 33	6 86	5 38	4 24
ANNUAL COST OF WATER—Deducting debt retirements and cost of permanent improvements:					
For use of one acre-foot only—					
Excluding interest	$2 78	$2 19	$3 54	$5 00	$1 86
Including interest	6 38	5 79	7 14	8 60	5 46
Per acre for average amount used—					
Excluding interest	6 58	4 61	5 12	7 80	4 39
Including interest	10 18	8 21	8 72	11 40	7 99
Per acre-foot for average amount used—					
Excluding interest	2 61	2 34	3 14	3 68	2 18
Including interest	4 04	4 17	5 35	5 38	3 98

* Est mated.

TABLE 20

ANNUAL COST OF WATER TO IRRIGATORS, WHITTIER EXTENSION MUTUAL WATER COMPANY, NORTH WHITTIER, 1920-1929, INCLUSIVE

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Acreage irrigated	2,000	2,000	2,000	----------	----------	----------	2,050	----------	----------	2,100
Average lift in feet	----------	----------	178-418	----------	----------	----------	----------	----------	----------	178-418
Percentage of water pumped	100	100	100	100	100	100	100	100	100	100
Average duty of water, acre-feet per acre	*1.00	*1.00	77	.96	1.02	1.29	1.11	.87	.97	1.10
Average number of shares per acre	1	1	1	1	1	1	1	1	1	1
Value of stock per acre	$200 00	$200 00	$200 00	$200 00	$200 00	$200 00	$200 00	$200 00	$200 00	$200 00
FACTORS IN ANNUAL COST OF WATER:										
Interest on value of capital stock, per acre	$12 00	$12 00	$12 00	$12 00	$12 00	$12 00	$12 00	$12 00	$12 00	$12 00
Annual assessment, per acre	None	7 50	None	6 50	6 50	2 50	3 00	9 00	5 00	10 00
Water rate, per hour-inch	0325	0325	0325	0325	025	025	025	025	025	025
Water rate, per acre-foot	19 66	19 66	19 66	19 66	15 12	15 12	15 12	15 12	15 12	15 12
Water charge per acre for average amount used	19 66	19 66	15 14	18 87	15 42	19 50	16 78	13 15	14 67	16 63
Amount of debt retired per acre	None	None	None	None	None	None	None	None	None	None
ANNUAL COST OF WATER:										
For use of one acre-foot only—										
Excluding interest	$19 66	$27 16	$19 66	$26 16	$21 62	$17 62	$18 12	$24 12	$20 12	$25 12
Including interest	31 66	39 16	31 66	38 16	33 62	29 62	30 12	36 12	32 12	37 12
Per acre for average amount used—										
Excluding interest	19 66	27 16	15 14	25 37	21 92	22 00	19 78	22 15	19 67	26 63
Including interest	31 66	39 16	27 14	37 37	33 92	34 00	31 78	34 15	31 67	38 63
Per acre-foot for average amount used—										
Excluding interest	19 66	27 16	19 66	26 43	21 50	17 05	17 82	25 46	20 28	24 21
Including interest	31 66	39 16	35 25	38 93	33 26	26 36	28 63	39 25	32 65	35 12

* Estimated.

Rainfall Variation.

Plate IX shows the monthly rainfall at Riverside, Santa Ana, Los Angeles, and Upland for the years 1917 to 1929, inclusive. This is presented in order to bring out more clearly the influence of the rainfall upon the underground water table, and therefore upon the required amount and cost of pumping supplemental water supplies in southern California, years of heavy rainfall being years of low pumping costs as indicated on Plates I to VIII. The cost of pumping stands out as the salient factor affecting the trends of cost under these companies during the past decade.

Cost of Production of Oranges, Orange County.

Tables 21 and 22 are presented to show the comparison between cost of irrigation water and total production cost on oranges. These tables, in which average labor and material costs in Orange County orange production are presented for the four years ending with 1929, are taken directly from the mimeographed "Summary of Cost of Production Study on Oranges, Orange County, 1929," compiled by the Agricultural Extension Service, University of California, cooperating with the Citrus Growers Department, Orange County Farm Bureau, under the direction of Harold E. Wahlberg, Farm Advisor of Orange County. The introduction to the "Summary" states: "The average total referred to in the various tables is obtained by dividing the total costs of each group by the total acreage of that group. It does not represent the actual sum of the column."

TABLE 21

ORANGE COUNTY ORANGE PRODUCTION STUDY

Comparison of Average Labor Costs per Acre, 1926-1929[1]

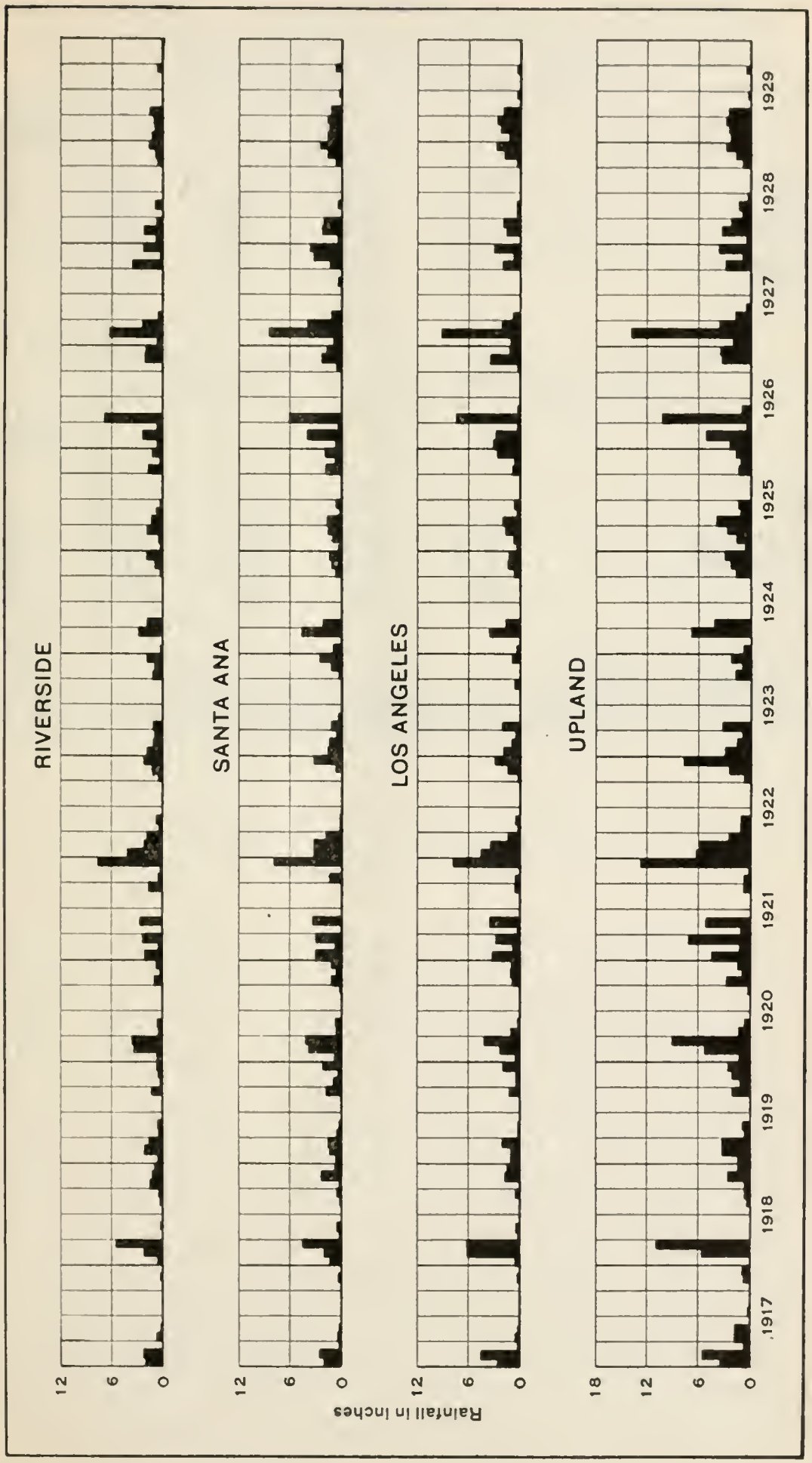
	1926	1927	1928	1929	Average, 4 years
Irrigation	$15 55	$12 20	$17 54	$13 67	$14 74
Fertilizer	4 66	5 53	5 25	5 24	5 17
Cover crops	1 11	1 94	2 35	2 48	1 97
Fumigation	8 90	16 47	12 40	13 46	12 81
Spraying	9 38	10 32	9 67	11 53	10 22
Disease control	2 73	3 04	5 33	3 88	3 74
Frost protection	----------	6 37	4 58	6 53	5 83
Windbreaks	----------	1 54	0 76	1 53	1 28
Pruning	4 34	10 41	9 08	12 87	9 17
Cultivation	21 88	16 11	20 71	16 83	18 88
Picking and hauling	32 04	39 87	23 15	45 63	35 17
Miscellaneous	2 86	4 05	2 74	2 33	2 99
Total	$84 88	$98 22	$93 40	$111 15	$96 91

It will be noted that the labor costs from year to year are generally constant, except for the harvesting charges that vary, of course, with the size of the crop.

The average labor costs per acre for the four years is $96.91. This includes the owner's labor at going wages, where he did the work himself.

[1] From "Summary of Cost of Production Study on Oranges, Orange County, 1929," compiled by the Agricultural Extension Service, University of California, cooperating with the Citrus Growers Department, Orange County Farm Bureau, under the direction of Harold E. Wahlberg, Farm Advisor of Orange County.

PLATE IX



MONTHLY RAINFALL AT SEVERAL STATIONS IN SOUTHERN CALIFORNIA, 1917–1929, INCLUSIVE.

TABLE 22

ORANGE COUNTY ORANGE PRODUCTION STUDY

Comparison of Material Costs per Acre, 1926-1929[1]

	1926	1927	1928	1929	Average, 4 years
Water	$16 68	$12 73	$11 18	$13 70	$13 57
Fertilizer	49 14	63 48	62 94	59 95	58 88
Cover crop	1 67	3 89	2 62	2 75	2 73
Fumigation	13 17	19 98	12 76	13 94	14 96
Spraying	12 16	15 74	11 15	16 14	13 79
Disease control	0 17	0 32	1 12	1 39	0 75
Frost protection		2 41	3 76	11 09	5 75
Miscellaneous	4 60	2 39	3 15	1 55	2 92
Total material	$73 89	$88 04	$96 61	$92 51	$87 76

Comparison of Overhead Costs Per Acre, 1926, 1927, 1928, 1929

	1926	1927	1928	1929	Average, 4 years
General expense	$7 95	$9 31	$9 47	$10 18	$9 23
Taxes	24 02	30 97	31 26	29 85	29 02
Total cash overhead	$31 97	$40 28	$40 73	$41 09	$38 52
Total all cash costs	190 74	226 54	230 74	244 75	223 19
Total computed overhead	183 80	170 55	177 55	167 67	174 89
Total all costs	$374 54	$397 09	$408 29	$412 42	$398 08

The cost of water and the amount used per acre was on the decline until 1929, when rainfall was below normal and the water table was appreciably lower.

The increased use of sprays for citrus during the first four years is reflected in this study.

[1] From "Summary of Cost of Production Study on Oranges, Orange County, 1929," compiled by the Agricultural Extension Service, University of California, cooperating with the Citrus Growers Department, Orange County Farm Bureau, under the direction of Harold E. Wahlberg, Farm Advisor of Orange County.

COST OF WATER IN CENTRAL AND NORTHERN CALIFORNIA*

Mutual water companies in central and northern California are operating under a wide range of conditions, which makes it very difficult to present comparable information in tabular form. In central California the conditions are more varied than in northern California. Some companies receive only very short runs of water during the peak of the flood flow in the spring and early summer, the stockholders depending upon pumping from private wells for most of their supply. A number of the companies in central California with inadequate water supplies were omitted from the study.

Central California.

The First and Second Edison Well companies are the farthest south of the systems considered. These two companies were organized in 1909 to furnish water to a subdivision of land about six miles east of Bakersfield. The water supply is obtained from deep wells. Due to the recession of the water table and quality of water obtained from some of the more shallow wells, it has been necessary to drill some new and deeper wells, three of which range from 987 to 1336 feet in depth. The pumping lifts range at present from about 185 to 365 feet. The supply is ample for the acreage now irrigated. The water is delivered to the high point on each 20 acres and distributed through a concrete pipe system.

Revenue for operation and maintenance is obtained from water charges. All capital expenditures are met by assessments on the stock. The paid up capital investment per acre on January 1, 1930, was approximately $112 for the First Edison Well Company and $200 for the Second Edison Well Company. The annual cost of water under these companies is higher than under any of the other mutual water companies in central and northern California, but is comparable with some of the other pumping installations in the foothill citrus belt of San Joaquin Valley.

Kaweah River Companies.—The mutual water companies diverting from the Kaweah River are entirely different in character. In these companies a share of stock is not appurtenant to the land and does not represent any definite area, but only a pro rata share of the water available. The water is diverted according to a schedule which recognizes priority of rights. Water is available to most of the companies only during the spring and early summer. The letters indicating the character of water supply in Table 23, column 6, refer more particularly to length of time water is available than to amount of water received.

The water supply in practically every case is supplemented by pumping from private wells. Before pumping became a common practice, a high water table existed over a large part of the delta and in many places very few or no surface applications were made. This resulted in the selling of all or part of their stock in the ditch companies by many of the stockholders. The series of years of low run-off during the last decade has resulted in a considerable lowering of the water level and an increased draft on the ground water supply. Available

* This discussion was prepared by J. E. Christiansen, junior irrigation engineer, University of California Agricultural Experiment Station.

data on the extent of private pumping on areas served by the mutual water companies show increases between the years 1924 and 1928 of 106 per cent in the number of electric-driven plants and of 140 per cent in the amount of power used. The annual power cost in 1928 was more than $100,000 for these plants.

This lowering of the water table has resulted in an increased use of water, where it is available, and also in a much greater seepage loss from the ditches and creeks used to distribute the water. This condition is illustrated by the experience of the Elk Bayou Ditch Company, which receives water from the Consolidated Peoples Ditch Company through Outside Creek. Formerly this creek was a flowing stream at its lower end throughout the entire year, regardless of whether or not water was entering its head. During the irrigation seasons of 1928 and 1929 the Elk Bayou Ditch Company received practically no water, although a considerable amount was turned in at the head of the creek, most of it being lost by seepage.

With the exception of the Consolidated Peoples Ditch Company, the mutual water companies diverting from Kaweah River deliver water directly to the individual stockholders. The Consolidated Peoples Ditch Company delivers only to the head of six independent laterals, two of which again distribute water to a group of sublaterals. Many of these laterals and sublaterals are organized into mutual water companies, only two of which own stock in the Consolidated Peoples Ditch Company. In all of the other cases the stock is owned directly by the individual served. The cost data given in Tables 23 and 24 do not include the costs of operating any of the independent lateral companies.

Kings River Companies.—The three companies diverting water from Kings River are similar in many respects to the Consolidated Peoples Ditch Company. They do not deliver water directly to all of the stockholders. Six independent mutual water companies and the Corcoran Irrigation District distribute water from the Peoples Ditch. Only two of these companies, the Settlers Ditch Company and Melga Canal Company, own stock in the Peoples Ditch Company. Some of the stock in the Settlers Ditch Company is owned in turn by the Melga Canal Company, the Corcoran Irrigation District, and users on other laterals. Holders of about 30 shares of stock in the Peoples Ditch Company obtain water directly from the main canal or from branches of the Peoples Ditch system.

There are seven independent mutual water companies distributing water from the Last Chance Ditch. None of these companies own stock in the Last Chance Water Ditch Company, all of the stock being owned directly by the water users served. The parent company delivers water directly from its main canal to owners of about twelve shares of stock.

The Lemoore Canal and Irrigation Company distributes water directly to the owners of nearly one-half of its stock. Some of the stock is owned by a contract company serving a gross area of 9668 acres, and by the Jacob Rancho Water Company, which serves about 11,000 acres. One large ranch company owns about 23 per cent of the stock and operates its own distributing system.

It is a general practice under all three main companies for stockholders to rent their surplus stock. During the time when the ground water level was near enough to the ground surface to subirrigate, it was often possible for a stockholder to rent or sell all of his stock and still produce good crops. During the past few years there has been a demand for stock in the Peoples Ditch Company or Settlers Ditch Company by the Corcoran Irrigation District. This, together with a series of dry years, has resulted in a considerable increase in the value of the stock in all of the companies. The low run-off also has resulted in a large increase in private pumping and some lowering of the ground water level.

San Joaquin River Companies.—Other companies in central California, diverting from San Joaquin River, have a more uniformly distributed water supply. Private pumping from wells is not necessary. The stock in these companies is appurtenant to the land and does not have a market value. The amounts given for capital investment per acre in Table 23, column 14, however, are not comparable for these companies. An appraisal of the sytem made several years ago was used in two cases, and original investment and present selling price of the stock was used for two others. Tables 23 and 24 show the annual cost of water to irrigators under most of the important mutual water companies in central California.

Northern California.

The conditions under which mutual water companies are operating in northern California are more uniform. Most of the companies receive their water supply from the Sacramento and Feather rivers, the diversions, with one exception, being made by pumping. Most of these companies were organized by land companies and the stock was made appurtenant to the land. When the land is sold one share of stock is issued for each acre. In several cases the land companies still hold a large part of the stock. No attempt was made to estimate depreciation on pumping plants, which would undoubtedly represent a considerable portion of the cost in some cases. The pumping lifts, in general, vary throughout a wide range, but for the larger part of the irrigation season they are near the maximum. The data given in Table 25, column 8, represent the approximate average lifts throughout the season.

The annual cost of water to irrigators under most of the important mutual water companies in northern California is shown in Tables 25 and 26. In addition to the cost, other pertinent information is given in these tables.

Cost of Irrigation Water for Rice.

Table 27 shows the annual cost of irrigation water for rice in central and northern California. The last two companies for which data are given in the table are public utilities.

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44 46 48

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TABLE 23

COST OF WATER TO IRRIGATORS FOR GENERAL CROPS, MUTUAL WATER COMPANIES, CENTRAL CALIFORNIA, AVERAGES FOR YEARS 1925-1929, INCLUSIVE

Compiled from data furnished by the individual mutual water companies

Name of company	Location	County or counties	Year organized	Source of water supply	Character of water supply*	Approximate percentage of water pumped	Approximate average lift, feet	Approximate gross area covered by stock, acres	Capital stock: Number of shares of stock outstanding	Capital stock: Usual number of acres, per share	Capital stock: Approximate market value of stock: Per share	Capital stock: Approximate market value of stock: Per acre	Approximate capital investment, per acre	Approximate average area irrigated annually	Approximate average annual amount of water, in acre-feet, per acre: Delivered	Approximate average annual amount of water, in acre-feet, per acre: Diverted	Factors in the annual cost of water: Average annual assessment, per acre	Factors in the annual cost of water: Average water charges: Per acre-foot	Factors in the annual cost of water: Average water charges: Per acre for average amount used	Factors in the annual cost of water: Interest at 6 per cent: Approximate market value of capital stock, per acre	Factors in the annual cost of water: Interest at 6 per cent: Approximate capital investment, per acre	Average annual cost of water with and without interest on capital stock or capital investment: Per acre: Without interest	Per acre: With interest	Per acre-foot: Without interest	Per acre-foot: With interest
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
Columbia Canal Company	Los Banos	Madera	1926	San Joaquin River	A	0	0	16,990	16,990	1	0	0			*2 2		[1]$1 00				$0 30	$1 00		$0 45	
Consolidated Peoples Ditch Company	Farmersville	Tulare	1874	Kaweah River	B	0	0	15,500	9,322	1 67	$35 00	$21 00				*4 0	0 48			$1 26		0 48	$1 74		
Evans Ditch Company	Visalia	Tulare	1854	Kaweah River	C	0	0	2,500	932	2 5	50 00	20 00				*2 8	1 64			1 20		1 64	2 84		
Farmers Ditch Company	Tulare	Tulare	1876	Kaweah River	D	0	0	8,000	199 25	40	400 00	10 00				*2 7	0 42			0 60		0 42	1 02		
Firebaugh Canal Company	Fresno	Fresno	1914	San Joaquin River	A	100	14-42	23,475	23,475	1	0	0	$32 50		*3 0	*2 6	3 80				1 95	3 80	5 75	1 90	$2 87
First Edison Well Company	Edison	Kern	1909	Five deep wells	A	100	182-250	394	394 46	1	0	0	*105 00	410	2 7	2 7	*1 67	$6 23	$16 80		6 30	*16 80	*23 10	6 23	8 55
Freemont Irrigation Association	Tracy	San Joaquin	1920	San Joaquin River	A	100	14	800	800	1	0	0		600	*2 0	2 5	*3 00					3 00		1 95	
Jacob Rancho Water Company	Lemoore	Kings	1908	Lemoore Canal and Last Chance Ditch[b]	C	0	0	11,013	11,013 5	1	*5 87	5 87					0 68			0 35		0 68	1 03		
Jennings Ditch Company	Visalia	Tulare	1900	Kaweah River[c]	C	0	0	800	80	10	100 00	10 00				4 8	3 30			0 80		3 30	3 90		
Last Chance Water Ditch Company	Hanford	Kings	1873	Kings River	C	0	0	29,000	45	640	5,000 00	7 60				*2 0	0 52			0 47		0 52	1 00		
Lemoore Canal and Irrigation Company	Lemoore	Kings	1873	Kings River	B	0	0	52,300	53	640	7,500 00	11 70				*2 5	[2]0 75			0 70		0 60	1 30		
Mathews Ditch Company	Visalia	Tulare	[a]	Kaweah River[c]	C	0	0	1,159	768	1 5	10 00	6 67				*4 1	1 17			0 40		1 17	1 57		
Melga Canal Company	Guernsey	Kings	1913	Peoples Ditch, Settlers Ditch and Lakeside Ditch[3]	C	0	0	7,993	7,997	1	0	0	13 30				1 25		0 80			1 25	2 05		
Modoc Ditch Company	Visalia	Tulare	1891	Kaweah River[c]	D	0	0	4,000	100	40	500 00	12 50				*2 8	0 75			0 75		0 75	1 50		
Oakes Ditch Company	Visalia	Tulare	1901	Kaweah River	C	0	0	1,000	34	30	200 00	6 67				*2 3	0 67			0 40		0 67	1 07		
Patterson Water Company	Patterson	Stanislaus	1910	San Joaquin River	A	100	28-84	14,500	14,500	1	0	0	13 80	14,000	2 0	2 7	7 00	*3 50	0		0 83	7 00	7 83	3 50	3 02
Peoples Ditch Company	Hanford	Kings	1873	Kings River	B	0	0	*44,000	63 27	640	10,000 00	15 60				*3 0	0 81			0 94		0 81	1 75		
Persian Ditch Company	Visalia	Tulare	[a]	Kaweah River	C	0	0	3,000	14,673	25	2 00	8 00				*2 2	0 96			0 48		0 96	1 44		
Poso Canal Company[e]	Los Banos	Fresno and Merced	1926	San Joaquin River[e]	A	0	0	50,248	50,248	1	0	0			*2 6		[4]1 02		*1 25			*2 87		*1 10	
																			*1 75			*3 37		*1 30	
San Luis Canal Company	Los Banos	Merced	1913	San Joaquin River	A	0	0	47,638	47,538	1	0	0			*2 2		[5]1 75				0 27	1 75		0 80	
Settlers Ditch Company	Hanford	Kings	1888	Peoples Ditch[e]	B	0	0	*5,300	34	320	5,000	15 60				*3 3	1 08			0 94		1 08	2 02		
Second Edison Well Company	Edison	Kern	1909	Four deep wells	A	100	225-305	276	276 81	1	0	0	*170 00	300	3 0	3 0	*12 00	10 71	32 13		10 20	*32 13	*42 33	10 71	14 11
Uphill Ditch Company	Visalia	Tulare	1901	Kaweah River[c]	D	0	0	1,000	700	2 7	25 00	9 25				*2 9	0 80			0 55		0 80	1 44		
Watson Ditch Company	Visalia	Tulare		Kaweah River[c]	B	0	0	2,000	585	5	100 00	20 00				*2 2	1 32			1 20		1 32	2 52		

* Estimated.

[a] Character of water supply indicated by the following letters A—Usually ample throughout season B, C, D—Degrees of deficiency during latter part of season. Gravity supply with no storage. Supplemented by private pumping from wells. B indicates an insufficient but better water supply than C, and C a better supply than D.

[b] Years 1928 and 1929 only

[c] Based on total number of shares of stock in company and usual number of shares per acre.

[d] Average capital investment during five-year period.

[e] Assessments levied for new construction only This figure not included in annual cost of water.

[f] Does not include any allowance for depreciation of pumping plants.

[g] Average for years 1927 to 1929, inclusive

[h] Jacob Rancho Water Company owns 8,347 shares of stock in Lemoore Canal and Irrigation Company, and 7 16 of a share of stock in Last Chance Water Ditch Company.

[i] Based upon approximate flow of water in Lemoore Canal and Irrigation Company and Last Chance Water Ditch Company Diversion from St Johns River Branch of Kaweah River

[j] Includes fifteen cents per acre chargeable to capital account and not included in annual cost of water.

[1] Melga Canal Company owns stock in the following ditch companies. Peoples Ditch Company, 6,705 shares, Settlers Ditch Company. 5,516 shares and Lakeside Ditch Company, 1,797.2 shares. Lakeside ditch diverts from St. Johns Branch of Kaweah River.

[2] For water used in excess of two acre-feet per acre

[3] Exclusive of Corcoran Irrigation District.

[4] Water rights held by San Joaquin and Kings River Canal and Irrigation Company, Poso Canal Company pays the rates of the serving public utility company and has been included under that company in Table 4

[5] Water charge of San Joaquin and Kings River Canal and Irrigation Company. Fresno County, $1.25, Merced County, $1 75. Rates in effect in 1930 uniform for all counties: rice, $7.50 per acre per season, general crops, $2.75, winter irrigation of grain and pasture, $1 50; or measured rate of $1 15 per acre-foot.

[6] Settlers Ditch Company owns 16 083 shares of stock in Peoples Ditch Company Some of the stock in Settlers Ditch Company is owned by Corcoran Ditch Company and the water users under Riverside Ditch.

[7] Area covered by stock in Settlers Ditch Company owned by users obtaining water direct from Settlers Ditch exclusive of Corcoran Irrigation District, Melga Canal Company, etc.

[8] Fresno County.

[9] Merced County

ALIFORNIA, 1929

annual cost of water				Average annual cost of water with and without interest on capital stock or capital investment			
;es		Interest at 6 per cent on					
		Approximate market value of capital stock, per acre	Approximate capital investment per acre	Per acre		Per acre-foot	
	Per acre for average amount used			Without interest	With interest	Without interest	With interest
	(9)	(10)	(11)	(12)	(13)	(14)	(15)
--	----------	----------	$0 30	$1 00	$1 30	$0 45	$0 59
--	----------	$1 26	----------	0 51	1 77	----------	----------
--	----------	1 20	----------	1 20	2 40	----------	----------
--	----------	0 60	----------	0 12	0 72	----------	----------
--	----------	----------	1 95	4 00	5 95	2 00	2 98
l	$19 53	----------	6 80	[e]19 53	[e]26 33	[e]6 51	[e]8 78
--	----------	----------	----------	3 55	----------	1 61	----------
--	----------	----------	0 35	0 80	1 15	----------	----------
--	----------	0 60	----------	2 05	2 65	----------	----------
--	----------	0 47	----------	0 62	1 09	----------	----------
-	----------	0 70	----------	0 79	1 49	----------	----------
-	----------	0 40	----------	0 83	1 23	----------	----------
-	----------	----------	0 80	1 00	1 80	----------	----------
-	----------	0 75	----------	0 75	1 50	----------	----------
-	----------	0 40	----------	0 83	1 23	----------	----------
)	----------	----------	0 83	7 00	7 83	3 50	3 92
-	----------	0 94	----------	0 90	1 84	----------	----------
-	----------	0 48	----------	0 80	1 28	----------	----------
-	[j]1 25	----------	----------	[j]2 75	[j]2 75	[j]1 06	[j]1 06
-	[k]1 75	----------	----------	[k]3 25	[k]3 25	[k]1 25	[k]1 25
-	----------	----------	0 27	1 75	2 02	0 80	0 92
	37 48	----------	12 00	[e]37 48	[e]49 48	[e]10 71	[e]14 14
-	----------	0 94	----------	1 20	2 14	----------	----------
-	----------	0 55	----------	0 74	1 29	----------	----------
-	----------	1 20	----------	1 30	2 50	----------	----------

ALIFORNIA, 1929

annual cost of water				Average annual cost of water with and without interest on capital stock or capital investment			
;es		Interest at 6 per cent on		Per acre		Per acre-foot	
	Per acre for average amount used	Approximate market value of capital stock, per acre	Approximate capital investment per acre	Without interest	With interest	Without interest	With interest
	(9)	(10)	(11)	(12)	(13)	(14)	(15)
--	----------	----------	$0 30	$1 00	$1 30	$0 45	$0 59
--	----------	$1 26	----------	0 51	1 77	----------	----------
--	----------	1 20	----------	1 20	2 40	----------	----------
--	----------	0 60	----------	0 12	0 72	----------	----------
--	----------	----------	1 95	4 00	5 95	2 00	2 98
l	$19 53	----------	6 80	[e]19 53	[e]26 33	[e]6 51	[e]8 78
--	----------	----------	----------	3 55	----------	1 61	----------
--	----------	----------	0 35	0 80	1 15	----------	----------
--	----------	0 60	----------	2 05	2 65	----------	----------
--	----------	0 47	----------	0 62	1 09	----------	----------
--	----------	0 70	----------	0 79	1 49	----------	----------
-	----------	0 40	----------	0 83	1 23	----------	----------
-	----------	----------	0 80	1 00	1 80	----------	----------
-	----------	0 75	----------	0 75	1 50	----------	----------
-	----------	0 40	----------	0 83	1 23	----------	----------
)	----------	----------	0 83	7 00	7 83	3 50	3 92
-	----------	0 94	----------	0 90	1 84	----------	----------
-	----------	0 48	----------	0 80	1 28	----------	----------
-	[j]1 25	----------	----------	[j]2 75	[j]2 75	[j]1 06	[j]1 06
-	[k]1 75	----------	----------	[k]3 25	[k]3 25	[k]1 25	[k]1 25
-	----------	----------	0 27	1 75	2 02	0 80	0 92
	37 48	----------	12 00	[e]37 48	[e]49 48	[e]10 71	[e]14 14
-	----------	0 94	----------	1 20	2 14	----------	----------
-	----------	0 55	----------	0 74	1 29	----------	----------
-	----------	1 20	----------	1 30	2 50	----------	----------

TABLE 24

COST OF WATER TO IRRIGATORS FOR GENERAL CROPS, MUTUAL WATER COMPANIES, CENTRAL CALIFORNIA, 1929

Compiled from data furnished by the individual mutual water companies

Name of company	Area irrigated, 1929		Approximate average amount of water in acre-feet per acre		Factors in the annual cost of water						Average annual cost of water with and without interest on capital stock or capital investment			
						Water charges			Interest at 6 per cent on		Per acre		Per acre-foot	
	Total area irrigated, acres	Crops, with acreages if available	Delivered	Diverted	Assessment for 1929, per acre	Rate schedule	Per acre-foot	Per acre for average amount used	Approximate market value of capital stock, per acre	Approximate capital investment per acre	Without interest	With interest	Without interest	With interest
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Columbia Canal Company	[a]9,707	[a]Grain, 4,627; pasture, 2,991; cotton, 1,935; alfalfa, 281; other, 73	*2.2		$1 00	None				$0 30	$1 00	$1 30	$0 45	$0 59
Consolidated Peoples Ditch Company		Deciduous trees, vines, alfalfa, cotton, corn		[b]3 3	0 51	None			$1 26		0 51	1 77		
Evans Ditch Company		Vines, deciduous trees, alfalfa, cotton		[b]2 4	1 20	None			1 20		1 20	2 40		
Farmers Ditch Company		Alfalfa, deciduous trees, cotton, vines		[b]1 5	0 12	None			0 60		0 12	0 72		
Firebaugh Canal Company	18,354	Cotton, 13,743; grain, 4,085; alfalfa, 304; vines, 162; beans, 60	*2.0		4 00	None				1 95	4 00	5 95	2 00	2 98
First Edison Well Company	412	Citrus, 306; olives, 86; grapes, 20	3.0	3 0	[c]5 40	([d])	$6 51	$19 53		6 80	[e]19 53	[e]26 33	[e]6 51	[e]8 78
Freemont Irrigation Association	649	Alfalfa and grain	*2.2	2 8	3 55	None					3 55		1 61	
Jacob Rancho Water Company		Alfalfa, grain, field crops			0 80	None				0 35	0 80	1 15		
Jennings Ditch Company		Alfalfa, deciduous trees, vines		[b]4 1	2 05	None			0 60		2 05	2 65		
Last Chance Water Ditch Company		Vines, deciduous trees, grain, alfalfa		[b]1 3	0 62	None			0 47		0 62	1 09		
Lemoore Canal and Irrigation Company		Alfalfa, grain, deciduous trees, vines		[b]1 7	[f]0 94	None			0 70		0 79	1 49		
Mathews Ditch Company		Alfalfa, deciduous trees, corn, grain		[b]3 5	0 83	None			0 40		0 83	1 23		
Melga Canal Company		Alfalfa, cotton, grain, corn			1 00	None				0 80	1 00	1 80		
Modoc Ditch Company		Alfalfa, deciduous trees, vines, corn		[b]2 2	0 75	None			0 75		0 75	1 50		
Oakes Ditch Company		Deciduous trees, alfalfa, vines, corn		[b]1 9	0 83	None			0 40		0 83	1 23		
Patterson Water Company	14,000	Alfalfa, 12,250; deciduous trees, 1,000; vines, 500; cotton, 100; rice, 100; truck, 50	2.0	2 6	7 00	([g])	3 50			0 83	7 00	7 83	3 50	3 92
Peoples Ditch Company		Vines, deciduous trees, alfalfa, grain, field crops		[b]2 5	0 90	None			0 94		0 90	1 84		
Persian Ditch Company		Alfalfa, deciduous trees, cotton, corn		[b]1 2	0 80	None			0 48		0 80	1 28		
Poso Canal Company[h]	[a]20,114	[a]Rice, 4,297; grain, 4,227; cotton, 4,129; pasture, 6,160; alfalfa, 1,168; deciduous trees and garden, 133	*2 6		1 50	[b]1 25 [b]1 75		[j]1 25 [k]1 75			[j]2 75 [k]3 25	[j]2 75 [k]3 25	[j]1 06 [k]1 25	[j]1 06 [k]1 25
San Luis Canal Company	[a]22,078	[a]Grain, 6,871; pasture, 5,550; cotton, 5,312; alfalfa, 3,586; other, 760	*2.2		1 75	None				0 27	1 75	2 02	0 80	0 92
Second Edison Well Company	300	Citrus	3.5	3 5	[c]22 60	([i])	10 71	37 48		12 00	[e]37 48	[e]49 48	[e]10 71	[e]14 14
Settlers Ditch Company		Alfalfa, deciduous trees, vines, pasture		[b]2 3	1 20	None			0 94		1 20	2 14		
Uphill Ditch Company		Alfalfa, deciduous trees, vines, corn		[b]2 4	0 74	None			0 55		0 74	1 29		
Watson Ditch Company		Alfalfa, deciduous trees, cotton, corn, vines		[b]2 0	1 30	None			1 20		1 30	2 50		

*Estimated.
[a] Year 1930.
[b] Based on total number of shares of stock in company and usual number of shares per acre.
[c] Assessments levied for new construction only. This figure not included in annual cost of water.
[d] $15.50 per 1440 hour-inches. Inch equals one-fiftieth cubic foot per second.
[e] Does not include any allowance for depreciation of pumping plants.
[f] Includes 15 cents per acre chargeable to capital account and not included in annual cost of water.
[g] For water in excess of two acre-feet per acre. Excess water $3.50 per acre-foot.
[h] Poso Canal Company is served by the San Joaquin and Kings River Canal and Irrigation Company, pays the rates of that company and has been included with that company in Table 4. The water charges of the serving public utility company were $1.25 and $1.75 per acre in Fresno and Merced counties, respectively. Rates in effect in 1930 were uniform for all counties: rice, $7.50 per acre per season; general crops, $2 75; winter irrigation of grain and pasture, $1.50; or a measured rate of $1.15 per acre-foot.
[i] Rate $25.50 per 1440 hour-inches. Inch equals one-fiftieth cubic foot per second.
[j] Fresno County.
[k] Merced County.

ctors in annual cost of water			Aver: witho
Average water charges		Interest at 6 per cent on approximate capital investment, per acre	Per
Per acre-foot	Per acre for average amount used		Without interest
(15)	(16)	(17)	(18)
----------	$4 08	$2 04	$4 78
[c]$1 72	3 78	0 60	3 78
----------	[a]1 60	2 70	1 66
3 00	3 60	----------	4 90
0	0	----------	3 76
0	0	0 60	3 00
0	0	0 60	1 80
0 97	2 13	2 70	3 19
1 95	3 32	1 38	4 33
3 20	4 80	----------	5 26
4 00	6 00	----------	7 00
----------	[k]5 80	1 20	6 16
----------	4 20	1 80	4 20
[c]1 54	5 70	0 60	5 70
0	0	----------	0 80
0 95	1 61	3 12	2 56
[c]1 31	1 84	3 00	5 94
1 00	2 20	1 80	2 20
[p]0 10-0 60	0 12	1 69	1 85

l cost of water				Average annual cost of water with and without interest on capital investment			
harges			Interest at 6 per cent on approximate capital investment, per acre	Per acre		Per acre-foot	
	Per acre-foot	Per acre for average amount used		Without interest	With interest	Without interest	With interest
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
lieia M		$4 86	$2 04	$5 51	$7 55		
olusa I	$1 87	4 45	0 60	4 45	5 05	[a]$1 87	[a]$2 10
urham		1 72	2 70	1 72	4 42	0 86	2 21
lkhorn	3 00	3 60		5 10		4 25	
eather	0	0	0 60	3 15	3 75	[a]1 37	[a]1 63
arden I	0	0	0 60	3 75	4 35	[a]1 39	[a]1 61
allwoo	0	0	0 60	1 50	2 10		
oam Ri	2 30	3 68	1 38	3 68	5 06	2 30	3 16
atomas	3 00	4 50		5 00		3 33	
atomas	4 00	6 00		7 00		4 67	
rangeva		[b]6 00	1 20	[c]6 20	[c]7 40		
lumas		4 20	1 80	4 20	6 00		
oberts	2 15	6 45	0 60	6 45	7 05	[a]2 15	[a]2 35
anford	0	0		1 00		0 20	
utter M							
winford	0 75	1 42	3 12	2 17	5 29	1 14	2 78
estern	1 21	2 67	3 00	7 17	10 17	[a]3 26	[a]4 62
rland P	1 00	2 00	1 80	2 00	3 80	1 17	2 24
ot	[f]0.10-0.60	0 05	2 19	1 75	3 94	0 62	1 41

[a] Esti
[a] Pe
[b] Est
[c] Ine
[d] On
[e] Do
[f] Ch

TABLE 25

COST OF WATER TO IRRIGATORS FOR GENERAL CROPS, MUTUAL WATER COMPANIES, NORTHERN CALIFORNIA, AVERAGES FOR YEARS 1925-1929, INCLUSIVE

Compiled from data furnished by the individual mutual water companies

Name of company	Location	County or counties	Year organized	Source of water supply	Character of water supply[a]	Approximate percentage of water pumped	Approximate average lift, feet	Gross area covered by stock, acres	Approximate capital investment, per acre	Approximate average area irrigated annually	Approximate average annual amount of water in acre-feet per acre		Factors in annual cost of water				Average annual cost of water with and without interest on capital investment			
														Average water charges			Per acre		Per acre-foot	
											Delivered	Diverted	Average annual assessment, per acre	Per acre-foot	Per acre for average amount used	Interest at 6 per cent on approximate capital investment, per acre	Without interest	With interest	Without interest	With interest
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Alicia Mutual Water Company	Marysville	Yuba	1917	Feather River	A	100	18	3,757	[b]$34 00	[c]1,380			$0 70		$4 08	$2 04	$4 78	$6 82		
Colusa Irrigation Company	Colusa	Colusa		Sacramento River	A	100	23	2,000	[d]10 00	760		2 2	0	[e]$1 72	3 78	0 60	3 78	4 38	[e]$1 72	$2 00
Durham State Land Settlement Water Users Association	Durham	Butte	1918	Butte Creek	A	0	0	3,600	[b]45 00	[a]2,750	2 0		0 06		[a]1 60	2 70	1 66	4 36	0 83	2 18
Elkhorn Mutual Water Company	Sacramento	Sacramento	1918	Sacramento River	A	100	22	6,000		2,670	[a]1 2	2 4	[f]1 30	3 00	3 60		4 90		4 08	
Feather River Water Company	Yuba City	Sutter	1926	Feather River	A	100	12			275		2 4	3 76	0	0		3 76		[e]1 57	
Garden Highway Mutual Water Company	Yuba City	Sutter	1923	Feather River	A	100	12	2,600	[b]10 00	[c]1,740		[g]2 3	3 00	0	0	0 60	3 00	3 60	[f]1 30	[e]1 56
Hallwood Irrigation Company	Marysville	Yuba	1910	Yuba River	A	0	0	6,400	[d]10 00	[c]4,470		[e]6 0	1 80	0	0	0 60	1 80	2 40		
Improvement Mutual Water Company	Robbins	Sutter	1923	Sacramento River[h]	A	100	18		[b]45 00	[c]1,260	[a]2 2		1 06	0 97	2 13	2 70	3 19	5 89	1 45	2 68
Loam Ridge Mutual Water Company	Orland	Glenn	1913	Wells	(i)	100	40	1,200	[b]23 00		1 7	1 9	1 01	1 95	3 32	1 38	4 33	5 71	2 55	3 35
Natomas Central Mutual Water Company	Sacramento	Sacramento and Sutter	1921	Sacramento River	A	100	22	19,400		3,100	[a]1 5		[j]0 46	3 20	4 80		5 26		3 51	
Natomas Riverside Mutual Water Company	Sacramento	Sacramento	1920	Sacramento River	A	100	23	3,526		1,590	[a]1 5	3 9	[f]1 00	4 00	6 00		7 00		4 67	
Orangevale Water Company	Orangevale	Sacramento		North Fork Ditch Company	A	0	0	2,185	[d]20 00			[k]1 5	[j]0 46		[k]5 80	1 20	6 16	7 36		
Plumas Mutual Water Company	Marysville	Yuba	1927	Feather River	A	100	18	3,000	[d]30 00	1,230			0		4 20	1 80	4 20	6 00		
Roberts Ditch Irrigation Company	Colusa	Colusa	1902	Sacramento River	A	100	25	1,880	[m]10 00	700		3 7	0	[a]1 54	5 70	0 60	5 70	6 30	[a]1 54	[a]1 70
Stanford Vina Ranch Irrigation Company	Vina	Tehama	1920	Deer Creek	A	0	0	5,603		3,080	4 3	5 4	0 80	0	0		0 80		0 19	
Sutter Mutual Water Company	Robbins	Sutter	1919	Sacramento River	A	100	17	45,140	[b]52 00	[c]22,400	1 7		0 95	0 95	1 61	3 12	2 56	5 68	1 50	3 24
Swinford Tract Irrigation Company	Colusa	Colusa	1920	Sacramento River	A	100	26	145	[d]50 00	140		1 4	4 10	[a]1 31	1 84	3 00	5 94	8 94	[a]4 17	[a]6 38
Western Canal Company	Oroville	Butte and Glenn	1915	Feather River and Lake Almanor	A	0	0	27,856	[b]30 00	[c]10,700	2 2	[a]7 7	0	1 00	2 20	1 80	2 20	4 00	1 00	1 82
Orland Project, United States Bureau of Reclamation	Orland	Glenn	1907	Stony Creek	A	0	0	20,142	[o]28 16		3 3	4 7	[a]1 73	[p]0 10–0 60	0 12	1 69	1 85	3 54	0 57	1 08

* Estimated.
[a] Character of water supply: A—Usually sufficient throughout irrigation season.
[b] Investment in irrigation system.
[c] Includes rice.
[d] Par value of capital stock.
[e] Per acre-foot diverted (pumped).
[f] Maintenance charge.
[g] Estimated for general crops only.
[h] Joint diversion with Sutter Mutual Water Company.
[i] Average for 1925-1928. Only rice grown in 1929.
[j] Company supply, supplemented by three private wells, furnishes ample water to area now irrigated.
[k] Estimate based on gross area.
[l] Includes $0.10 per acre deposited in sinking fund and not included in annual cost of water.
[m] Present market value of stock.
[n] Amount paid on construction charges in 1927 taken as average for 1925-1929.
[o] Operation and maintenance charge. Does not include annual repayments of construction charges amounting to $3.30 per acre.
[p] Charges for excess water: $0.10 per acre-foot for natural flow water and $0.60 per acre-foot for stored water.

	ıl cost of water			Average annual cost of water with and without interest on capital investment			
	harges		Interest at 6 per cent on approximate capital investment, per acre	Per acre		Per acre-foot	
	Per acre-foot	Per acre for average amount used		Without interest	With interest	Without interest	With interest
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
lieia M		$4 86	$2 04	$5 51	$7 55		
olusa I	$1 87	4 45	0 60	4 45	5 05	[a]$1 87	[a]$2 10
urham		1 72	2 70	1 72	4 42	0 86	2 21
lkhorn	3 00	3 60		5 10		4 25	
eather	0	0	0 60	3 15	3 75	[a]1 37	[a]1 63
arden I	0	0	0 60	3 75	4 35	[a]1 39	[a]1 61
allwoo	0	0	0 60	1 50	2 10		
oam Ri	2 30	3 68	1 38	3 68	5 06	2 30	3 16
atomas	3 00	4 50		5 00		3 33	
atomas	4 00	6 00		7 00		4 67	
rangeva		[b]6 00	1 20	[c]6 20	[c]7 40		
lumas		4 20	1 80	4 20	6 00		
oberts	2 15	6 45	0 60	6 45	7 05	[a]2 15	[a]2 35
anford	0	0		1 00		0 20	
utter M							
winford	0 75	1 42	3 12	2 17	5 29	1 14	2 78
estern	1 21	2 67	3 00	7 17	10 17	[a]3 26	[a]4 62
rland P	1 00	2 00	1 80	2 00	3 80	1 17	2 24
ot	[f]0.10-0.60	0 05	2 19	1 75	3 94	0 62	1 41

[a] Pe
[b] Est
[c] Inc
[d] On
[e] Do
[f] Ch

TABLE 26

COST OF WATER TO IRRIGATORS FOR GENERAL CROPS, MUTUAL WATER COMPANIES, NORTHERN CALIFORNIA, 1929

Compiled from data furnished by the individual mutual water companies

Name of company	Area irrigated		Approximate average amount of water in acre-feet per acre		Factors in annual cost of water					Average annual cost of water with and without interest on capital investment			
						Water charges				Per acre		Per acre-foot	
	Total area irrigated, acres	Crops, with acreages if available	Delivered	Diverted	Assessment for 1929, per acre	Rate schedule	Per acre-foot	Per acre for average amount used	Interest at 6 per cent on approximate capital investment, per acre	Without interest	With interest	Without interest	With interest
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Alicia Mutual Water Company	1,400	Deciduous trees, 663; alfalfa and miscellaneous, 337; rice, 400			$0 65	Actual cost on acreage basis		$4 86	$2 04	$5 51	$7 55		
Colusa Irrigation Company	852	Alfalfa and deciduous trees		2 4	0	$3.50 per hour for flow of pump	$1 87	4 45	0 60	4 45	5 05	[a]$1 87	[a]$2
Durham State Land Settlement Water Users Association	*2,750	Beans and other field crops, deciduous trees, alfalfa, truck	*2 0		0	0 80 per acre for each irrigation		1 72	2 70	1 72	4 42	0 86	2
Elkhorn Mutual Water Company	2,732	Alfalfa, 1,537; beans, 812; deciduous trees, 302; truck, 81	1 2	3 0	1 50	3 00 per acre-foot	3 00	3 60		5 10		4 25	
Feather River Water Company	236	Deciduous trees, 236		2 3	3 15	None	0	0	0 60	3 15	3 75	[a]1 37	[a]1
Garden Highway Mutual Water Company	1,306	Deciduous trees, 973; beans, 303; vines, 30		2 7	3 75	None	0	0	0 60	3 75	4 35	[a]1 39	[a]1
Hallwood Irrigation Company	5,400	Beans, orchard, vineyard and pasture, 4,550; rice, 850		6 6	1 50	None	0	0	0 60	1 50	2 10		
Loam Ridge Mutual Water Company	1,000	Deciduous trees, 730; citrus, 130; grain, 90; alfalfa, 50	1 6	1 8	0	0 15-0 20 per acre-inch	2 30	3 68	1 38	3 68	5 06	2 30	3
Natomas Central Mutual Water Company	2,650	Alfalfa, 1,046; rice, 656; truck, 607; beans, 272; deciduous trees, 69	1 5		0 50	3 00 per acre-foot	3 00	4 50		5 00		3 33	
Natomas Riverside Mutual Water Company	1,150	Alfalfa, 844; beans, 205; deciduous trees, 83; truck, 18	1 5	4 1	1 00	4 00 per acre-foot	4 00	6 00		7 00		4 67	
Orangevale Water Company		Deciduous trees, vines, olives, alfalfa		[b]1.5	[c]0 30	[d]24 00 per miner's inch per year		[b]6 00	1 20	[c]6 20	[c]7 40		
Plumas Mutual Water Company	1,243	Deciduous trees, 545; alfalfa and miscellaneous, 445; rice, 253			0	Actual cost on acreage basis		4 20	1 80	4 20	6 00		
Roberts Ditch Irrigation Company	800	Alfalfa, deciduous trees, corn and beans		3 0	0	2.25 per hour for flow of pump	2 15	6 45	0 60	6 45	7 05	[a]2 15	[a]2
Stanford Vina Ranch Irrigation Company	3,020	Field crops, 1,460; alfalfa, 520; deciduous trees, 500; cotton, 400; other, 140	5 0	5 4	1 00	None	0	0		1 00		0 20	
Sutter Mutual Water Company	31,973	Grain, 12,665; rice, 5,660; beets, 3,424; cotton, 2,130; deciduous trees, 1,703; vines, 1,300; beans, 1,039 asparagus, 938; pre-irrigation, 2,357; other, 757	[e]1 9		0 75	0.75 per acre-foot	0 75	1 42	3 12	2 17	5 29	1 14	2
Swinford Tract Irrigation Company	140	Deciduous trees, 130; alfalfa, 10		2 2	4 50	1.00 per hour for flow of pump	1 21	2 67	3 00	7 17	10 17	[a]3 26	[a]4
Western Canal Company	9,650	Rice, 6,862; cotton, 1,565; beans, 245; miscellaneous, 978	1 7		0	1.00 per acre-foot; minimum, $2.00 per acre	1 00	2 00	1 80	2 00	3 80	1 17	2
Orland Project, U. S. Bureau of Reclamation	13,479	Alfalfa, 4,708; deciduous trees, 3,425; field crops, 3,952; grain, 646; citrus, 331; vines, 256; olives, 161	2 8	4.1	1 70	[f]Excess water; $0.10 and $0.60 per acre-foot	[f]0.10-0.60	0 05	2 19	1 75	3 94	0 62	1

*Estimated.
[a] Per acre-foot diverted (pumped).
[b] Estimate based on gross area.
[c] Includes $0.10 per acre deposited in sinking fund and not included in annual cost of water.
[d] One miner's inch equals one-fiftieth of a cubic foot per second.
[e] Does not include grain for which average amount of water delivered was $0.62 per acre
[f] Charges for excess water: $0.10 per acre-foot for natural flow water, and $0.60 per acre-foot for stored water.

Y COMPANIES, NORTHERN AND CENTRAL CALIFORNIA,
YEAR 1929
vater companies

nnual cost of water				Average annual cost of water with interest on capital investment			
Water charges			Interest at 6 per cent on approximate capital investment, per acre	Per acre		Per acre-foot	
›ot	per acre for average amount used						
1929	Average, 1925-1929	1929		1925-1929	1929	1925-1929	1929
(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
--------	$8 16	$9 72	$2 04	$10 90	$12 41	----------	----------
--------	0	----------	0 60	8 85	----------	----------	----------
0	0	0	0 60	2 40	2 10	----------	----------
$1 10	[c]13 60	16 50	2 70	17 43	20 60	$1 22	$1 37
--------	6 80	6 00	----------	7 30	6 50	----------	----------
[d]2 00	12 00	12 00	0 83	26 83	26 83	2 68	2 68
--------	[e]8 40	8 40	1 80	10 20	10 20	----------	----------
--------	[f]1 25	[i]1 25	----------	[i]2 87	[i]2 75	[j]0 41	[j]0 39
	[f]1 75	[i]1 75	----------	[i]3 37	[i]3 25	[j]0 48	[j]0 46
0 75	8 90	7 28	3 12	12 97	11 15	1 38	1 15
1 00	6 30	6 60	1 80	8 10	8 40	1 29	1 27
--------	[g]1 25	[i]1 25	[i]1 25	[i]1 25	[i]1 25	[j]0 18	[j]0 18
	[g]1 75	[i]1 75	[i]1 75	[i]1 75	[i]1 75	[j]0 25	[j]0 25
	[g]2 25	[k]2 25	[k]2 25	[k]2 25	[k]2 25	[k]0 32	[k]0 32
--------	[h]8 50	8 50	----------	8 50	8 50	----------	----------

from the public utility company, pays the rates of that company and has been included with that

e for all counties; or a measured rate of $1.15 per acre-foot.
re; pumped water, $10.40 per acre.

TABLE 27

COST OF WATER TO IRRIGATORS FOR RICE, MUTUAL WATER COMPANIES AND PUBLIC UTILITY COMPANIES, NORTHERN AND CENTRAL CALIFORNIA, AVERAGES FOR YEARS 1925-1929, INCLUSIVE, AND YEAR 1929

Compiled from data furnished by the individual mutual water companies

Name of company	Rice area irrigated, acres		Approximate amount of water delivered, acre-feet per acre		Factors in annual cost of water							Average annual cost of water with interest on capital investment			
					Assessments, per acre		Water charges				Interest at 6 per cent on approximate capital investment, per acre	Per acre		Per acre-foot	
							Per acre-foot		per acre for average amount used						
	Average, 1925-1929	1929	Average, 1925-1929	1929	Average, 1925-1929	1929	Average, 1925-1929	1929	Average, 1925-1929	1929		1925-1929	1929	1925-1929	1929
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Mutual Water Companies															
Alicia Mutual Water Company	530	400			$0 70	$0 65			$8 16	$9 72	$2 04	$10 90	$12 41		
Garden Highway Mutual Water Company	[a]456	0			[a]8 25		0		0		0 60	8 85			
Hallwood Irrigation Company	[b]860	850			1 80	1 50	0	0	0	0	0 60	2 40	2 10		
Improvement Mutual Water Company	[c]425	564	[c]14.3	15	[c]1 13	1 40	[c]$0 95	$1 10	[c]13 60	16 50	2 70	17 43	20 60	$1 22	$1 3
Natomas Central Mutual Water Company	1,480	656			0 50	0 50			6 80	6 00		7 30	6 50		
Patterson Water Company	[c]200	100	*10	*10	14 00	14 00	[d]2 00	[d]2 00	12 00	12 00	0 83	26 83	26 83	2 68	2 6
Plumas Mutual Water Company	[c]275	253			0	0			[c]8 40	8 40	1 80	10 20	10 20		
Poso Canal Company		14,297	*7	*7	[c]1 62	1 50			[f]1 25	[i]1 25		[i]2 87	[i]2 75	[i]0 41	[i]0 3
									[f]1 75	[j]1 75		[j]3 37	[j]3 25	[j]0 48	[j]0 4
Sutter Mutual Water Company	7,950	5,660	9.4	9.7	0 95	0 75	0 95	0 75	8 90	7 28	3 12	12 97	11 15	1 38	1 1
Western Canal Company	9,875	6,862	6.3	6.6	0	0	1 00	1 00	6 30	6 60	1 80	8 10	8 40	1 29	1 2
Public Utility Companies															
San Joaquin and Kings River Canal and Irrigation Company		3,891	*7	*7	0	0			[g]1 25	[i]1 25	[i]1 25	[i]1 25	[i]1 25	[i]0 18	[i]0 1
									[g]1 75	[j]1 75	[j]1 75	[j]1 75	[j]1 75	[j]0 25	[j]0 2
									[g]2 25	[k]2 25	[k]2 25	[k]2 25	[k]2 25	[k]0 32	[k]0 3
Sutter Butte Canal Company		16,355			0	0			[h]8 50	8 50		8 50	8 50		

*Estimated.
[a] 1927 and 1928.
[b] 1926-1929, inclusive.
[c] 1927-1929, inclusive.
[d] For water in excess of four acre-feet per acre.
[e] 1928 and 1929.
[f] Charge by San Joaquin and Kings River Canal and Irrigation Company: Fresno County, $1.25; Merced County, $1.75. Poso Canal Company obtains its water from the public utility company, pays the rates of that company and has been included with that company in Table 4 (1929 crops). See footnote [g] below.
[g] Rate for all crops up to and including 1929: Fresno County, $1.25; Merced County, $1.75; Stanislaus County, $2.25. New rate in effect 1930: rice, $7.50 per acre for all counties; or a measured rate of $1.15 per acre-foot.
[h] Rate for 1926-1929 for gravity water. Charge for water pumped at booster plant, $1.30 per acre additional. New rates in effect 1930; gravity water, $9.00 per acre; pumped water, $10.40 per acre.
[i] Fresno County.
[j] Merced County.
[k] Stanislaus County.
[l] In 1930.

CHAPTER IV

IRRIGATION DISTRICTS

The irrigation district * may be defined as a public corporation organized under State laws empowering it to issue bonds and levy and collect taxes, with the object of providing funds for a water supply to irrigate lands within its boundaries and for the operation and maintenance of its irrigation system. California irrigation districts are political subdivisions of the State and are organized under the jurisdiction of the county or counties in which they are located. The affairs of a district are administered by a board of directors, assessor, tax collector, treasurer and secretary, all of whom are elected except the secretary, who is appointed by the board.

Method of Financing.

Districts issue bonds to provide funds for obtaining water supplies and distribution systems for the irrigation of land within their boundaries. Taxes are levied to raise funds to retire these bonds when they fall due, pay interest on the bonds, provide for the cost of operation and maintenance of the system, and all other general expenses. Some districts have water tolls or charges to cover operation and maintenance.

Bonds.—Irrigation district bonds, when approved by the California Bond Certification Commission, are legal investments for savings banks, trust companies, trust funds, and insurance companies. In certifying the bonds the commission limits the bonded indebtedness to 60 per cent of the market value of the irrigation system and land within the district. In California all irrigation district bonds are exempt from any personal property tax.

Assessments.—District assessment rolls are prepared and equalized by the irrigation district officials, who also attend to levying and collecting the taxes. Improvements are not assessed, nor does the assessed valuation include the value of the irrigation system, values shown in the assessment roll being for the land only.

The methods of fixing valuations per acre for assessment purposes vary. Some districts assess all the land at a flat rate per acre. Other districts base their valuations on characteristics of the land, such as irrigability by gravity or pumping, or the prevalence of alkalized swamp, river bottom, hillside, town or nonirrigable areas. Some districts have given one valuation to lands served by the system and another to lands not reached by the present ditches. In some cases districts vary assessed valuations according to distances from town centers.

* For detailed information regarding irrigation districts see Bulletin No. 18, "California Irrigation District Laws, 1929 Revision, Reviewed by Legislative Counsel"; Bulletin No. 21, "Irrigation Districts in California," and Bulletin No. 21-A, "Report on Irrigation Districts in California for the Year 1929," Division of Water Resources, Department of Public Works, State of California.

The assessments are generally paid in two installments, the first becoming delinquent on the last Monday in December and the second, on the last Monday in June. The assessment becomes a lien on the land from and after the first Monday in March.

"The rate of assessments levied under the provisions of this act shall be ascertained by deducting 15 per cent for anticipated delinquencies from the aggregate assessed value of the property in the district as it appears on the assessment roll for the current year, and then dividing the sum to be raised by the remainder of such aggregate assessed value." *

Special assessments may be made if the majority of votes cast at a special election favor them.

Factors in Cost of Water Under Irrigation Districts.

The main factors determining the annual cost of water to irrigators in an irrigation district are district tax, water tolls, amount of water delivered, and interest on capital invested.

District Tax.—The district tax may be segregated into bond interest, bond principal, rentals due, permanent improvements, cost of power, maintenance and operation, administration and general purposes. However, most districts limit their segregation to bond interest, bond principal, and general fund. Hence it is not easy to determine from the tax-rate just what portions of the general fund are used for permanent construction, maintenance and operation, or general purposes.

To ascertain that portion of the tax which goes into annual cost, the tax for bond principal and permanent improvements should be subtracted from the total tax and charged to capital account. In other words, that portion of the tax to be charged to annual cost covers interest on bonds, maintenance and operation, and other general expenses.

In reducing the district tax from the rate per $100 assessed valuation to a rate per acre, the usual assessed valuation per acre for irrigable lands was used. This was taken instead of the average assessed valuation per acre, the latter, in some cases, being too low because of low valuation of nonirrigable land or too high because of high valuation of lands in towns.

In computing the tax per acre, an average of the 1928–29 and 1929–30 assessments was used, rather than the average for a single year, because some of the district expenses may overlap from one assessment year to the next. The fiscal years used by districts are not uniform and few districts keep their records on the basis of the calendar year. Generally assessments levied in one year are to cover estimated expenses for the following year. In most districts the assessments so made are made payable in two installments, the first falling in December of the year in which the assessments are made and the second in June of the following year.

Water Tolls.—Some irrigation districts obtain their funds for operation and maintenance purposes from water tolls, using various units to determine the water charge. Many districts feel that the cost of

* California Irrigation District Act, Sec. 60.

installing measuring devices and of measuring the amount of water used by each irrigator is prohibitive, hence their water tolls are based on a flat rate per acre. In a few instances the flat rate varies according to the crop grown or whether the water is gravity or pumped. Other districts charge by the acre-foot, hour-inch, or cubic foot, depending upon the kind of measuring device used.

Unit charges may vary according to amount of water used. A few districts assess tolls on the basis of an irrigation, the rate varying with the crop grown or the method of irrigating. In the tabulations that follow all water tolls have been reduced to an acre-basis.

Amount of Water Delivered.—The amount of water used is a factor entering into the annual cost of water when it is desired to ascertain this cost on either the acre or the acre-foot basis. The quantities given in this report represent the average amounts of water delivered to irrigators, or in other words, the amounts of water paid for. Generally speaking, under districts having adequate water supplies the amount of water delivered may be considered as the "duty of water" of the respective systems.

Interest on Capital Invested.—The capital invested in the irrigation system of a district by the landowners may be segregated into two classes: (1) the total represented by retired bonds; (2) the total amount raised for permanent improvements by assessment since the district was organized. Information regarding the latter class is available for only a few districts and is disregarded herein so far as interest on capital invested is concerned. Interest on the amount per acre represented by retired bonds is usually a minor factor in determining the ultimate cost of water to the irrigator.

Cost of Water to Irrigators.

Table 28 has been prepared to show the annual cost of water to irrigators under many of the principal irrigation districts operating in the state in 1929.

The data have been grouped as representing northern, central and southern California. The tabulations comprise 30 columns. In addition to the cost of water to irrigators, factors affecting the cost of water and many other pertinent elements are shown in the table. Most of the headings are self-explanatory, and will not be referred to further.

Column 2 gives the location of the place designated as the meeting place of the board of directors.

Column 4, "Year organized," does not necessarily give the age of the system or water rights, because the district may have been organized to take over an existing system or water right.

Column 6, "Estimated irrigable area," makes allowance for roads, canals, towns and other nonirrigable lands.

Column 7, "Source of water supply," gives the sources of water, although in dry years water may not be available from all.

Column 14, "Average amount of water diverted, acre-feet per acre," includes transmission losses.

Column 15, "Average amount of water delivered, acre-feet per acre," would represent what is commonly termed net duty of water.

Column 16, "Bonded debt per net acre," is obtained by dividing the total bonded debt outstanding by the net acreage.

Column 17, "Total bonded debt retired per net acre," is obtained by dividing the amount of bonded debt retired by the acreage in the district. Refunding issues are not included.

Column 18, "Usual district assessed valuation per acre," is for the 1929–30 tax levy.

Column 19, "Interest on retired bonds per net acre at 6 per cent," is computed from amounts given in column 17.

Column 20, "Usual district tax per acre for the past two years," is obtained by reducing the tax rate per $100 for 1928–29 and 1929–30 to an acre basis and taking their average. This method was decided upon because in many districts the expenses of one year overlap those of the next year, the average for the two years giving fairer results. Generally this average may be taken as referring to the calendar year 1929.

Column 23, "Water tolls per acre for average amount used," is derived either from column 21 or from the product of the corresponding amounts in columns 15 and 22.

Column 24, "Bond principal tax per net acre," gives the average of bonds retired per acre for the last two years.

Column 25, "Improvement tax per net acre," shows average portion of the tax for the past two years that has gone into capital improvements.

The two columns (24 and 25) come under the head of "Deductions average past two years," as both should be deducted from the total tax per acre and thus charged to capital account rather than annual cost of water.

Amounts in the last four columns of the table are the final results obtained from calculations based on the previous columns. Column 26, "Annual cost of water per net acre for average amount delivered, excluding interest on retired bonds," is equal to column 20 plus column 23 minus columns 24 and 25. Column 27, "Annual cost of water per net acre for average amount delivered, including interest on retired bonds," is equal to column 26 plus column 19. Column 28, "Annual cost of water per acre-foot for average amount delivered, excluding interest on retired bonds," is equal to column 26 divided by column 15. Column 29, "Annual cost of water per acre-foot for average amount delivered, including interest on retired bonds," is equal to column 27 divided by column 15.

	Per net amou	Excludin interest c retired bonds
		(26)
A		
I	$3	
I	6	
I	0	
C	2	
C	4	
C	7	
C	7	
C	9	
I	7	
F	2	
F	6	
F	8	
C	6	
C	3	
F	8	
J	1	
M	2	
N	2	
O	7	
P	10	
P	4	
P	6	
P	7	
S	13	
T	6	
T	10	
	11	
A		
A	8	
B	0	
B	13	
C	8	
C	0	
E	2	
F	9	
Is	0	
Ja	0	
L	9	
Li	0	
M	31	
M	6	
N	2	
O	5	
Ri	3	
So	3	
St	5	
Te	9	
Tr	26	
Tr	8	
Tu	3	
Va	2	
W	27	
W	9	
W	6	
	3	

TABLE 28

COST OF WATER TO IRRIGATORS, IRRIGATION DISTRICTS, NORTHERN, CENTRAL AND SOUTHERN CALIFORNIA, 1929

Compiled from data furnished by the individual irrigation districts

Name of District	Town	County or counties	Year organized	Gross area in district, acres	Estimated irrigable area, acres	Source of water supply	Character of water supply as reported by district for acreage irrigated in 1929	Unit to which water is delivered by district	Percentage of water pumped	Lift, feet	Area irrigated, 1929: Total area irrigated, acres	Area irrigated, 1929: Crops, with acreages if available	Average amount of water diverted, acre-feet per acre	Average amount of water delivered, acre-feet per acre	Bonded debt per net acre, January 3, 1929	Total bonded debt retired, per net acre	Legal bonded assessed valuations per acre, 1928-1929	Interest on retired bonds per net acre at 6 per cent	Factors in annual cost of water: Water tells: Annual district tax per net acre for past ten years	Water tells: Rate schedule	Water tells: Per acre-foot	Water tells: Per acre for average amount used	Deductions—average, past two years: Bond principal tax per net acre	Deductions—average, past two years: Improvement tax, per net acre	Annual cost of water: Per net acre for average amount delivered: Excluding interest on retired bonds	Annual cost of water: Per net acre for average amount delivered: Including interest on retired bonds	Annual cost of water: Per acre-foot for average amount delivered: Excluding interest on retired bonds	Annual cost of water: Per acre-foot for average amount delivered: Including interest on retired bonds	Name of District
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
Northern California																													**Northern California**
Anderson-Cottonwood	Shasta, Redding	Shasta, Tehama	1924	54,000	29,000	Sacramento River	Ample	Farm			16,245	Alfalfa 7,400, truck 6,500, deciduous trees, 1,370, vines, 400, miscellaneous, 425	7.20		841.00	$7.03	$50.00	$0.18	$4.25	None			None	None	$3.87	$3.68			Anderson-Cottonwood
Big Springs	Montague	Siskiyou	1927	1,370	2,500	Big Springs	Ample	Farm	100	66	1,320	Alfalfa, 1,200, grain, 30	4.11		35.14	1.17	200.00	0.67	5.20	None			None	None	6.00	6.92			Big Springs
Browns Valley	Yuba City	Yuba	1908	60,000	11,700	North Fork Yuba River	Slightly deficient	Farm			6,962	Truck, 1,850, deciduous trees, 1,415, alfalfa, 645, vines, 470, grain, 90, citrus, 82, miscellaneous, 2,460	2.36	1.85	None	11.92	10.00	0.72	None	$4 per inch per year or $7.50 April 1 to September 1	$0.33	$0.61	None	None	0.61	1.33	$0.33	$0.77	Browns Valley
Butte Valley	Macdoel	Siskiyou	1920	28,000	17,000	Butte and Antelope Creeks	Deficient	Approximately 160 acres	0	0	8,500	Grain, pasture, alfalfa	0	0	35.56	None	10.00	None	2.00	None			None	None	2.00	2.00	0.83	*	Butte Valley
Capitol City Farms	Wilmington	Sacramento	1926	8,000	2,000	Bear River and Reservoir	Ample	Farmers' laterals	0	0	2,000	Deciduous trees, 2,000, grain, truck, vines, alfalfa, hay	3.04		67.34	None	156.00	None	6.02	None			None	None	8.94	8.02			Capitol City Farms
Carmichael	Carmichael	Sacramento	1916	3,138	3,000	Sacramento River	Ample	Farm	100	160	1,950	Deciduous trees, 1,500 citrus, 350 vines, 200	2.14	2.18	32.40	3.87	80.00	0.70	0.70	$2.50 per acre		2.50	1.50	None	1.50	7.00	8.75	1.00	3.83	Carmichael
Colusa-Tehama	Colusa	Colusa, Tehama	1920	7,077	7,000	North Fork Ditch Company	Ample	Tree acres	0	0	2,950	Deciduous trees, olives, vines, citrus	1.25	1.25	62.00	7.83	100.00	0.47	10.25	None					0.47	10.25			Colusa-Tehama
Corning	Corning	Tehama	1920	12,000	11,000	Sacramento River	Ample	Farm	100	20	1,000	Rice, 1,000	0.77		33.35	12.66	75.00	0.72	2.37	Rice, $1 general crops, $2 per acre		1.00	0.34	None	0.33	10.05			Corning-Tehama
Dixon	Dixon	Solano	1926	8,457	5,425	Yolo River	Ample	High point on each 160 acres	0	0	1,800	Rice, 1,500	16.56		47.50	15.86	75.00	0.65	3.87	Rice, $5 general crops, $1.25 per acre		3.92	None	None	7.58	8.74			Dixon
Dunnigan	Yuba	Tehama	1926	4,000	1,000	Deer Creek	Ample	Farm		0	2,000	Deciduous trees, 800, alfalfa, 500, truck, 200, miscellaneous, 450			18.33	1.50	100.00	0.00	3.00	None			*1.50	None	3.13	2.25			Dunnigan
Durham	Durham	Butte	1921	7,500	7,500	Butte Creek	Ample	Farm	100	65	6,000	Deciduous trees, 1,107, truck, 1,165, alfalfa, 1,164, vines, 165, miscellaneous, 339	2.15	2.15	38.00	1.00	125.00	None	0.00	None			None	None	0.00	0.00	1.70	2.70	Durham
Dry Creek	Healdsburg	Sonoma	1923	30,000	19,000	North Fork Russian River, Webber Creek	Slightly deficient	Farm		0	6,000	Deciduous trees, 6,000	1.35	1.35	38.16	None	25.00	None	0.50	$17.50 per miner's inch, steady flow, 120 days, $42 per miner's inch intermittent flow 120 days	46.25	0.84	None	None	8.98	8.98	6.65	6.65	Dry Creek
East Side	Lakeside	Sacramento	1917	3,000	3,000	North Fork Ditch Company	Ample	Free acres	0	0	2,583	Deciduous trees, 1,900, citrus, 683, vines, 50, truck, 16	1.81	1.81	36.87	10.99	50.00	0.63	4.27	$5 per acre irrigated land, $3 unirrigated	3.05	4.93	2.49	None	5.71	7.38	3.71	4.91	East Side
Fresno	Fresno	Fresno, Madera	1920	121,342	119,292	Sacramento River	Ample	No set unit	100	7	60,000	Rice, 14,000, alfalfa, 8,223 truck, 1,500 citrus, 937, deciduous trees, 700, vines, 155, miscellaneous, 18,859	8.25		15.00	8.09	40.00	0.83	1.04	Rice, $5, general crops, $1 per acre		2.86	None	None	3.00	6.11			El Dorado
Glenn-Colusa	Glenn	Glenn	1921	8,949	8,500	Shasta River	Deficient	Farm	100	138	1,640	Alfalfa, 1,640	2.70	2.70	68.35	None	200.00	None	13.44	None			4.22	None	8.12	8.12	3.01	3.01	Glenn-Colusa
Grassland	Gustine	Merced	1919	9,825	9,897	Pit River, Sage Reservoir	Ample	Charges for storage only	0	0	9,897	Grain, 8,118, alfalfa, 1,379			11.33	0.11	30.00	0.29	3.04	None			1.73	None	4.27	4.56			Grassland
Hacienda	Hacienda	Los Angeles	1917	13,254	10,500	Sacramento River	Ample	Approximately 40 acres	100	10	1,155	Alfalfa, 1,030, deciduous trees, 761 cotton, 328, grain, 310, miscellaneous, 1,161	3.47		17.18	3.84	50.00	0.35	3.53	$2 per acre per season	1.00		0.81	None	3.29	3.35			Hacienda
Madera	Madera	Madera	1925	28,111	14,331	Shasta River, Lake Dunsmuir	Ample	Farm			78,28	Deciduous trees, 968, alfalfa, 778, field crops, 482, vines, 4, miscellaneous, 1,577			78.28	None	50.00	None	2.73	None			None	None	2.73	2.73			Madera
Merced-Stevinson	Merced	Merced	1921	203,500	184,000	Pit River, Bureau Reservoir	Ample	Farm ready to receive water	0	0	8,200	Deciduous trees, 968, alfalfa, 778, field crops, 482, vines, 4, miscellaneous, 1,577	3.31		48.48	None	65.00	None	0.14	$0.10 per inch per season	0.10	2.40	None	None	2.54	2.54	2.42	2.42	Merced
Mt. Shasta	Mt. Shasta	Siskiyou	1910	28,100	22,000	South Fork Feather River, Reservoir	Ample	Farm	0	0	4,000	Citrus and citrus, 4,000, vines, 30	1.65	1.60	47.00	None	100.00	None	2.00	$5 per acre-foot	5.00	5.30	None	None	10.30	10.30	8.31	8.31	Mt. Shasta
Paradise	Paradise	Butte	1925	11,200	4,800	Little Butte Creek, Magalia Reservoir	Ample	Farm	0	0	3,000	Deciduous trees, 3,000, vines, 100 truck, 100	1.10	1.10	64.21	0.01	67.50	0.04	0.00	None			0.16	None	0.20	0.20	0.09	0.14	Paradise
Pine Grove	Jackson	Amador	1928	3,042	1,145	South Fork Feather River, Lake Pulsbury	Ample	Farm			1,640	Deciduous trees, 710 alfalfa, 800, grain, 130 truck, 60, vines, 10	3.75	3.72	21.12	None	60.00	None	2.08	$2.00 per acre-foot	2.00	4.18	None	None	4.43	6.21	3.00	5.00	Pine Grove
Pleasant Valley	Pleasant Valley	Ventura	1926	16,546	12,200	Sacramento River	Ample	Farm	100	22	4,174	Rice, 3,910 deciduous trees, 1,150, alfalfa, 718, grain, 118, cotton, 55, truck, 20, miscellaneous, 212	12.72		18.24	None	67.50	None	3.04	Rice, $5, general crops, $1.75 per acre		2.25	None	None	7.24	7.29			Pleasant Valley
Porterville	Porterville	Tulare	1918	22,935	22,000	Sacramento River	Ample	Usually each 160 acres	100	10	4,199	Rice, 4,130, alfalfa, 58, citrus, 5		1.88	48.87	8.10	18.00	0.49	0.17	Rice, $0.60, general crops, $1.50 per acre		0.28	1.82	None	13.23	13.72	8.92	8.92	Porterville
Red Bluff	Red Bluff	Tehama	1917	3,125	3,000	Feather River	Slightly deficient	Farm	0	0	3,500	Alfalfa, 2,000, grain, 1,500			19.50	11.75	25.00	0.48	4.25	$4 per acre		1.00	1.05	None	6.30	7.01			Red Bluff
Rio Mesa	Oxnard	Ventura	1922	1,650	1,700	Conejo Creek, Lake Wilmore	Ample	Farm		0	231	Rice, 191, alfalfa, 75, truck, 18, miscellaneous, 11	14.62		105.08	None	125.00	None	6.17	Rice, $6, general crops, $3 per acre		6.83	None	None	16.67	16.67			Rio Mesa
Thermalito	Oroville	Butte	1922	3,110	2,800	Feather River, Lake Wilmore	Ample	In each tract as of time of district formation	0	0	1,007	Citrus, 843, deciduous trees, 606, vines, 149, truck and field crops, 50, grain, 30, alfalfa, 10, miscellaneous, 349			1.97	105.89	None	180.00	None	11.05	None			None	None	11.05	11.05	5.61	5.61	Thermalito
Central California																													**Central California**
Alpaugh	Alpaugh	Tulare	[illegible]	8,175	8,000	Wells	Ample	Ten acres	100	75	*8,110	Cotton, 2,720, grain, 1,920, alfalfa, 400, vines, 10		1.45	52.74	7.45	50.00	0.15	3.50	$1 per hoop for 8 second-foot head	3.00	4.35	1.11	None	8.33	8.53	3.76	3.85	Alpaugh
Alta	Dinuba	Tulare, Fresno, Kings	1888	129,300	11,000	Kings River	Deficient	Farmers' laterals	0	0	100,000	Vines, 66,000, deciduous trees, 8,990, alfalfa, 7,500, cotton, 2,000, citrus, 600, field and truck, 800, miscellaneous, 10,500	0.66		2.41	1.96	60.00	0.12	1.50	None			0.33	0.25	0.91	1.03			Alta
Banta-Carbona	Carbona	San Joaquin	1921	10,279	10,248	San Joaquin River	Ample	High point on each 160 acres	100	34	11,076	Field and truck, 3,536, alfalfa, 3,149, grain, 2,746, vines, 191, deciduous trees, 97, miscellaneous, 312	2.07	1.96	79.38	None	150.00	None	4.23	$3 first, $2.75 second, $2.50 third, acre-foot	3.00	3.58	None	None	12.89	12.89	7.46	7.46	Banta-Carbona
Byron-Bethany	Byron	Contra Costa, San Joaquin, Alameda	1919	17,500	12,548	Old River (San Joaquin)	Ample	High point on each 160 acres	100	64	10,000	Alfalfa, 7,000 grain, 2,500 deciduous trees, 300, field and truck, 200	1.60	0.99	49.30	3.43	120.00	0.21	4.42	$3.60 per acre-foot	3.50	3.65	0.67	None	8.25	8.62	8.30	8.80	Byron-Bethany
Consolidated	Lost Hills	Kern, Tulare, Kings	1921	184,047	147,37	Kings River	Deficient	Farmers' laterals	0	0	129,000	Vines, deciduous trees, alfalfa, field crops	0.92		2.37	3.46	150.00	0.21	1.20	None			1.07	0.16	0.67	1.16			Consolidated
Corcoran	Corcoran	Kings	1922	51,000	41,000	Peoples Ditch Company, 7 wells	Very deficient	No set unit	66	64	18,000	Cotton, 14,000, grain, alfalfa		0.66	16.90	None	100.00	None	1.08	Kings River 41 People's Ditch, $1.50, Pump $2.50 per acre per year	1.23	0.92	None	None	0.64	2.64	0.53	0.53	Corcoran
East Side-Lerdo	Bakersfield	Kern, Tulare	1926	30,200	16,700	Old River (San Joaquin)	Ample	Area as small as ten acres	100	15	18,959	Deciduous trees, 5,354 field and truck, 6,769, alfalfa, 1,167, grain, 618, vines, 793	3.00	1.58	63.56	2.27	1.75	0.18	0.57	$4 per acre-foot	6.00	0.52	0.93	2.00	5.94	19.08	6.29	6.33	East Side-Lerdo
Fresno	Fresno	Fresno	1920	241,200	234,000	Kings River	Ample	Farm and farm laterals	0	0	180,000	Vines, 94,200, field and truck, 29,800, deciduous trees, 20,112, alfalfa, 12,817, citrus, 1,024, cotton, 1,581, miscellaneous, 8,060	1.79	1.70	3.00	0.24	100.00	0.37	1.50	None			1.37	0.20	1.57	1.57	0.93	0.93	Fresno
Helm-No. 2	Helm	Kings	1924	4,620	4,130	Kings River (Consolidated Irrigation District)	Very deficient	No set unit	0	0	3,700	Deciduous trees, vines, field crops, alfalfa	0.66		2.41	1.96	60.00	None	None	None			0.67	0.75	None	None			Helm No. 2
James	San Joaquin	Fresno	1920	26,956	18,200	Kings River, 41 wells	Ample	No set unit	100	70	11,040	Alfalfa, 6,791 cotton, 1,100, grain, 3,701 miscellaneous, 240	3.00		34.47	0.29	150.00	0.02	0.34	$2 first irrigation, $1.75 for additional			0.34	3.78	4.13	None	James
Lacey	Lacey	Kings	1920	34,838	30,000	Kings River	Very deficient	To each farm where the number per interval exceeds 17	0	0	22,300	Grain, field crops, alfalfa, cotton	1.18		2.65	0.16	100.00	0.37	1.80	None			0.99	None	2.31	1.16			Lacey
Lindsay-Strathmore	Lindsay	Tulare	1915	15,250	18,500	Wells Watchman Ditch	Slightly deficient	Farm	100	287	*9,500	Citrus, 6,700, vines, 625, truck, 192, grain, 40	1.63	1.61	109.40	4.67	40.00	0.24	10.00	$10 per acre-foot	10.00	16.19	3.66	1.00	31.00	31.29	19.24	19.44	Lindsay-Strathmore
Merced	Merced	Merced	1919	193,682	171,000	Merced River, McClure Lake	Ample	160 acres	100	60	124,184	Grain, 21,622, deciduous trees, 20,811, alfalfa, 17,777, cotton, 16,086, vines, 14,417, field and truck, 13,124, rice, 7,070, miscellaneous, 15,280	4.25	3.53	96.64	None	125.00	None	7.50	None			None	None	0.50	0.50	1.90	1.90	Merced
Modesto	Modesto	Stanislaus	1887	91,183	78,700	Tuolumne River Don Pedro Reservoir	Ample	Farm		0	*66,372	Alfalfa, 18,712 grain, 14,375, deciduous trees, 10,937, vines, 10,313, miscellaneous, 10,036	0.95	3.93	64.10	17.60	40.00	0.65	4.50	None			0.66	0.81	7.67	8.12	0.68	0.76	Modesto
Nagle-Burk	Fresno	San Joaquin	1920	2,871	2,844	Old River (San Joaquin)	Ample	No set unit	100	0	1,840	Alfalfa, 1,700, hay and grain, 140		3.19	65.35	3.16	100.00	0.19	9.50	None			6.50	None	3.00	5.19	1.57	1.82	Nagle-Burk
Oakdale	Oakdale	Stanislaus, San Joaquin	1909	74,400	66,000	Stanislaus River, Melones Reservoir	Ample	No set unit, usually each 160 acres	0	0	23,331	Alfalfa, 6,037, deciduous trees, 6,040, vines, 2,990, cotton, 2,254, rice, 1,374, truck and field, 2,049 grain, 1,037, miscellaneous, 1,552	0.35	4.13	52.25	2.77	55.00	0.10	2.55	None			None	None	3.55	3.71	0.63	0.66	Oakdale
Riverside	Riverside	Fresno	1926	13,450	11,900	Kings River	Deficient	To head of farm laterals	0	0	8,940	Grain, 3,040 alfalfa 3,040 truck and field, 2,040 cotton, 640			4.70	3.92	75.00	0.23	2.83	$2.25 per acre	2.25		1.06	None	1.74	4.56			Riverside
South San Joaquin	Manteca	San Joaquin	1909	71,114	56,465	Stanislaus River, Melones Reservoir	Ample	40 acres	0	0	40,000	Alfalfa, 16,400, grain, 12,002 vines, 11,253, truck 3,154 deciduous trees, 4,057 cotton, 1,105, miscellaneous, 4,027																	South San Joaquin
Terra Bella	Terra Bella	Tulare	1921	11,750	10,941	Kings River, 41 wells	Deficient	Farm	93	56	8,954	Cotton, 4,000, grain 1,455, alfalfa, 420	1.14		30.52	0.63	100.00	0.02	0.77	None			1.73	None	1.48	1.91			Terra Bella
Tract 1 Reclamation	Tulare	Tulare	1918	12,285	12,000	Wells	Ample	Ten acres	100	200-400	2,933	Citrus, 1,812, deciduous trees, 1,358, vines, 563	1.50	1.50	71.98	3.87	100.00	0.53	9.75	$12 per acre-foot	12.00	18.00	1.43	None	26.32	26.85	17.55	17.90	Tract 1 Reclamation
Tract 2 Reclamation	Tulare	San Joaquin	1922	5,088	500	Old River (San Joaquin)	Ample	Ten acres	100	33	500	Alfalfa, 500	1.66		35.02	None	100.00	None	2.75	None			None	None	2.75	2.75			Tract 2 Reclamation
Trinity-Hills	Trinity	Trinity	1918	10,736	10,160	Kings and San Joaquin Rivers	Ample	Ten acres	100	11	6,700	Grain, 3,000 alfalfa, 2,500 cotton, 500 miscellaneous, 800			7.70	2.35	10.00	0.06	0.25	None			0.26	None	0.49	0.55			Trinity-Hills
Turlock	Stanislaus, Merced	Merced	1887	181,818	172,000	Tuolumne River Don Pedro Reservoir	Ample	Head of farmers' laterals	0	0	*132,784	Alfalfa, 39,706 truck and field, 34,232, grain, 34,222, vines, 13,937, deciduous trees, 6,834 rice 1,062, miscellaneous, 1,777	3.55		50.10	4.84	100.00	0.72	4.17	None			1.10	1.16	3.12	3.10			Turlock
Vandalia	Porterville	Tulare	1923	1,278	1,253	Tule River and wells	Deficient	Farm	100	810	1,100	Citrus, 1,100	1.67	1.67	151.16	1.60	50.00	0.80	5.00	$6.50 per acre-foot	8.50	14.00	4.84	0.65	27.35	28.25	16.37	17.20	Vandalia
West Side	Firebaugh	Fresno	1918	16,625	11,811	San Joaquin River	Ample	Farm	100	83	11,322	Alfalfa, 6,918, grain, 2,284, field and truck, 1,081, deciduous trees, 469	1.83	1.46	45.80	1.25	100.00	0.07	0.17	$3 per acre-foot	3.00	4.58	None	None	4.50	9.57	4.50	9.83	West Side
Westlake	Westlake	Stanislaus, Merced	1923	21,600	21,000	Merced River, 10 wells	Ample	Farm	100	60	8,955	Alfalfa, 2,147, grain, 1,070 cotton, 1,187 beans, 520 miscellaneous, 217	2.18	1.45	51.19	None	100.00	None	1.50	$2.50 and $1 per acre-foot	2.50	3.32	None	None	0.91	0.91	1.44	1.44	West Side
Woodbridge	Woodbridge	San Joaquin	1924	13,581	12,330	Mokelumne River	Ample	Farm	0	0	*8,184	Vines, 2,153, truck, 1,371 alfalfa, 1,046 grain, 946 miscellaneous, 118	1.50	1.70	42.73	0.58	100.00	0.02	2.00	Alfalfa, $1 vines, $2 per acre per season, annuals, $2.50 per acre per irrigation		1.97	None	None	1.97	1.99	1.94	1.99	Woodbridge

Per net amou	Excludin nterest o retired bonds
	(26)
	$13 1
	4 5
	46 5
	39 5
	30 6
	8 7
	32 8
	18 0
	8 6
	12 2
	83 9
	24 2
	27 4
	36 5
	21 3
	36 9
	14 9
	13 9
	8 3
	17 5
	18 7
	13 7
	8 1
	17 2
	18 4

Per net a amou	Excludin nterest o retired bonds
	(26)
	$13 1
	4 5
	46 5
	39 5
	30 6
	8 7
	32 8
	18 0
	8 6
	12 2
	83 9
	24 2
	27 4
	36 5
	21 3
	36 9
	14 9
	13 9
	8 3
	17 5
	18 7
	13 7
	8 1
	17 2
	18 4

TABLE 28 - Continued

COST OF WATER TO IRRIGATORS, IRRIGATION DISTRICTS, NORTHERN, CENTRAL AND SOUTHERN CALIFORNIA, 1929

Compiled from data furnished by the individual irrigation districts

Name of district	Location	County or counties	Year organized	Gross area in district, acres	Estimated irrigable area, acres	Source of water supply	Character of water supply as reported by district officers, average irrigation in 1929	Unit to which water is delivered by district	Percentage of water pumped	Lift, feet	Area irrigated, 1929: Total area irrigated, acres	Area irrigated, 1929: Crops, with acreages if available	Average amount of water delivered, acre-feet per acre	Average amount of water delivered, acre-feet per acre	Bonded debt per net acre, January 1, 1930	Total bonded debt retired, per net acre	Usual district assessed valuation per acre, 1929-1930	Interest on retired bonds per cent per acre at 6 per cent	Usual district tax per net acre for past two years	Water tolls: Rate schedule	Water tolls: Per acre-foot	Water tolls: Per acre for average amount used	Deductions—average, past two years: Bond principal tax per net acre	Deductions—average, past two years: Improvement tax per net acre	Annual cost of water: Per net acre for average amount delivered: Excluding interest on retired bonds	Annual cost of water: Per net acre for average amount delivered: Including interest on retired bonds	Annual cost of water: Per acre-foot for average amount delivered: Excluding interest on retired bonds	Annual cost of water: Per acre-foot for average amount delivered: Including interest on retired bonds	Name of district
Southern California																													Southern California
[illegible]	Beaumont	Riverside	1916	6 141	3 193	Wells and creeks	Ample	Ten acres	15	140	2 000	Deciduous trees, 2,041	.	0 46	$81 26	$11 65	$161 00	$0 70	$10 25	$2 per acre per annum	$8 22	$6 40	$1 97	$1 76	$13 11	$13 81	$16 38	$17 27	Beaumont
Imperial	Elt entre	Imperial	1911	665 000	512,000	Colorado River	Ample	Farm	0	0	424 115	Alfalfa, 245 775 field and truck, 94,189 grain, 48,191, cotton, 30 431, citrus, 10,848, vines 3,496 deciduous trees, 654 miscellaneous, 3 [illegible]	3 62	3 85	29 35	1 78	100 00	0 10	5 00	$0.35 per gale per day	0 05	0 05	0 85	None	4 50	4 60	1 17	1 19	Imperial
La Canada	La Canada	Los Angeles	1924	1 794	1,274	Canyons and wells	Ample	Five acres	22	.	800	Miscellaneous, 800	0 40	0 40	253 48	None	1,000 00	None	17 50	First 600 cubic feet, $2 per month, maximum, over 600 cubic feet, per month, $0 10 per 100 cubic feet	22 63	29 08	None	None	49 58	49 58	35 65	116 44	La Canada
Lakeside	Lakeside	San Diego	1924	130	288	San Diego River	100	10-40	100	40	60	Miscellaneous, 50	0 60	0 60	121 53	None	100 00	None	4 25	$2 minimum and $0 05 per 100 cubic feet	.	35 26	None	None	39 81	39 81	.	.	Lakeside
La Mesa, [illegible] and Spring Valley	La Mesa	San Diego	1913	18 000	13,500	San Diego River, Boulder Creek	Ample	Farm	41	300	5,601	Citrus, 2,827, field and truck, 760 deciduous trees, 100, miscellaneous, 648	0 87	0 87	183 40	0 74	350 00	0 04	5 00	.	27 63	25 58	None	7 82	34 66	70 73	35 35	35 29	La Mesa, Lem[illegible]
[illegible] Heights	Littlerock	Los Angeles	1912	3,073	2,972	Little Rock Creek, reservoir	Deficient	Farm	0	0	2,040	Deciduous trees, 2,040	0 95	0 95	121 15	2 78	100 00	0 17	9 50	.	None	None	0 71	None	9 79	9 96	9 25	9 43	[illegible] Rock [illegible]
Newport Heights	Costa Mesa	Orange	1918	1,540	1,360	3 wells	Ample	Five acres	100	84	4,200	Deciduous trees, 996, alfalfa 774 field and truck 449, miscellaneous, 1,981	1 94	1 94	190 45	None	840 00	None	10 00	$0 40 per hour for 25 inch head save lots to $2 00 per month, etc.	11 52	22 63	None	None	33 93	33 93	16 93	16 93	Newport Heights
Newport Mesa	Costa Mesa	Orange	1919	664	600	Wells along Santa Ana River	Ample	Five acres	100	120	510	Field and truck, 115, deciduous trees, 90, citrus, 40, alfalfa, 20 vines, 5, miscellaneous, 40	1 19	1 19	125 00	None	600 00	None	12 00	Various	6 15	7 68	None	1 63	18 03	18 08	15 17	15 17	Newport Mesa
Oildale	Oildale	Los Angeles	1919	4 756	4 756	Little Rock Creek reservoir, wells	Ample	40 acres	58	270	1,008	Deciduous trees, 386 grain, 120 alfalfa, 68 vines, 20 miscellaneous, 220	1 24	1 24	98 72	None	100 00	None	6 63	None	.	.	None	None	6 63	6 63	5 35	5 35	Oildale
Palo Verde	Blythe	Riverside Imperial	1923	8,000	20,000	Colorado River	Ample	Farm	7	3	22,753	Cotton, 21,120 alfalfa, 1,842, field and truck 3,161 grain 1,257	6 44	6 53	60 60	0 31	90 00	0 50	15 44	None	.	.	1 60	1 94	17 20	17 55	1 87	1 92	Palo Verde
Ramona	Ramona	San Diego	1925	630	650	San Dieguito River, wells	Ample	Farm	100	25-165	40	Field and truck, 40, alfalfa, 20	2 30	2 30	153 55	None	50 00	None	7 73	$1 00 per 1 000 cubic feet	34 83	40 15	None	None	42 00	42 00	16 46	16 46	Ramona
Rincon	Rincon	San Diego	1922	3 000	3,000	Lake Hodges, Lake Henshaw	Ample	Farm	0	0	1,183	Grain, 1,000 citrus, 183 miscellaneous, 200	0 91	0 91	104 11	None	400 00	None	13 00	$0 08 per 100 cubic feet	13 07	11 24	None	None	24 07	24 24	26 30	26 30	San Dieguito
Rincon-Paris Fe	Rincon-Paris Fe	San Diego	1923	10 000	6,000	Lake Hodges, Lake Henshaw	Ample	Ten acres	0	0	2,400	Citrus, 1,900 deciduous trees, 100, miscellaneous, 340	0 98	0 89	100 28	None	200 00	None	12 00	$0 07 per 100 cubic feet, minimum monthly charge, $1	34 [illegible]	34 54	None	None	46 54	46 54	30 78	30 78	Rincon
San Ysidro	San Ysidro	San Diego	1911	502	402	Wells	Ample	Five acres	100	100-200	130	Miscellaneous, 130	2 66	2 66	54 11	None	450 00	None	12 50	$24 per acre per year	.	24 00	None	None	36 50	36 50	[illegible]	[illegible]	San Ysidro
Sycamore Mesa	Pasadena	Los Angeles	1922	210	270	Wells	Ample	Farm, subdivisions must pay for own lines	100	172	257	Field and truck, 130, citrus, 127 deciduous trees, 20	1 31	1 31	133 39	37 39	850 00	2 24	12 00	Graduates from $0 [illegible] to $0 015 per 100 cubic feet	10 00	11 23	4 87	None	34 [illegible]	34 [illegible]	37 31	37 [illegible]	Sycamore Mesa
Tulare	Tulare	San Diego	1923	16 162	14,010	Lake Henshaw	Ample	Ten acres	0	0	4,119	Citrus, 2,301, field and truck, 1,544, deciduous trees, 192, vines, 82, miscellaneous, 50	1 80	1 80	116 38	None	150 00	None	11 70	Graduates from $0 04 to $0 07 per 100 cubic feet	19 39	23 27	None	None	35 97	36 [illegible]	20 00	20 [illegible]	Tulare
Walnut	Rivera	Los Angeles	1893	911	841	San Gabriel River	Ample	Farm	90	63	911	Citrus, 654, deciduous trees, 180 field and truck, 85, alfalfa, 6, miscellaneous, 8	1 76	1 76	None	None	1,000 00	None	10 00	$1 per hour 200 inches $0.50 per hour, 100 inches, day rate, eight rate, one-half amount over $0.25 hour, night rate	2 27	8 83	None	None	18 83	18 83	8 59	8 59	Walnut
Los Angeles Metropolitan Improvement District No. 1	Los Angeles	Los Angeles	1916	11 010	...	Los Angeles Aqueduct	Ample	Farm	.	.	.	.	.	1 67	31 25	14 17	425 00	0 85	3 83	Average, $0 018 per 100 cubic feet	1 94	12 09	0 93	None	19 46	19 46	8 [illegible]	8 [illegible]	Los Angeles Metropolitan Improvement District No. 1
												.	.	0 60	.	.	525 00	0 85	2 92	Deciduous	1 83	7 06	1 37	None	8 38	8 [illegible]	8 31	10 28	
												.	.	2 10	.	.	595 00	0 85	2 12	Citrus	7 84	16 46	1 11	None	17 57	18 37	8 38	8 76	
												.	.	1 27	.	.	625 00	0 85	1 43	Alfalfa	7 84	17 80	0 93	None	18 73	19 85	8 74	8 [illegible]	
											53,194	Deciduous trees, 12,744, citrus, 9,567, alfalfa, 6 489, miscellaneous, 28 500	.	1 67	25 64	12 40	350 00	0 74	1 10	Average, $0 018 per 100 cubic feet	7 84	13 06	0 87	None	13 [illegible]	18 50	8 24	8 [illegible]	
												.	.	0 96	.	.	330 00	0 74	1 07	Deciduous	7 84	1 05	0 82	None	8 11	8 83	8 [illegible]	9 [illegible]	
												.	.	2 10	.	.	110 00	0 74	1 46	Citrus	7 84	16 46	0 64	None	17 [illegible]	18 02	8 [illegible]	8 58	
												.	.	1 27	.	.	150 00	0 74	1 18	Alfalfa	7 84	17 80	0 85	None	18 17	19 31	8 18	8 [illegible]	Los Angeles County Water Works District No. 3
Los Angeles County Water Works District No. 3	Los Angeles	Los Angeles	1925	74,535	.	Los Angeles Aqueduct	Ample	Farm	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

* The meeting place of the board of directors.
* A small percentage of the water diverted is bonded.
* A considerable acreage outside the district is also served with water purchased from the district
* For a detailed description of each district see state of California, Department of Public Works, Bulletin No 31, "Irrigation Districts in California"
* No bond interest payments in 1929.
* Include some bonds of large maturity
* Some irrigation water derived from drainage wells.
* Computed on a yearly flow basis.
* Some acreage double cropped, omitted twice.

CHAPTER V

FARM IRRIGATION PUMPING PLANTS*

General Statement.

The 1920 United States agricultural census reported that out of 4,219,040 acres irrigated in California in 1919, 1,126,687 acres received their water supply entirely by pumping, while an additional area of 171,736 acres received a portion of its supply by the same means. Of the above total area, 914,743 acres were served from pumped wells and within this latter group is found the greater part of the area which receives its water supply by means of farm pumping plants. The census of 1930 is certain to show a marked increase both in the area irrigated by pumping and in the number of individual plants, particularly in areas having deficient gravity supplies where pumping from wells has been greatly increased during the dry years of the last decade. In the San Joaquin Valley several hundred deep-well turbines have been installed since 1919 to provide for drainage of irrigated lands.

California farmers have not been backward in using new kinds of pumps and these have been provided largely by California manufacturers whose engineers have made notable advances in design. In 1920, 26,019 of the 33,804 irrigation pumps reported by the census for the entire United States were centrifugals, only 677 being classed as turbines.

While the centrifugal pump has held its own for pumping from surface bodies of water, deep-well turbines and other deep-well pumps, often described as direct flow, axial flow and mixed pump turbines, have practically eliminated centrifugals for pumping from wells where the lift to the ground surface exceeds 30 feet. On low lifts, usually less than 20 feet, screw pumps have demonstrated their economy where relatively large flows of two second-feet and upward are pumped from surface bodies of water. The area irrigated by means of deep-well plunger pumps is decreasing. In the foothill area of upper San Joaquin Valley, however, where small flows of from 10 to 200 gallons per minute, often with lifts exceeding 200 feet, are obtained, deep-well plungers driven by electric motors continue to be numerous. It seems certain, therefore, that the 1930 United States agricultural census will show not only a large increase in the number of irrigation pumps, but also a decided difference in the distribution of types in use in California.

Statistics accumulated in 1925† showed approximately 40,000 electric motors with a combined rated capacity of 656,000 horsepower. The report of the State Railroad Commission for the year ending June 30, 1929, gives the following data on agricultural power service by public utilities:

Number of consumers	53,401
Connected load, kilowatts	648,597
Energy consumed, kilowatt hours	1,118,845,023
Revenue	$15,825,570

* This discussion prepared by C. V. Givan, junior irrigation engineer, University of California Agricultural Experiment Station.

† Moses, B. D., "Electrical Statistics for California Farms." California Agricultural Experiment Station Circular 316; 1929.

Internal combustion engines driving irrigation pumping plants, even in areas where rural electric distribution systems have been extended, are more numerous than might be expected. Statistics relating to them, however, are infrequently published. The 1920 census reported the rated capacity of "gas" engines, presumably those using both natural gas and gasoline for fuel, used to drive irrigation pumps at 237,316 horsepower, as against 257,268 horsepower of electric motors in the same service in the United States, and the greater part of these engines were being used in California. Probably the ratio of internal combustion engines to electric motors driving farm pumping plants is now lower. As an example of the present distribution, Fresno Irrigation District, embracing 239,000 irrigable acres, may be cited. A survey made by this district in the fall of 1928 showed 1864 pumping plants driven by internal combustion engines, compared with 1525 electric pumping plants, with an installed rated motor capacity of 15,506 horsepower, even though the Fresno Irrigation District area has one of the best gravity supplies from Kings River and also is supplied with an extensive net-work of power lines operated by a large public utility.

Factors Affecting Cost of Pumping by Means of Farm Irrigation Pumping Plants.

The total cost of pumping may be subdivided into the following items:

1. Depreciation
2. Interest
3. Taxes and insurance
4. Power or fuel charges
5. Lubricants
6. Repairs
7. Attendance

The first three items in the above segregation are commonly described as fixed charges, since the owner must pay them even if his equipment remains idle.

Depreciation.—Pumps, wells, motors, engines, foundations, and pump houses either wear out or become obsolete, and provision must be made for replacement of the capital invested in them when they are no longer useful. Except where unusual conditions, such as abrasive material or unusually corrosive chemicals in the pumped water, prevail, a useful life of fifteen years for electric-driven deep-well pumps has been assumed. It has been suggested that a term of twelve years more nearly approaches the actual normal life, but a large portion of the cost, particularly where the pumping lift is less than 100 feet, is for the pump head and motor, which are considered as having a normal life of 20 years. Many electric motors have been in service for longer periods of time. Depreciation is provided for through establishment of a sinking fund into which annual payments of sufficient amount are made, the sum total of which, accumulated with interest compounded annually, equals the amount of the initial investment. The following tabulation gives the annual amount as a percentage of the amount accumulated over the indicated periods of years when interest on the sinking fund is earned at the rates of 3, 4, and 6 per cent per annum:

Accumulation period corresponding to estimated life in years	Percentage of amount accumulated which is deposited in sinking fund annually, according to interest rate earned		
	3 per cent	4 per cent	6 per cent
8	11.25	10.85	10.10
10	8.72	8.33	7.59
12	7.05	6.66	5.93
15	5.38	4.99	4.30
20	3.72	3.36	2.72
25	2.74	2.40	1.82
30	2.10	1.78	1.23

Four per cent, compounded annually, is considered a reasonable rate of interest earned on sinking fund balances, as this rate, compounded semiannually, may be earned on savings deposits in California banks. Often, in making estimates of pumping costs in advance of plant construction a shorter life than might be reasonably expected is used, in order that the estimate may be on the "safe" side. For instance, some farmers feel that if pumping equipment can not be depreciated within a ten-year period without exceeding pumping costs considered as being economical, the enterprise is not feasible. Whether such procedure is justified, depends on other factors not considered herein, such, for example, as costs of crop production and conditions affecting marketing.

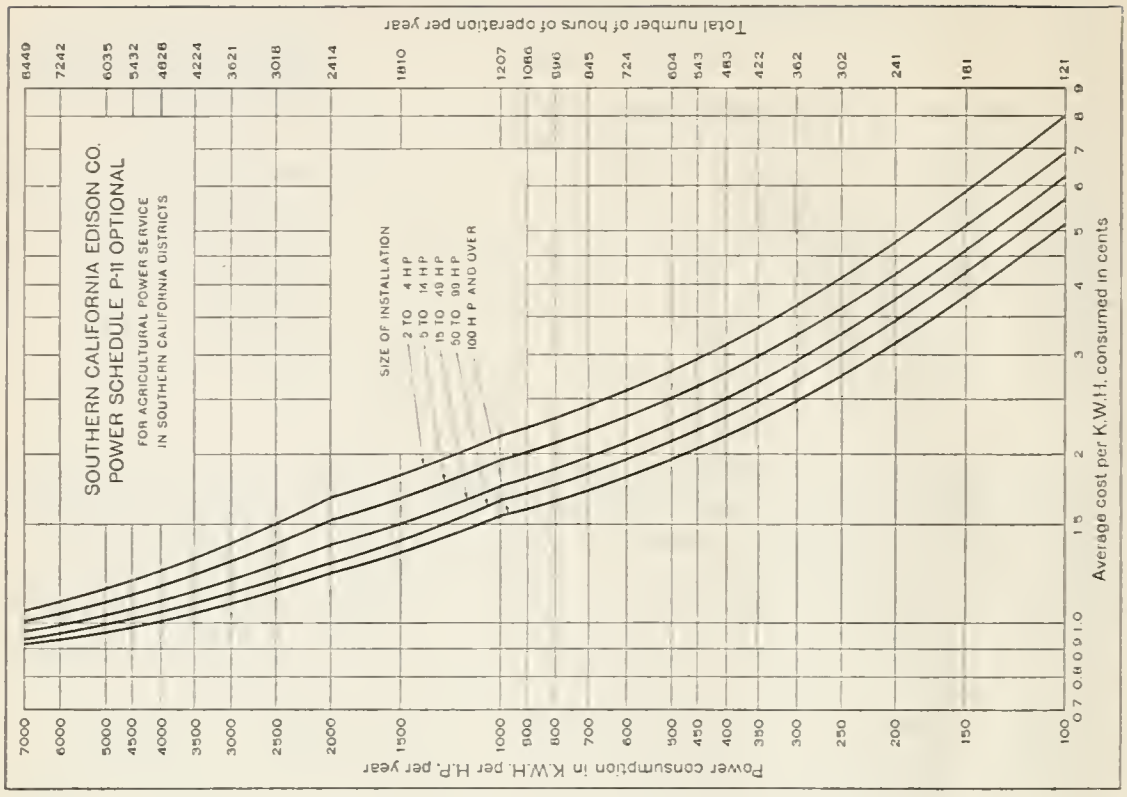
Interest.—When depreciation is accounted for by the method described above, interest on the full amount of the initial investment is properly chargeable. Six per cent per annum is considered a reasonable interest rate.

Taxes and Insurance.—Very few farm pumping plants are insured as the owner usually prefers to assume the risk from fire. County assessors have various methods of determining assessed valuations of wells and pumping equipment. Some assess wells and machinery at a certain percentage of a depreciated value, while others disregard the well and assess the plant on the basis of a flat sum for each rated horsepower of the prime mover. One per cent per annum has been taken as a fair allowance for taxes and insurance with the understanding that if insurance, particularly on large plants, is to be carried, an additional allowance is necessary.

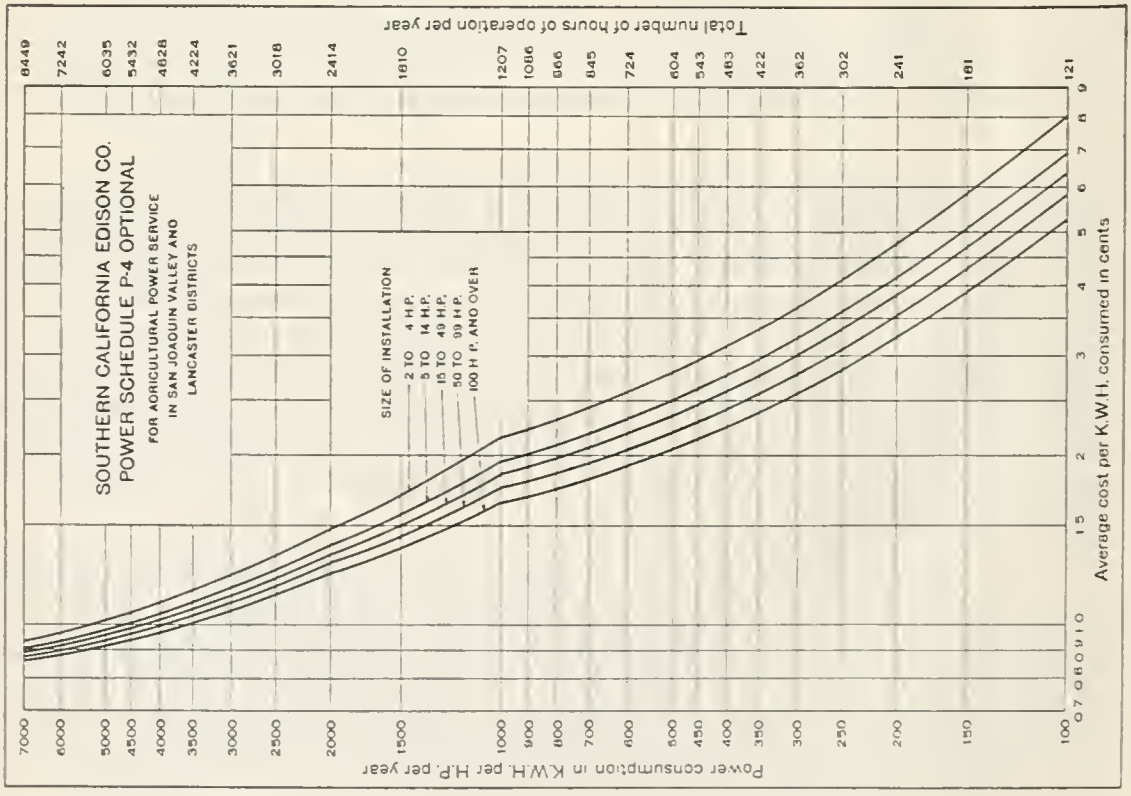
Electric Energy and Fuel Costs—Electric Energy.—The four diagrams presented in Plate X shows graphically agricultural power rate schedules of the principal public utilities serving electric energy to farm pumping plants in California. A typical rate schedule (graphically presented in Plate X-D) issued by a large public utility company operating in the San Joaquin Valley, is given in Table 29. It will be

PLATE X

B

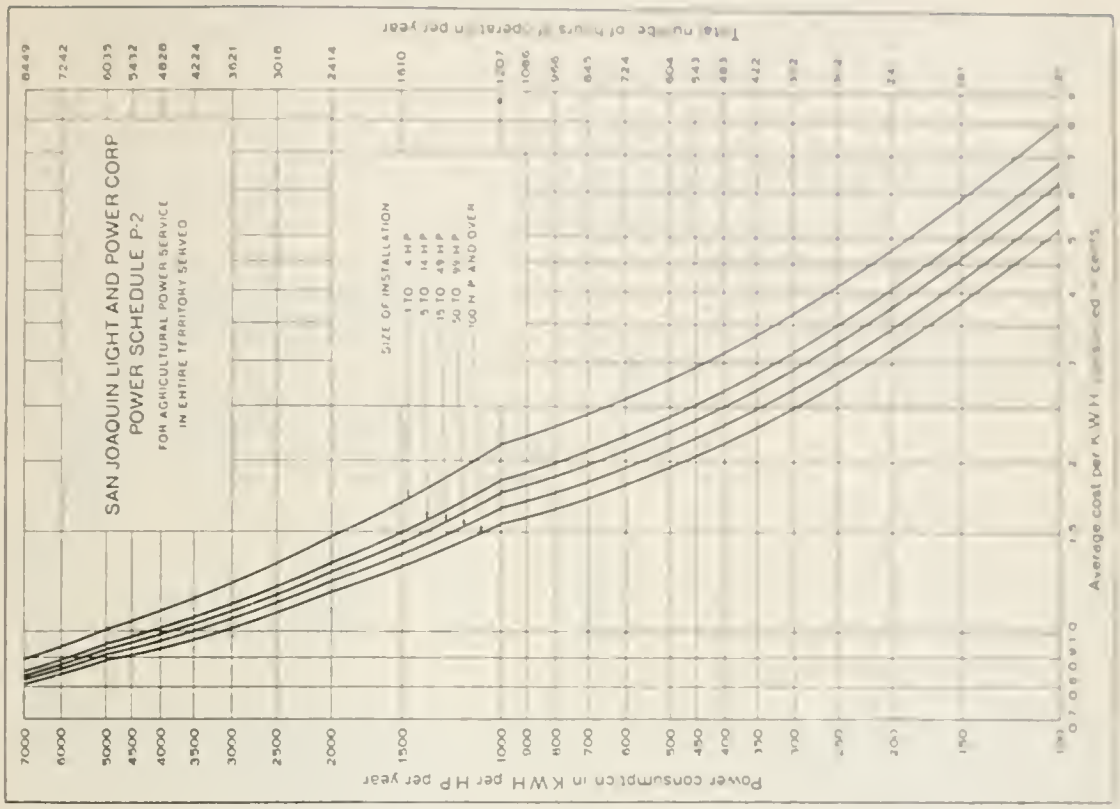


A

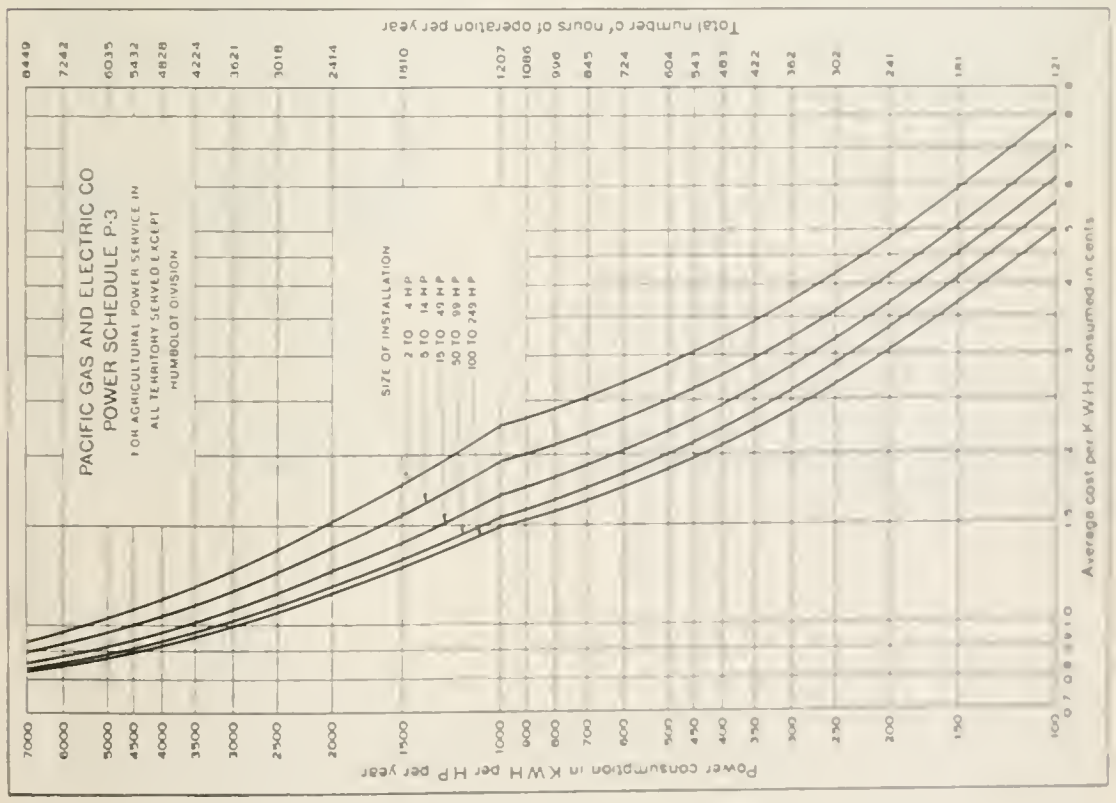


GRAPHIC PRESENTATION OF PRINCIPAL AGRICULTURAL POWER SCHEDULES.

D



C



GRAPHIC PRESENTATION OF PRINCIPAL AGRICULTURAL POWER SCHEDULES.

observed that the average cost per kilowatt hour consumed for each horsepower of connected load decreases as the connected load and consumption per unit of connected load increase.*

TABLE 29

AGRICULTURAL POWER SERVICE, SCHEDULE P-2, SAN JOAQUIN LIGHT AND POWER CORPORATION

Territory—Entire Territory Served

Size of installations in horsepower	Annual demand charge per horsepower	Energy charge in addition to demand charge; rate per kilowatt hour for consumptions per horsepower per year of			
		First 1,000 kilowatt hours in cents	Next 1,000 kilowatt hours in cents	Next 3,000 kilowatt hours in cents	All over 5,000 kilowatt hours in cents
1– 4	$6 50	1.50	0.8	0.7	0.6
5–14	5 50	1.30	0.8	0.7	0.6
15–49	5 00	1.25	0.8	0.7	0.6
50–99	4 50	1.20	0.8	0.7	0.6
100 and over	4 00	1.15	0.8	0.7	0.6

NOTE.—The above rates and charges may be based on horsepower of measured maximum demand occurring during the months in which the annual demand charges apply, instead of horsepower of connected load; provided the total connected load of the installation is 20 horsepower, or over, in which case the maximum demand shall not be taken as less than 75 per cent of the total connected load where the installation consists of one motor, and 50 per cent of the total connected load where the installation consists of two or more motors, and provided further that in no case shall the rates and charges be based on the maximum demand unless that maximum demand is at least 10 per cent greater or less than the total connected load.

The maximum demand shall be the greatest average horsepower demand registered during any fifteen-minute interval during the period in which the demand charges apply.

*Since preparation of the bulletin was completed, the Southern California Edison Company has been authorized to put a new agricultural power service rate schedule into effect in the San Joaquin Valley and the Lancaster district on May 1, 1931. This new schedule, P-4, is in addition to the annual horsepower service charge, and the rates per kilowatt hour consumed per horsepower of motor installation follows:

Size of installation in horsepower	First 1,000 kilowatt hours in cents	Second 1,000 kilowatt hours in cents	All over 2,000 kilowatt hours in cents
2– 4	1.50	0.8	0.7
5–14	1.30	0.8	0.7
15–49	1.25	0.8	0.7
50–99	1.20	0.8	0.7
100 and over	1.15	0.8	0.7

Under the new rate in no case will the total annual service charge be less than $13 for single-phase service, nor less than $19.50 for three-phase service.

Gasoline, Diesel Fuel Oil, and Natural Gas.—Table 30 gives the prices at which gasoline, Diesel fuel oil, and natural gas must be delivered to correctly designed internal combustion engines of types used to drive farm irrigation pumping plants, if the cost of fuel used by such engines is to equal the cost of electric energy delivered to a directly connected electric motor. Prices for electric energy ranging from 0.8 cent to 3 cents per kilowatt hour were selected as a basis for comparison, since the average annual prices paid by California farmers using electrically-driven farm irrigation pumping plants is well within this range. By far the greater amount of electric energy used is delivered by public utility companies at average annual prices of from one to two cents per kilowatt hour, as shown by the diagrams of power rate schedules in Plate X.

Approximately one kilowatt hour of electric energy delivered to an electric motor is required to produce 1.21 brake-horsepower-hours, assuming a motor efficiency of 90 per cent; or, in other words, 0.83 kilowatt hours, approximately, will produce one brake-horsepower-hour when the motor is fully loaded. Usually, electric motors are connected directly to most types of farm irrigation pumps. In such cases no energy is wasted in transmission from motor to pump. Because of their low operating speeds internal combustion engines of types commonly used to drive farm irrigation pumps are usually connected to the pumps by means of belts or gears. Correctly designed and maintained, belt drives have efficiencies of approximately 95 per cent, although many belt installations, particularly those in which the belt is twisted, consume 10 per cent or more of the engine brake-horsepower in transmission to the pump shaft. These factors have been taken into consideration in preparing Table 30. Rates of fuel consumption by engines have been increased to provide for the loss of power resulting from a transmission efficiency of 95 per cent. The rate at which electrical energy is consumed by electric motors has been computed as if these motors were connected directly to pumps.

A fuel consumption rate of about one-eighth gallon per brake-horsepower-hour at full load is usually guaranteed for gasoline engines. New engines, properly adjusted, meet such guarantees, but very often, after a season of operation without proper adjustment and maintenance, the consumption increases to one-sixth gallon per brake-horsepower-hour. It will be observed that the former rate of fuel consumption, when divided by a transmission efficiency of 95 per cent, is given in Table 30 as "Good performance," and the latter rate of consumption, using the same transmission efficiency, is termed "Fair performance."

Diesel engines are usually guaranteed to deliver one brake-horsepower-hour with a consumption of 0.06 gallon of fuel oil per brake-horsepower-hour at full rated load, and 0.07 gallon per brake-horsepower-hour at half rated load. Engines designed to use natural gas fuel (1150 British thermal units (Btu.) per cubic foot, approximately), when maintained in good condition and adjustment, deliver one brake-horsepower-hour at full rated load, measured at the engine pulley, for every ten cubic feet of natural gas consumed. Worn engines in poor adjusment may consume twelve cubic feet in doing the same amount of work. The lower rate of fuel consumption for each type of engine, has

been called "Good performance" and the higher rate of consumption "Fair performance" after these respective rates of fuel consumption have been divided by a transmission efficiency of 95 per cent.

The last six columns of Table 30 show the cost of electric energy supplied to motors at the selected prices of from 0.8 cent to 3 cents per kilowatt hour when such energy, less motor losses, is delivered directly to pumps having particular efficiencies of from 30 to 80 per cent. Costs of energy used, either electrical or in fuels, are given in cents for each acre-foot of water lifted against one foot of pumping head. The work done in lifting one acre-foot of water against one foot of pumping head is equal to slightly over 1.02 kilowatt hours, or its equivalent, 1.37 plus, horsepower-hours. It is apparent that, if fuels are delivered for prices given in Table 30, columns 2 to 7, inclusive, to engines which consume such fuels at the indicated rates per brake-horsepower-hour, delivered to the pump shaft, the total cost of fuel will be the same as the total cost of electrical energy when equivalent amounts of work are done.

The following example shows how the unit prices set forth in Table 30 may be used. Let it be assumed that a total amount of 500 acre-feet is to be lifted against a pumping head of 50 feet by means of a pump having an efficiency of 60 per cent. Electric energy in the amount required may be purchased for 1.4 cents per kilowatt hour delivered to an electric motor directly connected to the pump. Then from column 11, on line with selected price of 1.4 cents per kilowatt hour, a cost of 2.65 cents is indicated if one acre-foot is lifted against one foot of pumping head.

Since 500 acre-feet is to lifted 50 feet, the total cost in dollars of electric energy is obtained as follows:

$$\frac{500 \text{ (acre-feet)} \times 50 \text{ (feet)} \times 2.65 \text{ (cents)}}{100 \text{ (cents)} \times 1 \text{ (acre-foot)} \times 1 \text{ (foot)}}$$

or ---------- approximately $662.

If fuel costs 18.4 cents per gallon delivered to a Diesel engine consuming 0.06 gallon per brake-horsepower-hour delivered to the engine pulley, the total cost of fuel oil used also will amount to the same sum, approximately, as shown by the following operation:

$$\frac{500 \text{ (acre-feet)} \times 50 \text{ (feet)}}{0.60 \text{ (pump efficiency)}} \times \frac{18.4 \text{ (cents)}}{\text{(gallons)} \times 100 \text{ (cents)}} \times \frac{.06 \text{ (gallon)}}{\text{(Bhp-hr.)} \times 95 \text{ (belt efficiency)}} \times \frac{1.371 \text{ (Bhp-hr.)}}{1 \text{ (acre-foot)} \times 1 \text{ (foot)}}$$

or ---------- approximately $664.

TABLE 30

PRICES AT WHICH FUELS MUST BE DELIVERED TO ENGINES IF COSTS OF FUELS ARE TO EQUAL COSTS OF ELECTRICAL ENERGY DELIVERED TO MOTORS AT SELECTED UNIT PRICES, AND COSTS OF AMOUNTS USED IN PUMPING ONE ACRE-FOOT AGAINST PUMPING HEAD OF ONE FOOT

Fixed charges, repairs and attendance are not included

Selected prices of electrical energy in cents per k.w.h.	Equivalent prices at which gasoline must be delivered, in cents per gallon		Equivalent prices at which Diesel fuel must be delivered, in cents per gallon[1]		Equivalent prices at which natural gas must be delivered, in dollars per 1000 cubic feet		Electric energy or fuel costs in cents for lifting one acre-foot against one foot pumping head with selected unit prices of energy and equivalent fuel prices[6]					
Rate of consumption by direct-connected motor[2]	Range in rates of fuel consumption[3]		Range in rates of fuel consumption[3]		Range in rates of fuel consumption[3]		Pump efficiency					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
0.829 k.w.h.[4] per Bhp-hr.[5]	Good performance, 0.1316 gallons per Bhp-hr.[5]	Fair performance, 0.1755 gallons per Bhp-hr.[5]	Good performance, 0.0632 gallons per Bhp-hr.[5]	Fair performance, 0.0737 gallons per Bhp-hr.[5]	Good performance, 10.53 cubic feet per Bhp-hr.[5]	Fair performance, 12.63 cubic feet per Bhp-hr.[5]	30 per cent	40 per cent	50 per cent	60 per cent	70 per cent	80 per cent
Cents	Cents	Cents	Cents	Cents	Dollars	Dollars	Cents	Cents	Cents	Cents	Cents	Cents
0.8	5.01	3.78	10.5	9.0	0.630	0.525	3.03	2.27	1.82	1.52	1.30	1.14
1.0	6.30	4.72	13.1	11.2	0.787	0.656	3.79	2.84	2.27	1.89	1.62	1.42
1.2	7.56	5.67	15.7	13.5	0.945	0.787	4.55	3.41	2.73	2.27	1.95	1.71
1.4	8.82	6.61	18.4	15.7	1.10	0.919	5.30	3.98	3.18	2.65	2.27	1.99
1.6	10.1	7.56	21.0	18.0	1.26	1.05	6.06	4.55	3.64	3.03	2.60	2.27
1.8	11.3	8.50	23.6	20.2	1.42	1.18	6.82	5.11	4.09	3.41	2.92	2.56
2.0	12.6	9.45	26.2	22.5	1.57	1.31	7.58	5.68	4.55	3.79	3.25	2.84
2.5	15.7	11.8	32.8	28.1	1.97	1.64	9.47	7.11	5.68	4.74	4.06	3.55
3.0	18.9	14.2	39.4	33.8	2.36	1.97	11.40	8.53	6.82	5.68	4.87	4.26

[1] Diesel fuel oil, 24 [illegible] degrees Baume at 60 degrees Fahrenheit.
[2] Electric motor efficiency of 90 per cent assumed. Motor is connected directly to pump shaft, consequently, no allowance is made for power transmission losses.
[3] Power supplied by gasoline, Diesel and natural gas engines transmitted to pump shaft with assumed transmission efficiency of 95 per cent.
[4] K.w.h. is abbreviation of kilowatt hour of energy.
[5] Bhp-hr. is abbreviation of brake-horsepower-hour of energy delivered to pump shaft.
[6] Approximately, 1.127 k.w.h. delivered to motor, efficiency 90 per cent, if one acre-foot of water is lifted against pumping head of one foot by ideal pump with efficiency of 100 per cent.

Table 31 gives prices of gasoline and Diesel fuel oil, as quoted in December, 1930, delivered as indicated at several California distribution points. Gasoline prices include cost of delivery in small quantities to farms. During 1930 a great deal of gasoline was delivered in large quantities (500 gallons and upward) at much lower prices. Diesel oil prices include freight at carload rates from refinery to delivery point, the oil being conveyed in customers' packages. Recently Diesel oil, often delivered by tank truck to the pumping plant, has been sold in less than carload lots at prices of 5 cents upward per gallon.

TABLE 31

COST PER GALLON OF GASOLINE AND DIESEL FUEL OIL[1]

Location of delivery point	Gasoline[2]	Fuel oil[3]
	Cents per gallon	Cents per gallon
Sacramento	18.0	4.1
Fresno	17.0	3.9
Bakersfield	16.5	3.0
Lancaster	17.0	4.3
Riverside	17.0	3.4

[1] Cost based on prices quoted in December, 1930.
[2] Delivered in tank wagon to farm.
[3] F.O.B. railroad station in carload lots of not less than 30,000 pounds in customers' steel drums of approximately 53 gallons, 24 and 27 plus, degrees Baume, at 60 degrees Fahrenheit. Cost of hauling to pumping plant and storage charge should be added.

Natural gas is delivered by public utility companies to meter locations near the points of consumption. Table 32 gives a typical schedule of rates for natural gas furnished in southern California by one of these companies. A lower rate for natural gas sold by another company for use in internal combustion engines in the upper San Joaquin Valley was approved in 1930 by the State Railroad Commission.

Sometimes the owners of farm pumping plants must pay a part of the cost of a lateral pipe line, and such cost must be added to the charge for natural gas delivered at the public utility company's meter location.

TABLE 32

NATURAL GAS RATE SCHEDULE, NUMBER S-B, FOR GAS ENGINE SERVICE
SOUTHERN COUNTIES GAS COMPANY

TERRITORY—Applicable to all territory served in Los Angeles, Orange, San Bernardino, Ventura and Santa Barbara counties.

RATE "X"

First 100,000 cubic feet per consumer per month	$0.45 per 1,000 cubic feet
Next 400,000 cubic feet per consumer per month	0.40 per 1,000 cubic feet
Next 500,000 cubic feet per consumer per month	0.33 per 1,000 cubic feet
Over 1,000,000 cubic feet per consumer per month	0.30 per 1,000 cubic feet

Minimum charge: $3 per consumer per month; for continuous yearly service, accumulative minimum of $36 per consumer.

OPTIONAL RATE "Y"
Effective April 1 to November 30, inclusive

Y-1	$0.35 per 1,000 cubic feet with annual guarantee of 5,000,000 cubic feet
Y-2	0.30 per 1,000 cubic feet with annual guarantee of 10,000,000 cubic feet
Y-3	0.28 per 1,000 cubic feet with annual guarantee of 15,000,000 cubic feet
Y-4	0.25 per 1,000 cubic feet with annual guarantee of 20,000,000 cubic feet

Effective December 1 to March 31, inclusive, consumers served under optional Rate "Y" will pay rates as quoted under Rate "X". Gas consumed during this period will apply on annual guarantee shown above.

The fact that the total cost of pumping includes certain fixed charges against the pumping plant, as already explained, and the cost of attendance, lubricants, and repairing, which will be discussed later, in addition to the cost of electric energy or fuel, is to be constantly kept clearly in mind. Obviously, also, it must be possible to obtain fuel delivered to the engine at a cost considerably less than that of the electric energy required to do an equivalent amount of work if enough money is to be made available to pay for the additional fixed charges, repairs, lubricants, and attendance required to keep the engine and accessories in operation and maintained in good operating condition. In either case, also, a sufficient amount should be accumulated and made available for the purchase of a new motor or engine when it becomes necessary to replace the one in use.

Plant and Pump Efficiencies.—Tables 39 and 40 (presented in Appendix A) summarize efficiencies of 64 farm irrigation pumping plants tested in 1922 and 1923 by C. N. Johnston, M. B. Williams and W. B. Maher as published in 1925.* A series of tests of 304 farm irrigation pumping plants reported in 1925 by R. H. Cates, power engineer of the Southern California Edison Company, is of particular interest because the causes of low efficiencies of pumps among those tested were given, as follows:

Type of pumps tested	Number of pumps tested showing satisfactory efficiencies	Number of pumps tested with low efficiencies resulting from following causes:		
		Not fitted to conditions	Mechanical deficiencies	Worn out in long service or obsolete
Centrifugal	53	65	11	0
Turbine	70	66	13	13
Plunger	6	1	0	2
Air lift	0	4	0	0

The San Joaquin Light and Power Corporation maintains a field crew which annually tests several hundred farm pumping plants served by it. These records were open to inspection. In addition, a series of tests made by E. B. Abbett, California Lands, Inc., Fresno, was available.

Without presenting a statistical summary of the results of the above mentioned farm pumping plant tests, it may be stated that, even though a gradual improvement in overall plant efficiencies is apparent, about half of the plants tested had efficiencies of less than 50 per cent. Overall plant efficiencies considered as being attainable with reasonable care in selection and maintenance are given in Table 33.

* State of California, Department of Public Works, Bulletin No. 8, "Cost of Water to Irrigators in California," 1925, by Harry F. Blaney.

TABLE 33

REASONABLE OVERALL FARM IRRIGATION PUMPING PLANT EFFICIENCY PERCENTAGES

Type of plant	Capacity in gallons per minute[1]							
	100	250	450	900	1,350	1,800	2,250	2,700
Deep-well turbine directly connected to electric motor	25–35	35–40	45–55	55–65	60–65	65	65	65
Deep-well turbine belt-driven by electric motor	22–27	32–37	43–52	52–62	57–62	62	62	62
Centrifugal pump directly connected to electric motor	40–45	50–55	55–60	60–65	65–70	70	70	70
Deep-well plunger driven by electric motor	50–60	50–60	55–65	----------	----------	----------	----------	----------
Low-lift screw pump directly connected to electric motor	----------	----------	----------	50–55	55–60	65	65	65

[1] When pumping lift is less than 20 feet, approximately, centrifugal and deep-well turbines are operated at low speeds to obtain reasonable efficiencies for capacities exceeding approximately 200 gallons per minute.

Operation and Maintenance—Repairs.—Accurate records of the annual costs of repairing farm pumping plants, including the cost of parts replaced, extending over a term of years, are limited in number. Consequently, it is necessary to use estimates based upon rather limited data and the judgment of experienced operators. Data accumulated in 1930 in the upper San Joaquin Valley suggest the following estimates of annual allowances for repairs on deep-well turbines driven by directly connected electric motors as ample when capacities range from 450 to 900 gallons per minute.*

Rated capacity of electric motor driving pump, horsepower	*Estimated annual allowance for repairs*
5 and 7.5	$45
10	50
15	55
20	60
25	65
30	75
40	90
50	110
60	130
75	150
100	180

Annual repairs on internal combustion engines range from 2 to as high as 10 per cent of first cost, depending upon the size of engine, type, and character of attendance. Repairs on full Diesel and natural gas engines exceeding approximately 30 horsepower in size usually range from 2 to 5 per cent of first cost.

* Deep-well turbines operating in certain parts of Tulare Lake Basin are excepted because of gas, salts, and weak acid in water pumped from wells. In some localities in California it is difficult to prevent fine sand in water-bearing materials from entering deep-well pumps. Such material may cause sufficient wear to make necessary an additional allowance for repairs to pumps when capacities range from 450 to 900 gallons per minute.

Lubrication.—Consumption of lubricants by electrically driven deep-well turbines usually ranges from 50 to 100 hours per gallon. Some deep-well turbines have rubber bearings lubricated by water. Internal combustion engines use from 0.5 to 1.5 gallons of lubricating oil for each 1000 horsepower-hours of operation, although two-thirds of a gallon usually is a fair average consumption by large engines. Lubricating oil ranges in cost from about 40 to 60 cents per gallon.

Attendance.—Attendance of electrically driven farm pumping plants of moderate size is usually cared for by the farmer as a "chore," and consumes such a small part of his time that the cost is usually not considered in computing total pumping costs. When many electric motor driven plants must be operated, or when pumps are driven by engines which require considerable attention, an attendance charge for the time spent is justified and the amount is apparent, particularly if an operator is hired to keep the equipment operating.

Total Pumping Costs.

Table 34 gives the cost of water to irrigators using irrigation pumping plants on 44 farms in the upper San Joaquin Valley. In selecting these samples an attempt was made to include representative farms in Tulare, Kings, and Kern counties. However, since variation in pumping lift, depth of water applied, installed plant capacity per acre, hours of plant operation per acre, etc., was great, no attempt was made to compare the cost of pumping in the respective areas. It will be noticed that the cost of water per acre varies considerably on farms where like crops were grown and where pumping lifts were about the same. The principal reason for this difference in cost is variation in the ratio of the capacity of the pump to area irrigated and not variation in depth of irrigation water applied during the season.

In order to show the effect of the pumping lift and the duration of operation on the cost of pumping per acre-foot with deep-well turbines delivering 450 and 900 gallons per minute, respectively, Plates XI and XII have been prepared. The total annual cost of pumping includes interest at 6 per cent, taxes at 1 per cent, and depreciation at 5 per cent, on the cost of the deep-well turbine, motor, starting equipment and housing. Prices which prevailed in the first six months of 1930 were used in computing capital costs. Annual allowances to cover repairs, including lubrication, are indicated on these plates. Power charges were according to the P-2 schedule of the San Joaquin Light and Power Corporation.

The total annual cost of pumping, including the above items but not the annual charges on the well, was computed for operation times of 1000, 1500, and 2000 hour intervals. The maximum operation time considered was 8000 of the 8760 hours in the usual calendar year.

The slanting, discontinuous lines on Plates XI and XII show the estimated pumping costs per acre-foot for pumping lifts of from 20 to 250 feet from water level in wells to ground surface for the indicated hours of operation. The discontinuity results from the necessity of increasing the size of motor, pump head, and starting equipment at intervals of lift, the motor sizes being indicated to the right of the 1000-hour line. A flow of 450 gallons per minute for 1000 hours is

equivalent to 82.86 acre-feet and a flow of 900 gallons per minute doubles the volume.

It is interesting to note that if the 450 gallon per minute plant is operated 1000 hours per annum, water can be lifted 70 feet for approximately $5 per acre-foot, not including annual charges on the well, while if the operation time is increased to 3000 hours, about the same unit cost can be maintained with a lift of 160 feet.

Plate XIII is presented to compare the cost of pumping per acre-foot by means of the 450 gallon per minute turbine with a similar plant of double capacity when the quantity in acre-feet varies from the amount pumped between operation times of 2000 and 8000 hours for the smaller pump.

Plate XIV shows the combined annual charges for interest, taxes and depreciation per acre-foot of water pumped from 12 and 14-inch stove-pipe wells of from 150 to 600 feet in depth. The total costs upon which fixed charges were computed for the diagram include drilling, casing, and perforating. The normal life of each well was taken at 20 years and 3.36 per cent of the first cost was set aside annually to provide for replacement at the end of 20 years. Interest was charged at the rate of 6 per cent and an additional 1 per cent allowance made for taxes.

By combining costs given in Plate XIII with those in Plate XIV estimates of the total cost of pumping from 12 or 14-inch wells with either a 450 gallon per minute or 900 gallon per minute turbine may be obtained for comparison. Let it be supposed, for example, that the quantity to be pumped by either turbine is 300 acre-feet per annum, the well depth 400 feet and its diameter 14 inches. Furthermore, the lift is 150 feet, if 450 gallons per minute is the rate at which water is pumped, and is increased to 160 feet if the discharge is increased to 900 gallons per minute.

Then:

	Plant capacities, gallons per minute	
	450	900
From Plate XIII, cost of pumping, not including charges on well	$4.30	$5.50
From Plate XIV, annual charges on well	0.80	0.80
Total estimated cost of pumping per acre-foot	$5.10	$6.30

ATION PUMPING PLANTS IN CENTRAL CALIFORNIA

Principal items making up cost of water							
Power	Estimated repairs and lubricants	Estimated depreciation	Interest and taxes	Irrigation districts assessments and tolls	Number of pumps	Total connected load, horsepower	Approximate lift, feet
(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$10 96	$7 07	$4 53	$8 80	----------	1	10	150-175
9 20	13 10	5 85	6 05	----------	2	6	120
9 72	1 80	10 40	8 36	----------	20	91	
15 04	1 30	3 00	4 71	----------	1	50	161
10 54	0 61	1 76	2 53	----------	2	40	100
10 80	1 47	4 98	7 20	----------	1	40	120
7 68	0 39	1 33	2 13	----------	2	30	40
5 76	1 62	1 62	2 34	----------	1	10	33
4 71	0 64	1 17	1 94	----------	1	20	40
9 02	0 87	1 79	2 45	----------	2	35	95
7 50	1 00	1 68	2 38	----------	1	10	75
8 84	1 53	3 11	4 66	----------	1	15	79
12 00	2 63	5 52	8 53	----------	1	15	75
8 02	1 07	3 30	5 21	----------	1	20	103
9 39	0 79	2 23	3 97	----------	2	40	81
8 33	0 81	2 97	4 93	----------	1	25	90
7 36	0 72	2 27	3 21	----------	3	75	105-115
12 73	1 49	3 05	4 57	----------	1	15	110
9 52	1 14	2 25	3 39	----------	3	45	75
6 55	0 53	1 34	1 41	----------	3	45	60
					1	40	128
5 86	2 64	3 55	2 05	$1 49	1	30	135
					4	20	40
					1	50	140
4 42	0 71	2 78	2 10	2 59	3	22 5	50
					1	40	120
5 89	2 70	4 21	3 44	3 00	2	10	33-40
					3	45	110
2 17	0 23	0 86	1 49	3 92	4	27 5	35
3 24	0 95	0 73	0 84	2 15	1	10	45
9 41	2 27	2 27	3 18	2 45	1	5	41
4 45	1 51	1 67	2 54	2 51	1	7 5	42
6 71	0 79	1 82	1 74	----------	1	10	41
5 42	1 22	1 78	2 71	----------	1	15	50
5 96	0 70	2 04	1 72	----------	1	15	45
9 08	1 57	1 63	2 48	----------	1	15	40
11 28	1 39	1 39	1 94	----------	1	10	75
7 98	0 63	1 26	1 37	----------	4	50	35-40
9 36	0 75	1 48	2 54	----------	1	10	78
9 95	0 93	1 47	2 69	----------	3	55	80-90
12 00	2 78	3 67	5 17	----------	1	10	55
6 20	0 67	1 03	1 67	----------	5	85	50-65
6 63	0 54	1 22	2 65	----------	2	45	82-90
5 26	0 50	0 71	1 16	----------	5	225	110
6 74	1 57	1 57	2 51	----------	1	15	90
4 28	1 39	1 14	1 89	----------	1	75	40
6 80	0 67	0 83	1 29	----------	2	30	60-70
8 34	0 71	1 23	1 75	----------	6	85	60-90
3 82	0 55	0 62	1 03	----------	1	15	40

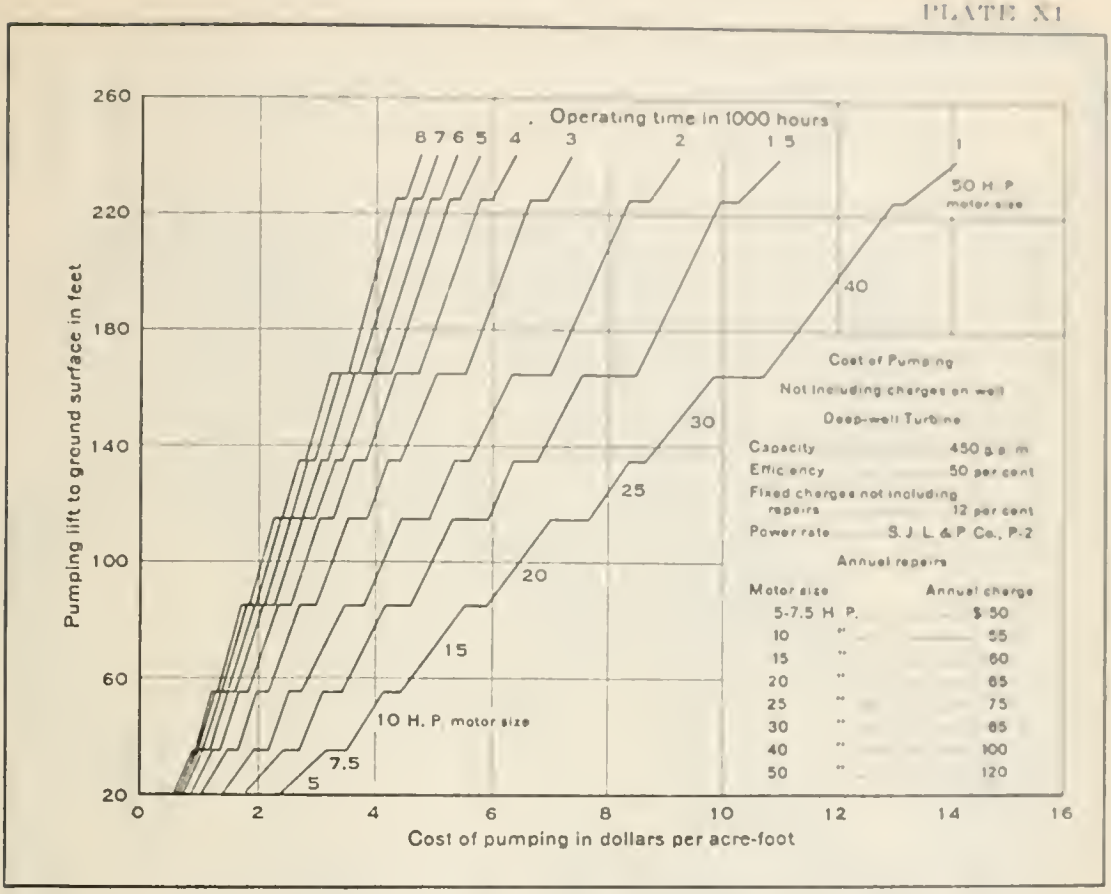
TABLE 34

COST OF WATER TO IRRIGATORS IN 1929 ON FARMS SUPPLIED EXCLUSIVELY BY FARM IRRIGATION PUMPING PLANTS IN CENTRAL CALIFORNIA

Location	Area and crops irrigated		Cost of water to irrigators, per acre	Principal items making up cost of water					Number of pumps	Total connected load, horsepower	Approximate lift, feet
	Total acres	Crops		Power	Estimated repairs and lubricants	Estimated depreciation	Interest and taxes	Irrigation districts assessments and tolls			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Two miles west of Lindsay	30	Oranges	$31 00	$10 96	$7 07	$4 53	$8 80	----------	1	10	150-175
One mile east of Orange Cove	20	Oranges	34 00	9 20	13 10	5 85	6 05	----------	2	6	120
Three miles southeast of Orange Cove	250	Oranges	30 00	9 72	1 80	10 40	8 36	----------	20	91	----------
One mile north of Arvin	100	Cotton	24 50	15 04	1 30	3 00	4 71	----------	1	50	161
One and one-half miles east of Lamont	141	Grapes, 95; alfalfa, 15; prunes, 15; figs, 10; peaches, 5	15 40	10 54	0 61	1 76	2 53	----------	2	40	100
One-quarter mile east of Arvin	75	Grapes, 40; cotton, 25; alfalfa, 10	24 40	10 80	1 47	4 98	7 20	----------	1	40	120
Three miles west, 1 mile north of Rosedale	155	Alfalfa	11 50	7 68	0 39	1 33	2 13	----------	2	30	40
One mile west of Rosedale	29	Alfalfa, 14; milo, 10; cotton	11 30	5 76	1 62	1 62	2 34	----------	1	10	33
One mile north of Bowerbank	95	Cotton, 65; alfalfa, 30	8 50	4 71	0 64	1 17	1 94	----------	1	20	30
One-half mile north of Shafter	120	Cotton, 65; potatoes, 24; beans, 16; grapes, 15; milo, 10; alfalfa, 8; double-cropped, 18	14 10	9 02	0 87	1 79	2 45	----------	2	35	95
One mile southwest of Shafter	50	Cotton, 18; grapes, 12; potatoes, 11; beans, 7.5; corn 2	12 60	7 50	1 00	1 68	2 38	----------	1	10	75
One-half mile south of Wasco	36	Grapes, 18; cotton, 18	18 10	8 84	1 53	3 11	4 66	----------	1	15	79
One mile north of Wasco	19	Cotton, 14; alfalfa, 5	28 70	12 00	2 63	5 52	8 53	----------	1	15	75
One and one-half miles west of Wasco	57	Cotton, 32; apricots, 10; peaches, 10; alfalfa, 5	17 60	8 02	1 07	3 30	5 21	----------	1	20	103
Three miles south of Wasco	158	Alfalfa, 70; cotton, 45; onion, 20; grain, 20; grapes, 3.5	16 40	9 39	0 79	2 23	3 97	----------	2	40	81
One and one-half miles northwest of McFarland	75	Cotton, 45; grapes, 20; alfalfa, 10	17 00	8 33	0 81	2 97	4 93	----------	1	25	90
Two miles west of McFarland	305	Grapes, 80; truck, 80; deciduous, 65; milo, 30; nursery, 20; alfalfa, 10; milo, grain, double-crop, 30	13 60	7 36	0 72	2 27	3 21	----------	3	75	105-115
One-half mile east of Pond	37	Cotton	21 80	12 73	1 49	3 05	4 57	----------	1	15	110
One-tenth mile west of Pond	145	Cotton, 120; alfalfa, 20; corn, 5	16 30	9 52	1 14	2 25	3 39	----------	3	45	75
Five miles west of Pond	310	Barley, 118; alfalfa, 92; clover, 80; sudan, 20	9 80	6 55	0 53	1 34	1 41	----------	3	45	60
Seven miles south, two miles west of Corcoran	1,000	Alfalfa, 360; barley, 280; wheat, 220; cotton, 80; corn, 30; pasture, 30	[a]15 60	5 86	2 64	3 55	2 05	$1 49	1 1 4	40 30 20	128 135 40
Five miles south, one mile west of Corcoran	600	Cotton, 300; wheat, 300	[b]12 60	4 42	0 71	2 78	2 10	2 59	1 3	50 22.5	140 50
Six miles south, two miles west of Corcoran	285	Alfalfa, 135; cotton, 120; barley, 30	[c]19 20	5 89	2 70	4 21	3 44	3 00	1 2	40 10	120 33-40
Two miles north, three miles west of Corcoran	1,600	Barley, 1,093; cotton, 427; alfalfa, 80	[d]8 70	2 17	0 23	0 86	1 49	3 92	3 4	45 27.5	110 35
One mile north of Corcoran	68	Cotton, 54; oats, 8; alfalfa, 6	[e]7 90	3 24	0 95	0 73	0 84	2 15	1	10	45
One-half mile south of Corcoran	22	Cotton, 12; alfalfa, 10	[e]19 60	9 41	2 27	2 27	3 18	2 45	1	5	41
One-tenth mile east of Corcoran	33	Cotton	[e]12 70	4 45	1 51	1 67	2 54	2 51	1	7.5	42
Four miles north, five miles east of Visalia	38	Grapes, 29; figs, 8	11 10	6 71	0 79	1 82	1 74	----------	1	10	41
Two miles west, four miles south of Visalia	45	Alfalfa and sudan	11 10	5 42	1 22	1 78	2 71	----------	1	15	50
Three miles west of Exeter	77	Peaches, 30; prunes, 30; grapes, 17	10 40	5 96	0 70	2 04	1 72	----------	1	15	45
Five miles east, two miles south of Tulare	35	Prunes, alfalfa, inter-crop	[f]15 20	9 08	1 57	1 63	2 48	----------	1	15	40
One mile north of Tulare	36	Alfalfa, 27; oats and corn, 9	16 00	11 28	1 39	1 39	1 94	----------	1	10	75
Two miles north, one mile west of Goshen	190	Alfalfa and grain, 130; grain, 60	11 20	7 98	0 63	1 26	1 37	----------	4	50	35-40
Seven miles west of Tulare	110	Alfalfa	14 10	9 36	0 75	1 48	2 54	----------	1	30	78
Eight miles west, four miles south of Tulare	154	Cotton, 106; alfalfa, 48	15 00	9 95	0 93	1 47	2 69	----------	3	55	80-90
One-half mile south of Waukena	18	Alfalfa	23 60	12 00	2 78	3 67	5 17	----------	1	10	55
Eight miles west, four miles north of Tulare	408	Cotton, 228; alfalfa, 80; barley, 80; grapes, 20	9 60	6 20	0 67	1 03	1 67	----------	5	85	50-65
Four miles south, two miles east of Tipton	245	Alfalfa, 100; cotton, 75; grapes, 70	11 00	6 63	0 54	1 22	2 65	----------	2	45	82-90
Nine miles east, four miles south of Tipton	1,250	Cotton, 630; barley, 410; grapes, 210	7 60	5 26	0 50	0 71	1 16	----------	5	225	110
One mile north, two miles east of Woodville	35	Corn, 15; barley, 15; cotton, 5	12 40	6 74	1 57	1 57	2 51	----------	1	15	60
One mile north, two miles west of Porterville	36	Cotton	8 70	4 28	1 39	1 14	1 89	----------	1	75	40
One mile west, four miles north of Tipton	163	Alfalfa, 143; corn, 20	9 60	6 80	0 67	0 83	1 29	----------	2	30	60-70
Four miles north of Tipton	468	Alfalfa	12 00	8 34	0 71	1 23	1 75	----------	6	85	60-96
One mile north of Angiola	100	Cotton, 60; barley, 40	6 00	3 82	0 55	0 62	1 03	----------	1	15	40

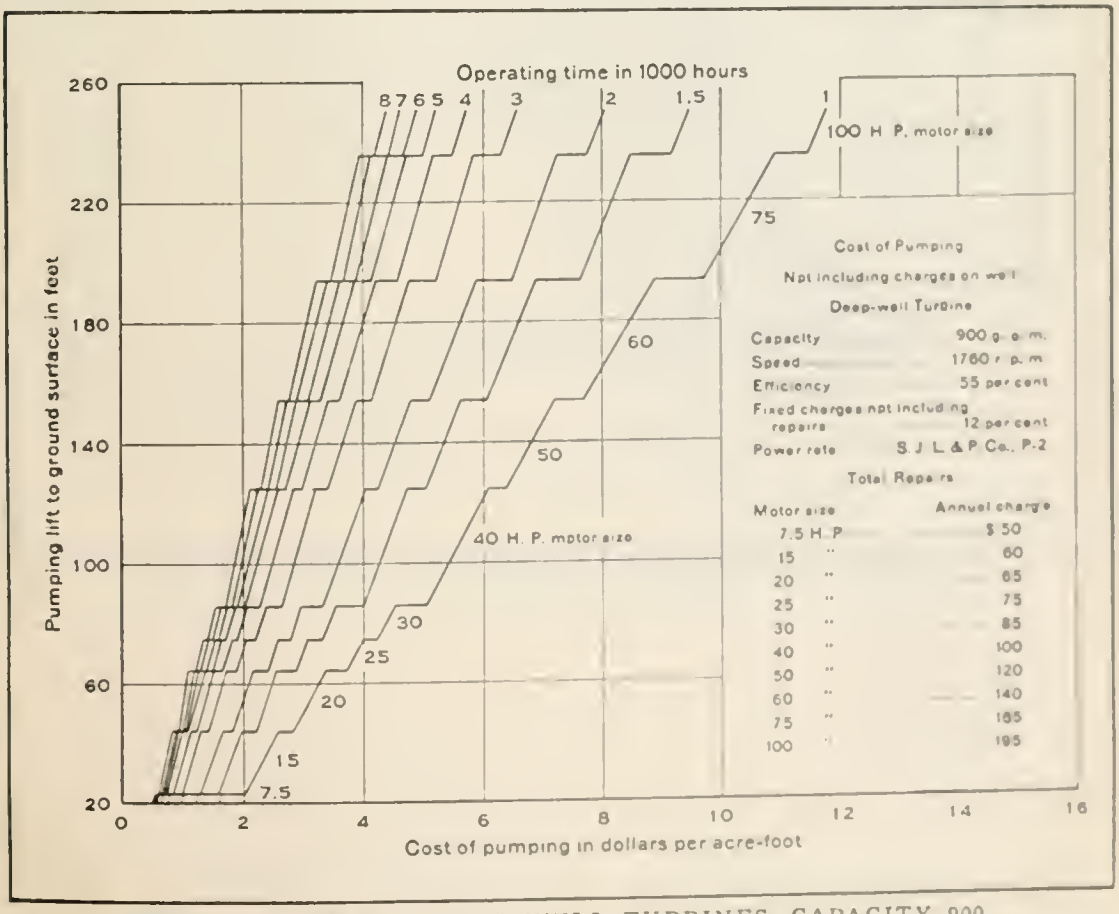
[a] 640 acres inside district; 105 acres irrigated once with gravity water.
[b] 154 acres irrigated once with gravity water.
[c] 134 acres irrigated once with gravity water.
[d] 924 acres irrigated once; 409 acres irrigated twice with gravity water.
[e] No gravity water used.
[f] Including $0.42 per acre, assessment and interest on 20 shares of Bliss Ditch stock; two irrigations of gravity water received.

PLATE XI



COST OF PUMPING, DEEP-WELL TURBINES, CAPACITY 450 GALLONS PER MINUTE.

PLATE XII



COST OF PUMPING, DEEP-WELL TURBINES, CAPACITY 900 GALLONS PER MINUTE.

PLATE XIII

COMPARISON OF COST OF PUMPING WITH DEEP-WELL TURBINES
NOT INCLUDING ANNUAL CHARGES ON WELLS

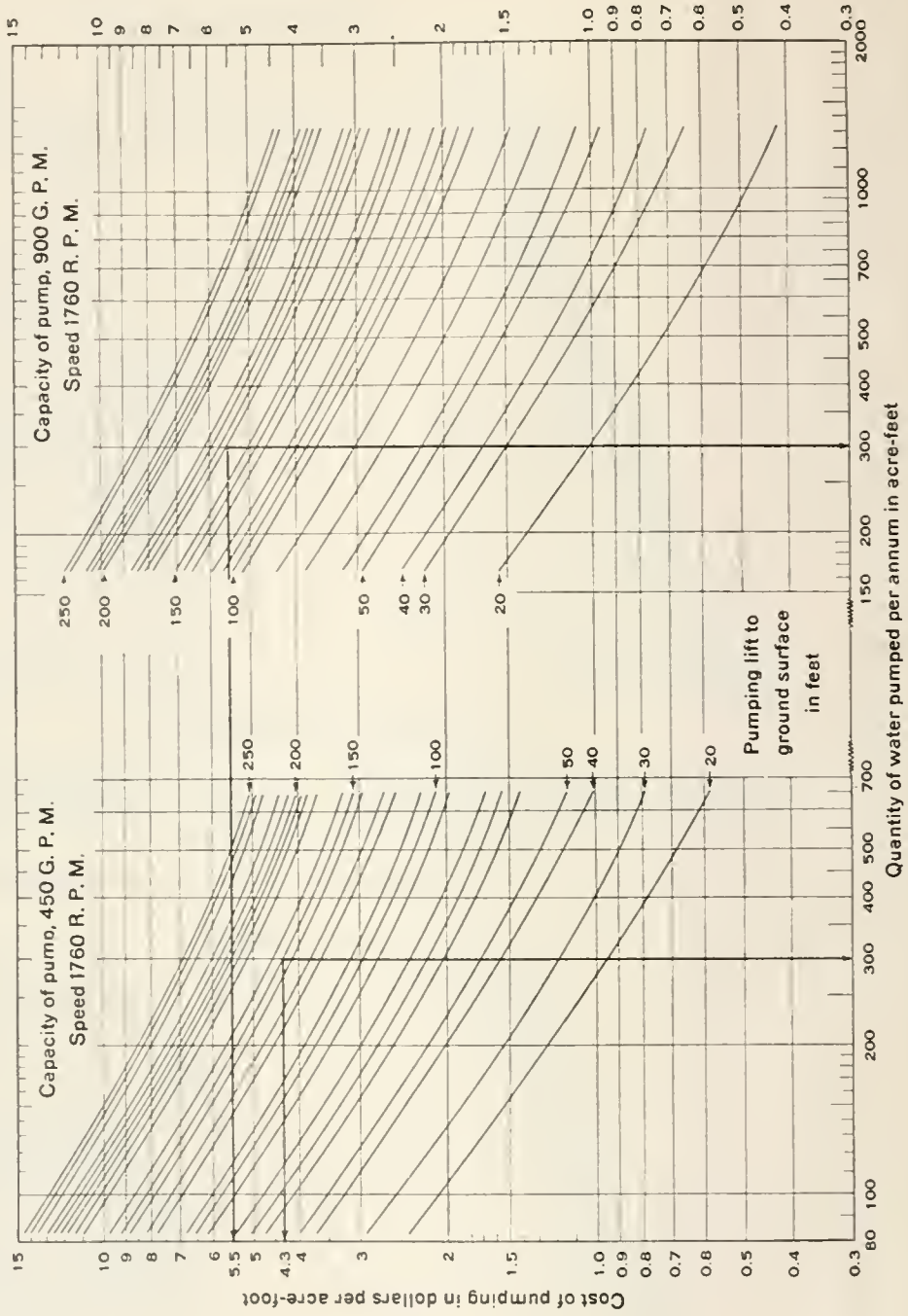
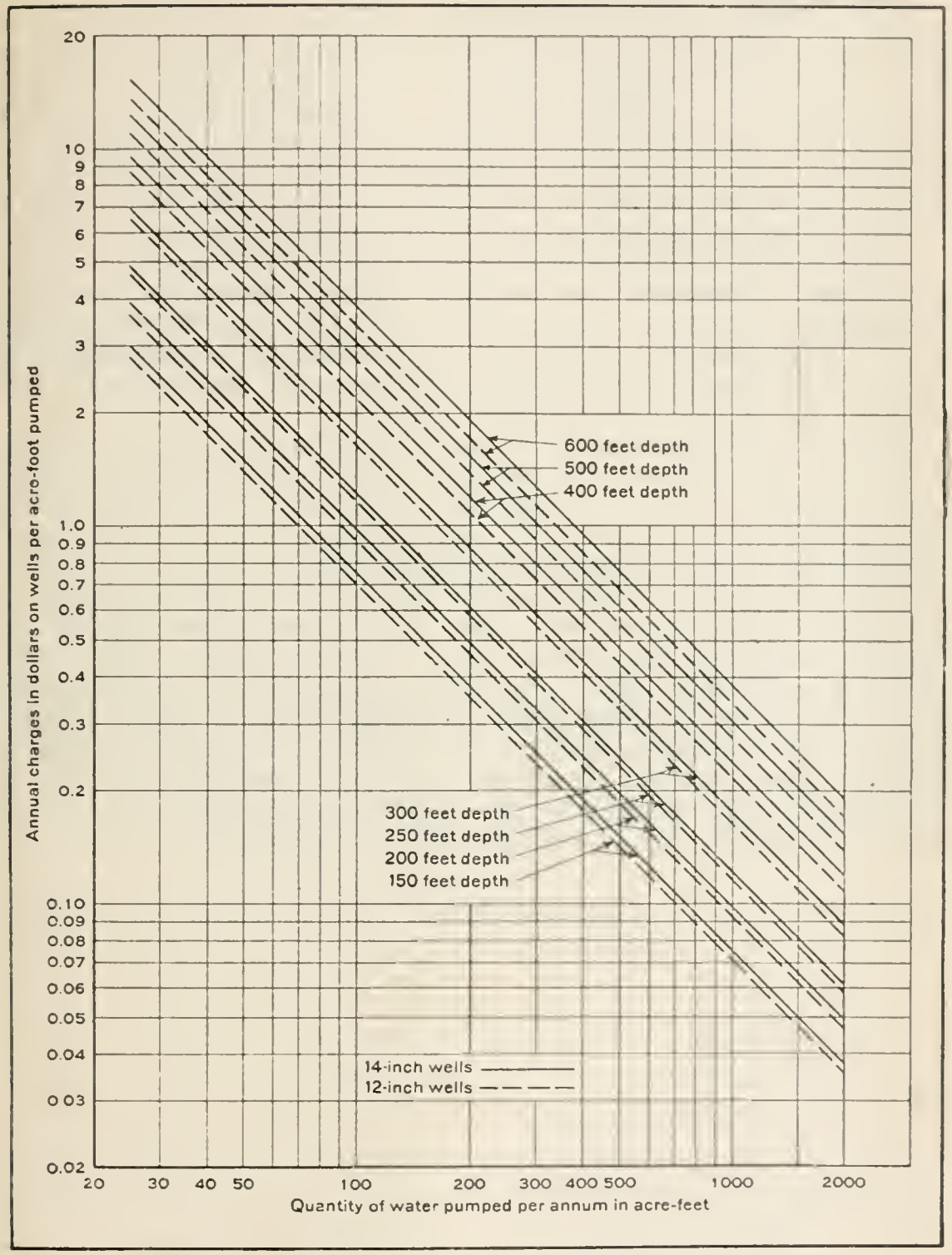


PLATE XIV



ANNUAL CHARGES ON PERFORATED STOVE-PIPE WELLS IN SAN JOAQUIN VALLEY.

7—81000

Examination of Plates X to XIV, inclusive, together with the illustrative examples, shows clearly the importance of operating a farm pumping plant for as long a period as possible if the cost of pumping is to approach the possible minimum. A glance at Table 34 discloses that, in general, the higher costs of pumped water per acre irrigated results from the use of large pumping plants to irrigate small areas, excepting, of course, farm pumping plants used to supply water for irrigating citrus orchards in the foothills of the upper San Joaquin Valley, where only small flows with high lifts are obtained.

Farm storage reservoirs, usually with earth embankments, are sometimes used to increase the operation period. Again, two or more farmers may cooperate in using a single plant if their respective farms do not require sufficient irrigation water to warrant a pumping plant for each, and farm systems may be so constructed that irrigation can be done at night without too much labor.

Table 30, columns 8 to 13 inclusive, shows the effect of variations in pump efficiency upon the cost of electric energy or fuels, and the four diagrams of electric energy rates presented in Plate X show the extent to which an increase of annual operation time will decrease the average cost of electric energy per kilowatt hour.

In actual practice, variations in the depth of water applied to various crops on various soil types by irrigators of varied skill are factors influencing the cost of water per acre irrigated when such water is supplied by farm irrigation pumping plants. Consequently, the value of even a large amount of carefully acquired data regarding actual costs of pumping for the irrigation of many separate farms is limited. This practical consideration makes it necessary to resort to the methods used in order to give useful data regarding the cost of water supplied by farm pumping plants to irrigators.

APPENDIX A

APPENDIX A

The tables which follow are reprinted from Bulletin No. 8, "Cost of Water to Irrigators in California," by Harry F. Blaney, Irrigation Engineer, Division of Agricultural Engineering, U. S. Department of Agriculture. That bulletin was published by the former Division of Engineering and Irrigation, State Department of Public Works. Since a small number of copies only were issued, it has been out of print for five years. The report was based on data gathered under cooperative agreement between the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture, the Department of Public Works of the State of California, and the University of California Agricultural Experimental Station.

tors in annual cost of water			Annual cost of water including interest on capital invested		
	Water charges				
	Per acre-foot	Per acre for average amount used	Per acre for first acre-foot	Per acre for average amount used	Per acre-foot for average amount used
	(17)	(18)	(19)	(20)	(21)
ches per month)		$3 50	[b]$2 00	$3 50	$1 06
4 hours	$2 02	3 23	2 02	3 23	2 02
ason		[c]6 00	6 00	6 00	5 26
4 hours	5 04	6 20	5 04	6 20	5 04
		5 00	5 00	5 00	1 47
ear		[c]7 00	7 00	7 00	4 12
ear		[d]8 18	8 18	8 18	6 01
4 hours	3 23	7 66	3 23	7 66	3 23
4 hours	2 02	5 56	2 02	5 56	2 02
4 hours	5 55	7 38	5 55	7 38	5 55
ason		[c]12 00	12 00	12 00	6 00
		2 30	2 30	2 30	0 92
year		7 80		7 80	1 30
urs—trees	1 51	1 51	1 51	1 51	1 51
urs—alfalfa	1 51	3 02	1 51	3 02	1 51
urs—rice	1 51	8 98	1 51	8 98	1 51
ed Irrigation District tax		1 11	1 11	1 11	0 53
		2 34	2 34	2 34	1 17
		1 00	1 00	1 00	0 50
hours	2 82	5 64	2 82	5 64	2 82
l—24 hours		1 50	1 50	1 50	0 39
l—24 hours	0 38	0 56	0 38	0 56	0 38
	0 38	0 90	0 38	0 90	0 38
—24 hours		1 50	1 50	1 50	0 60
—24 hours	0 38	1 16	0 38	1 16	0 38
—24 hours	0 38	0 89	0 38	0 89	0 38
	0 38	1 14	0 38	1 14	0 38
for 24 hours		1 50	1 50	1 50	0 39
for 24 hours	0 38	0 76	0 38	0 76	0 38
for 24 hours	0 30	1 52	0 30	1 52	0 30
for 24 hours	0 38	2 48	0 38	2 48	0 38
	0 38	1 03	0 38	1 03	0 38
for 24 hours		1 50	1 50	1 50	0 50
	0 38	1 24	0 38	1 24	0 38
00 average)		1 00	1 00	1 00	1 00
ns)	1 00	1 07	1 00	1 07	1 00
hours		3 00		3 00	2 00
	4 24	5 47	4 24	5 47	4 24
y		5 00	5 00	5 00	3 33
		1 75	1 75	1 75	0 80
nty		1 25	1 25	1 25	0 57
		2 25	2 25	2 25	1 02
ur	9 08	13 62	9 08	13 62	9 08
r hour	12 10	15 85	12 10	15 85	12 10
t	20 62	20 62	20 62	20 62	20 62
e)	25 14	25 14	25 14	25 14	25 14
ours (majority)	5 04	7 66	5 04	7 66	5 04
ours (alfalfa)	2 52	7 56	2 52	7 56	2 52
ours	10 10	10 10	10 10	10 10	10 10
	21 78	32 67	21 78	32 67	21 78
rs (beans and orchard)	5 04	7 56	5 04	7 56	5 04
er 24 hours (alfalfa)		5 54	2 52	5 54	1 85
	21 78	21 78	21 78	21 78	21 78

Forty-six miner's inches=1 second-foot.

[x]Acreage unknown

TABLE 35

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Public utilities in northern, central and southern California, 1922

Reprint of Table 1 of Bulletin No. 8, "Cost of Water to Irrigators in California"

Name of company	Address	County	Year organized	Source of water supply	Percentage of water pumped	Lift, feet	Area irrigated: Citrus trees, acres	Area irrigated: Deciduous trees and vines, acres	Area irrigated: Alfalfa, acres	Area irrigated: Grain, acres	Area irrigated: Rice, acres	Area irrigated: Miscellaneous, acres	Area irrigated: Total, acres	Average duty of water per acre at delivery gate, acre-feet	Factors in annual cost of water: Water charges: Rate	Water charges: Per acre-foot	Water charges: Per acre for average amount used	Annual cost of water including interest on capital invested: Per acre for first acre-foot	Per acre for average amount used	Per acre-foot for average amount used
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Northern California																				
Coneland Water Company[a]	Los Molinos	Tehama	1907	Mill and Antelope Creeks	0	0		x	x			x	10,000	3 30	$3 50 per acre (2-5 [i]miner's inches per month)		$3 50	[b]$2 00	$3 50	$1 06
Cottonwood Irrigation and Mining Company	Hornbrook	Siskiyou	1904	Cottonwood Creek	0	0							500	1 00	0 10 per [g]miner's inch per 24 hours	$2 02	3 23	2 02	3 23	2 02
El Dorado Water Corporation	Placerville	El Dorado	1919	American River, Webber Creek	0	0		4,800				200	5,000	1 14	30 00 per [g]miner's inch per season		[c]6 00	6 00	6 00	5 26
Excelsior Water and Power Company	Smartsville	Yuba and Nevada		Yuba River and Deer Creek	0	0		x	x			x	2,700	1 23	0 25 per [g]miner's inch per 24 hours	5 04	6 20	5 04	6 20	5 04
Natomas Water Company	Sacramento	Sacramento and El Dorado		American River	0	0	[a]300	1,383					1,683	3 40	5 00 per acre		5 00	5 00	5 00	1 47
North Fork Ditch Company	Sacramento	Placer	1899	American River	0	0	x	x				x	1,900	1 70	35 00 per [b]miner's inch per year		[c]7 00	7 00	7 00	4 12
Pacific Gas and Electric Company	Auburn	Placer	1905	South Yuba River	0	0		26,400					26,400	1 36	45 00 per [g]miner's inch per year		[d]8 18	8 18	8 18	6 01
Pacific Gas and Electric Company	Nevada City	Nevada	1905	South Yuba River	0	0		350					350	2 37	0 16 per [g]miner's inch per 24 hours	3 23	7 66	3 23	7 66	3 23
Pacific Gas and Electric Company	Oroville	Butte	1905	Feather River	0	0	x	x				x	1,500	2 75	0 10 per [g]miner's inch per 24 hours	2 02	5 56	2 02	5 56	2 02
Palermo Land and Water Company[f]	Palermo	Butte		Feather River	0	0	x	x					2,065	1 33	0 22 per [b]miner's inch per 24 hours	5 55	7 38	5 55	7 38	5 55
South Feather Land and Water Company[f]	Oroville	Butte and Yuba	1908	Lost Creek	0	0	x	x					1,800	[a]2 00	60 00 per [g]miner's inch per season		[c]12 00	12 00	12 00	6 00
Sutter-Butte Canal Company	Gridley	Butte and Sutter	1912	Feather River	5	27		4,741	2,814	2,618	28,037	18,568	56,778	2 50	2 30 per acre for most crops		2 30	2 30	2 30	0 92
														[a]6 00	7 80 per acre for rice year to year		7 80		7 80	1 30
Yolo Water and Power Company	Woodland	Yolo	1911	Cache Creek	0	0		2,104	9,333	523	9,419	2,085	23,464	1 00	3 00 per cubic foot per 24 hours—trees	1 51	1 51	1 51	1 51	1 51
														2 00	3 00 per cubic foot per 24 hours—alfalfa	1 51	3 02	1 51	3 02	1 51
														5 95	3 00 per cubic foot per 24 hours—rice	1 51	8 98	1 51	8 98	1 51
Central California																				
Consolidated Canal Company[f]	Fresno	Fresno	1901	Kings River	0	0		x	x			x	100,400	2 10	0 75 per acre+0.36 Consolidated Irrigation District tax		1 11	1 11	1 11	0 53
Eastside Canal and Irrigation Company	Newman	Merced	1887	San Joaquin River	0	0			x	x			6,500	[a]2 00	2 34 per acre (average)		2 34	2 34	2 34	1 17
Empire Water Company[e]	Lemoore	Kings	1906	Kings River	0	0		x	x	x			[a]16,000	[a]2 00	1 00 per acre		1 00	1 00	1 00	0 50
Foothill Ditch Company		Tulare						x		Field crops			1,800	[a]2 00	0 14 per [g]miner's inch per 24 hours	2 82	5 64	2 82	5 64	2 82
Kern County Canal and Water Company	Bakersfield	Kern		Kern River																
Anderson Canal Company	Bakersfield	Kern	1878	Kern River	0	0			x	x		x	[a]2,400	3 82	1 50 per acre		1 50	1 50	1 50	0 39
Buena Vista Canal Company	Bakersfield	Kern	1878	Kern River	0	0		125	3,281	1,964		3,409	8,779	1 47	0 75 per cubic foot per second—24 hours	0 38	0 56	0 38	0 56	0 38
Central Canal Company (Calloway	Bakersfield	Kern	1891	Kern River	0	0		856	13,115	5,378		3,747	23,096	2 37	0 75 per cubic foot per second—24 hours	0 38	0 90	0 38	0 90	0 38
				Kern River	0	0			6,760	980		3,080	10,820	[a]2 50	1 50 per acre		1 50	1 50	1 50	0 60
East Side Canal Company	Bakersfield	Kern	1892	Kern River	0	0		708	2,455	2,407		181	5,750	3 06	0 75 per cubic foot per second—24 hours	0 38	1 16	0 38	1 16	0 38
Farmer Canal Company	Bakersfield	Kern	1880	Kern River	0	0		30	1,340	580		803	2,753	2 35	0 75 per cubic foot per second—24 hours	0 38	0 89	0 38	0 89	0 38
Gates Canal Company	Bakersfield	Kern		Kern River	0	0							[a]300	[a]3 00	0 75 per cubic foot per second—24 hours	0 38	1 14	0 38	1 14	0 38
James Canal Company	Bakersfield	Kern	1878	Kern River	0	0			x	x		x	[a]6,800	3 82	1 50 per acre		1 50	1 50	1 50	0 39
Kern Island Canal Company	Bakersfield	Kern	1870	Kern River	0	0		x	x	x		x	35,015	1 69	0 75 per cubic foot per second for 24 hours	0 38	0 76	0 38	0 76	0 38
Kern River Canal and Irrigation Company	Bakersfield	Kern	1892	Kern River	0	0		550	3,720	1,324		311	5,905	5 06	0 60 per cubic foot per second for 24 hours	0 30	1 52	0 30	1 52	0 30
Lerdo Canal Company	Bakersfield	Kern	1892	Kern River	0	0		535	1,445	404			2,384	6 52	0 75 per cubic foot per second for 24 hours	0 38	2 48	0 38	2 48	0 38
Pioneer Canal Company	Bakersfield	Kern	1878	Kern River	0	0		10	2,550	1,235		5,140	8,935	2 70	0 75 per cubic foot per second for 24 hours	0 38	1 03	0 38	1 03	0 38
Plunkett Canal Company	Bakersfield	Kern	1878	Kern River	0	0			x	x		x	[a]1,000	[a]3 00	1 50 per acre		1 50	1 50	1 50	0 50
Stine Canal Company	Bakersfield	Kern	1878	Kern River	0	0		90	3,700	1,641		660	6,100	3 25	0 75 per cubic foot per second for 24 hours	0 38	1 24	0 38	1 24	0 38
Kings County Canal Company	Los Angeles	Tulare and Kings	1905	Floodwater Tule River	0	0							1,203	[a]1 00	1 00 per acre		1 00	1 00	1 00	1 00
Madera Canal and Irrigation Company	Madera	Madera	1888	Fresno and Merced Rivers	0	0		[a]4,900	[a]6,100			x	12,502	1 07	0 50 to 1 25 per acre-foot ($1.00 average)	1 00	1 07	1 00	1 07	1 00
Monterey County Water Company	Spreckels	Monterey	1901	Arroyo Seco River	0	0			1,200			900	2,100	1 50	1 50 per irrigation (2 irrigations)		3 00		3 00	2 00
Pacific Gas and Electric Company	Sonora	Tuolumne	1905	Stanislaus River	0	0		2,200					2,200	1 29	0 21 per [g]miner's inch per 24 hours	4 24	5 47	4 24	5 47	4 24
San Benito County Water Company	Hollister	San Benito	1908	San Benito River	0	0		1,000					1,000	1 50	5 00 per acre for 2 irrigations		5 00	5 00	5 00	3 33
San Joaquin and Kings River Canal and Irrigation Company	Los Banos	Merced	1905	San Joaquin and Kings rivers	0	0			[a]72,000			[a]7,877	79,877	[a]2 20	1 75 per acre in Merced County		1 75	1 75	1 75	0 80
San Joaquin and Kings River Canal and Irrigation Company	Los Banos	Fresno	1905	San Joaquin and Kings rivers	0	0								[a]2 20	1 25 per acre in Fresno County		1 25	1 25	1 25	0 57
San Joaquin and Kings River Canal and Irrigation Company	Los Banos	Stanislaus	1905	San Joaquin and Kings rivers	0	0								[a]2 20	2 25 per acre in Stanislaus County		2 25	2 25	2 25	1 02
Southern California																				
Appleton Land, Water and Power Company	Hesperia	San Bernardino	1911	Deep Creek	0	0		90	120				210	[a]1 50	0 015 per [b]miner's inch per hour	9 08	13 62	9 08	13 62	9 08
Bell Water Company	Bell	Los Angeles	1902	Wells	100								65	1 31	2 00 per 100 [b]miner's inches per hour	12 10	15 85	12 10	15 85	12 10
California Michigan Land and Water Company	Los Angeles	Los Angeles		Wells	100			x	x			x	[a]700	[a]1 00	0 04 and 0 20 per 100 cubic feet	20 62	20 62	20 62	20 62	20 62
Cuyamaca Water Company	San Diego	San Diego	1913	Boulder and San Diego rivers	0	0		x	x	x		x	4,000	[a]1 00	0 06 per 100 cubic feet (average)	25 14	25 14	25 14	25 14	25 14
Farmers Ditch Company	Santa Paula	Ventura	1917	Santa Clara River	0	0		x	x	x		x	4,200	1 52	0 20 per [b]miner's inch per 24 hours (majority)	5 04	7 66	5 04	7 66	5 04
										x				[a]3 00	0 10 per [b]miner's inch per 24 hours (alfalfa)	2 52	7 56	2 52	7 56	2 52
Lake Hemet Water Company[e]	Hemet	Riverside	1887	Lake Hemet	0	0	x	x	x			x	7,000	1 00	0 40 per [b]miner's inch per 24 hours	10 10	10 10	10 10	10 10	10 10
San Gabriel Valley Water Company	Los Angeles	Los Angeles	1908	Wells	100		200					x	[a]700	1 50	0 50 per 1,000 cubic feet	21 78	32 67	21 78	32 67	21 78
Santa Clara Water and Irrigation Company	Saticoy	Ventura	1871	Santa Clara River	0	0	x	x	x			x	2,250	1 50	0 20 per [b]miner's inch per 24 hours (beans and orchard)	5 04	7 56	5 04	7 56	5 04
									x					[a]3 00	0 04 to 0.10 per [b]miner's inch per 24 hours (alfalfa)		5 54	2 52	5 54	1 85
Sweetwater Water Company	National City	San Diego	1902	Sweetwater Reservoir	0	0	2,313	299	236			1,552	4,400	1 00	0 05 per 100 cubic feet	21 78	21 78	21 78	21 78	21 78

[a] Estimated. [b] Rate for one-fifth miner's inch per month. [c] One miner's inch to 5 acres, basis. [d] One miner's inch to 5.5 acres, basis. [e] Contract company. [f] Taken over by irrigation district [g] Forty miner's inches=1 second-foot. [h] Fifty miner's inches=1 second-foot. [i] Forty-six miner's inches=1 second-foot. x Acreage unknown

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TABLE 36

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Irrigation districts in northern, central and southern California, 1922

Reprint of Table 8 of Bulletin No. 8, "Cost of Water to Irrigators in California"

Name of district	Address	County	Year organized	Area in district, acres	Estimated irrigable area, acres	Source of water supply	Percentage of water pumped	Lift, feet	Area irrigated: Citrus trees, acres	Deciduous trees and vines, acres	Alfalfa, acres	Grain, acres	Rice, acres	Miscellaneous acres	Total, acres	Average duty of water at delivery gate, acre-feet	Total authorized bonded debt per acre	Bonded debt per acre (January 1, 1923)	Total bonded debt retired per acre	Usual district assessed valuation per acre for 1922-23	Factors in annual cost of water: Interest on retired bonds per acre at 6 per cent	Average district tax per acre for past two years	Water tolls: Kind of crops	Rate	Per acre-foot	For average amount used	Deductions, average past two years: Bond principal tax per acre	Permanent improvement tax per acre	Annual cost of water: Per acre for average amount used: Excluding interest on retired bonds	Including interest on retired bonds	Per acre-foot for average amount used: Excluding interest on retired bonds	Including interest on retired bonds
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
Northern California																																
Anderson-Cottonwood	Anderson	Shasta	1914	31,400	23,449	Sacramento River	9	12		847	2,279			x	5,283	[a] 4.00	$39.95	$37.15	$0.00	$860.00	$0.00	$5.10		None			$0.00	$0.00	$5.10		$1.28	
Ormnchel	Sacramento	Sacramento	1916	3,100	3,000	American River	100	55	x	Maximum					1,800	[a] 1.50	20.03	28.45	0.58	80.00	0.93	5.50		$2.50 per acre		$2.50	0.29	0	7.71	$7.74	5.14	
Citrus Heights	Fair Oaks	Sacramento	1920	3,028	3,000	North Fork Ditch Company	0		150	1,050					1,200	[a] 1.70	86.53	60.25	0	60.00	0	6.60		3.00 per acre		3.00	0	0	9.60		5.64	
Colusa	Marysville	Yuba	1919	5,512	5,412	Yuba River	0			x	x	x	Maximum	x	1,600	[a] 6.00	48.44	45.63	0	120.00	0	4.70		None			0	0	4.70		0.78	
Fair Oaks	Fair Oaks	Sacramento	1917	4,000	3,200	North Fork Ditch Company	0		1,600	600					2,200	2.40	50.00	40.00	0	80.00	0	3.40		$6.00 per acre		6.00	0	0	9.40		3.92	
Glenn-Colusa	Willows	Glenn, Colusa	1920	105,000	84,000	Sacramento River	94	5.8	x				34,500	x	42,000	0.50	34.64	31.63	1.27	30.00	0.08	2.56	Rice	0.67 per acre-foot	$0.67	4.62	0.58	0	6.60	8.68	0.96	
Glenn-Colusa	Willows	Glenn, Colusa														3.00					0.08	2.56	General	0.75 per acre (for first two acre-feet)		1.42	0.38	0	3.40	3.46	1.11	
Grenada	Grenada	Siskiyou	1921	5,080	4,064	Shasta River	100	64			2,400				2,400	[a] 2.00	47.74	47.24	0	200.00	0	12.00		None in 1922			0	0	12.00		6.00	
Happy Valley	Chico	Shasta	1891	18,277	10,731	Creek	0			2,000				200	2,200	0.50	41.86	40.49	0	80.00	0	9.00		None			0	0	9.00		18.00	
Jacinto	Orland	Glenn	1916	11,460	11,260	Sacramento River	94	5.8	40	349	767	60		1,196	2,412	2.25	20.77	10.33	0.44	80.00	0.93	2.85	General	$1.00 per acre		1.00	0.57	0	3.78	3.31	1.68	
Paradise	Paradise	Butte	1916	11,250	8,500	Little Butte Creek	0			1,570				1,090	2,660	1.00	43.56	43.56	0	50.00	0	5.40		None			0	0	5.40		5.40	
Princeton-Codora-Glenn	Princeton	Glenn, Colusa	1916	13,861	11,780	Sacramento River	100			2,000		x	1,800	x	5,000	[a] 0.61	12.83	12.03	0	67.50	0	1.33	Rice	$8.00 per acre		8.00	0		9.33		4.56	
Princeton-Codora-Glenn	Princeton	Glenn, Colusa				Sacramento River										[a] 2.00					0	1.33	General	2.75 per acre		2.75	0		4.08		2.04	
Reclamation District No 108		Colusa		55,000	50,700	Sacramento River	70	5					1,410		1,410	9.00							Rice	3.37 per acre		3.37			3.37		0.37	
Central California																																
Alpaugh	Alpaugh	Tulare	1915	8,058	8,064	21 wells	100	55		225	1,575	2,600			4,400	2.00	35.07	35.07	0	50.00	0	3.50		$0.50 per hour (200 inch head)	2.42	4.84	0	0.53	7.81		3.91	
Alta	Dinuba	Tulare, Fresno	1918	130,000	130,000	Kings River	0		900	64,100	x	3,000		x	100,000	[a] 1.50	3.84	3.15	0.63	45.00	0.04	1.15		None			0.10	0.15	0.99	0.94	0.60	
Byron-Bethany	Byron	Contra Costa	1919	17,600	11,313	Old River, San Joaquin	100	45 to 155			6,000				6,000	1.57	31.25	31.25	0	130.00	0	5.85		$2.50 per acre-foot	2.50	3.93	0	0	9.78		6.23	
Consolidated	Selma	Fresno, Tulare, Kings	1921	100,000	130,000	Kings River	0			Maximum	x	x	x		[a] 125,000	2.10	5.67	5.67	0	100.00	0	0.50		0.75 per acre		0.75	0	0	1.11		0.53	
Corcoran	Corcoran	Kings	1919	51,570		Kings River	0				x			x	16,000	3.26	14.74	14.74	0	100.00	0	1.40		0.50 and $1.00 per irrigation		2.00	0	0	3.40		1.04	
Fresno	Fresno	Fresno	1920	247,000	247,000	Kings River	0			[a] 194,000				x	215,000	1.64	8.23	8.23	0	100.00	0	1.27		None			0	0	1.27		0.69	
James	San Joaquin	Fresno	1920	26,500	20,000	Kings River and well	30	35		x		x			10,000	2.00	37.73	37.73	0	150.00	0	4.15		$2.00 per acre (gravity)		2.00	0	0	6.15		3.08	
James	San Joaquin	Fresno																			0	4.15		3.50 per acre (pumped)		3.50	0	0	7.65		3.83	
Lindsay-Strathmore	Lindsay	Tulare	1915	15,759	14,500	10 wells	100	300	Maximum	x					8,879	1.51	107.92	107.92	0	150.00	0	11.10		9.00 per acre-foot	9.00	13.59	0	0	24.69		16.35	
Merced	Merced	Merced	1919	100,000	116,000	Merced River	0			x				x	465,000	[a] 2.50	61.15	25.89	0	75.00	0	1.55		None			0	0	1.55		0.62	
Modesto	Modesto	Stanislaus	1887	81,183	75,000	Tuolumne River	0			17,273	21,496	9,985		12,898	60,652	3.50	51.93	51.11	0.87	60.00	0.05	5.22		None			0.36	1.23	3.63	3.68	1.45	
Oakdale	Oakdale	Stanislaus, San Joaquin	1909	74,246	63,000	Stanislaus River	0			6,019	8,918			5,459	10,296	3.30	52.33	52.33	0	54.25	0	3.60		None			0		3.60		1.12	
South San Joaquin	Manteca	San Joaquin	1909	71,112	50,100	Stanislaus River	0			9,643	32,185			9,375	51,203	2.40	60.96	60.11	0	100.00	0	5.25		None			0	[a] 0.37	5.88		2.45	
Terra Bella	Terra Bella	Tulare	1915	12,785	10,900	Well and stream	100	392	1,730	2,276				102	4,117	1.57	81.40	81.40	0	160.00	0	10.75		$10.00 per acre-foot	16.00	15.70	0	4.78	21.70		13.82	
Tranquillity	Tranquillity	Fresno	1918	10,750	10,150	Kings and San Joaquin rivers	20	12			7,000	3,000			10,000	1.80	24.19	24.19	0	150.00	0	6.00		None			0	2.25	8.25		2.08	
Turlock	Turlock	Stanislaus, Merced	1887	181,490	165,000	Tuolumne River	0			x	x	x		x	105,000	1.60	36.94	36.14	0.80	65.00	0.04	3.45		None			0.33	1.67	2.95	2.00	1.28	
Waterford	Waterford	Stanislaus	1914	13,577	10,747	Tuolumne River	0			1,361	1,130		200	x	3,108	3.20	49.35	49.35	0	90.00	0	4.00		None			0	0.44	3.56		1.11	
West Side	Tracy	San Joaquin	1915	11,800	11,765	San Joaquin River	100	63			3,523	4,360			10,671	2.00	46.19	46.19	0	100.00	0	7.50		None			0	0.15	7.45		3.68	
Southern California																																
Beaumont	Beaumont	Riverside	1919	3,176	2,000	Wells and creeks	50	50 to 100		2,936					2,936	.64	72.40	72.40	0	80.00	0	7.20		$7.00 per acre		7.00	0	0	14.20		22.19	
Imperial	El Centro	Imperial	1911	609,840	515,000	Colorado River	0		x	x	x	x		x	[a] 413,400	3.00	26.50	23.18	0	100.00	0	1.80		$1.00 per acre-foot (=$3.17)	1.00	3.00	0	0	7.97		2.66	
Little Rock Creek	Little Rock	Los Angeles	1892	3,073	3,050	Little Rock Creek	[c]				1,760				1,750	1.60	100.22	100.22	0	100.00	0	6.88		None			0	0	6.88		4.30	
Mesquite Mesa	Costa Mesa	Orange	1918	670		Wells	100	140			100			40	150	[a] 2.00	74.52	74.52	0	400.00	0	11.70	Alfalfa	$1.00 per irrigation		5.00	0	0	16.70		8.35	
Newport Mesa	Costa Mesa	Orange														[a] 1.50					0	11.70	Orchard	0.75 per irrigation		4.50	0	0	16.20		10.80	
Palmdale	Palmdale	Los Angeles	1916	4,756	[a] 90	Little Rock Creek	[c]				500				500	1.35	93.86	93.86	0	100.00	0	4.04		None			0	0	4.04		3.04	
San Pedro	San Pedro	San Diego	1912	40	492	Wells	100	75 to 168		x	x	x			130	2.36	50.82	50.82	0	225.00	0	9.00		$12.00 per acre		12.00	0	0	21.00		8.90	
Los Angeles Municipal Improvement District No 2		Los Angeles	1916	13,010		Los Angeles aqueduct										[a] 1.30	85.42	128.34	[d] 0.08	250.00	[e] 0.42	[a] 2.95	All (average)	0.014 per 100 cubic feet	6.10	7.93	[a] 1.32	0	9.56	9.98	7.35	
																[a] 1.00				300.00	[e] 0.42	[a] 3.55	Deciduous	0.014 per 100 cubic feet	6.10	6.10	[a] 1.59	0	8.06	8.48	8.06	
																[a] 2.00				800.00	[e] 0.42	[a] 5.91	Citrus	0.014 per 100 cubic feet	6.10	12.20	[a] 2.64	0	15.47	15.99	7.74	
																[a] 3.00				250.00	[e] 0.42	[a] 2.95	Alfalfa	0.014 per 100 cubic feet	6.10	18.30	[a] 1.32	0	19.93	20.35	6.64	
Los Angeles County Water Works District No 3	Los Angeles	Los Angeles	1914	74,535		Los Angeles aqueduct				8,495	15,381	7,078		25,324	56,278	1.30	134.95	128.71	[d] 0.41	700.00	[e] 0.27	[a] 3.19	All (average)	0.014 per 100 cubic feet	6.10	7.93	[a] 1.24	0	9.88	10.15	7.60	
																[a] 1.00				300.00	[e] 0.27	[a] 4.78	Deciduous	0.014 per 100 cubic feet	6.10	6.10	[a] 1.86	0	9.02	9.29	9.02	
																[a] 2.00				500.00	[e] 0.27	[a] 7.07	Citrus	0.014 per 100 cubic feet	6.10	12.20	[a] 3.10	0	17.07	17.54	8.54	
																[a] 3.00				200.00	[e] 0.27	[a] 3.19	Alfalfa	0.014 per 100 cubic feet	6.10	18.30	[a] 1.24	0	20.25	20.52	6.75	

[a] Estimated. [b] Operation and interest charges on irrigation works. [c] Consolidated Canal Company's water charge. [d] Average for U. S. only; 150,000 additional acres in Mexico. [e] Average of eleven mutual companies' assessments. [f] Aqueduct bonds not included. [g] Used 1922-23 tax rate and included aqueduct bond tax. x Average unknown.

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Butte-Glenn N		
Butte-Glenn N	3 00	
Durham State	3 80	
Elkhorn Mutu	1 25	
Hallwood Irrig	3 15	
Natomas Cent	-----	
Natomas Rive	3 44	
Orangevale W	4 00	
Orland Project	4 80	
Western Cana	1 84	
Western Cana	6 00	
	2 00	
Carter Water		
Consolidated E	3 47	
Delhi State La	-----	
Evans Ditch C	-----	-----
First Edison W	-----	
Jennings Ditch	5 12	
Lakeside Ditch	-----	
Last Chance W	-----	
Blowers Side	-----	
Independent	-----	
Lemoore Cana	-----	
Lerdo Mutual	-----	
Modoc Ditch C	0 00	
Patterson Wat	-----	
Peoples Ditch	7 00	
New Deal D	-----	
Riverside Di	-----	
Pioneer Water	-----	
Salinas Land C	3 45	
Second Edison	0 48	
Tehachapi Orc	8 80	
Tehachapi Vall	4 18	
Tulare Irrigatic	5 90	
Uphill Ditch C	-----	
Watson Ditch C	-----	
Wutchumna W	-----	
	-----	

* Estimated

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TABLE 37

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Mutual water companies in northern and central California, 1912

Reprint of Table 17 of Bulletin No. 8, "Cost of Water to Irrigators in California"

Name of company	Location	Year organized	Source of water supply	Land irrigated	Percentage of water company	Area irrigated: Citrus trees, acres	Area irrigated: Deciduous trees and vines, acres	Area irrigated: Alfalfa, acres	Area irrigated: Grain, acres	Area irrigated: Rice, acres	Area irrigated: Miscellaneous, acres	Area irrigated: Total acres	Average duty of water per acre at delivery gate, acre-feet	Capital stock: Number of shares of stock issued	Capital stock: Par value of stock, per share	Capital stock: Market value of stock, per share	Capital stock: Average number of shares, per acre	Capital stock: Value of stock, per acre	Factors in annual cost of water: Interest on value of capital stock, per acre at 6 per cent	Factors in annual cost of water: Average annual assessment, per acre	Factors in annual cost of water: Water rate: Schedule	Factors in annual cost of water: Water rate: Per acre-foot	Factors in annual cost of water: Water charge per acre, for average amount used	Factors in annual cost of water: Amount per acre deposited in sinking fund or charged to capital stock	Annual cost of water: Per acre for first acre-foot: Excluding interest on value of capital stock	Annual cost of water: Per acre for first acre-foot: Including interest on value of capital stock	Annual cost of water: Per acre, for average amount used: Excluding interest on value of capital stock	Annual cost of water: Per acre, for average amount used: Including interest on value of capital stock	Annual cost of water: Per acre-foot, for average amount used: Excluding interest on value of capital stock	Annual cost of water: Per acre-foot, for average amount used: Including interest on value of capital stock
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)
Northern California																														
Butte Creek Mutual Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		12			180		192	5.60	.174	$7.00		1.000	$7.00	$0.42	$0.25	$1.00 per acre, [illegible]		$1.00	$1.00	$1.42	$1.67	$1.25	$1.67	$2.[illegible]	
Butte-Glenn Mutual Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]								1.06						0.42	.05	$.50 per acre, general		1.00	1.00	1.42	4.47	1.05	4.47	1.42	4.42
Durham State Land Settlement	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		10	1.0			1,800	2,810	1.25					$50.00	3.00	0.00	$.10 per acre-foot	$1.00	1.25	0.00	4.10	4.10	1.35	4.10	1.08	3.28
Hilgard Mutual Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		110				1,000	2,000	1.15	1,000	10.00		1.00	10.00	2.40	1.00	$.10 per acre-foot	.10	1.15	0.00	6.70	6.70	4.15	6.83	1.[illegible]	[illegible]
Hallwood Irrigation Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							4,000	1.00	6,000	1.00	$2.00	1.00	6.00	1.08	1.50					2.58	2.58	1.50	2.58	1.50	2.58
Natomas Central Mutual Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						765	8,[illegible]	0.80	[illegible]	10.00		1.000	6.00	1.92	0.50	$.50 per acre-foot	4.00	.88	0.00	4.23	6.42	3.04	5.88	4.58	[illegible]
National Rice-milling Mutual Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		11				1,383	1,[illegible]	1.60	1,[illegible]	10.00		1.000	47.00	2.82	1.40	$.40 per acre-foot	4.00	4.00	0.00	5.60	7.82	5.00	7.82	5.00	[illegible]
Orangevale Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							2,[illegible]	1.92					$20.00	1.20	0.50	24 dollars per month each per season		4.00	0.00	5.40	6.50	5.30	6.53	[illegible]	[illegible]
Pilot Project, Sacramento Valley Reclamation Service	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1.45			4,1[illegible]	17,[illegible]	1.34				1.000	0.00	1.00	1.00	$.75 per acre, 3 acre-feet		1.84	0.00	1.75	1.75	1.84	1.84	0.85	[illegible]
Western Canal Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							14,[illegible]	1.94	[illegible]	1.00		1.000	1.00	0.00	0.40	$.00 per acre, rate		0.00	0.00	6.00	6.00	6.00	6.00	1.00	[illegible]
Western Canal Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]								1.00						0.00	0.00	$.00 per acre, general		2.11	0.00	2.06	2.06	2.00	2.06	1.00	[illegible]
Central California																														
Carter Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		10					140	6.41	140				[illegible]	.06	0.00	$3.42 per day-inch	8.07	.46	0.00	8.07	11.07	3.47	11.45	8.07	[illegible]
Consolidated Peoples Water Ditch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		4,[illegible]	4.1[illegible]			0,500	15,000	60		100.00	[illegible]	1.000	[illegible]	0.50	0.05				0.00	0.88	1.38	0.88	1.38	[illegible]	[illegible]
Durham State Land Settlement	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1.[illegible]			2,[illegible]	1,[illegible]	6.00							0.75	Flat rate $4.15				3.91	3.91				[illegible]
Fresno Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							900	1.00	[illegible]	100.00	1.00	1.000	5.00	0.00	3.40	None			0.00	3.50	6.40	3.50	6.40	3.[illegible]	[illegible]
First Edison Well Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		81					57	3.00	85	50.00		1.000	5.00	0.00	0.00	$.00 per 1,000 hour-inch	2.00	1	0.00	9.99	12.99	20.07	[illegible]	[illegible]
Jennings Ditch Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						230	1,[illegible]	[illegible]	48	6.00	50.00	1.000	5.00	0.00	0.00	None			0.00	3.24	3.24	2.48	[illegible]	[illegible]
Lakeside Ditch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							10,[illegible]	50	[illegible]	1.00	[illegible]	1.000	5.00	0.00	0.72	None			0.00	1.06	1.06	0.7[illegible]	1.06	0.[illegible]	[illegible]
East Chance Water Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	66	85	1,000.00	1,500.00	1.240	[illegible]	0.00	0.83	None			0.00	0.83	0.83	0.83	0.83	0.85	[illegible]
Flowers Side Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	55					1.00	0.00	0.00	None			0.00	0.70	0.70	0.70	0.70	0.67	[illegible]
Independent Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		95					3,[illegible]	3.[illegible]	8				14.00	0.00	0.00	None			0.00	1.05	1.05	1.05	1.05	0.85	[illegible]
Kennedy Land and Irrigation Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				2,[illegible]	[illegible]	1,140	5,[illegible]	1.[illegible]	70		2,000.00	4,000.00	5.00	0.85	0.[illegible]	None			0.00	4.00	4.85	1.00	4.85	0.10	[illegible]
Reed's Mutual Water Company, No. 9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		54					[illegible]	4.[illegible]	4	1.00	5.00	5.00	[illegible]	0.00	0.00	$.00 per acre			0.00	12.10	12.10	1.00	1.[illegible]	[illegible]	[illegible]
Sterling Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		43	[illegible]		1,[illegible]	[illegible]	[illegible]	[illegible]	100	100.00	400.00	0.075	10.00	0.60	1.00	None			0.00	1.40	1.40	1.40	1.40	0.70	[illegible]
Tell Fork Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		1,[illegible]	[illegible]	[illegible]			1,[illegible]	[illegible]	[illegible]	10.00		1.000	10.00	0.60	0.00	[illegible]			0.00	7.60	7.60	7.60	7.60	8.[illegible]	[illegible]
Peoples Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							50,[illegible]			100.00	8,000.00	640	5.00	0.83	0.00	None			0.00	0.93	0.93	0.93	0.93	[illegible]	[illegible]
New Dead Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]			100.00		[illegible]	.50	0.45	0.82	None			0.00	1.07	1.60	1.07	1.60	0.22	[illegible]
Riverside Ditch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]		100.00	100.00	50	[illegible]	0.42	0.00	None			0.00	1.37	0.85	1.37	0.85	[illegible]	[illegible]
Pioneer Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]		[illegible]	[illegible]	[illegible]	100.00	15.00	.00	15.00	1.08	1.[illegible]	$.10 per [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.77	.69	4.[illegible]	3.15	[illegible]
Rubiano Land Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]							0.00	0.00	$.15 per acre			0.00	11.48	11.48		9.[illegible]	9.[illegible]	[illegible]
Sewell Hudson Well Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							[illegible]	[illegible]	[illegible]	[illegible]		1.000	50.00	0.00	0.[illegible]	$1.00 per 1,000 [illegible]	[illegible]	[illegible]	[illegible]	15.00	17	16.17	9.[illegible]	[illegible]
Tehachapi Orchards Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]	1.46	[illegible]	50.00	50.00	1.000	50.00	1.00	0.00	[illegible]	[illegible]	[illegible]	[illegible]	12.08	4.18	7.18	9.09	[illegible]
Tehachapi Valley Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]	1.67		[illegible]	100.00	1.000	100.00	6.00	0.85	[illegible]	[illegible]	[illegible]	[illegible]	10.56	6.35	[illegible]	14.11	[illegible]
Tulare Irrigation Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]			100.00	[illegible]	0.100	[illegible]	0.45	0.50	None			0.00	2.[illegible]	2.[illegible]	1.78	[illegible]	0.50	[illegible]
Tybill Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]			100.00	40.00	0.553	10.00	0.84	0.98	None			0.00	1.82	0.98	1.82	0.49	[illegible]	[illegible]
Watson Ditch Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]			100.00	50.00	0.200	1.00	0.07	[illegible]	None			0.00	1.32	1.[illegible]	1.1[illegible]	1.62	0.50	[illegible]
Westbumma Water Company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]			100.00	1,500.00	0.012	[illegible]	0.00	[illegible]	None			0.00	3.24	3.24	1.48	3.24	0.78	[illegible]

[1] Estimated cost of system per acre. [2] [illegible] Water Ditch Company stock. [3] [illegible] Lake Canyon Water Ditch Company assessments. [4] [illegible] company. [5] On basis of [illegible] for five acres. [6] Twenty-five cents for first acre-foot. [7] Fifty cents [illegible] equals one second foot. [8] [illegible] equals one second foot. [9] Estimated. [10] Average [illegible]

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TABLE 38

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Mutual water companies in southern California, 1922*

Reprint of Table 18 of Bulletin No. 8, "Cost of Water to Irrigators in California."

Name of company	Location	Year organized	Source of water supply	Lift, feet	Percentage of water pumped	Area irrigated: Citrus trees, acres	Area irrigated: Deciduous trees, acres	Area irrigated: Alfalfa, acres	Area irrigated: Miscellaneous, acres	Area irrigated: Total, acres	Average duty of water per acre, acre-feet	Capital stock: Number of shares issued	Capital stock: Par value of stock per share	Capital stock: Market value of stock per share	Capital stock: Average number of shares per acre	Capital stock: Value of stock per acre	Factors in annual cost of water: Interest on value of capital stock per acre at 6 per cent	Factors in annual cost of water: Average annual assessment per acre for past 5 years	Factors in annual cost of water: Water rate: Per hour-inch	Factors in annual cost of water: Water rate: Per acre-foot	Factors in annual cost of water: Water charge per acre for average amount used	Factors in annual cost of water: Amount per acre deposited in sinking fund or charged to capital stock	Annual cost of water: For first acre-foot: Excluding interest on value of capital stock	Annual cost of water: For first acre-foot: Including interest on value of capital stock	Annual cost of water: Per acre, for average amount used: Excluding interest on value of capital stock	Annual cost of water: Per acre, for average amount used: Including interest on value of capital stock	Annual cost of water: Per acre-foot, for average amount used: Excluding interest on value of capital stock	Annual cost of water: Per acre-foot, for average amount used: Including interest on value of capital stock
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)
Mutual Companies																												
Anaheim Union Water Company	Anaheim	1884	Santa Ana River	100		7,500	500			8,000	b1 22	8,004	$100 00	$100 00	1 00	$100 00	$6 00	$5 60	$0 0120	$7 26	$8 86	$1 25	$11 61	$17 61	$13 21	$19 21	$10 83	$15 75
Arroyo Ditch and Water Company	Downey	1885	Rio Hondo	10		x	x			4,000	b1 00	3,700	5 00	30 00	1 00	30 00	1 80	2 50	0055	3 33	3 33	0 10	5 73	7 53	5 73	7 53	5 73	7 53
Azusa Irrigating Company	Azusa	1886	San Gabriel River	8	3,929					3,929	1 37	11,891	15 00	100 00	3 00	300 00	18 00	3 60	00487	2 95	4 04	1 00	5 55	23 55	6 64	24 64	4 85	17 38
Banning Heights Mutual Water Company	Banning	1913	White Water River	0			b700			b700	b1 00	14,000	15 00	15 00	10 00	150 00	9 00	None	0041	2 50	2 50	None	2 50	11 50	2 50	11 50	2 50	11 50
Banning Water Company	Banning	1884	San Gorgonio Creek				2,900			2,900	2 73	3,245	50 00	200 00	1 10	220 00	13 20	10 18	None	None	None	0 69	9 49	22 69	9 49	22 69	3 47	8 31
Beardsley Water Ditch Company	Duarte	1881	San Gabriel River	0	500	200			100	800	1 67	630	33 00	200 00	0 80	160 00	9 60	7 52	None	None	None	2 00	5 52	15 12	5 52	15 12	3 30	9 06
Bear Valley Mutual Water Company	Redlands	1903	Santa Ana River	0						14,300																		
Crafton Water Company	Redlands	1887	Bear Valley Mutual Water Company	0	1,800					1,800	2 00	3,321	100 00	250 00	1 00	250 00	15 00	5 80	None	None	None	0 78	5 02	20 02	5 02	20 02	2 51	10 01
Redlands Heights Water Company	Redlands	1891	Crafton Water Company	0	1,200					1,200	2 00	1,411	100 00	225 00	1 00	225 00	13 50	12 00	None	None	None	1 36	10 64	24 14	10 64	24 14	5 32	12 07
East Redlands Water Company	Redlands	1886	Bear Valley Mutual Water Company	0	443					443	2 00	443	100 00	150 00	1 00	150 00	9 00	8 50	None	None	None	0 71	7 79	16 79	7 79	16 79	3 90	8 40
Lugonia Park Water Company	Redlands	1894	Bear Valley Mutual Water Company	0	200					200	1 89	196	100 00		1 00	100 00	6 00	13 50	None	None	None	1 49	12 01	18 01	12 01	18 01	6 35	9 53
Redlands Water Company	Redlands	1882	Bear Valley Mutual Water Company and tunnel	0	1,380					1,380	2 11	1,500	100 00	100 00	1 00	100 00	6 54	7 10	None	None	None	0 98	6 12	12 66	6 12	12 66	2 90	6 00
West Redlands Water Company	Redlands	1902	Bear Valley Mutual Water Company	0	806					806	2 00	806	100 00	125 00	1 00	125 00	7 50	16 00	None	None	None	5 03	10 97	18 47	10 97	18 47	5 49	9 24
California Domestic Water Company	Whittier	1902	Wells	100	2,000					b2,000	1 60	8,005	50 00	120 00	1 50	180 00	10 80	15 90	None	None	None	2 62	13 28	24 08	13 28	24 08	8 30	15 05
La Habra Water Company	La Habra	1902	California Domestic Water Company	100	3,000					b3,000	1 60	5,005	50 00	180 00	1 50	270 00	16 20	24 00	None	None	None	2 62	21 38	37 58	21 38	37 58	13 36	23 49
Canyon Water Company of Pomona	Pomona	1897	San Antonio River	0	2,500					2,500	1 34	17,280	10 00	15 00	7 00	105 00	6 30	0 70	None	None	None	None	0 50	7 00	0 70	7 00	0 52	5 22
Capistrano Water Company	Capistrano	1892	San Juan Creek	0	50	350				400	b2 00	421	100 00	100 00	1 00	100 00	6 00	2 50	None	None	None	None	2 50	8 50	2 50	8 50	1 25	4 25
Carmel Water Company	Montebello	1905	Wells	100	325	20	40	450		835	1 20	3,498	10 00		4 00	40 00	2 40	10 48	None	None	None		10 48	12 88	10 48	12 88	8 73	10 73
Chino Water Company	Chino	1905	Wells	100	50	1,150				1,200	0 56	983	100 00	100 00	1 00	100 00	6 00	None	020	12 10	6 77	None	12 10	18 10	6 77	12 77	12 09	22 80
Citizens Light and Water Company, Bloomington	Bloomington	1907	Wells	100	3,825	100	25	50		4,000	1 81	5,197	50 00	250 00	1 00	250 00	15 00	4 50	010	6 05	10 95	None	10 55	25 55	15 45	30 45	8 54	16 82
Covina Irrigating Company	Covina	1886	San Gabriel River	0	4,500					4,500	1 56	10,000	50 00	100 00	3 00	300 00	18 00	16 50	00208	1 26	1 97	3 33	14 43	32 43	15 14	33 14	9 70	21 23
Cucamonga Water Company	Cucamonga	1887	Wells, tunnels	100	2,500	700			300	3,500	1 42	4,359	100 00	140 00	1 25	175 00	10 50	17 87	None	None	None	6 41	11 46	21 96	11 46	21 96	8 07	15 46
Del Monte Irrigation Company	Pomona	1887	Wells	0-340	100	1,800				1,800	2 33	22,600	10 00	20 00	12 55	251 00	15 06	22 60	None	None	None	2 78	19 82	34 88	19 82	34 88	8 51	14 97
Del Norte Water Company	Ventura	1910	Wells	180-320	100	40	80			600	0 30	2,500	10 00	17 50	1 00	17 50	1 05	0 60	025	15 13	4 54	None	16 03	17 08	5 44	6 49	18 13	21 63
Domingues Water Company	Compton	1910	Wells	30-100	100	x		x	Maj.	12,000	0 53	20,000	50 00	50 00	1 00	50 00	3 00		0125	7 56	4 01	None	7 56	10 56	4 01	7 01	7 56	13 23
Duarte Mutual Irrigation and Canal Company	Duarte	1890	San Gabriel River	90		1,200				1,200	1 20	1,259	10 00	500 00	1 00	500 00	30 00	9 00	None	None	None	1 67	7 33	37 33	7 33	37 33	6 11	31 11
Escondido Mutual Water Company	Escondido	1905	San Luis Rey River	0	1,600			450		2,050	b1 00	222,450	1 00	2 00	150 00	300 00	18 00	7 75	0083	5 02	5 02	1 56	11 21	29 21	11 21	29 21	11 21	29 21
Etiwanda Water Company	Etiwanda	1882	Tunnels	0	800			1,200		2,000	1 26	2,300	100 00	400 00	1 10	440 00	26 40	3 50	None	None	None	0 60	2 90	29 30	2 90	29 30	2 30	23 24
Fillmore Irrigation Company	Fillmore	1888	Sespe River	50-100	14	900	250		10	1,160	1 70	2,088	100 00		1 00	100 00	6 00	None			20 00	4 30	15 70	21 70	15 70	21 70	8 77	12 12
Fontana Water Company	Fontana	1909	Lytle Creek	0	3,820					3,820	b2 08	3,999	100 00	200 00	1 00	200 00	12 00	10 40	None	None	None	2 62	7 78	19 78	7 78	19 78	3 74	9 51
Fruitvale Mutual Water Company	San Jacinto	1921	San Jacinto River	19	1,144		1,790			2,934	2 08	4,000	100 00	76 00	1 13	85 88	5 15	6 16	0049	2 96	6 16	2 04	7 08	12 23	10 28	15 43	4 95	7 42
Gage Canal Company	Riverside	1884	Santa Ana River, wells	30	73	6,144				6,144	2 76	12,288	50 00	150 00	2 00	300 00	18 00	None			12 00	1 04	10 96	28 96	10 96	28 96	3 97	10 49
Glendora Consolidated Mutual Irrigation Company	Glendora	1920	Wells	450	100	2,050				2,050	1 18	5,040	100 00	90 00	2 30	207 00	12 42	25 30	040	24 20	28 56	6 21	43 29	55 71	47 65	60 07	40 39	50 91
Hudson Water Company	La Verne	1922	Wells	265	100	75				75	2 39	300	100 00		4 00	400 00	24 00	None	015	9 08	21 70	None	9 08	33 08	21 70	45 70	9 08	19 12
Irrigation Company of Pomona	Pomona	1886	Wells	92	100	600	1,300		100	2,000	1 08	24,500	10 00	3 00	10 00	30 00	1 80	20 00	None	None	None	6 50	13 50	15 30	13 50	15 30	12 50	14 60
Imperial Irrigation District*	El Centro	1911	Colorado River	0	0													1 80										
Imperial Water Company No. 1	Imperial	1900	Imperial Irrigation District	0	0	x	x	x	x	121,169	3 00	99,069	10 00	25 00	0 80	20 00	1 20	2 32	00165	1 00	3 00	None	5 12	6 32	7 12	8 32	2 37	2 77
Imperial Water Company No. 2	Holtville	1913	Imperial Irrigation District	0	0			x	x	6,000	3 00	7,218	10 00	20 00	1 00	20 00	1 20	4 50	00165	1 00	3 00	None	7 30	8 50	9 30	10 50	3 10	3 50
Imperial Water Company No. 3	Calipatria	1913	Imperial Irrigation District	0	155	150	12,000	32,680		45,000	b3 00	48,624	10 00	20 00	0 94	18 80	1 13	2 07	00140	0 85	2 55	None	4 72	5 85	6 42	7 55	2 14	2 52
Imperial Water Company No. 4	Brawley	1900	Imperial Irrigation District	0	0			x	x	20,000	3 00	19,801	10 00	15 00	1 00	15 00	0 90	2 20	00165	1 00	3 00	None	5 00	5 90	7 00	7 90	2 33	2 63
Imperial Water Company No. 5	Holtville	1901	Imperial Irrigation District	0	0			x	x	80,000	b3 30	89,841	10 00	12 50	0 94	11 75	0 70	2 54	00140	0 85	2 81	None	5 19	5 89	7 15	7 85	2 17	2 38
Imperial Water Company No. 6	Calexico	1901	Imperial Irrigation District	0	0			x	x	19,000	3 00	18,084	10 00	12 50	0 94	11 75	0 70	2 59	00165	1 00	3 00	None	5 39	6 09	7 39	8 09	2 46	2 70
Imperial Water Company No. 7	Holtville	1902	Imperial Irrigation District	0	0			x	x	18,250	b3 00	17,152	10 00	12 50	0 94	11 75	0 70	3 91	00165	1 00	3 00	None	6 71	7 41	8 71	9 41	2 90	3 14
Imperial Water Company No. 8	Brawley	1902	Imperial Irrigation District	0	0			x	x	35,000	2 80	44,000	25 00	20 00	0 94	18 80	1 13	2 46	00140	0 85	2 38	None	5 11	6 24	6 64	7 77	2 37	2 77
Imperial Water Company No. 9	Calipatria	1908	Imperial Irrigation District	0	0			x	x	18,000	3 00	b19,000	10 00	20 00	0 94	18 80	1 13	3 55	None	None	None	5 33	6 46	5 33	6 46	1 78	2 15
Imperial Water Company No. 12	Imperial	1907	Imperial Irrigation District	0	0			x	x	15,000	b3 00	15,400	25 00	25 00	1 00	25 00	1 50	4 50	00165	1 00	3 00	None	7 30	8 80	9 30	10 80	3 10	3 60
Imperial Southside Water Company	Holtville	1912	Imperial Irrigation District	0	0			x	x	18,000	3 00	b18,500	10 00	20 00	1 00	20 00	1 20	4 26	00165	1 00	3 00	None	7 06	8 26	9 06	10 26	3 02	3 42
La Puente Cooperative Water Company	West Covina	1909	Wells	70	100		1,700		300	2,000	1 35	2,000	50 00	50 00	1 00	50 00	3 00	4 00	0125	7 56	10 21	2 50	9 06	12 06	11 71	14 71	8 68	10 89
La Verne Water Association	La Verne	1921	Wells	220	100	600				600	b1 03	1,187	100 00	133 00	2 00	266 00	15 96		0300	18 15	29 58		18 15	34 11	29 58	45 54	18 15	27 94
Lemon Grove Mutual Water Company	Lemon Grove	1905	Cuyamaca Water Company	10		x			x	850	0 80	2,190	25 00	25 00	1 60	40 00	2 40	4 00	06035	36 51	29 21		40 51	42 91	35 21	35 61	44 51	44 51
Lugonia Water Company	Redlands	1887	Santa Ana River	0	2,750	50				2,800	1 20	3,150	100 00	140 00	1 12	156 80	9 40	1 90	None	None	None	None	1 90	11 30	1 90	11 30	1 58	9 42
Lytle Creek Water and Improvement Company	Rialto	1887	Lytle Creek, wells	70	3,000			200		3,200	2 70	3,238	50 00	225 00	1 00	225 00	13 50	8 00	None	None	None	0 31	7 69	21 19	7 69	21 19	2 85	7 85
Moneta Water Company	Gardena	1916	Wells	90	100		50	45	655	750	2 40	2,050	25 00		3 00	75 00	4 50	None	0147	8 89	12 45	1 42	7 47	11 97	11 03	15 53	7 88	11 09
Montalvo Mutual Water Company	Ventura	1912	Wells	110	100	240	300		428	968	0 89	980	50 00	100 00	1 00	100 00	6 00	4 60	0125	7 56	6 73	None	12 16	18 16	11 23	17 33	12 73	19 47
Montebello Land and Water Company	Montebello	1900	Wells	50	100	1,000			200	1,200	0 92	1,250	100 00		1 00	100 00	6 00	12 00	None	None	None	None	12 00	18 00	12 00	18 00	13 05	19 57
Monte Vista Irrigation Company	Ontario		Wells	250	100	500	400		50	950	1 00	1,000	10 00	100 00	1 00	100 00	6 00	4 00	018	10 89	11 87	4 00	10 89	16 89	11 87	17 87	10 89	16 39
Mound Water Company	Ventura	1904	Wells		100	240			552	792	0 95	792	100 00	100 00	1 00	100 00	6 00	1 10	0104	6 29	5 98	None	7 39	13 39	7 08	13 08	7 45	13 77
Mutual Land and Water Company	Rialto	1908	Wells	60	100	500				500	1 70	585	50 00	185 00	1 00	185 00	11 10	13 00	None	None	None	None	13 00	24 10	13 00	24 10	7 65	14 17
North Fork Water Company	San Bernardino	1885	Santa Ana River		0	1,800				1,800	b2 20	4,800	100 00	120 00	2 50	300 00	18 00	1 50	None	None	None	None	1 50	19 50	1 50	19 50	0 68	8 86
Palo Verde Mutual Water Company	Blythe	1908	Colorado River		0			6,726	22,409	29,134	b4 30	41,446	10 00	35 00	1 00	35 00	2 10	5 25	None	None	None		5 25	7 35	5 25	7 35	1 22	1 71
Piru Water Company	Piru	1887	Piru Creek	0	335			20		355	3 60	2,000	10 00	10 00		10 00	0 60	None			8 40	None	8 40	9 00	8 40	9 00	2 33	2 50

Annual cost of water					
For first acre-foot		Per acre, for average amount used		Per acre-foot, for average amount used	
Excluding interest on value of capital stock	Including interest on value of capital stock	Excluding interest on value of capital stock	Including interest on value of capital stock	Excluding interest on value of capital stock	Including interest on value of capital stock
(24)	(25)	(26)	(27)	(28)	(29)
$5 00	$6 50	$5 00	$6 50	$3 01	$3 91
8 00	17 00	8 00	17 00	3 00	6 37
3 20	5 60	3 20	5 60	1 19	2 07
9 00	34 41	9 00	34 41	3 91	14 96
22 50	29 37	26 90	33 77	22 03	27 67
2 90	10 97	4 90	12 97	2 90	7 68
23 19	35 19	28 11	40 11	20 38	29 78
10 80	13 20	12 53	14 93	10 80	12 87
10 60	22 60	10 60	22 60	5 10	10 86
2 00	5 54	5 00	8 54	2 00	3 42
1 15	1 75	1 47	2 07	0 86	1 22
14 47	21 97	12 95	20 45	15 24	24 05
20 83	33 80	20 83	33 80	12 63	20 48
9 38	27 38	11 69	29 69	7 26	18 45
3 50	9 50	3 50	9 50	1 75	4 75
14 05	17 05	38 28	41 28	13 77	14 85
22 06	34 06	17 54	29 54	22 78	38 37
20 95	25 45	20 95	25 45	18 38	22 32
16 88	24 38	18 09	25 59	15 60	22 03

Annual cost of water					
For first acre-foot		Per acre, for average amount used		Per acre-foot, for average amount used	
Excluding interest on value of capital stock	Including interest on value of capital stock	Excluding interest on value of capital stock	Including interest on value of capital stock	Excluding interest on value of capital stock	Including interest on value of capital stock
(24)	(25)	(26)	(27)	(28)	(29)
$5 00	$6 50	$5 00	$6 50	$3 01	$3 91
8 00	17 00	8 00	17 00	3 00	6 37
3 20	5 60	3 20	5 60	1 19	2 07
9 00	34 41	9 00	34 41	3 91	14 96
22 50	29 37	26 90	33 77	22 03	27 67
2 90	10 97	4 90	12 97	2 90	7 68
23 19	35 19	28 11	40 11	20 38	29 78
10 80	13 20	12 53	14 93	10 80	12 87
10 60	22 60	10 60	22 60	5 10	10 86
2 00	5 54	5 00	8 54	2 00	3 42
1 15	1 75	1 47	2 07	0 86	1 22
14 47	21 97	12 95	20 45	15 24	24 05
20 83	33 80	20 83	33 80	12 63	20 48
9 38	27 38	11 69	29 69	7 26	18 45
3 50	9 50	3 50	9 50	1 75	4 75
14 05	17 05	38 28	41 28	13 77	14 85
22 06	34 06	17 54	29 54	22 78	38 37
20 95	25 45	20 95	25 45	18 38	22 32
16 88	24 38	18 09	25 59	15 60	22 03

TABLE 38—Continued

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Mutual water companies in southern California, 1922*

Reprint of Table 18 of Bulletin No. 8, "Cost of Water to Irrigators in California"

Name of company	Location	Year organized	Source of water supply	Lift, feet	Percentage of water pumped	Area irrigated: Citrus trees, acres	Area irrigated: Deciduous trees, acres	Area irrigated: Alfalfa, acres	Area irrigated: Miscellaneous, acres	Area irrigated: Total, acres	Average duty of water per acre, acre-feet	Capital stock: Number of shares issued	Capital stock: Par value of stock per share	Capital stock: Market value of stock per share	Capital stock: Average number of shares per acre	Capital stock: Value of stock per acre	Factors in annual cost of water: Interest on value of capital stock per acre at 6 per cent	Factors in annual cost of water: Average annual assessment per acre for past 5 years	Factors in annual cost of water: Water rate: Per hour-inch	Factors in annual cost of water: Water rate: Per acre-foot	Factors in annual cost of water: Water charge per acre for average amount used	Factors in annual cost of water: Amount per acre deposited in sinking fund or charged to capital stock	Annual cost of water: For first acre-foot: Excluding interest on value of capital stock	Annual cost of water: For first acre-foot: Including interest on value of capital stock	Annual cost of water: Per acre, for average amount used: Excluding interest on value of capital stock	Annual cost of water: Per acre, for average amount used: Including interest on value of capital stock	Annual cost of water: Per acre-foot, for average amount used: Excluding interest on value of capital stock	Annual cost of water: Per acre-foot, for average amount used: Including interest on value of capital stock
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)
Rincon Ditch Company	Whittier	1913	San Gabriel River		0	150	651	x	x	974	1 66	974	$25 00		1 00	$25 00	$1 50	$5 00	None	None	None	None	$5 00	$6 50	$5 00	$6 50	$3 01	$3 91
Riverside Water Company	Riverside	1885	Santa Ana River		0	1,733	350	3,720	2,255	8,058	2 67	19,271	10 00	$75 00	2.00	150 00	9 00	None			$8 00	None	8 00	17 00	8 00	17 00	3 00	6 37
San Antonio Irrigation Company	Downey	1869	Rio Hondo River		0			300	500	800	2 70	8,224	5 00	5 00	8 00	40 00	2 40	3 20	None	None	None	None	3 20	5 60	3 20	5 60	1 19	2 07
San Antonio Water Company	Ontario	1882	San Antonio River	180	40	5,000				5,000	2 30	6,064	100 00	350 00	1 21	423 50	25 41	11 00	None	None	None	$2 00	9 00	34 41	9 00	34 41	3 91	14 96
San Cayetano Mutual Water Company	Santa Paula	1913	Wells	300	100	400	100			500	1 22	1,231	50 00	57 25	2 00	114 50	6 87	2 50	$0.03306	$20 00	24 40	None	22 50	29 37	26 00	33 77	22 03	27 67
Santa Ana Valley Irrigation Company	Orange	1877	Santa Ana River	75	25	x	x			17,428	1 09	17,428	5 00	134 49	1 00	134 49	8 07	1 65	.0048	2 00	4 00	1 65	2 00	10 97	4 00	12 97	2 90	7 68
San Dimas Water Company	San Dimas	1894	Wells	200–350		2,200				2,200	1 38	2,200	100 00	200 00	1.00	200 00	12 00	11 60	.0214	12 95	17 87	1 36	23 19	35 19	28 11	40 11	20 38	29 78
Saticoy Development Company	Saticoy	1902	Wells and canyon	165			528			528	1 16	528	40 00	40 00	1 00	40 00	2 40	7 20	.0178	10 80	12 53	7 20	10 80	13 20	12 53	14 93	10 80	12 87
South Mountain Water Company	Redlands	1890	Wells and canyon		50	500				500	2 08	1,000	100 00	100 00	2 00	200 00	12 00	13 00	None	None	None	2 40	10 60	22 60	10 60	22 60	5 10	10 86
South Side Improvement Company	Fillmore	1887	Santa Clara River, wells	26	38	1,300	150			1,450	2 50	2,916	10 00	29 50	2 00	59 00	3 54	None	.0033	2 00	5 00	None	2 00	5 54	5 00	8 54	2 00	3 42
Standefer Water Company	Rivera	1902	San Gabriel River		0	900	452			1,352	[b]1 70	13,525	1 00		10 00	10 00	0 60	0 70	.00075	0 45	0 77	None	1 15	1 75	1 47	2 07	0 86	1 22
Sunny Slope Water Company	Lamanda Park	1895	Wells	153	100	1,400				1,400	0 85	1,400	100 00	125 00	1 00	125 00	7 50	5 50	.0168	10 15	8 63	1 18	14 47	21 97	12 95	20 45	15 24	24 05
Temescal Water Company	Corona	1887	San Jacinto River, wells	85	50	4,682				4,682	1 65	8,608	100 00	117 50	1 84	216 20	12 97	27 60	None	None	None	6 77	20 83	33 80	20 83	33 80	12 63	20 48
Thermal Belt Water Company	Santa Paula	1893	Santa Paula Creek, wells		87	1,275	300			1,575	1 61	1,500	100 00	300 00	1 00	300 00	18 00	7 20	.00625	3 78	6 09	1 60	9 38	27 38	11 69	29 69	7 26	18 45
Trabuca Water Company	Capistrano	1892	Trabuco Creek, wells	40	38		350			350	2 00	350	100 00	100 00	1 00	100 00	6 00	3 50	None	None	None	None	3 50	9 50	3 50	9 50	1 75	4 75
Walnut Grove Mutual Water Company	Monrovia	1906	Wells	80	100			x	x	781	2 78	781	50 00		1.00	50 00	3 00	2 40	.0225	13 01	37 84	2 05	14 05	17 05	38 28	41 28	13 77	14 85
Whittier Extension Mutual Water Company	North Whittier	1913	Wells	174–418	100	2,000				2,000	0 77	2,500	100 00	200 00	1.00	200 00	12 00	2 40	.0325	19 66	15 14	None	22 06	34 06	17 54	29 54	22 78	38 37
Yorba Linda Water Company	Yorba Linda	1909	Wells	302	100	2,500				2,500	1 14	2,750	100 00	75 00	1 00	75 00	4 50	24 80	None	None	None	3 85	20 95	25 45	20 95	25 45	18 39	22 32
Yucaipa Water Company No. 1	Yucaipa	1910	Wells; tunnels	250	60		2,600			2,600	1 16	3,500	100 00	125 00	1 00	125 00	7 50	11 40	.0125	7 56	8 77	2 08	16 88	24 38	18 09	25 59	15 60	22 03

*This table prepared in cooperation with D. A. Lane, Assistant Engineer of Los Angeles City Water Department. [a] Companies absorbed by district late in 1922. [b] Estimated [x] Acreage unknown.

Annual cost of water					
Per acre-foot		Per acre		Per acre-foot per foot lift	
Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant
(25)	(26)	(27)	(28)	(29)	(30)
$7 52	$9 59	$18 42	$23 50	$0 188	$0 240
2 49	2 81	2 66	3 01	0 062	0 070
11 72	14 89	25 31	32 18	0 279	0 355
4 61	5 29	13 65	15 65	0 110	0 126
2 56	2 91	9 44	10 74	0 061	0 070
2 88	3 31	12 96	14 90	0 067	0 077
3 61	4 35	11 02	13 27	0 080	0 097
2 86	3 26	13 73	15 65	0 064	0 072
4 33	5 32	14 03	17 24	0 096	0 118
6 53	7 52	15 87	18 27	0 145	0 167
5 18	6 42	15 43	19 13	0 111	0 138
6 14	7 87	7 43	9 53	0 128	0 164
3 03	3 25	33 45	35 85	0 061	0 065
7 62	10 49	12 42	17 10	0 212	0 292
38 38	55 31	12 28	17 70	0 914	1 317
4 59	5 95	20 20	26 20	0 104	0 135
13 87	19 09	33 13	45 63	----------	----------
10 78	14 76	7 23	9 89	0 180	0 246
10 93	13 76	21 20	26 70	0 177	0 222
8 16	10 63	12 82	16 70	0 112	0 146
3 30	4 17	13 70	17 30	0 110	0 139
4 09	5 10	9 12	11 37	0 087	0 108
5 78	7 48	19 37	25 08	0 206	0 267
5 27	6 25	10 92	12 94	0 115	0 136
6 98	9 26	20 72	27 50	0 279	0 370

Annual cost of water					
Per acre-foot		Per acre		Per acre-foot per foot lift	
Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant
(25)	(26)	(27)	(28)	(29)	(30)
$7 52	$9 59	$18 42	$23 50	$0 188	$0 240
2 49	2 81	2 66	3 01	0 062	0 070
11 72	14 89	25 31	32 18	0 279	0 355
4 61	5 29	13 65	15 65	0 110	0 126
2 56	2 91	9 44	10 74	0 061	0 070
2 88	3 31	12 96	14 90	0 067	0 077
3 61	4 35	11 02	13 27	0 080	0 097
2 86	3 26	13 73	15 65	0 064	0 072
4 33	5 32	14 03	17 24	0 096	0 118
6 53	7 52	15 87	18 27	0 145	0 167
5 18	6 42	15 43	19 13	0 111	0 138
6 14	7 87	7 43	9 53	0 128	0 164
3 03	3 25	33 45	35 85	0 061	0 065
7 62	10 49	12 42	17 10	0 212	0 292
38 38	55 31	12 28	17 70	0 914	1 317
4 59	5 95	20 20	26 20	0 104	0 135
13 87	19 09	33 13	45 63	----------	----------
10 78	14 76	7 23	9 89	0 180	0 246
10 93	13 76	21 20	26 70	0 177	0 222
8 16	10 63	12 82	16 70	0 112	0 146
3 30	4 17	13 70	17 30	0 110	0 139
4 09	5 10	9 12	11 37	0 087	0 108
5 78	7 48	19 37	25 08	0 206	0 267
5 27	6 25	10 92	12 94	0 115	0 136
6 98	9 26	20 72	27 50	0 279	0 370

TABLE 39

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Private pumping plants in Sacramento Valley, 1922

Reprint of Table 30 of Bulletin No. 8, "Cost of Water to Irrigators in California"

Plant					Well			Pump			Acreage irrigated			Cost of plant		Annual costs for plant				Annual cost per acre-foot pumped				Annual cost of water					
																		Fixed charges				Fixed charges		Per acre-foot		Per acre		Per acre-foot per foot lift	
No.	Location	Year installed	Size of motor, horse-power	Overall plant efficiency, per cent	Size, inches	Depth, feet	Depth to static water, feet	Total hours operated	Lift, feet	Discharge, cubic feet per second	Total acres	Kind of crops	Duty of water per acre, acre-feet	Total	Per acre irrigated	Power bill	Estimated attendance	Interest on cost of plant at 6 per cent	Taxes, insurance, depreciation, repairs, renewals (estimated)	Power bill	Attendance	Interest	Taxes, insurance, depreciation, repairs, renewals	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
	Electric																												
1	Dixon	1911	10	42.3	12	72	37	570	40.0	0.67	13	Alfalfa	2.45	$1,100	$84.62	$118.29	$22.80	$66.00	$99.00	$3.71	$0.71	$2.07	$3.10	$7.52	$9.59	$18.42	$23.50	$0.188	$0.240
2	Dixon	1918	15	60.0	0	0		955	40.0	1.75	130	Orchard	1.07	750	5.77	242.63	38.20	45.00	67.50	1.74	0.37	0.32	0.48	2.40	2.81	2.66	3.01	0.062	0.070
3	Dixon	1916	7½	22.0		100	42	561	42.0	0.32	7	Alfalfa	2.16	800	114.29	83.21	22.44	48.00	72.00	5.49	1.48	3.17	4.75	11.72	14.89	25.31	32.18	0.279	0.355
4	Dixon		10	18.5		100	37	1,215	42.0	0.88	30	Alfalfa	2.96	1,000	33.33	271.00	48.60	60.00	90.00	3.05	0.68	0.55	1.01	4.61	5.29	13.65	15.66	0.110	0.126
5	Dixon	1918	30	42.5	12	125	39	1,366	42.0	2.27	70	Alfalfa	3.66	1,500	21.43	470.29	54.64	90.00	135.00	1.83	0.21	0.35	0.52	2.50	2.91	9.44	10.74	0.061	0.070
6	Dixon		35	42.0		200	35	1,710	43.0	2.40	76	Alfalfa	4.50	2,450	32.24	697.25	68.40	147.00	220.50	2.04	0.20	0.43	0.64	2.88	3.31	12.96	14.90	0.067	0.077
7	Dixon		25	37.0		120	35	1,246	45.0	1.91	65	Alfalfa	3.05	2,450	37.69	444.55	49.84	147.00	220.50	2.25	0.25	0.74	1.11	3.61	4.35	11.02	13.27	0.080	0.097
8	Dixon		50	34.6		120	35	1,740	45.0	2.53	76	Alfalfa	4.80	2,450	32.24	754.29	69.60	147.00	220.50	2.07	0.19	0.40	0.60	2.66	3.26	13.73	15.65	0.064	0.072
9	Dixon		25	32.0		120	35	925	45.0	1.94	46	Alfalfa	3.24	2,450	53.26	387.25	37.00	147.00	220.50	2.60	0.25	0.99	1.48	4.33	5.32	14.03	17.24	0.096	0.118
10	Dixon	1916	15	29.7	12	100	32	920	45.0	0.79	25	Alfalfa	2.43	1,000	40.00	269.73	36.80	60.00	90.00	4.44	0.61	0.99	1.48	6.53	7.52	16.87	16.27	0.145	0.167
11	Dixon	1921	10	52.6	12	06	34	631	46.5	1.05	20	Alfalfa	2.98	1,235	61.75	173.11	25.24	74.10	115.15	2.90	0.42	1.24	1.86	5.18	6.42	15.43	19.13	0.111	0.138
12	Dixon	1922	25	36.5		200	35	499	48.0	2.04	70	Alfalfa	1.21	2,450	35.00	280.84	19.06	147.00	220.50	3.31	0.23	1.73	2.60	6.14	7.87	7.43	9.53	0.126	0.164
13	Dixon		10	39.0		90	40	2,417	50.0	1.10	20	Alfalfa		800	40.00	500.35	96.68	48.00	72.00	2.26	0.44	0.22	0.33	3.03	3.25	33.45	35.85	0.091	0.065
14	Davis	1919	35				24		35.9	1.11		Trees, alfalfa	1.63	2,690	99.70	162.57	24.32	161.40	242.10	2.89	0.43	2.87	4.30	7.02	10.49	12.42	17.10	0.212	0.292
15	Davis	1919	25	16.2	12	265		213	42.0	0.71	40	Trees, alfalfa		3,556	88.90	155.02	8.52	213.36	320.00	12.30	0.68	16.93	25.40	38.38	55.31	12.28	17.70	0.914	1.317
16	Davis	1912	10	62.0	12	125	18	362	44.0	1.46	10	Alfalfa	4.40	1,000	100.00	97.12	14.48	60.00	90.00	2.21	0.33	1.36	2.05	4.59	5.95	20.20	26.20	0.104	0.135
17	Davis	1922	20	15.4	12	109	18	494		0.85	12	Alfalfa	2.39	2,500	208.33	156.66	16.16	150.00	225.00	5.47	0.56	5.22	7.84	13.87	19.09	33.13	45.63		
18	Davis	1922	20	46.8	12	130		319	60.0	1.26	50	Pasture, alfalfa	0.67	2,225	44.50	148.40	12.76	133.50	200.25	4.43	0.38	3.98	5.97	10.78	14.76	7.23	9.89	0.180	0.246
19	Davis	1915	20	25.0	12	133	14	344	62.0	0.81	12	Alfalfa	1.94	1,100	91.67	141.99	13.76	66.00	99.00	6.09	0.59	2.83	4.25	10.93	13.70	21.20	26.70	0.177	0.222
20	Davis	1920	25	56.0	12	141	50	627	73.0	1.64	40	Alfalfa	1.57	2,590	64.75	254.17	25.08	155.40	233.10	4.05	0.40	2.47	3.71	8.16	10.63	12.82	16.70	0.112	0.146
21	Woodland	1906	100	25.1	12	200	17	1,194	30.0	8.34	200	Alfalfa	4.15	12,000	60.00	1,614.71	47.76	720.00	1,080.00	1.94	0.06	0.87	1.30	3.30	4.17	13.70	17.30	0.110	0.139
22	Winters	1919	40	50.0	12	86	27	597	47.0	3.57	80	Miscellaneous	2.23	3,000	37.50	435.23	23.88	180.00	270.00	2.44	0.13	1.01	1.52	4.09	5.10	9.12	11.37	0.087	0.108
	Distillate																												
23	Winters	1915	16	37.0		36	21	453	28.0	1.85	21	Alfalfa	3.35	2,000	95.24	81.60	45.30	120.00	280.00	1.16	0.64	1.70	3.98	5.78	7.46	19.37	25.08	0.206	0.267
24	Winters	1919	20	32.0	12	187	35	750	46.0	1.23	37	Orchard	2.07	1,250	33.78	153.00	75.00	75.00	175.00	2.00	0.98	0.98	2.20	5.27	6.25	10.92	12.94	0.115	0.136
25	Woodland	1920	65	48.0	12		17	504	25.0	8.44	120		2.97	13,500	112.50	393.60	201.60	810.00	1,890.00	1.10	0.57	2.28	5.31	6.98	9.26	20.72	27.50	0.279	0.370

	Annual cost of water					
	Per acre-foot		Per acre		Per acre-foot per foot lift	
:e, ion, ls	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant
	(25)	(26)	(27)	(28)	(29)	(30)
01	$3 37	$4 04	$5 63	$6 75	$0 116	$0 139
63	7 84	10 26	4 08	5 34	0 200	0 262
79	5 84	7 70	7 77	10 24	0 122	0 160
76	11 03	14 20	5 51	7 10	0 158	0 203
47	6 54	8 85	12 30	16 64	0 092	0 125
39	11 24	14 83	25 08	33 08	0 152	0 200
83	12 75	16 64	10 96	14 32	0 152	0 198
66	18 67	27 77	10 08	14 98	0 218	0 325
21	14 70	19 51	11 90	15 80	0 167	0 222
20	17 36	22 83	14 06	18 50	0 167	0 220
84	12 18	16 07	8 04	10 61	0 093	0 122
38	15 07	19 32	10 70	13 71	0 108	0 139
82	26 74	37 27	21 92	30 57	0 185	0 258
01	39 01	56 34	14 05	20 27	0 262	0 378
97	19 77	27 09	9 89	13 55	0 122	0 167
94	28 31	38 93	16 13	22 20	0 164	0 225
62	5 87	7 62	5 87	7 62	----------	----------
18	29 44	38 90	14 72	19 45	0 151	0 200
40	20 21	27 15	8 89	11 95	0 097	0 131
22	18 74	25 55	14 61	19 93	----------	----------
49	32 68	44 35	14 38	19 52	0 163	0 222
92	31 25	45 20	13 43	19 43	0 156	0 226
----	[a]12 59	[a]15 61	17 62	21 86	0 210	0 260
18	17 63	21 08	37 38	44 70	0 085	0 102
21	13 95	18 09	12 13	15 73	0 263	0 341
60	26 46	38 19	8 47	12 22	0 389	0 562
13	18 54	24 63	17 61	23 40	0 452	0 601
01	6 43	7 77	11 18	13 52	0 148	0 179
77	7 60	9 45	16 72	20 79	0 169	0 210
11	5 28	6 02	2 75	3 13	0 261	0 298
92	8 59	10 54	2 75	3 38	0 215	0 263
67	4 99	6 10	5 24	6 41	0 103	0 126
30	2 20	2 40	11 19	12 21	0 048	0 052
54	1 45	1 81	5 63	7 02	0 138	0 172
25	1 41	1 58	----------	----------	0 052	0 058
25	1 39	1 56	----------	----------	0 041	0 046
85	2 01	2 58	----------	----------	0 086	0 110
23	6 27	7 76	25 28	31 28	0 243	0 301
77	8 57	10 41	11 65	14 15	0 153	0 186
18	2 93	3 72	5 48	6 96	0 105	0 133
17	9 99	12 10	12 28	14 88	0 206	0 250
18	14 30	18 42	37 32	48 08	0 176	0 227
82	3 66	4 21	14 09	16 22	0 035	0 040
77	8 98	10 83	27 67	33 37	0 070	0 085
86	13 84	17 75	31 83	40 84	0 055	0 071
34	2 48	2 71	8 63	9 43	0 055	0 060
78	4 93	5 45	20 52	22 68	0 055	0 061

TABLE 40

COST OF WATER FOR IRRIGATION IN CALIFORNIA

Private electric pumping plants in central California, 1923

Reprint of Table 32 of Bulletin No. 8, "Cost of Water to Irrigators in California"

	Plant				Well			Pump			Acreage irrigated			Cost of plant		Annual costs for plant				Annual cost per acre-foot pumped				Annual cost of water					
																		Fixed charges				Fixed charges		Per acre-foot		Per acre		Per acre-foot per foot lift	
No.	Location	Year installed	Size of motor, horsepower	Overall plant efficiency, per cent	Size, inches	Depth, feet	Depth to static water, feet	Total hours operated	Lift, feet	Discharge, cubic feet per second	Total acres	Kind of crops	Duty of water per acre, acre-feet	Total	Per acre irrigated	Power bill	Estimated attendance	Interest on cost of plant at 6 per cent	Taxes, insurance, depreciation, repairs, renewals, (estimated)	Power bill	Attendance	Interest	Taxes, insurance, depreciation, repairs, renewals	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
26	San Jose	1911	30	38 9	10	80	20	820	29.0	1 96	80	Prunes	1 67	$1,500	$18 75	$284 52	$32 80	$90 00	$135 00	$2 12	$0 24	$0 67	$1 01	$3 37	$4 04	$5 63	$6 75	$0 116	$0 139
27	San Jose	1919	15	34 0	10	120	30	363	39.2	1.12	65	Nursery	0.52	1,370	21 08	129 00	14 52	82 20	123 30	3 78	0 43	2 42	3 63	7 84	10 26	4 08	5 34	0 200	0 262
28	San Jose	1912	35	53.3				454	48 0	2 82	80	Prunes	1 33	3,300	41 25	306 60	18 16	198 00	297 00	2 88	0 17	1 86	2 79	5 84	7 70	7 77	10 24	0 122	0 160
29	Los Gatos		20	35.3		52		937	70.0	0.48	75	Orchard	0.50	*2,000	26 67	199 73	37 48	120 00	180 00	5 28	0 99	3 17	4 76	11 03	14 20	5 51	7 10	0 158	0 203
30	Santa Clara		40	57.5	16	404	25	638	71 0	3.20	90	Pears, plums	1 88	6,535	72 61	494 27	25 52	392 10	588 15	2 92	0 15	2 31	3 47	6 54	8 85	12 30	16 64	0 092	0 125
31	San Jose	1905	50	23 7		196	55	997	74 0	1.28	48	Fruit	2 23	6,400	133 33	586 00	39 88	384 00	576 00	5 48	0 37	3 59	5 39	11 24	14 83	25 08	33 08	0 152	0 200
32	Mountain View	1918	20	29 7	12	125	27	738	84 0	0 70	50	Fruit	0 86	2,800	56 00	269 58	29 52	168 00	252 00	6 24	0 68	3 89	5 83	12 75	16 64	10 96	14 32	0 152	0 198
33	Santa Clara		25	53 4				371	85 4	1.58	90	Pears, plums	0 54	7,434	82 60	230 76	14 84	446 04	669 06	4 71	0 30	9 10	13 66	18 67	27 77	10 08	14 98	0 218	0 325
34	Santa Clara	1920	50	28 8	14	276	71	698	88 0	1.07	77	Prunes, apricots	0 81	5,000	65 00	439 17	27 92	300 00	450 00	7 04	0 45	4 81	7 21	14 70	19 51	11 90	15 80	0 167	0 222
35	San Jose	1920	50	29 4	24	210	60	740	103.8	0.78	60	Prunes, peaches	0 81	4,450	74 17	417 50	29 60	267 00	400 50	8 55	0 61	5 47	8 20	17 36	22 83	14 06	18 50	0 167	0 220
36	Campbell	1920	75	43 2	16	412	111	1,106	131 5	2 00	280	Prunes, apricots	0 66	12,000	42 86	1,127 74	44 24	720 00	1,080 00	6 10	0 24	3 89	5 84	12 18	16 07	8 04	10 61	0 093	0 122
37	San Jose		40	36.8				798	139 0	0.86	82	Peaches, apricots	0.71	4,100	50 00	470 53	31 92	246 00	369 00	8 14	0 55	4 25	6 38	15 07	19 32	10 70	13 71	0 108	0 139
38	San Jose	1922	30	32 1	14	495	80	1,910	144 5	0 29	57	Prunes, apricots	0.82	8,220	144 21	434 98	76 40	493 20	739 80	9 29	1 63	10 53	15 82	26 74	37 27	21 92	30 57	0 185	0 258
39	Cupertino	1920	50	40 0	14	265	136	326	149 0	0.99	76	Prunes, apricots	0 36	7,800	102 63	338 08	13 04	468 00	702 00	12 52	0 48	17 33	26 01	39 01	56 34	14 05	20 27	0 262	0 378
40	Santa Clara		75	52 6				368	162 0	2 13			*0.50	*8,000		563 11	14 72	480 00	720 00	8 58	0 22	7 32	10 97	19 77	27 09	9 89	13 55	0 122	0 167
41	Cupertino		50	37 4	16	342	135	533	173.0	0 76	60	Orchard	0 57	6,050	100 83	401 77	21 32	363 00	544 50	11 75	0 62	10 62	15 94	28 31	38 93	16 13	22 20	0 164	0 225
42	Cupertino		75			254		1,180		2 80		Orchard	*1 00	*8,000		847 02	47 20	480 00	720 00	3 08	0 17	1 75	2 62	5 87	7 62	5 87	7 62		
43	Cupertino	1917	35		12	281	120	890	195 0	0 42		Prunes, apricots	*0.50	4,900		439 17	35 60	294 00	441 00	14 12	1 14	9 46	14 18	29 44	38 90	14 72	19 45	0 151	0 200
44	Los Gatos	1922	75	32 2	14	912	110	952	208.0	1 68	300	Prunes, peaches	0 44	15,400	51 33	1,267 17	38 08	924 00	1,386 00	9 52	0 29	6 94	10 40	20 21	27 15	8 89	11 95	0 097	0 131
45	Santa Clara		100		14	1,069	125	918		1 73	170	Prunes, peaches	0 78	*15,000	88 25	1,088 06	36 72	900 00	1,350 00	8 24	0 28	6 81	10 22	18 74	25 55	14 61	19 93		
46	Santa Clara		100		16	1,001	125	1,080	*200 0	0.88	180	Prunes, apricots	0 44	15,400	85 56	1,160 44	43 20	924 00	1,386 00	14 65	0 54	11 67	17 49	32 68	44 35	14 38	19 52	0 163	0 222
47	Santa Clara		50		14	565	125	623	*200 0	0 74	90	Fruit	0 43	*9,000	100 00	375 04	24 92	540 00	810 00	9 69	0 64	13 95	20 92	31 25	45 20	13 43	19 43	0 156	0 226
48	Santa Clara	1918	30		10		50		60 0	1 38	46	Prunes	*1 40	3,250	70 65	493 53	24 00	195 00	292 50					*12 59	*15 61	17 62	21 86	0 210	0 260
49	Morgan Hill	1923	40	48 2	14	300		1,910	207.0	0 48	36	Berries	2.12	4,400	122 22	874 40	76 40	264 00	396 00	11 45	1 00	3 45	5 18	17 63	21 08	37 38	44 70	0 085	0 102
50	San Martin	1922	40	33 7		355	26	369	53 0	2 11	75		0 865	4,478	59 71	487 65	14 76	268 68	403 02	7 51	0 23	4 14	6 21	13 95	18 09	12 13	15 73	0 263	0 341
51	San Martin	1923	15	44 8	12	98		185	67 9	1 03	50	Prunes	0 32	3,130	62 60	134 55	7 44	187 80	281 70	8 41	0 45	11 73	17 60	26 46	38 19	8 47	12 22	0 389	0 562
52	Gilroy	1920	50	26 0	12	150	23	285	41.0	1.12	28	Prunes	0 95	2,700	96 43	239 05	11 40	162 00	243 00	8 98	0 43	6 09	9 13	18 54	24 63	17 61	23 40	0 452	0 601
53	Gilroy	1914	20	32 7			23	911	43 5	1.39	61	Prunes, alfalfa	1 74	2,365	38 80	432 85	36 44	141 90	212 85	4 08	0 34	1 34	2 01	6 43	7 77	11 18	13 52	0 148	0 179
54	Gilroy	1921	30	27 9	12	170	18	532	45 0	1 36	40	Truck, alfalfa	2 20	2,710	67 75	404 00	21 28	162 60	243 90	4 59	0 24	1 85	2 77	7 60	9 45	18 72	20 79	0 169	0 210
55	Watsonville	1917	7½	27 6		Lake		481	20 2	0 81	62	Apples, truck	0 52	400	6 45	115 30	19 24	24 00	36 00	3 57	0 60	0 74	1 11	5 28	6 02	2 75	3 13	0 261	0 298
56	Watsonville	1920	15	50 0	12	154	0	339	40.0	1.09	96	Apples, pears	0 32	1,000	10 42	161 00	13 56	60 00	90 00	5 23	0 44	1 95	2 92	8 59	10 54	2 75	3 38	0 215	0 263
57	Watsonville	1923	20	50 6	12	170	19	806	48 3	1 93	124	Apples, apricots	1 046	2,405	19 40	398 10	32 24	144 30	216 45	3 07	0 25	1 11	1 67	4 99	6 10	5 24	6 41	0 103	0 126
58	Chualar	1919	20	49 5	16	270	20	3,910	46 2	2 18	140	Alfalfa	5 09	2,350	16 78	1,200 94	156 40	141 00	211 50	1 68	0 22	0 20	0 30	2 20	2 40	11 19	12 21	0 048	0 052
59	Modesto	1919	20			River		1,607	10 5	4 18	145	Orchard, alfalfa	3 88	3,403	23 48	451 04	64 28	204 18	306 27	0 80	0 11	0 36	0 54	1 45	1 81	5 03	7 02	0 138	0 172
60	Turlock		20	35 3				3,330	27.3	1 90				1,500		481 93	133 20	90 00	135 00	0 91	0 25	0 17	0 25	1 41	1 58			0 052	0 058
61	Turlock	1923	15	40 0				4,140	34 0	1 56				1,500		446 46	165 60	90 00	135 00	0 83	0 31	0 17	0 26	1 39	1 56			0 041	0 046
62	Delhi	1923	15	60 7		Canal		619	23 4	2 46				1,200		121 42	24 76	72 00	108 00	0 96	0 20	0 57	0 85	2 01	2 58			0 086	0 110
63	Chowchilla	1923	3	24 2	12	74	12	656	25 8	0 45	6	Truck	4 03	600	100 00	71 63	26 24	36 00	54 00	2 96	1 08	1 49	2 23	6 27	7 75	25 28	31 28	0 243	0 301
64	Chowchilla	1922	10	34 8	10	108		1,084	56 0	0 46	31	Peaches, apricots	1 36	1,300	41 95	202 22	43 36	78 00	117 00	4 78	1 02	1 84	2 77	8 57	10 41	11 65	14 15	0 153	0 186
65	Visalia	1920	10	45.7	10	65	21	872	28 0	1 41	55	Prunes, alfalfa	1 87	1,350	24 55	144 65	34 88	81 00	121 50	1 41	0 34	0 79	1 18	2 93	3 72	5 48	6 98	0 105	0 133
66	Exeter	1920	7½	19 6		139		1,638	48 6	0.27	30	Grapes	1.23	1,300	43 33	185 94	65 52	78 00	117 00	6 04	1 78	2 11	3 17	9 99	12 10	12 28	14 88	0 206	0 250
67	Exeter	1921	3	40 8	10	151	57	2,240	81.0	0 11	8½	Oranges	2.61	1,524	179 30	90 59	89 60	91 44	137 16	4 08	4 04	4 12	6 18	14 30	18 42	37 32	48 08	0 176	0 227
68	Lemon Cove	1923	10	65 0	12	133		3,025	104 2	0.61	40	Oranges	3.85	1,410	35 25	317 99	121 00	84 60	126 90	2 06	0 78	0 55	0 82	3 86	4 21	14 09	16 22	0 035	0 040
69	Lindsay	1909	5	49 6	12	300	85	4,405	128.0	0.17	20	Oranges	3.08	1,900	95 00	206 15	176 20	114 00	171 00	3 35	2 86	1 85	2 77	8 98	10 83	27 67	33 37	0 070	0 085
70	Porterville	1922	15	63 6	12	427	210	3,630	249.9	0.22	30	Oranges	2.30	4,500	150 00	405 93	145 20	270 00	405 00	6 88	2 10	3 91	5 86	13 84	17 75	31 83	40 84	0 055	0 071
71	Tulare	1922	15	35 0	12	97	18	3,350	45 0	1.06	85	Alfalfa	3.48	1,130	13 30	500 77	134 00	67 80	101 70	1 69	0 45	0 23	0 34	2 48	2 71	8 63	9 43	0 055	0 060
72	McFarland	1923	10	41 1	12	203	64	5,830	90 0	0 41	40	Alfalfa, grapes	4 16	1,450	36 25	457 61	233 20	87 00	130 50	2 75	1 40	0 52	0 78	4 93	5 45	20 52	22 68	0 055	0 061

* Estimated

	Annual cost of water					
	Per acre-foot		Per acre		Per acre-foot per foot lift	
're, ion, ls	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant	Excluding interest on cost of plant	Including interest on cost of plant
	(25)	(26)	(27)	(28)	(29)	(30)
01	$3 37	$4 04	$5 63	$6 75	$0 116	$0 139
63	7 84	10 26	4 08	5 34	0 200	0 262
79	5 84	7 70	7 77	10 24	0 122	0 160
76	11 03	14 20	5 51	7 10	0 158	0 203
47	6 54	8 85	12 30	16 64	0 092	0 125
39	11 24	14 83	25 08	33 08	0 152	0 200
83	12 75	16 64	10 96	14 32	0 152	0 198
66	18 67	27 77	10 08	14 98	0 218	0 325
21	14 70	19 51	11 90	15 80	0 167	0 222
20	17 36	22 83	14 06	18 50	0 167	0 220
84	12 18	16 07	8 04	10 61	0 093	0 122
38	15 07	19 32	10 70	13 71	0 108	0 139
82	26 74	37 27	21 92	30 57	0 185	0 258
01	39 01	56 34	14 05	20 27	0 262	0 378
97	19 77	27 09	9 89	13 55	0 122	0 167
94	28 31	38 93	16 13	22 20	0 164	0 225
62	5 87	7 62	5 87	7 62	----------	----------
18	29 44	38 90	14 72	19 45	0 151	0 200
40	20 21	27 15	8 89	11 95	0 097	0 131
22	18 74	25 55	14 61	19 93	----------	----------
49	32 68	44 35	14 38	19 52	0 163	0 222
92	31 25	45 20	13 43	19 43	0 156	0 226
----	*12 59	*15 61	17 62	21 86	0 210	0 260
18	17 63	21 08	37 38	44 70	0 085	0 102
21	13 95	18 09	12 13	15 73	0 263	0 341
60	26 46	38 19	8 47	12 22	0 389	0 562
13	18 54	24 63	17 61	23 40	0 452	0 601
01	6 43	7 77	11 18	13 52	0 148	0 179
77	7 60	9 45	16 72	20 79	0 169	0 210
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92	8 59	10 54	2 75	3 38	0 215	0 263
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30	2 20	2 40	11 19	12 21	0 048	0 052
54	1 45	1 81	5 63	7 02	0 138	0 172
25	1 41	1 58	----------	----------	0 052	0 058
25	1 39	1 56	----------	----------	0 041	0 046
85	2 01	2 58	----------	----------	0 086	0 110
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77	8 57	10 41	11 65	14 15	0 153	0 186
18	2 93	3 72	5 48	6 96	0 105	0 133
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18	14 30	18 42	37 32	48 08	0 176	0 227
82	3 66	4 21	14 09	16 22	0 035	0 040
77	8 98	10 83	27 67	33 37	0 070	0 085
86	13 84	17 75	31 83	40 84	0 055	0 071
34	2 48	2 71	8 63	9 43	0 055	0 060
78	4 93	5 45	20 52	22 68	0 055	0 061

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APPENDIX B

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PUBLICATIONS OF THE

DIVISION OF WATER RESOURCES

DEPARTMENT OF PUBLIC WORKS

STATE OF CALIFORNIA

When the Department of Public Works was created in July, 1921, the State Water Commission was succeeded by the Division of Water Rights, and the Department of Engineering was succeeded by the Division of Engineering and Irrigation in all duties except those pertaining to State Architect. Both the Division of Water Rights and the Division of Engineering and Irrigation functioned until August, 1929, when they were consolidated to form the Division of Water Resources.

STATE WATER COMMISSION

First Report, State Water Commission, March 24 to November 1, 1912.
Second Report, State Water Commission, November 1, 1912, to April 1, 1914.
*Biennial Report, State Water Commission, March 1, 1915, to December 1, 1916.
Biennial Report, State Water Commission, December 1, 1916, to September 1, 1918.
Biennial Report, State Water Commission, September 1, 1918, to September 1, 1920.

DIVISION OF WATER RIGHTS

*Bulletin No. 1—Hydrographic Investigation of San Joaquin River, 1920–1923.
*Bulletin No. 2—Kings River Investigation, Water Master's Reports, 1918–1923.
*Bulletin No. 3—Proceedings First Sacramento-San Joaquin River Problems Conference, 1924.
*Bulletin No. 4—Proceedings Second Sacramento-San Joaquin River Problems Conference, and Water Supervisor's Report, 1924.
Bulletin No. 5—San Gabriel Investigation—Basic Data, 1923–1926.
Bulletin No. 6—San Gabriel Investigation—Basic Data, 1926–1928.
Bulletin No. 7—San Gabriel Investigation—Analysis and Conclusions, 1929.
*Biennial Report, Division of Water Rights, 1920–1922.
*Biennial Report, Division of Water Rights, 1922–1924.
Biennial Report, Division of Water Rights, 1924–1926.
Biennial Report, Division of Water Rights, 1926–1928.

DEPARTMENT OF ENGINEERING

*Bulletin No. 1—Cooperative Irrigation Investigations in California, 1912–1914.
*Bulletin No. 2—Irrigation Districts in California, 1887–1915.
Bulletin No. 3—Investigations of Economic Duty of Water for Alfalfa in Sacramento Valley, California, 1915.
*Bulletin No. 4—Preliminary Report on Conservation and Control of Flood Waters in Coachella Valley, California, 1917.
*Bulletin No. 5—Report on the Utilization of Mojave River for Irrigation in Victor Valley, California, 1918.
*Bulletin No. 6—California Irrigation District Laws, 1919 (now obsolete).
Bulletin No. 7—Use of water from Kings River, California, 1918.
*Bulletin No. 8—Flood Problems of the Calaveras River, 1919.
Bulletin No. 9—Water Resources of Kern River and Adjacent Streams and Their Utilization, 1920.
*Biennial Report, Department of Engineering, 1907–1908.
*Biennial Report, Department of Engineering, 1908–1910.
*Biennial Report, Department of Engineering, 1910–1912.
*Biennial Report, Department of Engineering, 1912–1914.
*Biennial Report, Department of Engineering, 1914–1916.
*Biennial Report, Department of Engineering, 1916–1918.
*Biennial Report, Department of Engineering, 1918–1920.

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*Reports and Bulletins out of print. These may be borrowed by your local library from the California State Library at Sacramento, California.

DIVISION OF WATER RESOURCES

Including Reports of the Former Division of Engineering and Irrigation

*Bulletin No. 1—California Irrigation District Laws, 1921 (now obsolete).
*Bulletin No. 2—Formation of Irrigation Districts, Issuance of Bonds, etc., 1922.
Bulletin No. 3—Water Resources of Tulare County and Their Utilization, 1922.
Bulletin No. 4—Water Resources of California, 1923.
Bulletin No. 5—Flow in California Streams, 1923.
Bulletin No. 6—Irrigation Requirements of California Lands, 1923.
*Bulletin No. 7—California Irrigation District Laws, 1923 (now obsolete).
*Bulletin No. 8—Cost of Water to Irrigators in California, 1925.
Bulletin No. 9—Supplemental Report on Water Resources of California, 1925.
*Bulletin No. 10—California Irrigation District Laws, 1925 (now obsolete).
Bulletin No. 11—Ground Water Resources of Southern San Joaquin Valley, 1927.
Bulletin No. 12—Summary Report on the Water Resources of California and a Coordinated Plan for Their Development, 1927.
Bulletin No. 13—The Development of the Upper Sacramento River, containing U. S. R. S. Cooperative Report on Iron Canyon Project, 1927.
Bulletin No. 14—The Control of Floods by Reservoirs, 1928.
*Bulletin No. 18—California Irrigation District Laws, 1927 (now obsolete).
Bulletin No. 18—California Irrigation District Laws, 1929 Revision.
Bulletin No. 19—Santa Ana Investigation, Flood Control and Conservation (with packet of maps), 1928.
Bulletin No. 20—Kennett Reservoir Development, an Analysis of Methods and Extent of Financing by Electric Power Revenue, 1929.
Bulletin No. 21—Irrigation Districts in California, 1929.
Bulletin No. 21-A—Report on Irrigation Districts in California for the Year 1929, 1930.
Bulletin No. 22—Report on Salt Water Barrier (two volumes), 1929.
Bulletin No. 23—Report of Sacramento-San Joaquin Water Supervisor, 1924–1928.
Bulletin No. 24—A Proposed Major Development on American River, 1929.
Bulletin No. 28-A—Industrial Survey of Upper San Francisco Bay Area, 1930.
Bulletin No. 31—Santa Ana River Basin, 1930.
Bulletin No. 32—South Coastal Basin, a Cooperative Symposium, 1930.
Bulletin No. 34—Permissible Annual Charges for Irrigation Water in Upper San Joaquin Valley, 1930.
Bulletin No. 35—Permissible Economic Rate of Irrigation Development in California, 1930.
Bulletin No. 36—Cost of Irrigation Water in California, 1930.
Biennial Report, Division of Engineering and Irrigation, 1920–1922.
Biennial Report, Division of Engineering and Irrigation, 1922–1924.
Biennial Report, Division of Engineering and Irrigation, 1924–1926.

COOPERATIVE AND MISCELLANEOUS REPORTS

*Report of the Conservation Commission of California, 1912.
*Irrigation Resources of California and Their Utilization (Bul. 254, Office of Exp. U. S. D. A.) 1913.
*Report, State Water Problems Conference, November 25, 1916.
*Report on Pit River Basin, April, 1915.
*Report on Lower Pit River Project, July, 1915.
*Report on Iron Canyon Project, 1914.
*Report on Iron Canyon Project, California, May, 1920.
*Sacramento Flood Control Project (Revised Plans), 1925.
Report of Commission Appointed to Investigate Causes Leading to the Failure of St. Francis Dam, 1928.
Report of the Joint Committee of the Senate and Assembly Dealing With the Water Problems of the State, 1929.
Report of the California Joint Federal-State Water Resources Commission, 1930.
Conclusions and Recommendations of the Report of the California Irrigation and Reclamation Financing and Refinancing Commission, 1930.
Report of the Joint Committee of the Senate and Assembly Dealing with the Water Problems of the State, 1931.

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*Reports and Bulletins out of print. These may be borrowed by your local library from the California State Library at Sacramento, California.

PAMPHLETS

Rules and Regulations Governing the Supervision of Dams in California, 1929.
Water Commission Act with Latest Amendments Thereto, 1929.
Rules and Regulations Governing the Appropriation of Water in California, 1929.
Rules and Regulations Governing the Determination of Rights to Use of Water in Accordance with the Water Commission Act, 1925.
Tables of Discharge for Parshall Measuring Flumes, 1928.
General Plans, Specifications and Bills of Material for Six and Nine Inch Parshall Measuring Flumes, 1930.

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