THE RESOURCES AGENCY OF CALIFORNIA

Department of Water Resources

BULLETIN No. 39-62

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

VOLUME I

TEXT

JULY 1964

HUGO FISHER
Administrator
The Resources Agency of California

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
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VOLUMES OF BULLETIN NO. 39-62

Volume I - Text.

Volume II - Appendixes A and B: Water Level Data, Central Coastal and Los Angeles Regions.

Volume III - Appendixes C, D, E, F, and G: Water Level Data, Lahontan, Colorado River Basin, Santa Ana, and San Diego Regions.

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(The following appendixes are bound in Volume III)

ATE OF CALIFORNIA—RESOURCES AGENCY WILLIAM E. WARNE, Director

EPARTMENT OF WATER RESOURCES
. BOX 388
CRAMENTO

April 9, 1964

Honorable Edmund G. Brown, Governor
and Members of the Legislature
of the State of California

Gentlemen:

I have the honor to transmit herewith Bulletin No. 39-62, "Water Supply Conditions in Southern California during 1961-62." This bulletin was prepared pursuant to Sections 225 and 226 of the California Water Code, and is the 31st of a series which has been published annually since 1932.

During the water year 1961-62 (October 1, 1961, through September 30, 1962) precipitation was somewhat above normal. However, the accumulated deficiency of precipitation at Los Angeles during the drought which has prevailed in Southern California since 1944 is equal to approximately three years of normal precipitation.

Heavy rains during February 1962 contributed to heavy runoff in streams, especially those in Santa Barbara and Ventura Counties. In areas where surface flow was above normal, storage in surface reservoirs increased. Ground water supplies were replenished in most areas by both local and imported water. The amount of water imported to coastal Southern California from the Colorado and Owens Rivers decreased from 1,375,600 acre-feet in 1960-61 to 1,354,100 acre-feet in 1961-62. Sea water continued to intrude coastal ground water basins, because of continuing inland ground water extractions.

Sincerely yours,

William E. Warne

Director

Enc.

AUTHORIZATION

The California Legislature of 1929 enacted legislation designated Chapter 832, Statutes of 1929, quoted in part, 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 herey 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."

* Reduced by the Governor to $390,000.

Pursuant to this legislation the Division of Water Resources, predecessor of the Department of Water Resources, undertook a series of hydrologic investigations of the Southern California area. Subsequent sessions of the Legislature provided funds for the continuation of these studies. Initially, this included some investigation of the quality of irrigation waters; later, pursuant to Chapter 1552, Statutes of 1949, this work was expanded to include the study of pollution and degradation of waters of the State. Current authorization for this work is set forth in Sections 225, 226, 229, and 12616 of the California Water Code.

ACKNOWLEDGMENT

The Department of Water Resources gratefully acknowledges the assistance and contributions of the many public agencies, private organizations, and individuals whose cooperation has greatly facilitated the preparation of this bulletin. In this regard, special mention is made of the following:

City of San Bernardino

City of San Diego

Los Angeles County Flood Control District

Los Angeles Department of Water and Power

Orange County Flood Control District

Riverside County Flood Control and Water Conservation District

San Bernardino County Flood Control District

San Luis Obispo County Flood Control and Water Conservation District

The Metropolitan Water District of Southern California

United States Geological Survey

United States Weather Bureau

United Water Conservation District

Ventura County Flood Control District

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

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CHAPTER I. INTRODUCTION

This report is the 31st in the Bulletin No. 39 series, a water supply report which has been published annually since 1932. The 31-year period encompassed by this series of reports has seen dramatic changes in the Southern California area. The population has increased from just over two million to more than nine million during this span, and the resulting changes in urban and agricultural developments have not only imposed continually increasing demands upon available water supplies, but have also brought about changes in the regimen of the water requirements.

The original concept of the Bulletin No. 39 series, as stated in the first issue, was to provide a "useful manual for all interested in water development and supply in the South Coastal Basin." Although the area encompassed by the report has been broadened to include all of Southern California, and the scope of the report has been expanded to include additional items of water supply, the basic concept and purpose of the report series remain unchanged.

The early reports of the Bulletin No. 39 series were limited to publication of ground water level records in the Santa Ana, San Gabriel, and Los Angeles River Valleys, and the West and South Coastal Plains. Subsequently, the area covered by the report was extended to include the San Jacinto and Antelope Valleys, and a general water supply summary for the southern portion of the State was added in 1948. The summary contained information on precipitation, runoff, surface reservoir storage, importations, water quality, and changes in ground water levels. This summary has been continued in the present report.

To permit more rapid dissemination of data, the period covered by the report was changed in 1956 from the calendar year to the water year (October 1 - September 30), or precipitation year (July 1 - June 30), as the data permitted. The report area was also expanded at that time to include the entire Southern District which today encompasses the area shown on Plate 1, "Location of Southern District." In addition, discussions of sea-water intrusion, weather modification operations, surface water, and sewage discharges to the Pacific Ocean and its tidal estuaries were added to provide a more complete description of water supply conditions. Because of the widespread critical nature of the problems, the discussion of sea-water intrusion has been expanded in this issue to include a larger number of threatened areas. Precipitation data have not been included in the appendixes subsequent to Bulletin No. 39-58, published in August 1960.

Scope of Activity and Report

This report contains a discussion of water supply conditions in Southern California for the 1961-62 season, with supporting basic data compiled by the Department of Water Resources and other water agencies operating in the Southern California area. Presented in the report are data on precipitation, surface streamflow, and subsurface waters, including consideration of both quantity and quality of these resources. Information is also given on the activities of representative water agencies. This material is intended for the use of water agencies and the public in the study of surface and ground water problems, and in the planning for optimum use of California's water resources.

Bulletin No. 39-62 is presented in three volumes. Volume I contains a description of the water supply conditions during the 1961-62 season. Volumes II and III consist of seven appendixes which contain ground water level data for the year 1961-62 for the following regions: Central Coastal, Los Angeles, Lahontan, Colorado River Basin, Santa Ana, and San Diego.

Also included in Volume III is Appendix G which contains a listing of all data attributed to the U. S. Geological Survey for the years 1956 through June of 1961. These data supersede and correct data published in the Bulletin 39 series for those years. These corrections are required because of an error found in the machine procedures with respect to the reference point used by the U. S. Geological Survey.

Methods and Procedures

The use of machine data handling procedures facilitated preparation of the appendixes to this report. Ground water level data were placed on IBM cards, checked by computer, and tabulated by machine process. In connection with this procedure, it was necessary to adopt a coding or numbering system to designate hydrologic units and ground water basins, and wells. These coding systems are described in the following paragraphs.

Areal Designation Code

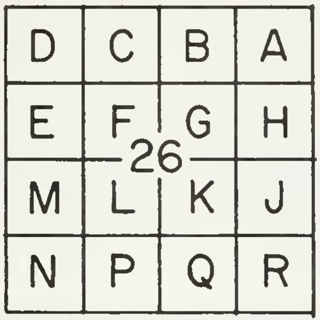
The areal designation code for hydrologic units and ground water basins is based on a decimal numbering system using the form 0-00.00; however, in the appendixes of this report, machine limitations have required the shortening of this to the form 00000. The number to the left of the dash (the first digit in the machine data) refers to the geographic region as defined in Section 13040 of the California Water Code, and delineated on Plate 1. The two digits to the left of the decimal point (the second and third digits in the machine data) refer to a hydrologic unit. This unit generally comprises a major watershed, which may include areas overlying both water-bearing and nonwater-bearing formations. For simplication, the designation "hydrologic unit" is also given to groups of small adjacent watershed areas, with similar hydrologic conditions, which drain directly to the ocean. The Malibu Hydrologic Unit is an example of this type of watershed area.

The two digits to the right of the decimal point (the last two digits in the machine data) refer to a subunit within the hydrologic unit, including, as before, areas overlying both water-bearing and nonwater-bearing formations. The locations and numerical codings for the hydrologic units and subunits are shown on plates pertinent to Chapter III of this volume, and on plates incorporated in Volumes II and III of this bulletin.

<u>Well Numbering System</u>

The well numbering system employed herein is the State Well Numbering System also employed by the United States Geological Survey and is referenced to the township, range and section subdivision of the Federal Land Survey. It conforms to that used in all ground water investigations made by the United States Geological Survey in California and has been adopted by the Department of Water Resources. A cross-index between this numbering system and systems in common use by other agencies in the Southern California area was published as Volume IV of Bulletin 39-57.

Under the adopted system each section is divided into 40-acre plots, called lots, which are lettered as follows:



Wells are numbered within each of these lots according to the sequence in which they have been assigned state well numbers. For example, a well which has the number 10N/18E-26A1, S, would be in Township 10 North, Range 18 East, Section 26, San Bernardino Base and Meridian, and would be further located as the first well assigned a state well number in Lot A. In this report, well numbers are referenced either to the San Bernardino Base and Meridian (S) or the Mount Diablo Base and Meridian (M).

For some wells, the letter following the section number is designated "X." This indicates that the well has been field located and accurately plotted with respect to its position on the map; however, the map control for the Public Land Survey in that area at present is inadequate and does not warrant assignment of a more accurate location number.

Definition of Seasons

Reference is made to a number of periods or seasons in the description of water supply conditions presented in the ensuing chapters of this report. Since the time span for each of these periods or seasons depends upon the type of data being accumulated, the periods are defined in the following paragraphs.

Precipitation

Precipitation data cover the 12-month period, July 1 through June 30. This conforms to standard United States Weather Bureau practice.

Sewage Disposal

Sewage disposal data also cover the 12-month period, July 1 through June 30. This conforms to practice of local agencies.

Surface Runoff, Artificial Recharge, and Imported Water

Surface runoff, artificial recharge, and imported water data are compiled for the water year, which comprises the 12-month period, October 1 through September 30.

Reservoir Storage

The quantity of water in storage in surface storage reservoirs having individual capacities in excess of 10,000 acre-feet is given as of October 1 of each year.

Ground Water Levels

The appendixes to this report contain ground water level data for the period July 1, 1961, through June 30, 1962, with the exception of Appendix G. Since ground water levels are generally lowest in the fall (following the summer period of heaviest extraction), and highest in the spring (following the winter period of recharge and reduced extractions), the fall and spring measurements of ground water elevations are considered to be the most significant, and the most representative of the actual conditions of the ground water reserves. For this reason, most comparative measurements are made in the spring and the fall.

In this report, the changes in ground water elevations are related to the period spring to spring, generally approximating the period April 1961 to April 1962, in an endeavor to make the report as current as possible. In a few instances, particularly when only annual measurements are collected, some other period must be referred to, corresponding to the period of field measurements. Where such deviations are made, appropriate notes are provided.

Prior Reports

Bulletin No. 39, entitled "Records of Ground Water Levels at Wells," was first published in 1932 as a part of the investigations initiated by Chapter 832, Statutes of 1929. Since then, water levels at selected wells have been published annually in Bulletins Nos. 39-A through 39-W, and Bulletins Nos. 39-56 through 39-60. Bulletin No. 39-56, the first of the numbered series, followed Bulletin No. 39-W without interruption in the annual continuity of data.

Since 1930, many bulletins covering various aspects of the hydrology of the South Coastal Basin have been published by the Department of Water Resources and its predecessor, the Division of Water Resources, nearly all of which have been based at least to some extent upon the basic data collected and drawn upon for the Bulletin 39 series. These bulletins include data on water use, ground water levels, quality of water, value and cost of water for irrigation, water losses and evaporation data, ground water geology, and evaluation of overdraft on ground water basins in Southern California.

In addition, water condition reports are prepared by the Department of Water Resources as of the first of each month from February through

May of each year. These reports contain forecasts of the anticipated run-off for the ensuing April-July snowmelt period. The May 1 report contains a section on ground water conditions and a tabulation of ground water level data.

Contemporary Basic Data Reports

This report is one of several related reports issued periodically by the Department of Water Resources, designed primarily to publish basic hydrologic data and to present discussions of water supply conditions. Concurrent reports, not all of which are published annually, are listed below. The year indicated in the title for the data reports listed below is that of the latest publication for the area on subject matter concerned.

Bulletin Series No.	
23-61	Surface Water Flow for 1961 (formerly Sacramento-San Joaquin Water Supervision) August 1963
65-61	Quality of Surface Water in California, 1960 and 1961, Part I - Northern and Central California, August 1963
65-59	Quality of Surface Waters in California, 1959, Part II - Southern California, November 1962
66-60	Quality of Ground Waters in California, 1960, Part I - Northern and Central California, November 1963; Part II - Southern California, December 1963
68-62	Reclamation of Water from Sewage and Industrial Wastes, July 1, 1955 - June 30, 1962; June 30, 1962
77-60	Ground Water Conditions in Central and Northern California; 1959-60, January 1963
91-1	Data on Wells in the West Part of the Middle Mojave Valley Area, San Bernardino County, California; June 1960

Bulletin Series No.	
91-2	Data on Water Wells and Springs in the Yucca Valley - Twentynine Palms Area, San Bernardino and Riverside Counties, California; June 1960
91-3	Data on Water Wells in the Eastern Part of the Middle Mojave Valley Area, San Bernardino County, California; August 1960
91-4	Data on Water Wells in the Willow Springs, Closter, and Chaffee Areas, Kern County, California; September 1960
91-5	Data on Water Wells in the Dale Valley Area, San Bernardino and Riverside Counties, California; March 1961
91-6	Data on Wells in the Edwards Air Force Base Area, California; June 1962
91-7	Data on Water Wells and Springs in the Chuckwalla Valley Area, Riverside County, California; May 1963
91-8	Data on Water Wells and Springs in the Rice and Vidal Valley Areas, Riverside and San Bernardino Counties, California; May 1963
91-9	Data on Water Wells in Indian Wells Valley Area, Inyo, Kern, and San Bernardino Counties, California; May 1963

Summary of 1961-62 Water Supply Conditions

The drought that has prevailed in Southern California since 1944 was partially alleviated during the 1961-62 season as a result of the somewhat above-normal precipitation which occurred in most of this area. However, the accumulated deficiency of precipitation is still quite large; at Los Angeles, for example, this deficiency is approximately 45 inches, which is equivalent to about 3 years' normal rainfall in that area.

Heavy rains between February 7 and February 25 produced more than 50 percent of the total seasonal precipitation, contributing to heavy runoff. This was particularly evident in streams draining the Santa Ynez and Topa Topa Mountains in Santa Barbara and Ventura Counties where the heaviest rains occurred. In contrast, runoff in the Santa Ana River system and in streams in San Diego County was below normal. In areas where above-normal runoff occurred, the amount of water stored in surface reservoirs increased.

The amount of water imported to coastal Southern California decreased from 1,375,600 acre-feet during 1960-61 to 1,354,100 acre-feet during 1961-62. This decrease can probably be partially attributed to the above-normal precipitation in the area. Despite the above-normal precipitation the local water supply conditions in Southern California are still far below normal. It is apparent that a number of years of above-normal precipitation, plus the continued importation of water will be required to meet present needs. In addition, since most of the local supplies are committed in meeting these needs, any increased demands must be met by increased imports.

CHAPTER II. SURFACE WATER SUPPLY CONDITIONS

The 1961-62 season was one of normal or above-normal precipitation in most of Southern California; as such, it was the third year that has interrupted a series of years of subnormal precipitation which began in 1945. However, dry watersheds and depleted ground water basins absorbed much of the precipitation so that runoff did not in all instances reflect the precipitation picture, particularly in the area south of the City of Los Angeles. Surface water supply and disposal conditions are discussed in the following pages, including aspects of precipitation, storage in surface reservoirs, imports, runoff to the ocean, and sewage discharges to the ocean.

Precipitation

Precipitation in coastal Southern California, as measured in terms of percent of mean for the 50-year period 1897-98 through 1946-47, was near normal in San Diego County, increasing in a northerly direction, reaching a maximum around the latitude of Santa Barbara County, then decreasing to around normal in northern San Luis Obispo County. It was above normal in the northern desert areas and generally below normal in the Colorado River desert area. This general distribution may be seen from an inspection of Plate 2, "Precipitation during 1961-62 in Percent of 50-Year Mean Precipitation." Table 1, which lists the 1961-62 precipitation in inches and in percent of the 50-year mean for selected stations, presents essentially the same picture.

The general effect of the 1961-62 season on the long-range water supply picture is indicated on Plate 3, "Representative Precipitation

Characteristics in Southern California." From this plate it may be seen that, while above-normal rainfall occurred in much of the northern part of the area, the deficit which has accumulated during the drought period and which has prevailed since 1945, approximates two to three years of normal precipitation.

TABLE 1

SEASONAL AND MEAN PRECIPITATION AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA

Station	County	50-year mean, 1897-1947, in inches	1961-62 Season	
			In inches	In percent of mean
San Luis Obispo	San Luis Obispo	21.68	25.99	120
Paso Robles	San Luis Obispo	15.82	17.23	109
Santa Maria	Santa Barbara	13.52	16.78	124
Santa Barbara	Santa Barbara	18.56	26.38	142
Ventura	Ventura	15.59	23.24	149
Los Angeles	Los Angeles	14.81	18.79	127
Pomona	Los Angeles	18.21	17.25	95
Santa Ana	Orange	14.16	13.93	98
San Bernardino	San Bernardino	17.21	14.03	82
Bishop	Inyo	6.14	9.00	147
Barstow	San Bernardino	4.17	3.37	81
Blythe	Riverside	4.03	2.83	70
Brawley	Imperial	2.40	2.15	90
Oceanside	San Diego	12.38	10.64	86
San Diego	San Diego	10.36	9.63	93

It is notable from a water supply standpoint that a large portion of the precipitation for the 1961-62 season was accumulated during storms which occurred during the middle of February. As a result, surface flow was available to replenish surface reservoirs, particularly in San Luis Obispo, Santa Barbara, and Ventura Counties.

The importance of these February rains to the seasonal picture is suggested by the cumulative monthly precipitation at selected stations, presented in Table 2.

To provide representative values for seasonal precipitation over the hydrologic units and regions in Southern California, the seasonal precipitation (in percent of the 50-year mean) at individual stations in an area is averaged. The result is designated the areal average precipitation index for that area. For hydrologic regions, an arithmetic average of the areal precipitation indexes for the areas within the region is used. These areal and regional average precipitation indexes are presented in the following sections, with a discussion of precipitation characteristics in each of the hydrologic regions in Southern California during the 1961-62 season.

Central Coastal Region (No. 3) - (Santa Barbara and San Luis Obispo Counties)

Precipitation data for those hydrologic units in the Santa Barbara and San Luis Obispo portions of the Central Coastal Region are presented in Table 3; the location of the units are shown on Plate 6. Precipitation in this area varied from a minimum of 96 percent of the mean for the 50-year period, 1897-98 through 1946-47, in the Arroyo Grande Group to a maximum of 166 percent of the mean in the Cambria Group. Seasonal precipitation at the City of San Luis Obispo was almost 26 inches, and at the City of Santa Barbara 26.4 inches were recorded. In general, the indexes are somewhat higher in Santa Barbara County than in San Luis Obispo County, as can be seen from Table 3. The regional average of precipitation index for the 33 stations in this region was 124 percent of the mean.

TABLE 2

CUMULATIVE MONTHLY PRECIPITATION
AT SAN LUIS OBISPO, LOS ANGELES,
SAN DIEGO AND BARSTOW

Month	Cumulative monthly precipitation at San Luis Obispo			Cumulative monthly precipitation at Los Angeles			Cumulative monthly precipitation at San Diego			Cumulative monthly precipitation at Barstow		
	50-year mean, 1897-1947, in inches	1961-62 Season		50-year mean, 1897-1947, in inches	1961-62 Season		50-year mean, 1897-1947, in inches	1961-62 Season		50-year mean, 1897-1947, in inches	1961-62 Season	
		In inches	In percent of mean		In inches	In percent of mean		In inches	In percent of mean		In inches	In percent of mean
July	0.00	0.01	0	0.01	0	0	0.03	0	0	0.15	0	0
August	0.04	0.01	25	0.03	0.03	100	0.09	0.04	44	0.41	0.59	144
September	0.27	0.02	7	0.31	0.08	26	0.23	0.04	17	0.58	0.59	102
October	1.08	0.02	2	0.90	0.08	9	0.79	0.24	30	0.87	0.59	68
November	2.76	4.62	167	1.96	2.10	107	1.61	1.03	64	1.16	1.05	69
December	6.56	6.76	103	4.46	3.54	79	3.59	2.48	69	1.75	1.74	99
January	11.50	9.64	84	7.41	6.10	82	5.51	5.19	94	2.41	2.06	86
February	16.02	23.60	147	10.78	17.67	164	7.67	8.27	108	3.04	3.15	104
March	19.62	25.76	131	13.45	18.77	140	9.32	8.91	96	3.72	3.29	88
April	20.96	25.89	124	14.40	18.77	130	10.05	8.92	89	3.98	3.29	83
May	21.54	25.93	120	14.74	18.79	127	10.32	9.54	92	4.08	3.37	83
June	21.68	25.99	120	14.81	18.79	127	10.36	9.63	93	4.17	3.37	81

TABLE 3

AVERAGE PRECIPITATION INDEXES FOR HYDROLOGIC
UNITS IN CENTRAL COASTAL REGION (NO. 3)
FOR THE 1961-62 SEASON

Hydrologic unit	Areal designation code number*	Number of stations	Average precipitation index
Salinas Valley	3- 4.00	7	103
San Luis Obispo Group	3- 8.00	2	112
Arroyo Grande Group	3-11.00	1	96
Santa Maria River Valley	3-12.00	3	125
Cuyama River Valley	3-13.00	3	142
San Antonio Creek Valley	3-14.00	2	151
Santa Ynez River Valley	3-15.00	6	122
South Coast Basins, Santa Barbara County	3-16.00	4	123
Carrizo Plain	3-19.00	2	146
Cambria Group	3-21.00	1	166
Santa Barbara County Coastal Group	3-22.00	2	135
Southern Central Coastal Region		33	124

*See Plate 6.

There were no reports of weather modification activities in this region during the 1961-62 water year.

Los Angeles Region (No. 4)

In the Los Angeles Region, the average of precipitation indexes for the 1961-62 season was 131 percent of the 50-year mean, 1897-1947, as shown in Table 4. The average areal precipitation index within the region ranged from a low of 101 percent in the Upper Santa Ana Valley in Los Angeles County to a high of 163 percent in the Malibu Coastal Group in Los Angeles County. Values significantly above average are noted for the

Ventura River Valley and Santa Clara River Valley Units. Precipitation, as measured at the U. S. Weather Bureau Station located atop the Federal Building in downtown Los Angeles, amounted to 18.8 inches or 127 percent of the 50-year mean.

TABLE 4

AVERAGE PRECIPITATION INDEXES FOR
HYDROLOGIC UNITS IN LOS ANGELES REGION (NO. 4)
FOR THE 1961-62 SEASON

Hydrologic unit	Areal designation code number*	Number of stations	Average precipitation index
Upper Ojai Valley	4- 1.00	2	136
Ojai Valley	4- 2.00	2	139
Ventura River Valley	4- 3.00	7	158
Santa Clara River Valley	4- 4.00	29	147
Acton Valley	4- 5.00	5	134
Pleasant Valley	4- 6.00	1	133
Arroyo Santa Rosa Valley	4- 7.00	1	142
Las Posas Valley	4- 8.00	5	142
Simi Valley	4- 9.00	2	134
Conejo Valley	4-10.00	3	136
Coastal Plain, Los Angeles County	4-11.00	59	140
San Fernando Valley	4-12.00	36	131
San Gabriel Valley	4-13.00	70	115
Upper Santa Ana Valley, Los Angeles County	4-14.00	7	101
Malibu Coastal Group	4-16.00	3	163
Los Angeles Region		232	131

*See Plate 7.

Weather modification operations were conducted by the Los Angeles County Flood Control District in the drainage area above San Gabriel Dam, where ground-based silver iodide smoke generators were operated for a total of 1,029 hours during the period November 20, 1961, through March 21, 1962.

Lahontan Region (No. 6) - (Southern Portion)

In the southern portion of the Lahontan Region, the areal average precipitation indexes, presented in Table 5, range from a minimum of 71 percent in Riggs Valley to a maximum of 183 percent in Deep Springs Valley; the regional precipitation index was 129 percent. It is noted that most of the higher values were found in the more northerly hydrologic units but, because of the small number of precipitation stations and the occurrence of localized summer thunderstorms, these index figures may not be truly indicative of areawide characteristics.

TABLE 5

AVERAGE PRECIPITATION INDEXES FOR HYDROLOGIC UNITS IN LAHONTAN REGION (NO. 6) FOR THE 1961-62 SEASON

Hydrologic unit	Areal designation code number*	Number of stations	Average precipitation index
Mono Valley	6- 9.00	3	84
Long Valley	6-11.00	2	148
Owens Valley	6-12.00	11	146
Deep Springs Valley	6-15.00	1	183
Death Valley	6-18.00	1	99
Riggs Valley	6-23.00	1	71
Kelso Valley	6-31.00	1	78
Lower Mojave River Valley	6-40.00	2	72
Middle Mojave River Valley	6-41.00	1	81
Upper Mojave River Valley	6-42.00	4	103
Antelope Valley	6-44.00	31	136
Fremont Valley	6-46.00	1	138
Searles Valley	6-52.00	1	106
Indian Wells Valley	6-54.00	1	145
Rose Valley	6-56.00	2	163
Southern Lahontan Region		63	129

*See Plate 8.

No weather modification activities were reported for this area during the 1961-62 season.

Colorado River Basin Region (No. 7)

Available data indicate that the areal average precipitation index in this region ranged from a minimum of 32 percent of the 50-year mean in the Needles Valley to a maximum of 112 percent of the mean in the Twentynine Palms and Means Valleys. The regional precipitation index was 74 percent for the 1961-62 season. However, a paucity of observation stations in this region, coupled with the highly localized effects of thundershowers, suggests that the indexes given in Table 6 may not be truly indicative of actual areawide conditions.

There were no reports of weather modification activities in this region during the 1961-62 season.

Santa Ana Region (No. 8)

The areal average precipitation indexes for the 1961-62 season in the Santa Ana Region, as shown in Table 7, range from a minimum of 73 percent of the 50-year mean at Cajalco Valley to a maximum of 109 percent in the coastal plain; the regional average precipitation index was 101 percent. Measured seasonal precipitation at the U. S. Weather Bureau Stations in Santa Ana and San Bernardino amounted to 13.9 and 14.0 inches, respectively, or 98 and 82 percent of the mean.

Weather modification operations were conducted by the San Bernardino Valley Municipal Water District in the Santa Ana River watershed during the 1961-62 season. A total of 3,544 hours of operation was logged, using ground-based silver iodide smoke generators during the period from October 1, 1961, through May 1, 1962.

TABLE 6

AVERAGE PRECIPITATION INDEXES FOR HYDROLOGIC UNITS IN COLORADO RIVER BASIN REGION (NO. 7) FOR THE 1961-62 SEASON

Hydrologic unit	Areal designation code number*	Number of stations	Average precipitation index
Ward Valley	7- 3.00	1	45
Chuckawalla Valley	7- 5.00	1	71
Bristol Valley	7- 8.00	1	51
Twentynine Palms Valley	7-10.00	1	112
Means Valley	7-17.00	1	112
Lucerne Valley	7-19.00	1	74
Morongo Valley	7-20.00	1	69
Coachella Valley	7-21.00	14	73
Borrego Valley	7-24.00	1	78
Terwilliger Valley	7-26.00	1	77
San Felipe Valley	7-27.00	1	97
Coyote Wells Valley	7-29.00	1	66
Imperial Valley	7-30.00	4	86
Orcopia Valley	7-31.00	1	46
East Salton Sea Valley	7-33.00	1	80
Palo Verde Valley	7-38.00	3	67
Calzona Valley	7-41.00	1	76
Needles Valley	7-44.00	1	32
Colorado River Basin Region		36	74

*See Plate 9.

San Diego Region (No. 9)

The regional precipitation index in the San Diego Region for the 1961-62 season was 92 percent. It will be noted from data presented in Table 8 that the areal average precipitation indexes ranged from a

TABLE 7

AVERAGE PRECIPITATION INDEXES FOR
HYDROLOGIC UNITS IN SANTA ANA REGION (NO. 8)
FOR THE 1961-62 SEASON

Hydrologic unit	Areal designation code number*	Number of stations	Average precipitation index
Coastal Plain, Orange County	8-1.00	40	109
Upper Santa Ana Valley	8-2.00	38	96
Cajalco Valley	8-3.00	2	73
Elsinore Valley	8-4.00	1	95
San Jacinto Valley	8-5.00	2	81
Bear Valley	8-9.00	1	102
Santa Ana Region		84	101

*See Plate 10.

minimum of 60 percent of the mean in the Otay Valley to a maximum of 119 percent in San Juan Valley; lower than average values predominate in the south, with higher values in the north. Measured precipitation at the City of San Diego was 9.6 inches, or 93 percent of the mean.

There were no reports of weather modification activities in this region during the 1961-62 season.

Runoff

Runoff in Southern California streams is generally responsive to the amount and intensity of precipitation. In areas where precipitation was substantially above normal, notably in Ventura and Santa Barbara Counties, seasonal runoff, primarily as a result of the storms of February, was considerably above the mean for the 53-year period 1894-95 through 1946-47. In other areas where precipitation was near or below normal, runoff was generally considerably below normal, primarily because of the

TABLE 8

AVERAGE PRECIPITATION INDEXES FOR
HYDROLOGIC UNITS IN SAN DIEGO REGION (NO. 9)
FOR THE 1961-62 SEASON

Hydrologic unit	Areal designation code number*	Number of stations	Average precipitation index
San Juan Valley	9- 1.00	5	119
San Mateo Valley	9- 2.00	1	113
Coahuila Valley	9- 6.00	1	80
San Luis Rey Valley	9- 7.00	3	94
Warner Valley	9- 8.00	3	83
San Pasqual Valley	9-10.00	2	95
Santa Maria Valley	9-11.00	2	87
San Dieguito Valley	9-12.00	2	96
Poway Valley	9-13.00	1	103
Mission Valley	9-14.00	4	92
San Diego River Valley	9-15.00	3	95
Sweetwater Valley	9-17.00	5	79
Otay Valley	9-18.00	2	60
Tia Juana Valley	9-19.00	1	88
Campo Valley	9-30.00	1	83
Agency Flat Valley	9-31.00	1	71
Santa Ysabel Valley	9-45.00	1	100
Spencer Valley	9-46.00	1	87
San Diego Region		39	92

*See Plate 11.

very dry condition of the watersheds as a result of the previous three years of very subnormal precipitation which permitted high infiltration rates and therefore a lower volume of runoff.

The estimated unimpaired runoff during the 1961-62 water year, for selected stations representative of conditions in Southern California, is presented in Table 9 together with a comparison of estimated or measured maximum and minimum runoff for each station with the 53-year mean for the

TABLE 9

ESTIMATED 1961-62 SEASONAL UNIMPAIRED RUNOFF AT SELECTED STATIONS IN SOUTHERN CALIFORNIA

In acre-feet

Station	Period of record	1961-62	53-year mean[a]	Percent of mean	Maximum[b]		Minimum[b]	
					Season	Quantity	Season	Quantity
Central Coastal Region								
Arroyo Grande at Arroyo Grande	1939 to date	19,260[c]	23,900	81	1906-07	76,200	1930-31	800
Huasna River near Arroyo Grande	1959 to date	22,490	17,200[d]	114	1906-07	64,730[d]	[e]	0[d]
Los Angeles Region								
Sespe Creek near Fillmore	1911-13 1927 to date	188,577	93,900	201	1940-41	376,000	1950-51	3,520
Arroyo Seco near Pasadena	1910 to date	6,562	7,300	90	1921-22	25,400	1898-99	160
Santa Anita Creek near Sierra Madre	1916 to date	6,290	4,920	128	1942-43	16,600	1898-99	210
San Gabriel River near Azusa	1894 to date	120,100	122,000	98	1921-22	419,000	1960-61	1,250
Lahontan Region								
Owens River below Long Valley	1916 to date	142,963	168,500	85	1906-07	292,000	1930-31	73,010
Rock Creek near Valyermo	1923-37 1938 to date	14,250	15,000	95	1921-22	39,000	1950-51	1,380
Deep Creek near Hesperia	1904-22 1929 to date	50,940	47,100[f]	106	1921-22	177,000[g]	1960-61	4,240[g]
Colorado River Basin Region								
Colorado River at Less Ferry	1911 to date	14,575,600	11,880,000[ch]	123	1916-17	21,860,000[cg]	1933-34	4,377,000[cg]
Colorado River at Hoover Dam	1933 to date	8,304,300	11,168,000[cj]	74	1941-42	17,880,000[cg]	1933-34	5,058,000[cg]
Colorado River at Yuma	1878 to date	716,190	5,646,000[cj]	15	1908-09	26,070,000[cg]	1960-61	707,270[cg]
Palm Canyon Creek near Palm Springs	1930-41 1947 to date	170	3,580[k]	5	1936-37	18,980[g]	1955-56	0.2[g]

ESTIMATED 1961-62 SEASONAL UNIMPAIRED RUNOFF AT SELECTED STATIONS IN SOUTHERN CALIFORNIA
(continued)

In acre-feet

Station	Period of record	1961-62	53-year mean[a]	Percent of mean	Maximum[b]		Minimum[b]	
					Season	Quantity	Season	Quantity
Santa Ana Region								
Cucamonga Creek near Upland	1928 to date	3,770	6,190	61	1921-22	20,900	1898-99	930
Santa Ana River near Mentone	1896 to date	33,450	70,600	47	1915-16	280,000	1950-51	13,090
San Diego Region								
Murrieta Creek at Temecula	1930 to date	1,310	8,670	15	1915-16	60,300	1960-61	320
Santa Ysabel Creek at Sutherland Dam	1936 to date	1,249	15,200	8	1915-16	95,200	1960-61	130
Cottonwood Creek at Morena Dam	1911 to date	368	12,400	3	1915-16	75,300	1960-61	70

a. Mean for period 1894-95 through 1946-47, except as noted.
b. Indicated maxima and minima are recorded or estimated values for period 1894-95 to date except as noted.
c. Measured runoff, unadjusted for upstream development.
d. Huasna River, Arroyo Grande 53-year mean computed from Santa Maria Station.
e. Zero flow reported for eleven seasons.
f. Average for period 1920-21 through 1949-50.
g. Indicated maxima and minima are recorded or estimated values for a given period of record.
h. Average for period 1922-23 through 1955-56.
j. Average for period 1936-37 through 1955-56.
k. Average for period 1930-31 through 1940-41 and 1947-48 through 1957-58.

stream in question. The historical seasonal unimpaired runoff of selected streams, for the period 1894 to the present, and the accumulated deviation of this runoff from the long-term mean are delineated on Plate 4, "Representative Runoff Characteristics in Southern California." The estimated seasonal unimpaired runoff (runoff unaffected by the works of man) at Arroyo Seco near Pasadena was 90 percent of the 53-year mean. Values for the Santa Ana River near Mentone, Sespe Creek near Fillmore, and Huasna River near Arroyo Grande were 47 percent, 201 percent, and 114 percent of the mean, respectively.

Runoff in streams in San Diego County was notably below normal during the 1961-62 season. This is apparently related to the previously noted fact that precipitation in this area was relatively less than in most parts of coastal Southern California. The estimated unimpaired runoff of Cottonwood Creek at Morena Dam was only 3 percent of the mean for the 53-year period 1894-95 through 1946-47, while Santa Ysabel Creek at Sutherland Dam was 8 percent of the mean.

Runoff in streams in and adjacent to the easterly desert areas was generally near normal. The estimated seasonal unimpaired runoff of the Owens River below Long Valley was 143,000 acre-feet, or 85 percent of the 53-year mean. Runoff in Rock Creek, as measured near Valyermo, was 95 percent of mean. The unadjusted seasonal runoff in the Colorado River as measured at Lee's Ferry, Arizona, was 123 percent of normal.

Discharge to the Pacific Ocean and Tidal Estuaries

During the 1961-62 season, substantial amounts of water flowed into the Pacific Ocean and tidal estuaries despite efforts of Southern

California water agencies to conserve and use such flows for water supply purposes. However, a large part of these flows represented runoff from urban areas near the coast or high intensity flood flows which, by their nature, are not economically susceptible of storage and conservation.

Table 10 presents data for the 1961-62 season on discharge to the ocean as measured near the coast on the larger streams draining a major portion of coastal Southern California. For comparative purposes, data for the preceding year are also included in the table. The 1961-62 discharge to the ocean was 10 times that of the previous year for the 18 streams for which records are available. This was primarily a direct result of the concentration of the season's precipitation in the month of February. As would be anticipated from the precipitation pattern previously described, nearly 75 percent of the discharge to the ocean during the 1961-62 season was from the Santa Clara, Los Angeles, Ventura, and Santa Ynez Rivers.

Storage in Surface Reservoirs

In accompaniment to the general water supply picture previously described, the amount of local water stored in Southern California reservoirs increased in most regions during the 1961-62 season, although effects of the prolonged drought which commenced in 1945 are still apparent. The amount of water in storage in selected reservoirs in or supplying water to Southern California is presented in Table 11 for both October 1, 1961, and October 1, 1962.

In coastal Southern California, the amount of local water stored in surface reservoirs with individual capacities of 10,000 acre-feet or

TABLE 10

ESTIMATED SEASONAL DISCHARGE TO THE PACIFIC OCEAN AND TIDAL ESTUARIES FROM SELECTED STREAMS IN SOUTHERN CALIFORNIA DURING 1960-61 AND 1961-62

Stream	Discharge, in acre-feet	
	1960-61	1961-62
Central Coastal Region		
Santa Maria River	0	24,160
Santa Ynez River	70	69,951
Los Angeles Region		
Ventura River	210	79,960
Santa Clara River	460	224,580
Ballona Creek	15,380	50,090
Dominguez Channel	39,050	32,220
Los Angeles River	32,000	177,400
Los Cerritos Channel	1,830	7,490
San Gabriel River	2,170*	44,670*
Santa Ana Region		
Santa Ana River	40	4,040
Peters Canyon Drain	450	1,910
San Diego Region		
Aliso Creek	0	180
Trabuco Creek	20	910
San Juan Creek	610	5,800
Santa Margarita River	0	0
San Luis Rey River	0	0
TOTALS	62,660	723,361

*Includes discharge from Coyote Creek.

more amounted to approximately 312,880 acre-feet as of October 1, 1962, or 34 percent of total storage capacity. This is 151,410 acre-feet more than the 161,470 acre-feet stored in these reservoirs on October 1, 1961. Reservoirs storing either imported water or a mixture of imported and local

TABLE 11

WATER IN STORAGE IN SELECTED SURFACE RESERVOIRS
IN, OR SUPPLYING WATER TO, SOUTHERN CALIFORNIA
ON OCTOBER 1, 1961 AND OCTOBER 1, 1962

Watershed	Reservoir	Capacity, in acre-feet	Water in storage, in acre-feet		Water in storage, in percent of capacity	
			October 1, 1961	October 1, 1962	October 1, 1961	October 1, 1962
Central Coastal Region						
Old Creek	Whale Rock	40,000	0	7,157	0	17.8
Santa Ynez River	Gibraltar	15,600	2,830	9,915	18	67.1
	Cachuma	206,500	134,400	190,390	65	92.5
Los Angeles Region						
Coyote Creek	Casitas	250,000	3,880	49,400	2	19.4
Piru Creek	Lake Piru	100,000	300	25,690	0.3	25.7
Bouquet Creek	Bouquet Canyon[a]	36,500	30,920	25,665	85	70.3
Lahontan Region						
Rush Creek	Grant Lake[a]	47,530	10,560	22,060	22	46
Owens River	Long Valley[a] (Lake Crowley)	183,470	78,960	117,370	43	63.9
Rose Valley	Haiwee (South)[a]	58,530	44,230	34,920	76	59.7
Colorado River Basin Region						
Colorado River	Lake Mead	27,207,000	17,928,000	23,624,000	66	86.8
	Lake Mohave	1,810,000	1,350,000	1,349,000	74	74.5
	Lake Havasu	688,000	549,400	566,700	80	91.6

WATER IN STORAGE IN SELECTED SURFACE RESERVOIRS
IN, OR SUPPLYING WATER TO, SOUTHERN CALIFORNIA
ON OCTOBER 1, 1961 AND OCTOBER 1, 1962
(continued)

Watershed	Reservoir	Capacity, in acre-feet	Water in storage, in acre-feet		Water in storage, in percent of capacity	
			October 1, 1961	October 1, 1962	October 1, 1961	October 1, 1962
Santa Ana Region						
Bear Creek	Bear Valley	72,170	1,250	7,100	1.7	9.8
San Jacinto River	Lake Hemet	13,400	608	650	4.5	4.8
	Railroad Canyon	14,700	1,090	520	7.4	3.5
Cajalco Creek	Lake Mathews	180,000	124,750[b]	103,022[b]	68	56.6
Santiago Creek	Santiago	25,000	2,250[b]	3,790[b]	9.0	15.1
San Diego Region						
San Luis Rey River	Lake Henshaw	194,320	2,520	5,900	1.5	3.0
Santa Ysabel Creek	Sutherland	29,680	2,600	3,240	9	11.1
San Dieguito River	Lake Hodges	33,550	2,990[c]	3,920[c]	9	11.6
San Vicente Creek	San Vicente Lake	90,230	54,280[c]	50,070[c]	60	55.5
Boulder Creek	Cuyamaca	11,600	0	0	0	0
San Diego River	El Capitan Lake	112,810	10,060	9,750	9	8.6
Sweetwater River	Lake Loveland	25,250	940	1,590	3.5	6.2
	Sweetwater (Main)	27,150	3,560[c]	2,570[c]	13	9.5
Cottonwood Creek	Morena Lake	50,210	540	530	1	1.0
Otay River	Barrett Lake	44,760	1,000	1,500	2	3.3
	Lower Otay Lake	56,520	3,640[c]	3,730[c]	6	6.6

a. Component of the Aqueduct System of the City of Los Angeles.
b. Includes Colorado River water imported via Colorado River Aqueduct.
c. Includes Colorado River water imported via Colorado River Aqueduct and San Diego Aqueduct.

waters, including the Owens Aqueduct system, contained 373,100 acre-feet of water in storage, or 53 percent of total capacity, on October 1, 1962. This was a slight increase over the amount of these waters in storage on October 1, 1961.

In San Diego County, the total water in storage as of October 1, 1962, amounted to 82,800 acre-feet, or 12 percent of storage capacity, a decrease of 2,300 acre-feet from the previous year, despite the importation of 171,760 acre-feet of Colorado River water during the 1961-62 water year. These values reflect the scarcity of runoff in the county during the year.

The total amount of water stored in three major reservoirs of the Los Angeles Department of Water and Power in the Owens Valley increased from 46 percent of capacity on October 1, 1961, to 60 percent of capacity on October 1, 1962. These reservoirs are used primarily for the regulation of flow through the Los Angeles Aqueduct.

Waters stored in the major reservoirs of the Colorado River amounted to 25,540,000 acre-feet as of October 1, 1962. This was 19 percent more than the amount of water stored in these reservoirs on October 1, 1961.

Colorado River Diversions

Diversions of water from the Colorado River by principal water agencies in California during the 1961-62 water year amounted to approximately 4,991,340 acre-feet. This is a decrease of about 122,200 acre-feet from the volume diverted during the 1960-61 season. Table 12 presents quantities of water diverted by each principal agency during the 1960-61 and the 1961-62 water years.

TABLE 12

QUANTITY AND PERCENT CHANGE IN AMOUNT OF WATER DIVERTED FROM THE COLORADO RIVER FOR USE IN CALIFORNIA DURING 1960-61 AND 1961-62

Agency	Diversion, in acre-feet: 1960-61	Diversion, in acre-feet: 1961-62	Percent change
The Metropolitan Water District of Southern California	1,053,610	1,028,670	- 2.4
Palo Verde Irrigation District	409,670	371,190	-10.4
Imperial Irrigation District	3,090,040	2,987,840	- 3.4
Coachella Valley County Water District	518,370	558,570	+ 7.8
Yuma Project (Reservation Division)	41,850	45,070	+ 7.7
TOTALS	5,113,540	4,991,340	- 2.4

Water Imported to Coastal Southern California

Waters imported to Southern California by both the City of Los Angeles Department of Water and Power and The Metropolitan Water District of Southern California during the 1961-62 season totaled approximately 1,354,100 acre-feet, which represents a decrease of 21,500 acre-feet from that imported during the previous year. Plate 5, "Historical Importations of Water to Coastal Southern California," graphically presents these importations.

Deliveries of water through the Colorado River Aqueduct as measured at the Hayfield Pumping Plant, which is located approximately 125 miles west of the intake at Lake Havasu, were 1,011,130 acre-feet for the 1961-62 water year, a decrease of 3 percent from the 1960-61 season. Deliveries of water to member agencies of The Metropolitan Water District of Southern California totaled about 990,410 acre-feet during the water year, an increase of about 5.4 percent over the previous year. Data for the 1960-61 and 1961-62 water year deliveries of Colorado River water to each of the coastal counties are presented in Table 13. The difference in the values for the volume of water measured at the Hayfield Pumping Plant and the sum of the deliveries to the various counties shown in Table 13 is accounted for by unavoidable aqueduct and distribution system losses. Change of storage in Lake Mathews is also a contributing factor to the system balance.

TABLE 13

COLORADO RIVER WATER IMPORTED TO COUNTIES
IN COASTAL SOUTHERN CALIFORNIA
DURING 1960-61 AND 1961-62

County	Seasonal import, in acre-feet		Percent change
	1960-61	1961-62	
Los Angeles County	445,570	464,100	+ 4.2
Orange County	231,360	291,020	+25.8
San Diego County	204,370	187,630	- 8.2
Riverside County	52,690	41,140	-22.1
San Bernardino County	5,590	6,520	+14.3
TOTALS	939,580	990,410	+ 5.4

The Department of Water and Power of the City of Los Angeles imported a total of 342,940 acre-feet of water through its aqueduct system from Owens Valley. The aqueduct was operated at full capacity during the 1961-62 water year, except for short periods of shutdown for maintenance purposes.

Sewage Discharge to the Pacific Ocean and Tidal Estuaries

Sewage effluent discharged to the Pacific Ocean and its estuaries, through 12 outfalls which dispose of essentially all such effluent along the coast, amounted to approximately 800,000 acre-feet during the 1961-62 fiscal year. This is about 7 percent more than that discharged during the previous year. The amount of effluent discharged through each outfall during the 1961-62 season, compared with discharges during the 1960-61 season, is shown on Table 14.

TABLE 14

SEWAGE DISCHARGED TO THE PACIFIC OCEAN AND TIDAL ESTUARIES FROM MAJOR DISPOSAL FACILITIES IN SOUTHERN CALIFORNIA DURING 1960-61 AND 1961-62

Station	Discharge, in acre-feet		Percent change
	1960-61	1961-62	
City of Santa Barbara	5,630	6,570	17
City of Ventura	2,450*	3,400*	39
City of Oxnard	4,280	4,720	10
City of Los Angeles			
Hyperion	292,100	311,630	7
Terminal Island	7,100	7,930	12
County Sanitation Districts of Los Angeles County	302,850	312,100	3
County Sanitation Districts of Orange County	63,670	82,260	29
City of San Diego	53,580	54,650	2
City of Coronado	N.R.	1,390	--
City of Chula Vista	3,160*	3,440*	9
International Outfall Sewer	4,210	2,150	-49
TOTALS	739,030	790,240	

*Estimated

The large increases in Orange County and the City of Ventura reflect the increase in population and industry in Southern California, in addition to the extension of sewerage facilities into areas previously unsewered.

The 49 percent decrease in 1961-62 in the amount of waste discharged from the International Outfall Sewer is at least partially attributable to the limitation on the water supply of the City of Tijuana. A partial diversion of sewage from the City of Tijuana from the outfall sewer, for testing purposes, and on March 23, 1962, a complete diversion of sewage for disposal south of the city, also contributed to this reduction.

CHAPTER III. GROUND WATER SUPPLY CONDITIONS

Ground water supply conditions improved somewhat in the coastal area of Southern California during the 1961-62 season, the extent of improvement depending on local water supply picture. A comparison of ground water level measurements made in the spring of 1962 with those made during the previous spring indicates that ground water levels generally rose in the more northerly areas, while only a minor rise, if any, was noted in the ground water levels in the southerly areas. As would be expected, ground water levels rose substantially in many of the smaller basins, but showed only moderate rises in the larger basins.

A brief summary of the ground water supply conditions during the 1961-62 season is presented in this chapter for each of the hydrologic regions in Southern California. It includes discussions of ground water levels and, where applicable, artificial recharge activities which effect such levels.

Central Coastal Region (No. 3)
(Santa Barbara and San Luis Obispo Counties)

Between the spring of 1961 and the spring of 1962, ground water level elevations rose moderately in most of the basins for which data are available. Exceptions to the general increase were San Simeon, Santa Rosa and Toro Basins. However, there is a paucity of data for these basins so that the true picture of the ground water table may not be indicated. Despite this moderate rise, water levels remained below sea level in portions of the South Coast Basins (Santa Barbara County).

The estimated average changes in ground water levels in basins in this region are given in Table 15, and available ground water level data

TABLE 15

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO. 3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1961-62

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
3-4.00	Salinas Valley				
3-4.06	Paso Robles Basin	41	+ 8	26S/12E-26D1, M 228.9	27S/13E- 9K1, M Flowing
3-8.00	San Luis Obispo Group				
3-8.01	Morro Basin	4	+10	29S/10E-25F3, M 43.1	29S/10E-25B2, M 8.4
3-8.03	Los Osos Basin	3	+ 1	30S/11E- 7K1, M 43.1	30S/10E-13G1, M 17.1
3-8.04	San Luis Obispo Basin	4	+ 2	31S/12E-32D1, M 24.8	31S/12E- 4K1, M 8.0
3-11.00	Arroyo Grande Group				
3-11.01	Arroyo Grande Basin	17	+10	32S/13E-29E1, M 67.7	32S/14E-19A1, M 1.6
3-12.00	Santa Maria River Valley	35	+ 2	11N/34W-19Q1, S 296.4	9N/32W-23K1, S 9.2
3-13.00	Cuyama River Valley	11	+ 2	9N/26W- 4J1, S 301.0	7N/24W-13C2, S 20.7

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO. 3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
3-14.00	San Antonio Creek Valley	1	+ 3	8N/32W-35Q1, S 139.0	8N/34W-16G1, S Flowing
3-15.00	Santa Ynez River Valley				
3-15.01	Lompoc Subarea	42	+ 6	7N/34W-12E1, S 311.1	7N/34W-27H1, S 1.0
3-15.02	Santa Rita Subarea	25	+ 5	6N/33W- 9D1, S 68.1	6N/33W-14D1, S 3.8
3-15.03	Buellton Subarea	16	+ 6	6N/32W- 2Q1, S 61.7	6N/32W-12R2, S 6.1
3-15.04	Santa Ynez Subarea	20	+ 4	7N/30W-33M2, S 195.4	6N/31W-21G3, S 7.3
3-15.05	Headwater Subarea	5	+ 2	6N/30W-14R2, S 22.3	6N/30W-24E1, S 2.3
3-16.00	South Coast Basins (Santa Barbara County)				
3-16.01	Goleta Basin	20	+ 4	4N/27W- 6Q9, S 251.0	4N/28W-18G2, S Flowing
3-16.02	Santa Barbara	3	+ 5	4N/27W- 8E2, S 138.9	4N/27W-18R2, S 34.4
3-16.04	Carpinteria Basin	16	+ 9	4N/25W-26C2, S 312.8	4N/25W-30D1, S 4.5

AVERAGE CHANGES IN GROUND WATER ELEVATION IN
SELECTED VALLEYS AND BASINS IN CENTRAL COASTAL REGION (NO. 3)
(SANTA BARBARA AND SAN LUIS OBISPO COUNTIES)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
3-19.00	Carrizo Plain	3	+ 3	29S/18E-28K1, M 40.2	30S/18E- 2N1, M 16.5
3-21.00	Cambria Group				
3-21.03	San Simeon Basin	1	0	27S/ 8E- 9L1, M 14.5	27S/ 8E- 9L1, M 9.8
3-21.04	Santa Rosa Basin	3	0	27S/ 8E-26C3, M 37.7	27S/ 8E-26C2, M 12.0
3-21.05	Villa Basin	1	+ 3	28S/ 9E-23E2, M 20.6	28S/ 9E-23E2, M 17.0
3-21.08	Toro Basin	1	- 1	29S/10E- 1P1, M 7.5	29S/10E- 1P1, M 7.5

for the Central Coastal Region, for the period July 1961 through June 1962, are tabulated in Volume II, Appendix A. In Table 15 and the five similar tables that follow, the change in ground water elevation may or may not have been calculated for those wells which showed the maximum or minimum depth to ground water. Hydrographs of selected wells, whose locations are given on Plate 6, "Location of Wells at Which Water Levels are Shown - Central Coastal Region (No. 3)," are presented on Plate 12A.

In the Upper Salinas Valley, ground water levels in the Paso Robles Basin rose in elevation an average of approximately eight feet. Depths to ground water ranged from flowing, at a well 8 miles north of Templeton, to 229 feet below the ground surface 2 miles east of Paso Robles.

In the San Luis Obispo Group, the average elevations of ground water rose from one foot in the Los Osos Basin to 10 feet in Morro Basin. Observed depths to ground water ranged from 8 feet below the ground surface, approximately 2.5 miles southwest of San Luis Obispo, to more than 40 feet near the south limits of the City of Morro Bay.

Observations of ground water levels in the Arroyo Grande Group indicated the ground water surface elevation rose an average of 10 feet between the spring of 1961 and the spring of 1962. Observed depths to ground water ranged from 1.5 feet below the ground surface, at a well located 6.5 miles east of Grover City, to more than 300 feet, 9.5 miles southwest of Grover City.

All ground water basins in the Santa Ynez River Valley showed a rise in water surface elevations, varying from a rise two feet in the Headwater Subarea to about six feet in the Lompoc and Buellton Subareas.

In the South Coast Basin of Santa Barbara County, ground water levels rose in all basins, with depths to ground water indicating an average rise ranging from four feet in the Goleta Basin to a maximum average of nine feet in the Carpinteria Basin. However, static water ground levels at many of the wells in these basins remained below sea level (as much as 50 feet below sea level in the Goleta Basin) during the entire season. Thus, conditions favorable to sea-water intrusion continued.

Los Angeles Region (No. 4)

Ground water surface elevations in 45 of the 57 basins in this region for which data are available indicated rises, some as much as 50 feet. Declines of from 1 to 6 feet were observed in several of the smaller basins of San Gabriel Valley and the Upper Santa Ana Valley of Los Angeles County. Ground waters continued below sea level in most of the coastal ground water basins during the entire year, and sea water continued as a threat to the deterioration of the quality of ground waters within these basins.

Estimated average changes for selected ground water basins in the Los Angeles Region are presented in Table 16, and a complete tabulation of available data for that region for the 1961-62 season is presented in Volume II, Appendix B. Historical fluctuations of ground water levels at selected wells, whose locations are shown on Plate 7, "Location of Wells at Which Water Level Fluctuations are Shown, Los Angeles Region (No. 4)," are graphically indicated on Plate 12A.

In Ventura County, ground water level observations indicated that a substantial rise in all ground water elevations occurred between

TABLE 16

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4) DURING 1961-62

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-1.00	Upper Ojai Valley	3	+12	4N/22W-17G1, S 158.0	4N/22W-10K2, S 10.5
4-2.00	Ojai Valley	48	+41	4N/22W- 4M8, S 355.0	4N/23W- 1F2, S 10.5
4-3.00	Ventura River Valley				
4-3.02	Upper Ventura River Basin	77	+14	4N/23W-21C5, S 173.3	4N/24W-13N1, S 1.5
4-4.00	Santa Clara River Valley				
4-4.01	Oxnard Plain Pressure Area	95	+14	1N/21W- 4M2, S 135.0	1N/22W-20N2, S 10.7
4-4.02	Oxnard Plain Forebay Area	32	+30	2N/22W-23K4, S 164.0	2N/22W-12A1, S 10.9
4-4.03	Mound Pressure Area	26	+ 9	2N/22W-10G1, S 253.0	2N/23W-24F1, S 11.0

AVERAGE CHANGES IN GROUND WATER ELEVATION IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-4.04	Santa Paula Basin	55	+16	3N/21W-36P1, S 340.3	2N/22W- 2K4, S 1.8
4-4.05	Fillmore Basin	64	+ 7	4N/20W-31H1, S 326.2	3N/20W- 8F2, S 2.2
4-4.06	Piru Basin	36	+ 6	4N/18W-20M1, S 246.9	8N/21W-26J1, S 12.1
4-4.07	Eastern Basin	21	+ 7	5N/14W-30R1, S 257.0	4N/17W-15N1, S Flowing
4-6.00	Pleasant Valley	35	+10	2N/21W-24F1, S 384.8	2N/21W-35C1, S 40.7
4-7.00	Arroyo Santa Rosa Valley	4	+ 7	2N/20W-24E1, S 262.0	2N/20W-25L1, S 63.4
4-8.00	Las Posas Valley				
4-8.01	West Las Posas Basin	10	+ 8	2N/21W-16R1, S 363.1	2N/21W-16J1, S 88.2
4-8.02	East Las Posas Basin	36	+ 6	3N/20W-31K1, S 625.0	2N/19W- 3A4, S 34.3
4-9.00	Simi Valley	58	+ 6	2N/18W- 3A2, S 440.6	2N/17W- 9M2, S 6.7

AVERAGE CHANGES IN GROUND WATER ELEVATION IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-10.00	Conejo Valley	85	+10	1N/19W- 9G1, S 300.0	1N/19W-15E2, S 0.6
4-11.00	Coastal Plain (Los Angeles County)				
4-11.01	Santa Monica Basin	48	+ 3	1S/16W-18L2, S 188.0	2S/15W-27L2, S 2.4
4-11.02	West Coast Basin	317	+ 2	2S/14W-27D4, S 259.0	4S/13W- 5M3, S 1.0
4-11.03	Central Basin Pressure Area	238	+ 3	3S/13W-34G1, S 283.0	5S/12W-11D1, S 6.0
4-11.04	Los Angeles Forebay Area	48	0	2S/13W- 3J1, S 418.0	1S/13W-35F1, S 4.5
4-11.05	Montebello Forebay Area	125	+12	1S/12W-33P2, S 339.0	2S/11W- 7C4, S 5.7
4-11.06	Hollywood Basin	2	+ 2	1S/14W-18J1, S 139.3	1S/14W-18A1, S Flowing
4-11.08	Whittier Area	14	+ 7	3S/11W-13D1, S 270.0	3S/11W- 2M1, S 24.6

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-12.00	San Fernando Valley				
4-12.01	San Fernando Basin	115	0	2N/15W-15L2, S 359.0	2N/16W-27P2, S Flowing
4-12.02	Bull Canyon Basin	1	+ 1	2N/16W- 2G1, S 125.9	2N/16W- 2G1, S 124.8
4-12.03	Sylmar Basin	17	0	3N/15W-26G1, S 248.6	3N/15W-36E1, S 9.8
4-12.05	Tujunga Basin	22	+ 8	2N/13W-18N1, S 388.8	2N/14W-14B1, S 7.6
4-12.07	Verdugo Basin	13	+ 8	2N/13W-27Q1, S 249.5	1N/13W-10Q1, S 24.9
4-13.00	San Gabriel Valley				
4-13.01	Main San Gabriel Basin	200	+ 2	1S/12W- 3M1, S 389.0	2S/11W- 6A1, S 6.3
4-13.02	Monk Hill Basin	21	+ 2	1N/12W- 5P1, S 313.8	1N/12W- 5N1, S 103.8
4-13.03	Pasadena Subarea	66	- 2	1S/12W- 3M2, S 395.1	1N/12W-24B2, S 0.5
4-13.04	Santa Anita Subarea	12	+ 2	1N/11W-21C1, S 256.0	1N/11W-22F1, S 6.7

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-13.05	Upper Canyon Basin	13	+52	1N/10W-27K2, S 188.4	1N/10W-27C2, S 3.0
4-13.06	Lower Canyon Basin	3	+21	1N/10W-29J1, S 212.9	1N/10W-28C1, S 13.9
4-13.07	Glendora Basin	8	+ 4	1N/ 9W-29C1, S 471.0	2S/10W-15F4, S 13.0
4-13.08	Way Hill Basin	10	- 5	1S/ 9W- 5F1, S 179.2	1S/ 9W- 3E1, S 50.6
4-13.09	San Dimas Basin	20	- 3	1N/ 9W-36M1, S 314.6	1S/ 9W- 4J1, S 84.7
4-13.10	Foothill Basin	5	+13	1N/ 9W-35Q3, S 277.0	1N/ 9W-35H1, S 29.5
4-13.11	Spadra Basin	10	- 3	1S/ 9W-25E2, S 190.0	1S/ 9W-22J1, S Flowing
4-13.12	Puente Basin	28	+ 6	2S/10W- 7C1, S 55.0	1S/ 9W-32G2, S 0.5
4-14.00	Upper Santa Ana Valley (Los Angeles County)				
4-14.01	Chino Basin	2	0	1S/ 8W-28G1, S 298.6	1S/ 8W-31J1, S 119.9
4-14.02	Pomona Basin	14	- 3	1S/ 8W- 7G2, S 470.0	1S/ 9W-11R1, S 120.3

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1961-62
(continued)

	Hydrologic unit or basin	Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-14.03	Live Oak Basin	16	- 1	1S/ 8W- 5D2, S 223.0	1N/ 8W-33A1, S 23.4
4-14.04	Claremont Heights Basin	21	- 6	1N/ 8W-34A3, S 310.0	1N/ 8W-26D1, S 19.2
4-15.00	Tierra Rejada Valley	8	- 2	2N/19W-15N2, S 278.7	2N/19W-14P1, S 57.2
4-16.00	Malibu Coastal Group				
4-16.01	Hidden Valley Basin	17	+27	1N/20W-25C1, S 250.0	1N/19W-28M1, S 8.0
4-16.02	Russell Basin	4	+ 7	1N/19W-26C1, S 141.0	1N/19W-28A1, S 3.8
4-16.05	Arroyo Sequit Canyon Basin	2	+17	1S/20W-25E2, S 34.5	1S/20W-25E1, S 7.2
4-16.06	Nicholas Canyon Basin	1	+16	1S/19W-30P1, S 5.9	1S/19W-30P1, S 4.8
4-16.09	Trancas Canyon Basin	4	+14	1S/19W-35F2, S 68.6	1S/19W-35Q2, S 10.0
4-16.10	Zuma Canyon Basin	1	+46	2S/18W- 6E2, S 27.9	2S/18W- 6M2, S 17.3

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN LOS ANGELES REGION (NO. 4)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
4-16.11	Ramera Canyon Basin	5	+17	1S/18W-31N1, S 88.6	2S/18W- 5C4, S 8.6
4-16.14	Solstice Canyon Basin	1	+ 1	1S/18W-34H1, S 45.6	1S/18W-34H1, S 45.1
4-16.16	Malibu Creek Basin	6	+ 9	1S/17W-29N1, S 66.8	1S/17W-32L5, S 9.2
4-16.19	Las Flores Canyon Basin	1	+ 2	1S/17W-26E1, S 252.9	1S/17W-35E1, S 15.4
4-16.20	Piedra Gorda Canyon Basin	3	+30	1S/17W-36D1, S 373.6	1S/17W-36H2, S 37.4
4-16.25	Las Virgenes Canyon Basin	4	+ 2	1N/17W-17H1, S 106.0	1N/17W- 8L1, S 18.8

the spring of 1961 and the spring of 1962, documenting the significantly above-normal precipitation for that area. Notable rises were in Ojai and the Oxnard Forebay Basins where average rises of 41 and 30 feet, respectively, were recorded. Approximately 51,000, acre-feet of waters were released from the Piru to the Santa Clara River and spread in Piru Basin and Oxnard Plain Forebay Area, which aided substantially in the rise of ground water surface elevations. However, despite the above-normal precipitation and water spread, the piezometric levels in a portion of the Oxnard Plain continued below sea level, maintaining conditions favorable to the intrusion of the ground water basins by sea water. The extent of this intrusion is discussed in detail in Chapter IV.

Measured depths to ground water in Ventura County and tributary areas varied from flowing, at a well located 0.5 mile north of Del Valle in Eastern Basin, to over 600 feet below the ground surface 3 miles northwest of Somis in the East Las Posas Basin.

Ground water surface elevations in the basins of the Coastal Plain of Los Angeles County generally rose between the spring of 1961 and the spring of 1962, ranging from no change in the Los Angeles Forebay Area to three feet in the Santa Monica Basin and the Central Basin Pressure Area. Exceptionally large rises were noted in the Montebello Forebay and Whittier Areas, where ground water levels rose 12 and 7 feet, respectively. These rises resulted from the spreading of approximately 117,000 acre-feet of water in the Montebello Forebay Area during the 1961-62 water years. In the West Coast Basin, over 4,000 acre-feet of fresh water were injected through a series of injection wells at the sea-water intrusion barrier project in that basin.

Piezometric levels at wells throughout a large portion of the Coastal Plain of Los Angeles County continued to be below sea level during the 1961-62 season. The lowest elevation of the depression in piezometric levels in the West Coast Basin, in the spring of 1962, was about 95 feet below sea level in the vicinity of Alameda Street and Sepulveda Boulevard in the southeastern portion of the basin. This was slightly higher than that observed in 1961. In the Central Basin Pressure Area, piezometric water levels were observed to be as much as 148 feet below sea level on the northeast slope of the Dominguez Hills.

In the San Fernando Valley, observations of ground water levels indicated little or no change in ground water surface elevations, except in the Tujunga and Verdugo Basins where rises of eight feet were observed. These basins, however, are small in area and abut the foothills of the San Gabriel Mountains. Depths to ground water varied from flowing, at a well one mile southwest of Northridge, to approximately 390 feet below the ground surface in Tujunga.

Ground water surface elevations varied widely in the San Gabriel Valley, ranging from an average rise of 52 feet in the Upper Canyon Basin to a decline of 6 feet in the Claremont Basin. In the Main San Gabriel Basin, the largest basin in the valley, the average change was a rise of two feet. Depths to ground water at wells in the San Gabriel Valley ranged from flowing, at a well 3 miles west of Pomona, to more than 470 feet below the ground surface, at a well 1.5 miles northeast of Glendora.

In the Los Angeles County area of the Upper Santa Ana Valley, observed ground water levels indicated declines in all basins, except Chino which remained stable, with Claremont Basin having an average decline of six feet.

Lahontan Region (No. 6) - (Southern Portion)

Ground water level changes in the Lahontan Region were of minor magnitude in most ground water basins. Maximum changes in ground water surface elevations were in the Lancaster Basin of Antelope Valley where an average decline of three feet was observed, and Neenach Basin, also in the Antelope Valley, where ground water levels rose an average of six feet. It should be noted, however, that there is a paucity of wells in most ground water basins in the Lahontan Region in which depths to ground water are observed. Therefore, the average changes in levels shown in Table 17 may not be truly indicative of regional ground water conditions. The maximum depth to ground water observed in the region was 676 feet below the ground surface, at a well located about 5 miles west of Hesperia in the Upper Mojave River Basin.

Ground water level data of the Lahontan Region for the 1961-62 season are tabulated in Volume III, Appendix C, and a summary of the data is presented in Table 17. Historical changes in ground water elevations at selected wells in the southern portion of the Lahontan Region, are depicted on Plate 12B. The location of these wells is shown on Plate 8, "Location of Wells at Which Water Level Fluctuations are Shown, Lahontan Region (No. 6)."

Colorado River Basin Region (No. 7)

Between the spring of 1961 and the spring of 1962, there was little or no change in ground water surface elevations in most ground water basins for which data were available. In the basins where a change in levels was noted, a downward trend was indicated with the maximum indicated decline being an average of three feet in Deadman Valley in

TABLE 17

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6) (SOUTHERN PORTION) DURING 1961-62

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
6-29.00	Mesquite Valley	1	+1/2	20N/12E-19F1, S 129.0	19N/12E- 2M1, S 33.6
6-33.00	Soda Lake Valley	4	-1/2	14N/ 9E-30G2, S 76.6	12N/ 8E-27X2, S 19.3
6-34.00	Silver Lake Valley	1	0	15N/ 8E-22R1, S 56.1	15N/ 8E-22R1, S 56.0
6-35.00	Cronese Valley	3	-1/2	12N/ 7E-30J1, S 49.8	12N/ 7E-18R2, S 15.9
6-37.00	Coyote Lake Valley	6	-1/2	12N/ 2E-31A1, S 55.9	11N/ 2E- 8K1, S Flowing
6-39.00	Troy Valley	1	-1/2	9N/ 4E-31K1, S 16.4	8N/ 3E- 4B3, S 10.0
6-40.00	Lower Mojave River Valley	6	- 1	9N/ 1E-21C1, S 104.3	9N/ 3E- 29G, S 9.5

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6) (SOUTHERN PORTION) DURING 1961-62 (continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
6-41.00	Middle Mojave River Valley	8	- 1	8N/ 6W-15H1, S 142.5	7N/ 4W-18D1, S 8.5
6-42.00	Upper Mojave River Valley	32	- 1	4N/ 5W-22H1, S 676.6	6N/ 4W-29M3, S 7.0
6-43.00	El Mirage Valley	4	- 1	5N/ 7W- 9H1, S 286.1	7N/ 7W-27L1, S 39.9
6-44.00	Antelope Valley				
6-44.01	Neenach Basin	11	+ 6	8N/16W- 8G1, S 291.3	8N/16W-26G1, S 7.1
6-44.05	Lancaster Basin	23	- 3	7N/13W-34J1, S 337.1	5N/12W- 2K1, S 5.5
6-44.06	Buttes Basin	3	-1/2	6N/10W-20P1, S 239.3	5N/12W-12A2, S 20.9
6-44.07	Rock Creek Basin	18	+ 3	5N/ 9W-34D1, S 429.8	4N/ 9W- 6Q1, S 4.0
6-44.08	North Muroc Basin	5	-1/2	11N/ 9W-24B1, S 141.9	10N/ 9W-24A2, S 72.9

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN SELECTED VALLEYS AND BASINS IN LAHONTAN REGION (NO. 6)
(SOUTHERN PORTION)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
6-47.00	Harper Valley	11	-3	10N/ 5W- 3J1, S 225.6	11N/ 3W-30A2, S Flowing
6-49.00	Superior Valley	3	-2	31S/45E- 1C1, M 117.6	31S/46E-16J1, M 93.1
6-50.00	Cuddeback Valley	3	-2	30S/42E-24L1, M 153.5	30S/42E-10L1, M 71.1

San Bernardino County. There are, however, few wells for which data are available in most of the basins in this region. Therefore, the average of changes presented in Table 18 may not truly reflect regional ground water conditions. Depths to ground water in the Colorado River Basin Region ranged from ground surface at a number of flowing wells in the Coachella Valley southeast of the town of Coachella, to more than 540 feet below the ground surface, at a well located approximately one mile northeast of Palm Springs, also in the Coachella Valley.

All available ground water level data for the Colorado River Basin Region, for the period July 1961 through June 1962, are tabulated in Volume III, Appendix D, and are summarized by ground water basin in Table 18. Historical ground water levels for well 10S/6E-21A1, S, located in Borrego Valley, are depicted in a hydrograph on Plate 12B. The location of this well is shown on Plate 9, "Location of Wells at Which Water Level Fluctuations are Shown, Colorado River Basin (No. 7)."

Santa Ana Region (No. 8)

In the Santa Ana Region, ground water levels varied over a wide range between the spring of 1961 and the spring of 1962. Fifteen of the 23 basins for which data were available showed rises in ground water surface elevations. In many of the basins where rises in ground water surface elevations were indicated, there were large amounts of local and/or imported waters spread for the recharge of the underground supply. Approximately 205,200 acre-feet of Colorado River water were spread in the Santa Ana Forebay Area of the Anaheim Basin, for this purpose. As a result, the average ground water level in the area rose about 11 feet between the spring of 1961 and the spring of 1962.

TABLE 18

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN COLORADO RIVER BASIN REGION (NO. 7)
DURING 1961-62

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
7- 5.00	Chuckwalla Valley	2	-1	5S/16E-25F1, S 147.9	4S/16E-32D1, S 81.3
7- 9.00	Dale Valley	6	0	1N/10E-36P1, S 333.1	1N/12E-20D1, S 27.9
7-10.00	Twentynine Palms Valley	16	0	1N/ 8E-11L1, S 368.9	1N/ 9E-33J1, S 4.0
7-11.00	Copper Mountain Valley	5	0	1N/ 7E-30P1, S 369.0	1N/ 7E-26N1, S 167.5
7-12.00	Warren Valley	2	-1	1N/ 6E-29R2, S 259.9	1S/ 5E- 2B1, S 28.3
7-13.00	Deadman Valley	3	-3	1N/ 6E- 4Q1, S 450.8	1N/ 6E- 9Q2, S 262.8
7-17.00	Means Valley	3	0	2N/ 5E-25J1, S 370.0	2N/ 5E- 1H2, S 66.6

AVERAGE CHANGES IN GROUND WATER LEVEL ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN COLORADO RIVER BASIN REGION (NO. 7)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
7-18.00	Johnson Valley	1	- 1	4N/3E-24Q1, S 56.1	4N/4E-19C1, S 44.1
7-19.00	Lucerne Valley	21	0	5N/1E-10H2, S 204.0	4N/1W-14B1, S 0.1
7-20.00	Morongo Valley	4	-1/2	1S/4E-22J1, S 178.1	1S/4E-32H1, S 52.5
7-21.00	Coachella Valley	23	-1/2	3S/4E-30C1, S 546.1	6S/8E-19R1, S Flowing
7-24.00	Borrego Valley	11	-1/2	10S/6E- 8B1, S 270.4	9S/6E-36A1, S 16.6
7-27.00	San Felipe Valley	2	- 1	12S/5E-34J1, S 61.0	12S/4E-24K1, S 31.4

Available ground water level measurements for the Santa Ana Region for the period July 1961 through June 1962 are tabulated in Volume III, Appendix E, and the average change in ground water surface elevations for selected ground water basins is presented in Table 19. Hydrographs of wells depicting long-term water level fluctuations in the region are delineated on Plate 12B. The location of these wells is shown on Plate 10, "Location of Wells at Which Water Level Fluctuations are Shown, Santa Ana Region (No. 8)."

The maximum observed depth to ground water in Orange County was approximately 330 feet below the ground surface, at a well located approx-2 miles northeast of Orange in the Santa Ana Forebay Area. The minimum observed depth from ground surface to ground water was one foot, at a well located approximately three miles west of Anaheim in the Anaheim Basin Pressure Area. In the Anaheim Basin Pressure Area, observed piezometric water levels indicated an average rise of approximately 11 feet between the spring of 1961 and the spring of 1962, which can be attributed to spreading operation in the Santa Ana Forebay Area. Despite this rise in water levels, water surface elevations throughout most of the basin remained below sea level, and conditions conducive to sea-water intrusion continued.

In the Upper Santa Ana Valley, ground water levels rose in most basins for which data were available. These increases ranged from 2 feet in Riverside Basin to more than 20 feet in Coldwater Basin, much of which can be attributed to spreading operations. Depths to ground water in wells in the Upper Santa Ana Valley ranged from zero or rising water just upstream of Prado Dam to more than 500 feet below the ground surface, at

TABLE 19

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN SANTA ANA REGION (NO. 8)
DURING 1961-62

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
8-1.00	Coastal Plain (Orange County)				
8-1.01	Anaheim Basin Pressure Area	122	+ 11	5S/ 9W-22E4, S 145.0	4S/10W- 7K1, S 1.1
8-1.02	Santa Ana Forebay Area	69	+ 11	4S/ 9W-22R1, S 333.5	4S/ 9W- 8C1, S 16.1
8-1.03	Irvine Area	25	+ 18	6S/ 8W- 5E2, S 279.0	5S/ 9W-15R3, S 36.7
8-1.04	La Habra Basin	4	+ 1	3S/10W- 7Q1, S 162.7	3S/10W-10N1, S 25.6
8-1.05	Yorba Linda Basin	3	+ 3	3S/ 9W-23K1, S 197.3	3S/ 9W-34C1, S 15.8
8-1.06	Santa Ana Narrows Basin	82	+ 3	3S/ 9W-33K5, S 65.4	3S/ 7W-20P1, S 1.3
8-2.00	Upper Santa Ana Valley				
8-2.01	Chino Basin	140	-1/2	1S/ 7W- 8N1, S 580.0	3S/ 7W- 6Q1, S 2.3
8-2.02	Claremont Heights Basin	9	+ 3	1N/ 8W-35J2, S 435.0	1S/ 8W- 2M3, S 142.5

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN SANTA ANA REGION (NO. 8)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
8-2.03	Cucamonga Basin	9	- 1	1N/7W-29R3, S 512.8	1S/7W- 4E2, S 201.5
8-2.04	Rialto Basin	8	+ 12	1N/5W-29A1, S 468.0	2N/6W-26L2, S 14.0
8-2.05	Colton Basin	26	- 7	1S/5W- 2K1, S 301.0	1S/4W-21K3, S 29.6
8-2.06	Bunker Hill Basin	103	0	1N/3W-28P1, S 436.6	1N/3W-19E1, S 0.5
8-2.10	Devil Canyon Basin	6	- 5	1N/4W-23K1, S 282.0	1N/4W-14R9, S 9.0
8-2.12	Beaumont Basin	17	- 3	2S/1W-34Q1, S 400.9	2S/1W- 2J1, S 11.1
8-2.13	San Timoteo Basin	7	+ 3	1S/3W-24R1, S 356.8	2S/2W-20K1, S 39.0
8-2.15	Riverside Basin	42	+ 2	1S/5W-23N1, S 214.7	2S/5W-20A2, S 6.9
8-2.16	Arlington Basin	4	- 1	3S/6W-28H1, S 84.2	3S/6W-24J1, S 7.3
8-2.17	Temescal Basin	44	+1/2	3S/7W-35C1, S 196.3	3S/7W-21M3, S 1.1
8-2.18	Bedford Basin	4	+ 12	4S/6W-35G2, S 73.7	4S/6W- 8H1, S 4.6

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN SANTA ANA REGION (NO. 8)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
8-2.19	Coldwater Basin	6	+23	5S/6W- 3Q1, S 245.2	5S/6W-10C1, S 55.3
8-2.20	Lee Lake Basin	3	+ 5	5S/6W-12N1, S 170.7	5S/5W-07C1, S 13.3
8-4.00	Elsinore Valley	53	+ 2	6S/5W- 3L2, S 338.5	6S/4W-28L1, S 2.5
8-5.00	San Jacinto Valley	32	- 4	3S/1E-20G3, S 319.0	6S/3W-14N1, S 13.8

a well located approximately 2 miles northeast of Upland in the Chino Basin.

Ground water levels in the San Jacinto Valley showed an average decline of approximately 4 feet between the spring of 1961 and the spring of 1962, and depths to ground water varied from 13 feet below the ground surface in Palomar Valley to more than 300 feet, at a well 2 miles south of Valle Vista. A hydrograph for well 4S/1W-35Q1, in the San Jacinto Valley, depicting the historical changes in ground water elevations, is presented on Plate 12B.

San Diego Region (No. 9)

During the 1961-62 season, water levels rose in 13 of the 23 ground water basins for which data were available in the San Diego Region. The greatest indicated rise was in the San Juan Creek Basin of San Juan Valley in the northeastern part of the region, where a rise of 12 feet was noted. On the other hand, Warner Valley in the Lake Henshaw area of San Diego showed a decline of approximately five feet between the spring of 1961 and the spring of 1962. In the balance of the basins, the indicated changes were small. Ground water surface elevations remained below sea level in several coastal basins of San Diego County, including Tia Juana Basin, San Dieguito Basin, and Mission Basin on the San Luis Rey River, thereby maintaining conditions which are conducive to sea-water intrusion.

Ground water level measurements for the San Diego Region, for the period July 1961 through June 1962, are tabulated in Volume III, Appendix F, and average changes in ground water levels are summarized on Table 20. Hydrographs of ground water levels for selected wells in this

TABLE 20

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN SELECTED VALLEYS AND BASINS IN SAN DIEGO REGION (NO. 9) DURING 1961-62

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet: Maximum	Minimum
9-1.00	San Juan Valley				
9-1.01	Aliso Creek Basin	10	+ 3	6S/8W-26F4, S 73.8	8S/8W-14H3, S 6.3
9-1.02	San Juan Creek Basin	40	+12	7S/8W-36C1, S 93.5	8S/8W-13D1, S 3.4
9-5.00	Temecula Valley				
9-5.01	Murrieta Basin	13	- 2	6S/4W-27M1, S 156.1	8S/3W-13K1, S 13.9
9-7.00	San Luis Rey Valley				
9-7.01	Mission Basin	10	+ 5	11S/4W- 4Q4, S 82.2	11S/5W-13N2, S 22.1
9-7.02	Bonsall Basin	28	- 4	10S/3W-16E2, S 65.3	10S/3W-20B1, S 12.0
9-8.00	Warner Valley	23	- 5	10S/3E-33F1, S 200.0	10S/3E-29J1, S 32.0

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN SAN DIEGO REGION (NO. 9)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
9-10.00	San Pasqual Valley				
9-10.01	Lake Hodges Basin	10	+ 1	13S/2W- 3K1, S 95.0	13S/2W- 2C2, S 9.8
9-10.02	San Pasqual Basin	38	- 2	12S/1W-30Q1, S 73.4	13S/1W- 4A1, S 10.5
9-10.03	Felicita Basin	21	+ 4	12S/2W-28P1, S 109.3	12S/2W-24R1, S Flowing
9-10.04	Green Basin	1	+ 1	13S/1W-31K1, S 39.1	13S/1W-31K1, S 36.9
9-10.05	Highland Basin	2	+ 6	13S/1W- 5N2, S 48.1	13S/1W- 5L1, S 16.8
9-10.06	Pamo Basin	3	+ 1	12S/1E- 2L1, S 26.5	12S/1E- 2P2, S 12.7
9-10.08	Santa Ysabel Basin	1	+ 2	12S/3E-28C1, S 22.5	12S/3E-21N1, S 2.9
9-11.00	Santa Maria Valley				
9-11.01	Ramona Basin	22	+ 1	13S/1E-23K1, S 69.2	13S/1W-24K1, S 6.6
9-11.03	Wash Hollow Basin	1	- 2	13S/2E-15E1, S 24.2	13S/2E-15E1, S 23.8
9-11.04	Upper Hatfield Basin	1	- 2	13S/2E- 9H1, S 14.5	13S/2E- 9H1, S 12.7

AVERAGE CHANGES IN GROUND WATER ELEVATIONS IN
SELECTED VALLEYS AND BASINS IN SAN DIEGO REGION (NO. 9)
DURING 1961-62
(continued)

Hydrologic unit or basin		Number of wells considered in analysis	Average change in ground water level during the year, in feet	Location and observed extremes of depth to ground water during 1961-62, in feet	
				Maximum	Minimum
9-11.05	Santa Teresa Basin	1	-1/2	13S/2E- 3E1, S 28.9	13S/2E- 3E1, S 27.4
9-11.06	Ballena Basin	2	+1/2	13S/2E-10K1, S 25.7	13S/2E-11C1, S 13.1
9-12.00	San Dieguito Valley				
9-12.01	San Dieguito Basin	27	+ 1	13S/3W-33G1, S 94.5	14S/3W- 7C2, S 1.9
9-15.00	San Diego River Valley	13	+ 1	13S/4E- 6A1, S 95.0	15S/1E-20B4, S 20.0
9-17.00	Sweetwater Valley	19	0	17S/2W-22E1, S 107.3	17S/2W-25P2, S 3.4
9-19.00	Tia Juana Valley	3	0	19S/2W- 1N2, S 65.8	19S/2W- 4C2, S 6.5
9-20.00	Jamul Valley	1	- 2	16S/1E-16Q1, S 17.8	16S/1E-16Q1, S 15.9

region are presented on Plate 12B; the location of these wells is shown on Plate 11, "Location of Wells at Which Water Level Fluctuations are Shown, San Diego Region (No. 9)."

Artificial Recharge

The replenishment of ground water basins by artificial recharge, as a means of conserving surface runoff and regulating imported water, is widely practiced in Southern California. Approximately 520,000 acre-feet of local and imported waters were reported as being spread or injected at 40 ground water recharge projects during the 1961-62 water year. Of this total amount, about 398,000 acre-feet, or 77 percent, consisted of imported Colorado River water. This represented an approximate 100 percent increase over the amount spread during the previous year. Essentially all of this imported supply was spread in the Montebello Forebay Area of the Central Basin in Los Angeles County and the Santa Ana Forebay Area of the Anaheim Basin in Orange County. In the Montebello Forebay Area, 1,043 acre-feet of water were also spread; this water was produced by the new Water Reclamation Plant of the County Sanitation Districts of Los Angeles County at Whittier Narrows. The Bulletin 68 series of reports describes the reclamation of water from sewage and industrial wastes in more detail.

These artificial recharge activities played an important role in increasing the amounts of water stored in most basins of the coastal plain, or in retarding the decline of water levels in other basins. The measured or estimated amounts of artificial recharge to the underground reservoirs at the various projects during the 1961-62 water year are tabulated on Table 21.

TABLE 21

SUMMARY OF PRINCIPAL GROUND WATER RECHARGE ACTIVITIES
IN SOUTHERN CALIFORNIA DURING 1961-62 WATER YEAR

Hydrologic unit	Areal Designation Code Number	Agency conducting spreading operation[a]	Number of projects operated	Reported or estimated amount spread, in acre-feet
Ojai Valley	4- 2.00	VCFCD	1	102[b]
Santa Clara River Valley	4- 4.00			
Oxnard Plain Pressure Area	4- 4.01	UWCD	1	212
Oxnard Plain Forebay Area	4- 4.02	UWCD	2	44,880
Piru Basin	4- 4.06	UWCD	1	6,580
Coastal Plain, Los Angeles County	4-11.00			
West Coast Basin	4-11.02	LACFCD	2	6,860[c]
Montebello Forebay Area	4-11.05	LACFCD	3	117,369[d]
San Fernando Valley	4-12.00			
San Fernando Basin	4-12.01	LACFCD	3	18,410
		LADW&P	1	10,642
Tujunga Basin	4-12.05	LACFCD	1	699
San Gabriel Valley	4-13.00			
Main San Gabriel Basin	4-13.01	LACFCD	9	29,981
Monk Hill Basin	4-13.02	LACFCD	1	1,180
Pasadena Subarea	4-13.03	LACFCD	1	1,370
Santa Anita Subarea	4-13.04	LACFCD	1	668
		CSMWD	1	1,502
Upper Canyon Basin	4-13.05	DMWC	1	8,032
		SGRSC	1	25,954
Glendora Basin	4-13.07	LACFCD	1	1,165
		LACFCD	1	625
Upper Santa Ana Valley, Los Angeles County	4-14.00			
Claremont Heights Basin	4-14.04	PVPA	2	2,811
		CPWD	1	234

SUMMARY OF PRINCIPAL GROUND WATER RECHARGE ACTIVITIES
IN SOUTHERN CALIFORNIA DURING 1961-62 WATER YEAR
(continued)

Hydrologic unit	Areal Designation Code Number	Agency conducting spreading operation[a]	Number of projects operated	Reported or estimated amount spread, in acre-feet
Coastal Plain, Orange County	8-1.00			
Santa Ana Forebay Area	8-1.02	OCWD	1	39,953[e]
		OCWD & SAVIC	2	134,773[e]
		AUWC	2	1,781[f]
		OCFCD	2	25,732[g]
Irvine Area	8-1.03	OCWD	3	1,322[e]
Yorba Linda Basin	8-1.05	AUWC	1	1,115[h]
Santa Ana Narrows Basin	8-1.06	AUWC	1	2,685[i]
Upper Santa Ana Valley	8-2.00			
Chino Basin	8-2.01	SBCFCD	2	86
		EWC	2	592
Cucamonga Basin	8-2.03	SAWC & SBCFCD	1	3,444
		SBCFCD	1	111
Bunker Hill Basin	8-2.06	SBVWCD	3	6,991
		SBCFCD	1	79
Lytle Basin	8-2.07	FUWC	1	7,009
Devil Canyon Basin	8-2.10	SBCFCD	1	2,371
Beaumont Basin	8-2.12	RCFC & WCD	1	1
Temescal Basin	8-2.17	RCFC & WCD	1	53
Coldwater Basin	8-2.19	TWC	3	1,573[j]
Lee Lake Basin	8-2.20	TWC	2	124
San Jacinto Valley	8-5.00	RCFC & WCD	1	431
Total local and imported water reported spread				509,502

a. Abbreviations of agencies conducting spreading operations are presented in alphabetical order: AUWC-Anaheim Union Water Company; CPWD-City of Pomona Water Department; CSMWD-City of Sierra Madre Water Department; DMWC-Duarte Mutual Water Company; ESWC-East Side Water Committee; EWC-Etiwanda Water Company; FUWC-Fontana Union Water Company; LACFCD-Los Angeles County Flood Control District; LADW&P-Los Angeles Department of Water and Power; OCFCD-Orange County Flood Control District; OCWD-Orange County Water District; PVPA-Pomona Valley Protective Association; RCFC&WCD-Riverside County Flood Control and Water Conservation District; SAWC-San Antonio Water Company; SBCFCD-San Bernardino County Flood Control District; SBVWCD-San Bernardino Valley Water Conservation District;

SUMMARY OF PRINCIPAL GROUND WATER RECHARGE ACTIVITIES IN SOUTHERN CALIFORNIA DURING 1961-62 WATER YEAR (continued)

SGRSC-San Gabriel River Spreading Corporation; SAVIC-Santa Ana Valley Irrigation Company; TWC-Temescal Water Company; UWCD-United Water Conservation District; VCFCD-Ventura County Flood Control District.

b. Project discontinued on 4-17-62 by action of Ventura County Board of Supervisors.

c. Includes 4,450 acre-feet of softened Colorado River water.

d. The 117,400 acre-feet of water reported spread in the Montebello Forebay Area is composed of 1,000 acre-feet of reclaimed sewage from Whittier Narrows Treatment Plan, a portion of the 208,000 acre-feet of Colorado River water purchased for replenishment, and local water. An indeterminate amount of the imported water purchased for spreading is infiltrated in the unlined channels of the San Gabriel River and the Rio Hondo between point of release and the points of diversion to the spreading grounds.

e. Total quantity is unsoftened Colorado River water.

f. Includes about 1,350 acre-feet of unsoftened Colorado River water.

g. Includes about 24,800 acre-feet of unsoftened Colorado River water.

h. Includes about 1,000 acre-feet of unsoftened Colorado River water.

i. Includes about 2,000 acre-feet of unsoftened Colorado River water.

j. Includes about 50 acre-feet of unsoftened Colorado River water.

CHAPTER IV. QUALITY OF WATER AND SEA-WATER INTRUSION

During 1961-62, the principal water quality problem in Southern California continued to be the intrusion of sea water in coastal ground water basins. During this period, the saline fronts advanced in most areas under surveillance. The following sections present summary information on quality of surface and ground waters, and on the current status of sea-water intrusion.

Water Quality

Results of mineral analyses of surface and ground waters indicate considerable variations exist within the different basins, making detailed evaluations of changes from year to year very complex. Since comprehensive evaluations of water quality changes are presented in the Department of Water Resources Bulletins, Series No. 65, "Quality of Surface Waters of California," and Series No. 66, "Quality of Ground Waters in California," no attempt is made to include this type of information here. This report contains mineral analyses of surface and ground water samples collected during 1961-62 at a few selected points in Southern California. These analyses are presented in Tables 22 and 23 and are intended to give only a general indication of water quality.

Sea-Water Intrusion

The movement of sea water into the fresh water aquifers of a number of the coastal ground water basins in Southern California continued during 1961-62. The amount and nature of sea-water intrusion are dependent upon the location and size of the ground water basin, the

TABLE 22

MINERAL ANALYSES OF SURFACE WATER AT
SELECTED STATIONS IN SOUTHERN CALIFORNIA

Station number	Station	Date sampled and: estimated discharge	$ECx10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
318-35.5	Santa Ynez River at Mission Bridge 0.9 mile south of Solvang	5- 1-62 13 cfs	1,030	90	59	52	317	256	35	0.5	0.34	466	19
42-5.7	Ventura River, north of Ventura, in Foster Memorial Park, 300 feet downstream from highway bridge, at USGS gaging station	5- 3-62 8 cfs	1,082	130	36	58	273	263	53	19	0.50	760	20
43-17.0	Santa Clara River, east of Santa Paula and about 1.5 miles upstream from Willard Bridge	5- 3-62 80 cfs	1,847	195	77	140	292	721	66	6.4	0.94	780	27
47-23.9	Los Angeles River, north-east of Los Angeles at Figueroa Street	5- 8-62 0.3 cfs	2,331	97	41	349	405	333	358	2	1.12	410	64
48-20.7	San Gabriel River, south-west of El Monte and 0.5 mile upstream from Whittier Narrows Dam	5- 8-62 100 cfs	1,086	90	30	101	139	280	90	1.5	0.14	346	37
82-30.5	Santa Ana River at Prado Dam	5- 7-62 46 cfs	1,122	111	29	92	322	118	121	14	0.28	374	32
93-20.0	Santa Margarita River, north of Fallbrook, about 0.5 mile downstream from confluence with Sandia Creek	5- 9-62 3.3 cfs	1,277	107	27	128	364	142	158	0	0.20	378	42
620A-28.8	Rock Creek, southeast of Pearblossom and about 300 feet upstream from confluence with Pallett Creek	2-28-62 25 cfs	463	58	19	17	220	53	3	5.4	0.09	223	10
619-95	Mojave River, northwest of Victorville, about 0.2 mile southeast of U. S. Highway 91 bridge	5-14-62 22 cfs	481	38	12	46	187	41	28	2.9	0.12	143	39

TABLE 23

MINERAL ANALYSES OF GROUND WATER FROM SELECTED WELLS IN SOUTHERN CALIFORNIA

State well number	Location	Date sampled	ECx10^6 at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
				Central Coastal Region									
Santa Maria River Valley													
10N/34W-19H1	Three miles west of Santa Maria, 1.0 mile north of Betteravia Road on Black Road, just west of Black Road	10- 5-61	1,420	142	66	88	256	451	93	18	0.24	625	23
Lompoc Subarea, Santa Ynez River Valley													
7N/35W-26F4	Five miles west of Lompoc, 300 feet north of Central Avenue produced, 100 feet west of Union Sugar Avenue	6- 6-62	2,400	193	137	124	383	470	373	3.0	0.26	1,051	19
				Los Angeles Region									
Oxnard Plain Pressure Area, Santa Clara River Valley													
1N/22W-15B3	One mile south of Oxnard, 130 feet north of Dempsey Road, 150 feet west of Ventura R.R.	6-25-62	1,350	139	46	92	260	434	50	12	0.70	537	34
Oxnard Plain Forebay Area, Santa Clara River Valley													
2N/22W-12E1	One mile south of Saticoy, 0.2 mile northwest of Vineyard Avenue, 0.35 mile southwest of Los Angeles Avenue	8-14-61	2,208	255	93	172	368	921	101	3.0	0.72	1,017	26

MINERAL ANALYSIS OF GROUND WATER FROM
SELECTED WELLS IN SOUTHERN CALIFORNIA
(continued)

State well number	Location	Date sampled	$ECx10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
				Los Angeles Region (continued)									
Central Coastal Plain Pressure Area, Coastal Plain (Los Angeles County)													
3S/12W-8F1	Two miles southwest of Downey, 1,600 feet south and 300 feet west of intersection of Imperial Highway and County Farm Road	12-19-61	520	59	12	39	248	41	18	4.3	0.10	197	28
Montebello Forebay Area, Coastal Plain (Los Angeles County)													
2S/11W-19L1	Two miles west of Whittier, 1,050 feet west of Norwalk Boulevard, 1,600 feet from Dunlap Crossing along road	8-15-61	835	98	22	53	180	185	63	1.8	--	327	24
San Fernando Basin, San Fernando Valley													
1N/14W-23E1	1.5 miles southwest of Burbank; 284 feet east of Buena Vista Street, 641 feet south of Alameda Street	5-17-62	906	98	25	66	270	186	32	16	0.18	348	28
Main San Gabriel Basin, San Gabriel Valley													
1S/11W-26K1	Two miles southeast of El Monte, 0.1 mile north of Valley Road, 550 feet northwest of Covina Lane	5- 8-62	572	78	16	22	223	63	25	22	0.01	260	13

MINERAL ANALYSIS OF GROUND WATER FROM SELECTED WELLS IN SOUTHERN CALIFORNIA (continued)

State well number	Location	Date sampled	$EC \times 10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
	Lahontan Region												
Lancaster Basin, Antelope Valley													
8N/13W-32N1	Eight miles west of Lancaster, 100 feet east of 90th Street, West and 100 feet north of Avenue "G"	4-17-62	600	59	11	60	221	43	49	23	0.40	193	39
	Colorado River Basin Region												
Coachella Valley													
5S/8E-31D1	Two miles southeast of Indio, 0.4 mile southwest of Highway 99, 60 feet east of Van Buren Avenue	5-11-62	625	85	7	46	144	134	53	11	0.06	243	26
	Santa Ana Region												
Anaheim Basin Pressure Area, Coastal Plain (Orange County)													
4S/11W-24P1	3.5 miles northwest of Garden Grove, 0.8 mile north of Katella Avenue, 67 feet west of Dale Street	3- 5-62	640	72	9	37	239	48	34	0	0.15	215	25
Santa Ana Forebay Area, Coastal Plain (Orange County)													
4S/9W-18C2	Three miles north of Orange, 470 feet north of Fletcher Avenue, 300 feet west of Batavia Street	12-19-61	917	107	18	69	203	204	73	5.0	0.16	340	29

MINERAL ANALYSIS OF GROUND WATER FROM SELECTED WELLS IN SOUTHERN CALIFORNIA (continued)

State well number	Location	Date sampled	$ECx10^6$ at 25°C	Mineral constituents, in parts per million								Total hardness as $CaCO_3$ in ppm	Percent Na
				Ca	Mg	Na+K	HCO_3	SO_4	Cl	NO_3	B		
	Santa Ana Region (continued)												
Chino Basin, Upper Santa Ana Valley													
1S/7W-20A1	One mile northeast of Ontario, 85 feet south of 4th Street, 300 feet east of Cucamonga Avenue	4-20-62	414	48	10	27	176	38	16	11	0.03	161	25
Bunker Hill Basin, Upper Santa Ana Valley													
1S/4W-15M2	One mile south of San Bernardino, 0.7 mile south of Mill Street, 100 feet west of "E" Street	6- 1-62	529	68	9	38	234	68	14	1.0	0.19	204	27
	San Diego Region												
Mission Basin, San Luis Rey River Valley													
11S/4W-18C9	Three miles northeast of Oceanside, 2500 feet northwest of Mission Road, 150 feet southwest of power line	4- 9-62	2,300	214	56	223	279	352	442	0	0.25	765	38
Tia Juana Valley													
18S/2W-33K4	Three miles west of San Ysidro, 81 feet east of 19th Street, 25 feet north of Sunset Avenue	4-18-62	3,882	248	73	475	390	559	726	0	0.48	920	52

magnitude of ground water extractions with respect to water supply, and the length of time ground water levels have been below sea level. In certain basins, water users have had to curtail pumping in an effort to forestall further deterioration of their limited ground water supplies from such intrusion. Even this action has not been completely successful and, where ground water levels remain below sea level, the relentless advance of sea-water intrusion fronts continues.

The major basins undergoing sea-water intrusion are Oxnard Plain Pressure Area, West Coast Basin, and Anaheim Basin Pressure Area. Bulletin No. 39-57, Volume I, of this series of reports, described the location and hydrologic features of the three basins listed above, and presented the history of sea-water intrusion and corrective measures which have been undertaken in these basins. However, the protracted period of subnormal supply in Southern California has resulted in an extension of the problem of sea-water intrusion to a number of additional basins. To provide a somewhat more comprehensive description of this problem, a discussion of the status of sea-water intrusion in a number of basins in San Luis Obispo and San Diego Counties, as well as additional basins in Los Angeles and Orange Counties, is presented in this issue of Bulletin No. 39. A more detailed study of sea-water intrusion in California is contained in Bulletin No. 63, "Sea-Water Intrusion in California," published by the Department of Water Resources in November 1958.

San Luis Obispo County

Sea-water intrusion has become evident in several of the coastal basins in San Luis Obispo County in recent years. The geologic and hydrologic features of the affected basins are similar. The water-bearing aquifers are generally unconfined belts of alluvium less than 100 feet in thickness, which occupy the valley floor of the numerous minor independent stream courses. The valley streams flow for a part of each year, providing recharge water along the entire length of the aquifer. Ground water extractions during the summer months have lowered the water table near the coast to the extent that sea water has moved into the seaward portion of the aquifers and degraded the water supply. Although water levels generally recover during the winter months, when surface flow reaches the ocean and pumping is reduced, the body of intruded sea water, having moved horizontally through a porous media under small head differentials, retains most of its prior advance.

The status of sea-water intrusion in Cayucos, Old, Morro, Chorro, and San Luis Obispo Basins is described in the following paragraphs. Lines of equal chloride ion concentration (isochlors) appropriate to each of these basins for the spring of 1962 are delineated on Plate 13, "Generalized Status of Sea-Water Intrusion in Ground Water Basins, San Luis Obispo County, Spring 1962."

Cayucos Basin. It is not known when intrusion first became evident in Cayucos Basin. During 1961-62, the 500 parts per million (ppm) isochlor line was located 0.3 mile inland from the ocean.

Old Basin. Sea-water intrusion first became a problem in Old Basin in 1960. During 1961, intrusion had extended 0.5 mile inland from the ocean and affected the major producing area of the basin. As a result of the artificial spreading of water in the lower basin area, intrusion was successfully pushed back from the important water supply well fields. In the spring of 1962, the 500 ppm isochlor line was located about 0.3 mile inland from the ocean. Ground water levels in the well field area are presently maintained above sea level.

Morro Basin. Sea-water intrusion first became a problem in Morro Basin during 1959-60. During 1961-62 the 250 ppm isochlor line advanced to about 0.2 mile inland from the ocean, and intrusion is influencing the mineral quality in a number of the important water supply wells in Morro Basin. The water levels are generally below sea level during the summer and fall months. However, except for cones of depression at pumping wells, the water levels are above sea level during the winter and spring months.

Chorro Basin. Sea-water intrusion was first recognized in Chorro Basin in 1951, in one of three adjacent wells located near the head of the tidal slough. In 1960, intrusion became severe in the other two wells. Sea water could have arrived in the vicinity of the wells by way of the tidal slough at high tide or by moving up the aquifer from its downstream extent. The water levels are below sea level during the summer and fall months but recover during the winter and spring.

San Luis Obispo Basin. Sea-water intrusion first became a problem in San Luis Obispo Basin in 1960. While the affected wells are located 1.7 miles from the ocean, a tidal slough extends up the stream channel to the vicinity of the well field. In the spring of 1962, the 500 ppm isochlor line was located between the second and third wells of a group of five wells which extend for a distance of 650 feet in an alignment parallel to San Luis Obispo Creek. The static water levels appear to be above sea level most of the year. The cone of depression at the well field is below sea level and apparently provides the landward gradient which results in the intrusion of sea water.

Ventura County

The major points of sea-water intrusion in Ventura County are in the vicinity of Port Hueneme and Point Mugu in the Oxnard Plain Pressure Area. The status of the intrusion in this area is discussed in this section.

Oxnard Plain Pressure Area. Isochlors, or lines of equal chloride ion concentration, of 100 and 500 ppm, in the Oxnard Plain Pressure Area, are presented on Plate 14, "Generalized Status of Sea-Water Intrusion, Oxnard Plain Pressure Area, Spring 1962." Ground water level contours for June 1962 are also shown on this plate. These data indicate that movement of sea water has generally been landward during the past year, with significant intrusion occurring in the area centering around Port Hueneme. The occurrence of sea water in water-bearing formation in the Mugu Lagoon area is also noted.

Near Port Hueneme, there was a continued advance inland along the entire intrusion front, and the area underlain by sea water increased considerably. The lines of 100 ppm and 500 ppm chloride ion concentration advanced as much as 1,000 feet during 1961-62. As of spring 1962, the total maximum landward advance of the 500 ppm isochlor line was 2.2 miles in the easterly direction. The chloride content in water produced from wells located southeast of the 1960-61 intrusion front increased rapidly during 1961-62. This new problem area is considered to be part of the Port Hueneme intrusion area. It is noted that fresh water is found to be seaward of this eastward protrusion of the sea-water front. This area of fresh water may indicate the existence of a fresh-water front moving landward down the hydraulic gradient from the area of offshore fresh-water storage.

In the vicinity of Mugu Lagoon, the intrusion front remained in much the same position during 1961-62 as during the prior year. The waters pumped from intruded wells in this area are characterized by wide fluctuations in their chloride content. Although the depressed condition of the water table continued to exist during 1961-62, the chloride content in some of the sampled wells remained unchanged. The total maximum landward advance of the 500 ppm isochlor line remains at about 2.1 miles in the vicinity of Wood Road.

Los Angeles County

As previously noted, discussion regarding sea-water intrusion in the West Coast Basin of the Coastal Plain of Los Angeles County has been presented in previous volumes of this series of reports. With this issue of Bulletin No. 39, we are including discussion of sea-water intrusion into Trancas and Malibu Basins along the coast of the Santa Monica Mountains, and into Santa Monica Basin of the coastal plain to provide a more complete picture of the problem in this county.

The geologic and hydrologic features of Trancas and Malibu Basins are similar. The basins consist of generally unconfined alluvium, usually less than 150 feet in thickness, with areas of less than a square mile each. The significant recharge to these basins results from percolation from streamflow following winter rains. Production of ground water in excess of sustained yield has caused sea water to invade the production areas of these basins.

The geology of Santa Monica Basin is similar to that of West Coast Basin, and each has several common aquifers. A detailed discussion of the geology and hydrology of this basin is presented in Appendix A, "Ground Water Geology," and Appendix B, "Safe Yield Determinations," to Department of Water Resources Bulletin 104, "Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County."

Trancas Basin. Sea-water intrusion in this basin was first noted around 1950. However, a 1954 analysis indicated the presence of native quality water in the lower end of the basin in that year. By 1960, intrusion had severely affected the producing wells located in the lower end of the basin and had extended 0.3 mile inland from the ocean. In the spring of 1962, the quality of the produced water had returned to near-native quality. A reduction of pumping due to the availability of imported water coinciding with the wet winter of 1961-62 may account for at least the temporary abatement of intrusion in this basin.

Malibu Creek Basin. Studies by the Department of Water Resources indicate that in 1950 sea water underlaid about 160 acres of Malibu Basin and that the saline wedge extended inland a maximum distance of about 0.5 mile. By the spring of 1962, sea-water intrusion had encroached into the entire production area of lower Malibu Basin and extended at least

0.7 mile inland from the ocean. A reduction in pumping due to the availability of imported water and a wet winter with surface flow wasting to the ocean have not noticeably improved the ground water quality in this basin.

Santa Monica Basin. About 70 percent of the ground water production in Santa Monica Basin is developed from aquifers found under the Ballona Gap area, which is located adjacent to the north edge of West Coast Basin. Sea-water intrusion became a problem in this gap in the late 1930's. The probable extent of sea-water intrusion in Ballona Gap in the spring of 1962 is represented by 500 and 1,000 ppm isochlor lines delineated on Plate 15, "Generalized Status of Sea-Water Intrusion, Santa Monica and West Coast Basins, Spring 1962," which indicates the 500 ppm isochlor line was located about 1.5 miles inland from the ocean. The relatively minor landward slope on the water table, together with diminished pumping since 1960, has probably reduced the rate of intrusion in this area. However, the danger exists that the intrusion may move southwest into West Coast Basin through aquifers common to both basins.

West Coast Basin. Sea water has intruded the fresh-water aquifers of the West Coast Basin along Santa Monica Bay from Palos Verdes Hills to Ballona Gap. Lines of equal chloride concentration of 250, 500, and 1,000 ppm for the spring of 1962 are delineated on Plate 15. Ground water level contours for June 1962 are also shown on this plate.

In the spring of 1962, the 500 ppm isochlor was located an average distance of 1.3 miles inland from the coast, and the 250 ppm isochlor line was located approximately 500 feet farther inland. In the

Cities of Los Angeles and El Segundo, at the north end of the intrusion area in West Coast Basin, both the 250 and 500 ppm chloride lines evidenced little change from the previous spring. In the Redondo Beach area, at the south end of the intrusion front, the isochlor lines moved slightly inland during 1961-62, as evidenced by the continuing increase of chloride ion concentrations in the intruded wells.

The Los Angeles County Flood Control District's West Coast Basin Barrier Project in the Cities of Manhattan Beach and Hermosa Beach is located in the center of the intrusion area. The project consists of a 1.5-mile-long line of fresh-water injection wells located 0.5 mile inland from the coast. During 1961-62, the body of fresh water located immediately landward of the injection line continued to enlarge due to injection activities. Landward of the injected fresh-water barrier, a separated body of saline water continued to exist. During 1961-62, the 250 and 500 ppm isochlor lines delineating the landward front of the isolated saline body continued to slowly advance inland. However, it is significant that by the spring of 1962 and chloride ion content in the waters in this isolated saline body had generally diminished to less than 1,000 ppm.

The Gaspur aquifer located in the Dominguez Gap area of West Basin has been undergoing degradation due to sea-water intrusion and oil-field brines disposal. Sea-water intrusion was first recognized in 1913. Oil-field brines degraded the waters in a large inland area of the aquifer during the 1930's. It is believed that the interface between the sea-water intrusion and oil-field brines exists near the Pacific Coast Highway, a distance of about two miles inland from the original shoreline. A low area or depression in the Gaspur aquifer piezometric surface exists immediately inland of Pacific Coast Highway. This depression is believed to be caused by the downward movement of the degraded Gaspur aquifer ground water into the underlying Gage aquifer through an area of aquifer mergence which is located along the west flank of the Dominguez Gap immediately north of Pacific Coast Highway.

The Los Angeles County Flood Control District recently completed a report entitled "Dominguez Gap Barrier Project Geologic Investigation, March 1962," which deals with their studies of sea-water intrusion in the general area of Los Angeles Harbor. Among other matters, this report points out that evidence indicates also that direct sea-water intrusion is occurring in the Gage aquifer from the Los Angeles Harbor in the Wilmington area.

Orange County

Ground water basins in Orange County are being intruded by sea water in the Anaheim Basin Pressure Area and in the San Clemente Area.

Anaheim Basin Pressure Area. Lines of equal chloride ion concentrations of 50, 100, and 500 ppm for the Anaheim Basin Pressure Area for the spring of 1962 are delineated on Plate 16, "Generalized Status of Sea-Water Intrusion, Santa Ana and Alamitos Gaps and Bolsa Chica Mesa, Orange and Los Angeles Counties, Spring 1962." Ground water level contours for the Talbert aquifer in Santa Ana Gap, the upper zone under Bolsa Chica Mesa, and the "A-Zone" in Alamitos Gap for June 1962 are also shown on this plate.

Sea-water intrusion continued its landward movement during 1961-62 in the Talbert aquifer in Santa Ana Gap. The 500 ppm isochlor line advanced approximately 500 feet during the year and is now about 3.3 miles inland from the coast. The chloride ion concentration in wells along the intrusion front continued to increase.

The upper water-bearing zone underlying Bolsa Chica Mesa is slowly being intruded by sea water. This intrusion has advanced as much as 0.5 mile landward of the Newport-Inglewood fault zone. During 1961-62, the intrusion front remained in about the same position as it was in the prior year, although the chloride ion concentration in the wells behind the front continued to increase.

The Los Angeles County Flood Control District conducted a study of the extent of sea-water intrusion in the several aquifers underlying Alamitos Gap which straddles the Los Angeles-Orange County boundary adjacent to the coast. Their findings were published in May 1961 in a report entitled "Alamitos Barrier Project, Geologic Investigation." In that report, it was noted that the Pliocene and Pleistocene deposits, which had been upfolded in the vicinity of the Newport-Inglewood uplift, were subsequently eroded by an ancestral San Gabriel River system. This action exposed some of the aquifers to depths of 70 to 90 feet below current sea level, and this erosional feature was later backfilled by Recent deposits. Today, these deposits, which are not displaced by the Newport-Inglewood uplift, extend to an outcrop on the ocean floor. The report further pointed out that sea water has moved through these deposits as well as through surface tidal channels, intruding the Pleistocene aquifers at points of mergence, under the influence of a ground water pressure gradient which moves water in a direction away from the ocean toward the land.

The most important water-producing aquifer intruded by sea water in the Los Alamitos area is the "A-Zone," and intrusion in that zone is considered in the Flood Control District's report to pose the greatest threat of damage to ground water supplies. Therefore, monitoring of the extent of sea-water intrusion in the Alamitos Gap has been directed primarily at this zone. Measurements of chloride ion concentrations during 1961-62 indicate that the intrusion front in the "A-Zone" has advanced about 500 feet in a northerly direction since the prior year, and was located about 1.6 miles landward of the Newport-Inglewood fault zone in the spring of 1962.

San Clemente Area. The City of San Clemente developed a local ground water supply by drilling wells into the coastal terrace adjacent to San Mateo Creek. The aquifer is about 350 feet in thickness and composed of a series of semiconsolidated sandstone beds containing numerous coarse gravel lenses. The shallow perforations in an observation well located 0.2 mile from the ocean yield almost undiluted sea water. The chloride content in a production well located 0.5 mile from the ocean began to increase in 1958. Ground water production was subsequently reduced. While there appears to be no active intrusion in the wells with deeper perforations, the intrusion in the shallower zones is believed to have been between 0.3 and 0.5 mile inland from the ocean in 1962.

San Diego County

Sea-water intrusion has been evident in several of the coastal basins in San Diego County for a number of years. The geologic and hydrologic features of the affected basins are similar. The water-bearing aquifers are belts of alluvium, generally less than 150 feet in thickness, which occupy the valley floors of the separate stream courses extending from the mountains to the ocean. The aquifers are, with local exceptions, unconfined, permitting recharge along the length of the aquifer from the sporadic runoff which is typical of the county. Historic extractions, in combination with the protracted drought, have resulted in water tables being drawn below sea level in many of the basins, causing conditions which can permit the intrusion of sea water. However, connate brines exist in some of the old formations adjacent to the ground water basins in San Diego County. With the lowering of ground water levels in the basins, the connates migrate into and degrade the ground waters. Due to the similarity in the resulting prominent ions contributed by sea-water intrusion and connate brines, it is frequently difficult to identify the source of degradation.

Mission San Luis Rey Basin. The ground water in Mission Basin on the San Luis Rey River has been undergoing degradation due to several causes, including sea-water intrusion. The water level elevations in the lower end of Mission Basin have been below sea level since late 1949. The resulting landward hydraulic gradient permits the occurrence of sea-water intrusion. A well located 1.7 miles from the ocean has produced water with chloride ions ranging from 3,600 to 10,000 ppm since as early as 1953. High chloride ground waters, by the spring of 1962, were present in most of the water wells located within 2.5 miles of the ocean. The body of high chloride ion water is advancing inland on the landward hydraulic gradient.

San Dieguito Basin. The ground water in San Dieguito Basin has been undergoing degradation due to several causes, including sea-water intrusion. Available evidence indicates that water levels have been below sea level, providing a landward gradient that could permit sea-water intrusion since at least 1954. Ground water with chloride ion concentrations considerably in excess of the chloride ion concentrations found in other problem waters in San Dieguito Basin have advanced as far as 2.5 miles inland from the ocean, by the spring of 1962.

Tia Juana Basin. The ground water in Tia Juana Basin has been undergoing degradation due to several causes, including sea-water intrusion. The ground water level elevation at the lower end of Tia Juana Basin has dipped below sea level seasonally, starting in 1950, and remained below sea level continuously since late in 1954. This provided a landward hydraulic gradient that could permit sea-water intrusion to occur. Prior to 1954, the ground water produced from isolated wells located in the coastal end of the basin had shown signs of deterioration. Subsequent to 1954, the chloride ion concentration throughout the coastal end of the basin increased rapidly. By the spring of 1962, this degradation had advanced 2.0 miles inland from the ocean.

CHAPTER V. MISCELLANEOUS ACTIVITIES AFFECTING WATER SUPPLY CONDITIONS

The formation of water districts and construction activities relating to water often affects the water supply conditions in Southern California; for this reason a brief outline of the more important activities which occurred during the 1961-62 water year is presented below.

Construction of Dams

The dams with capacities greater than 100 acre-feet, completed during the water year, were Chet Harritt Dam at Lakeside, San Diego County, and Encino Dam at Encino, Los Angeles County. The remaining projects, Alta Loma Dam on the Alta Loma Channel; Palisades Dam at Capistrano Beach; Squires Dam at Agua Hedionda; and Villa Park Dam at Santiago Creek were incomplete as of September 30, 1962. Table 24 gives the beginning date of construction of the above dams, their purpose, capacity in acre-feet, and the agency responsible for the construction of the dam.

Other Water Supply Projects

The Metropolitan Water District of Southern California completed the second expansion of the F. E. Weymouth Softening and Filtration Plant at La Verne in April 1962, with the exception of the softeners. The installation of the softeners will enable the plant to soften and filter water at a rate of 620 cubic feet per second, with a final hardness of 125 parts per million. The district was also constructing the Robert B. Diemer Filtration Plant near Yorba Linda, a project quite similar to that described above, with an initial capacity of 200 million gallons per day and an ultimate capacity of 400 million gallons per day. The plant began operation in December 1963.

TABLE 24

DAM PROJECTS COMPLETED OR UNDER CONSTRUCTION IN SOUTHERN CALIFORNIA DURING THE WATER YEAR 1961-62*

Dam Project	Construction period		Agency responsible for construction	Purpose	Location	Reservoir capacity, in acre-feet
	Started	Completed				
Alta Loma	June 1961	Incomplete	San Bernardino County Flood Control District	Flood control	Alta Loma Channel San Bernardino County	108
Chet Harritt	April 1961	Oct. 1962	Helix Irrigation District	Terminal storage	Lakeside San Diego County	10,500
Encino	Oct. 1960	Oct. 1962	Los Angeles Department of Water and Power	Terminal storage	Encino Los Angeles County	10,300
Palisades	July 1962	Incomplete	Tri Cities Municipal Water District	Terminal storage	Capistrano Beach Orange County	147
Squires	Jan. 1962	Incomplete	Carlsbad Metropolitan Water District	Terminal storage	Agua Hedionda San Diego County	600
Villa Park	May 1961	Incomplete	Orange County Flood Control District	Flood control and conservation	Santiago Creek Orange County	15,600

* Greater than 100 acre-feet capacity.

On August 20, 1962, the Whittier Narrows Water Reclamation Plant made its first delivery to the Central and West Basin Water Replenishment District. This unique plant treats sewage to develop water for recharging ground water supplies. The project was designed and constructed and is operated by the County Sanitation Districts of Los Angeles County. Treated water is delivered to spreading grounds in the Coastal Plain of Los Angeles County, which are operated by the Los Angeles County Flood Control District. The plant has an operating capacity of about 13,000 acre-feet annually.

Water District Formation Activities

During the 1961-62 fiscal year, the Metropolitan Water District annexed four areas. These are the Marina Area of Los Angeles City, which was annexed to the West Basin Municipal Water District and to the Metropolitan Water District; areas in Riverside County, which were annexed to Western Municipal Water District of Riverside County and to the Metropolitan Water District; an area in Orange County, which was annexed to Orange County Municipal Water District and to the Metropolitan Water District; and an area in Riverside County, which was annexed to the Eastern Municipal Water District and the Metropolitan Water District. In addition, two areas in San Diego County, Ramona Municipal Water District and Rincon del Diablo Municipal Water District, were annexed to San Diego County Water Authority and the Metropolitan Water District. During the period of time considered, there were no annexations to the Metropolitan Water District as separate units.

In addition to the above annexations, the following water districts were formed in Southern California during the 1961-62 fiscal year.

San Luis Obispo County

Baywood Park County Water District

Ventura County

Anacapa Municipal Water District

Los Angeles County

Upper Santa Clara Valley Water Agency

Orange County

East Orange County Water District

Santa Ana Mountains County Water District

Riverside County

Desert Water Agency

San Gorgonio Pass Water Agency

Imperial County

Brawley County Water District

Palo Verde County Water District

Salton Sea Water District (California Water District)

San Luis Obispo County

Baywood Park County Water District

Ventura County

Calleguas Municipal Water District

Los Angeles County

Upper Santa Clara Valley Water Agency

Orange County

East Orange County Water District

Santa Ana Mountains County Water District

Riverside County

Desert Water Agency

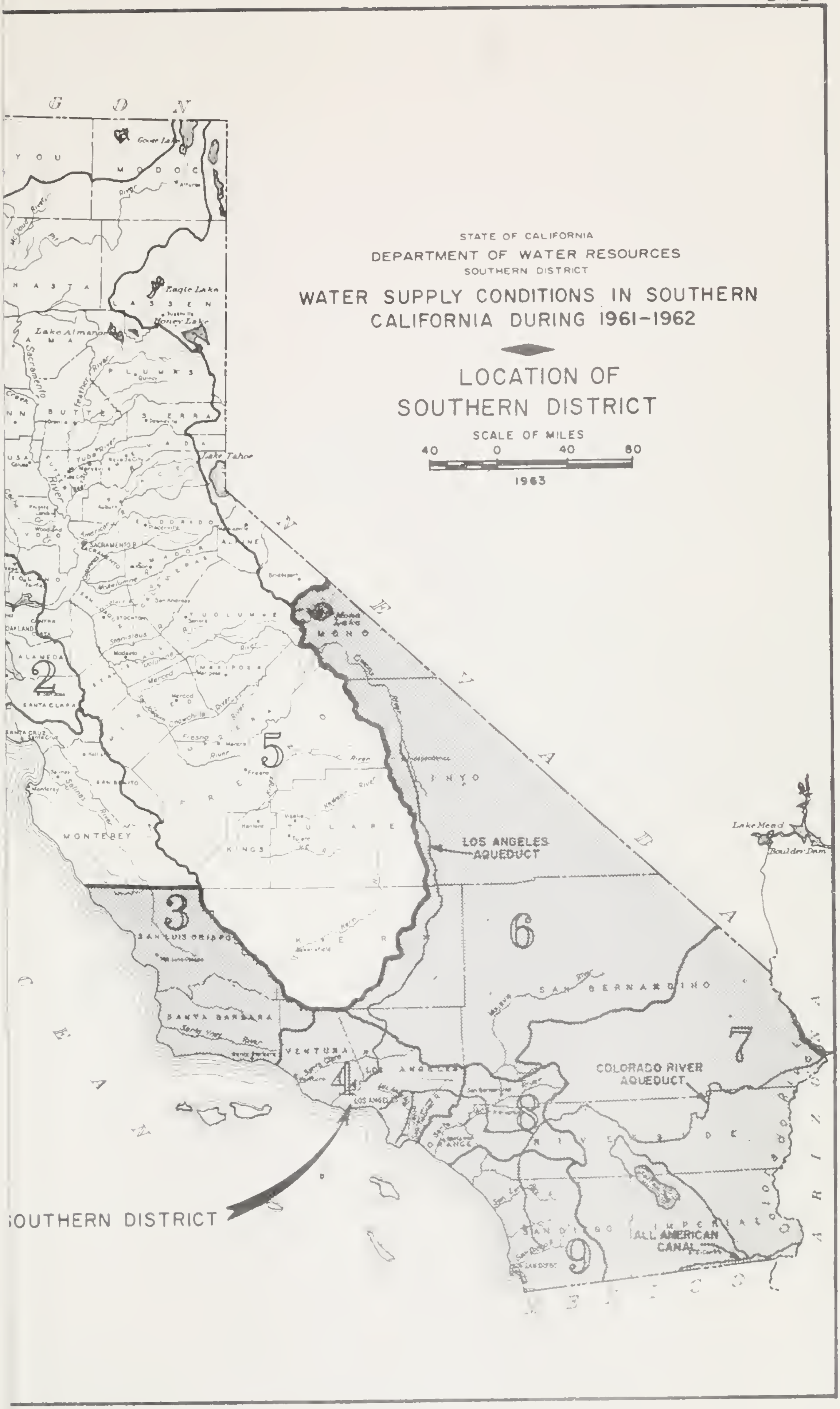
San Gorgonio Pass Water Agency

[illegible] County

[illegible] County Water District

[illegible] County Water District

[illegible] Water District ([illegible])


STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-1962
LOCATION OF SOUTHERN DISTRICT
SCALE OF MILES
40 0 40 80
1963
LOS ANGELES AQUEDUCT
COLORADO RIVER AQUEDUCT
ALL AMERICAN CANAL
SOUTHERN DISTRICT
Lake Mead
Boulder Dam
Lake Tahoe
Eagle Lake
Honey Lake
Lake Almanor
MODOC
LASSEN
PLUMAS
BUTTE
SIERRA
ALPINE
MONO
TUOLUMNE
MARIPOSA
FRESNO
TULARE
KINGS
INYO
KERN
MONTEREY
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL
SANTA CLARA
ALAMEDA
2
3
4
5
6
7
8
9

REGIONS

1 NORTH COASTAL

2 SAN FRANCISCO

3 CENTRAL COASTAL

4 LOS ANGELES

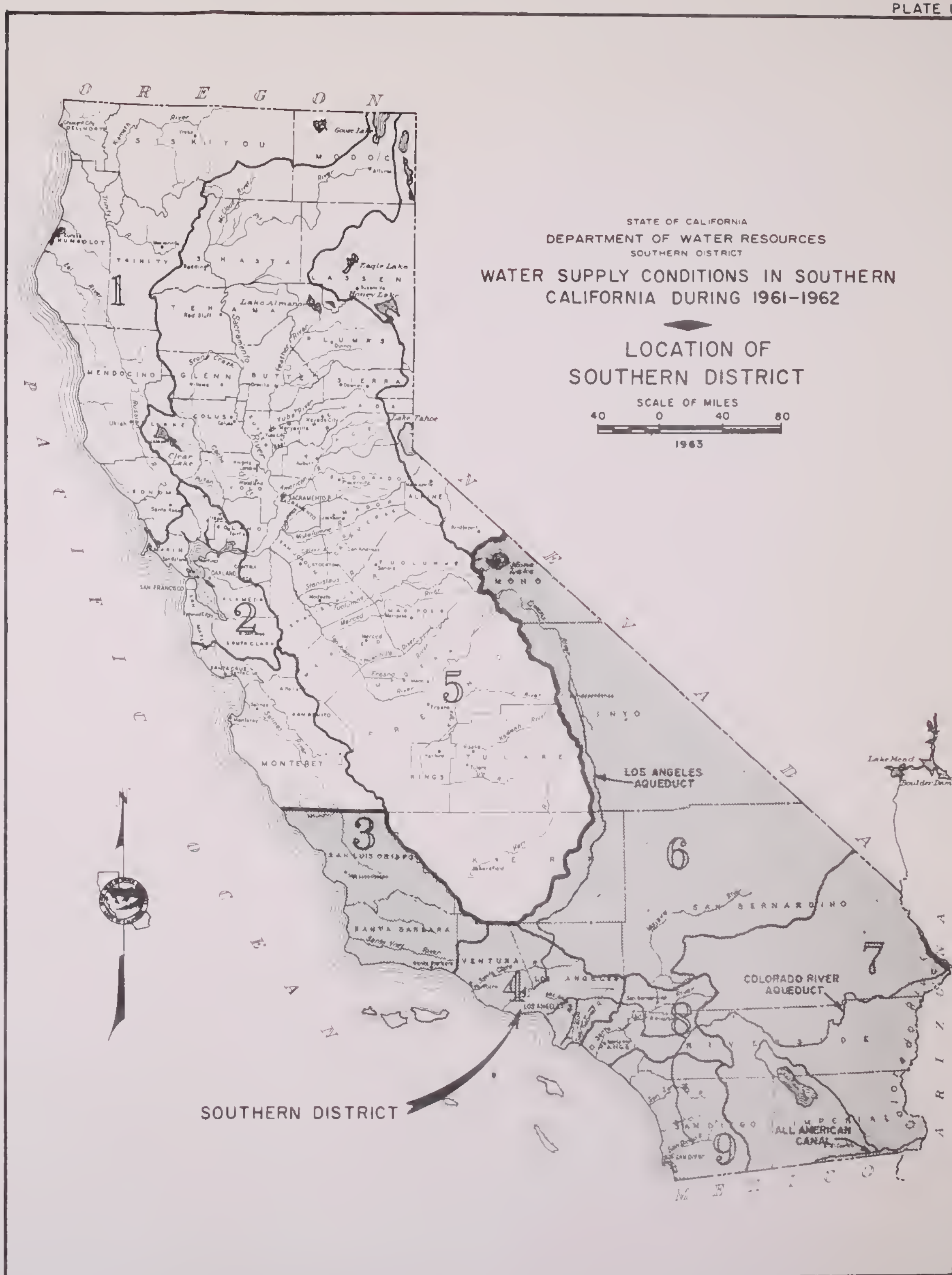
5 CENTRAL VALLEY

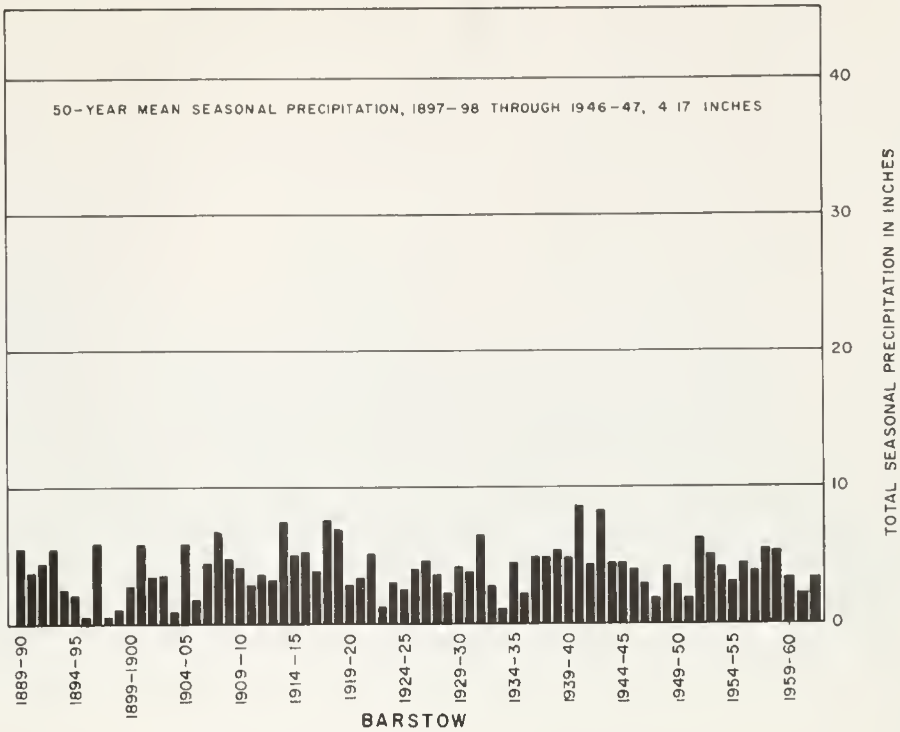
6 LAHONTAN

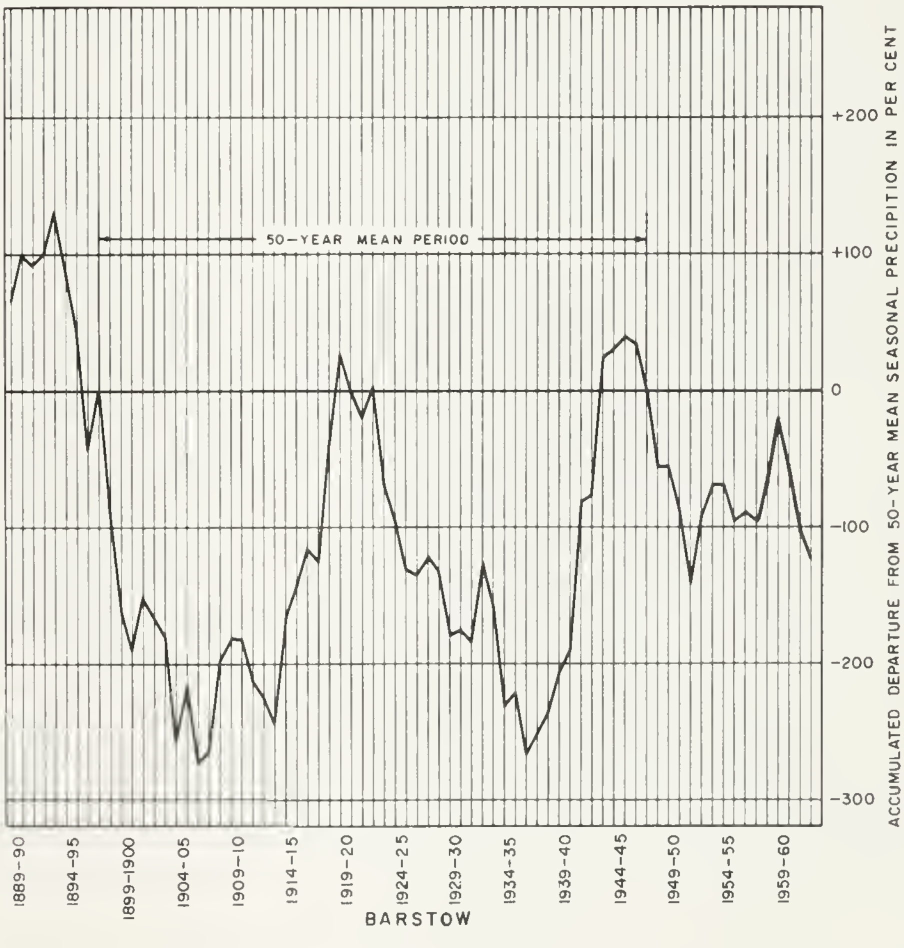
7 COLORADO RIVER BASIN

8 SANTA ANA

9 SAN DIEGO

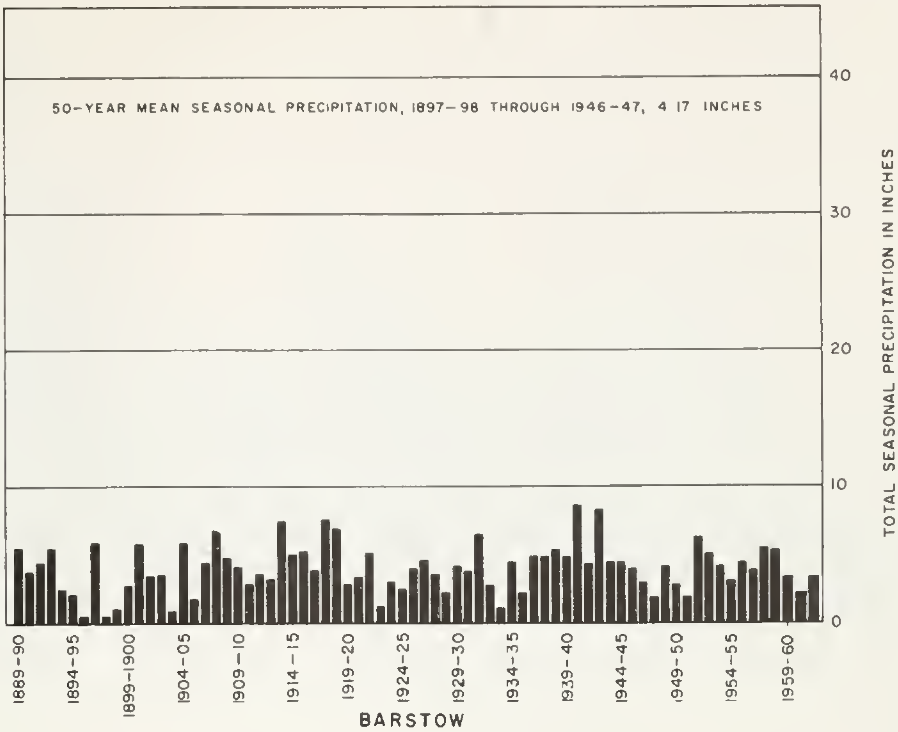




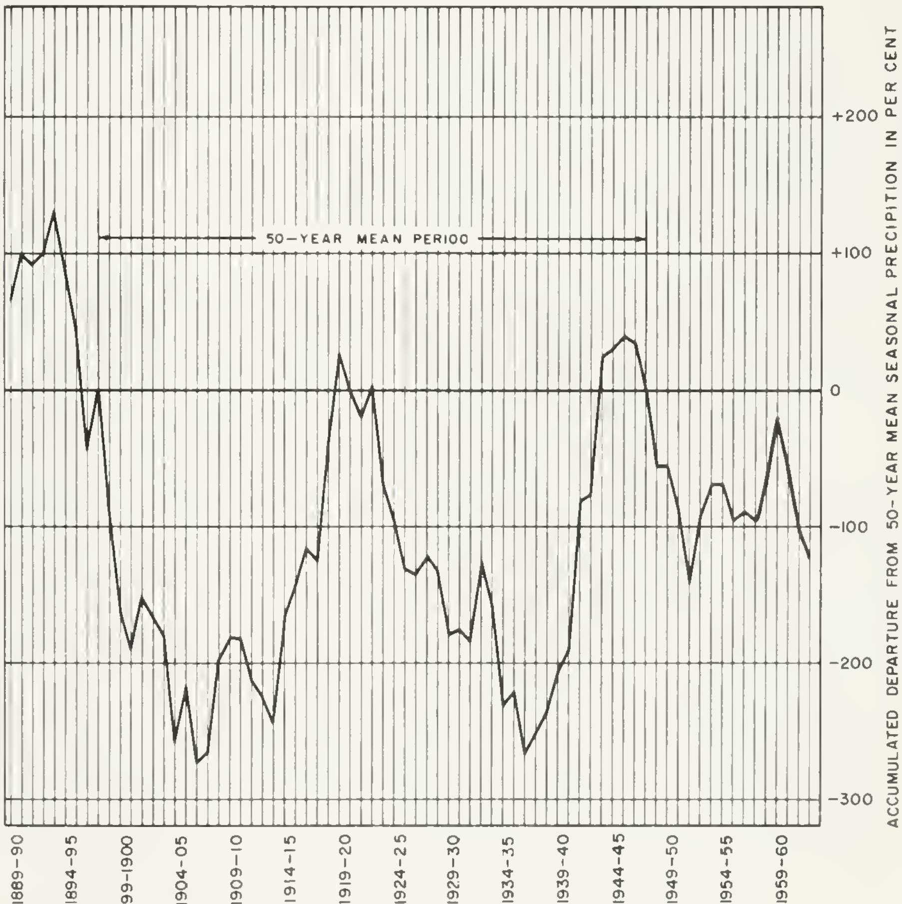


T I O N

R N CALIFORNIA



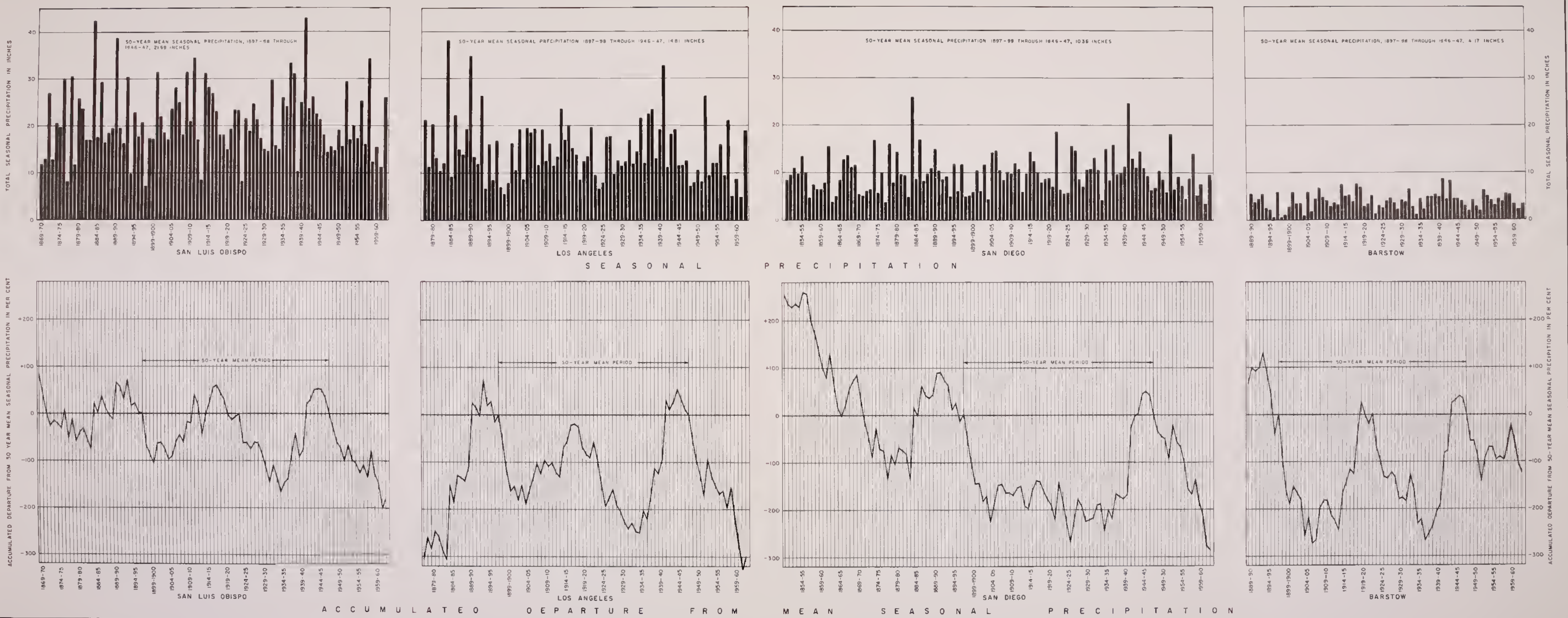
BARSTOW



BARSTOW

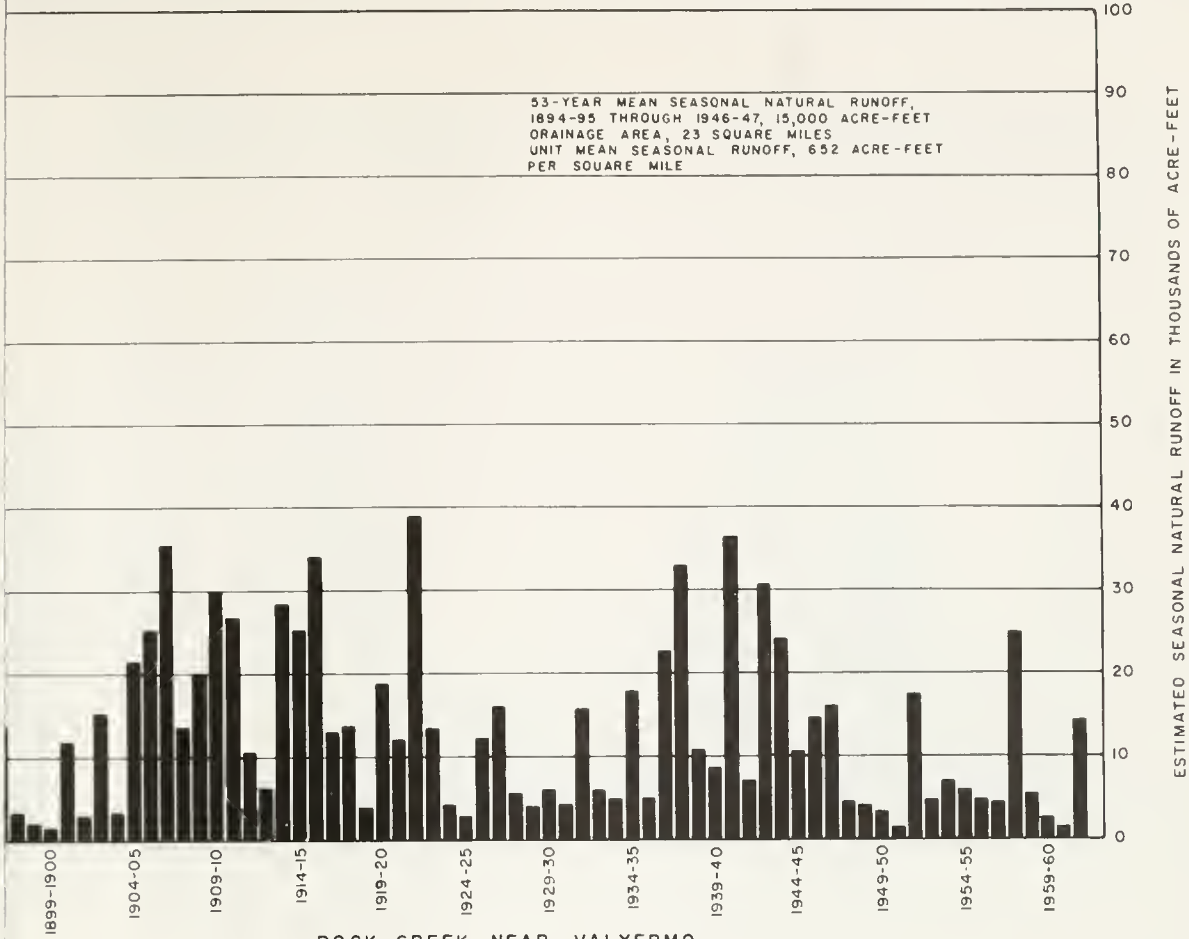
T I O N

R N C A L I F O R N I A

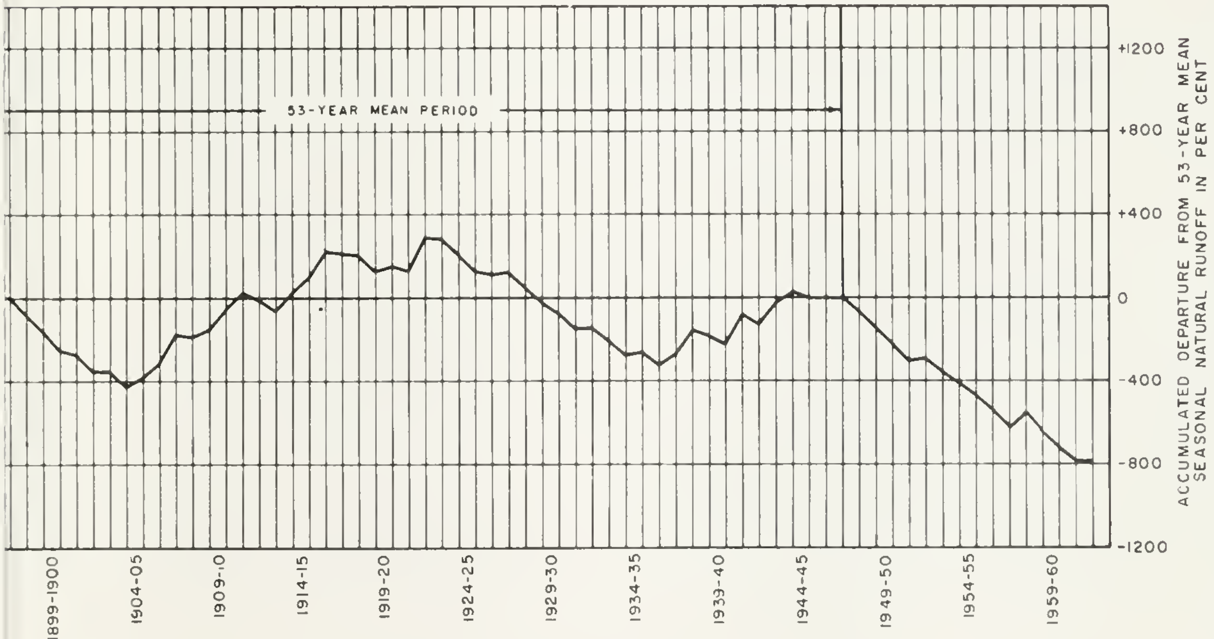


REPRESENTATIVE PRECIPITATION CHARACTERISTICS IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1963



ROCK CREEK NEAR VALYERMO



ROCK CREEK NEAR VALYERMO

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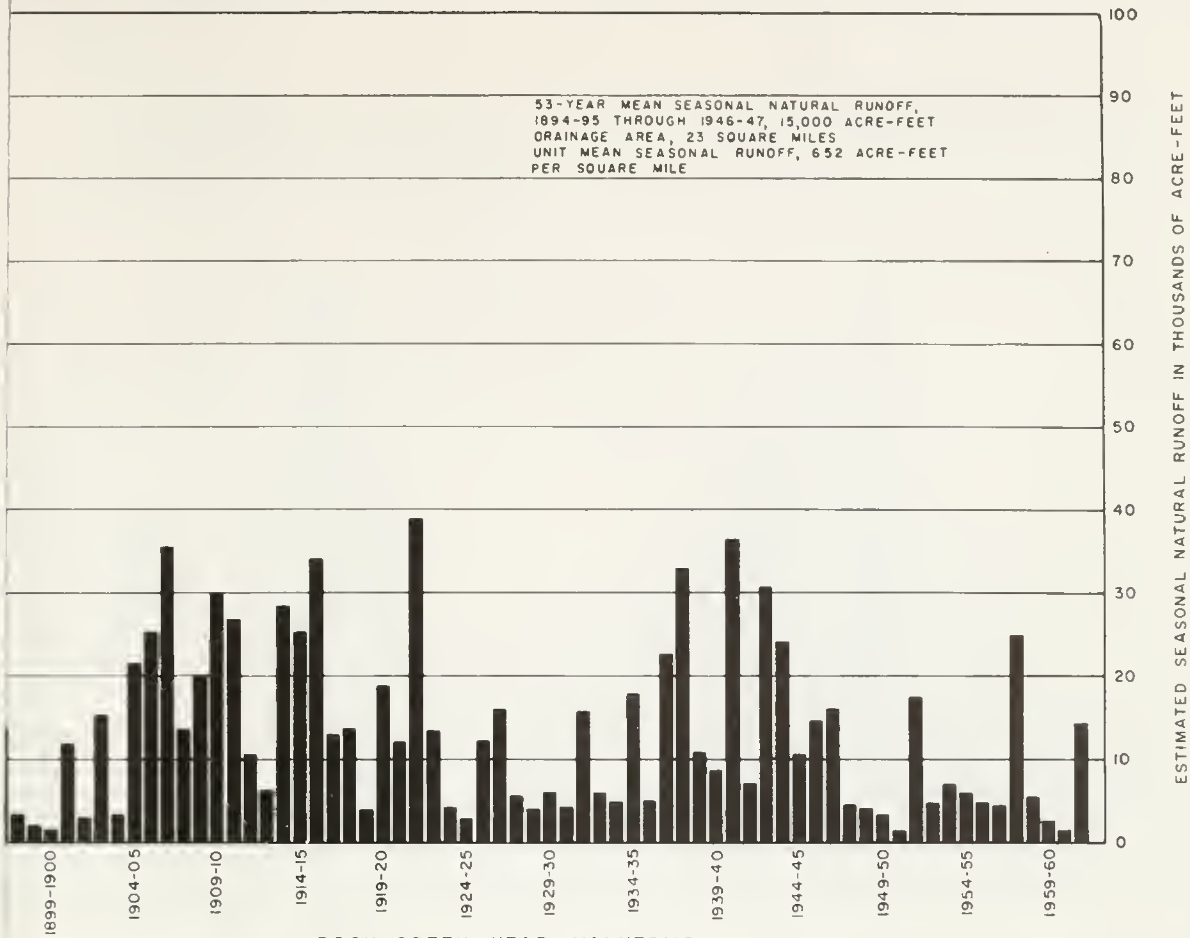
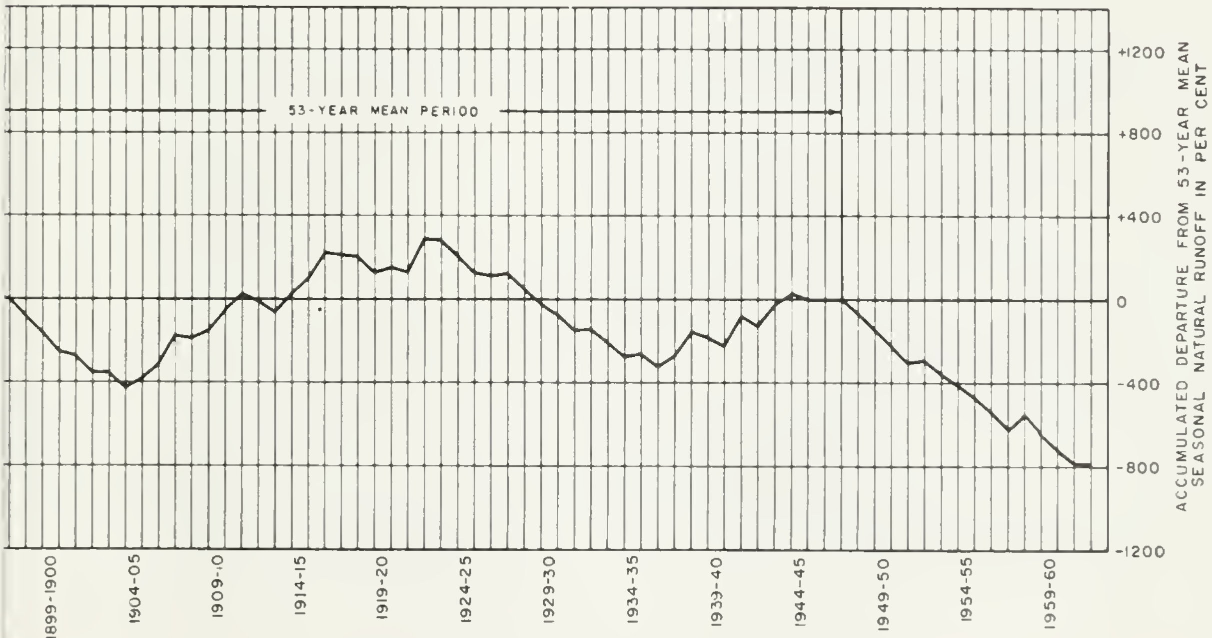
A L I F O R N I A



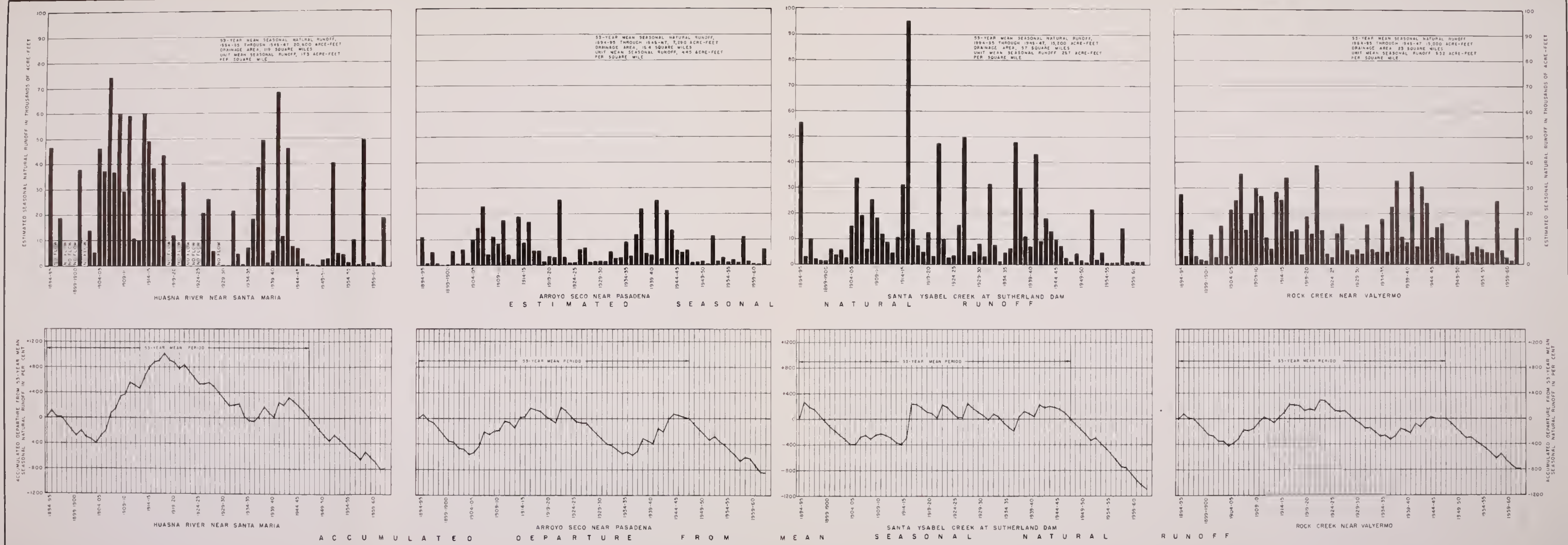
ROCK CREEK NEAR VALYERMO



ROCK CREEK NEAR VALYERMO

O F F

A L I F O R N I A



REPRESENTATIVE RUNOFF CHARACTERISTICS IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1963

LEGEND

MEAN SEASONAL PRECIPITATION FOR 50-YEAR PERIOD 1897-1947

LESS THAN 10 INCHES

10 TO 20 INCHES

20 TO 30 INCHES

MORE THAN 30 INCHES

50-YEAR MEAN ISOHYETAL LINES

SOUTHERN CALIFORNIA DISTRICT BOUNDARY

—80—

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

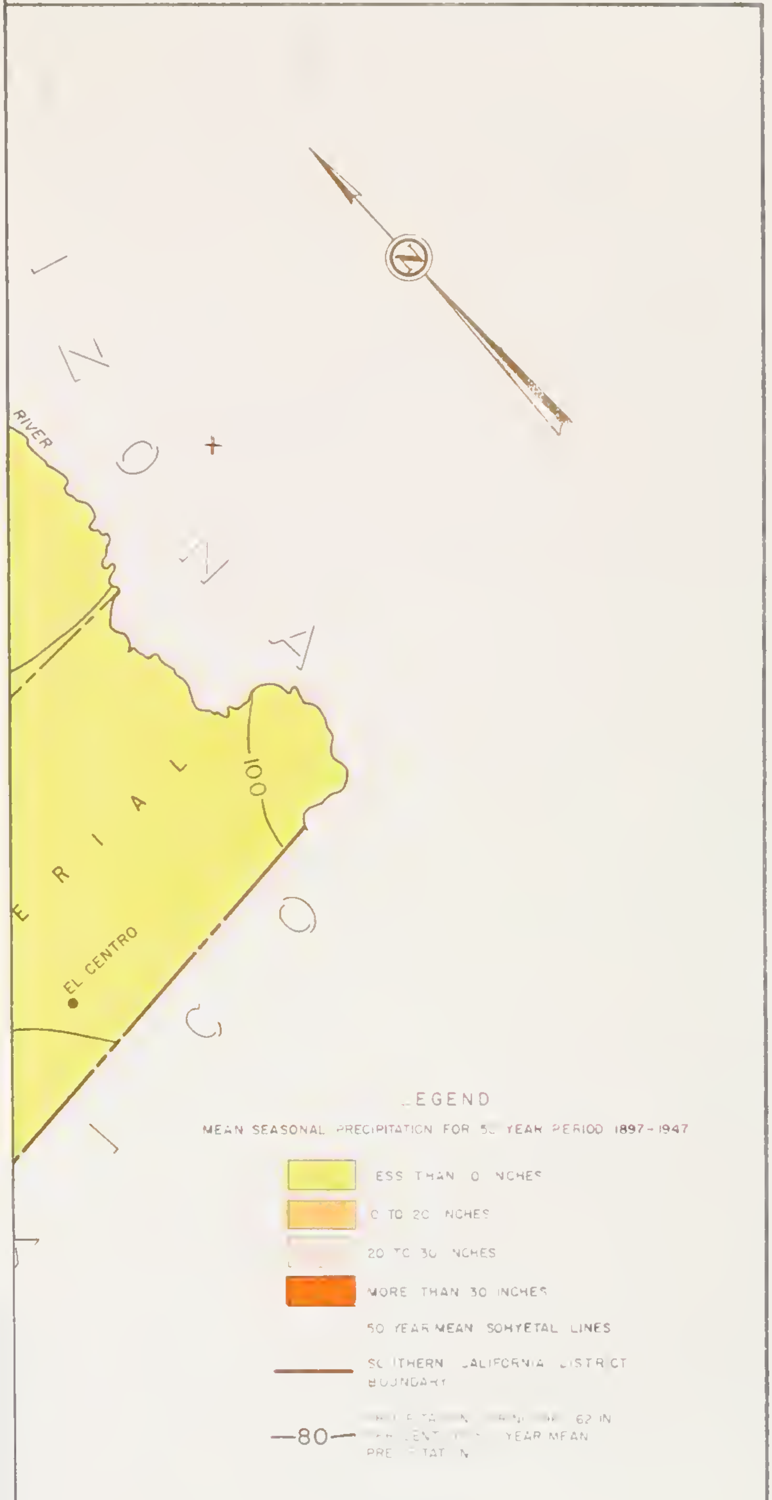
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

PRECIPITATION DURING 1961-62 IN PER CENT OF 50-YEAR MEAN PRECIPITATION

SCALE OF MILES

20 40

1963



STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

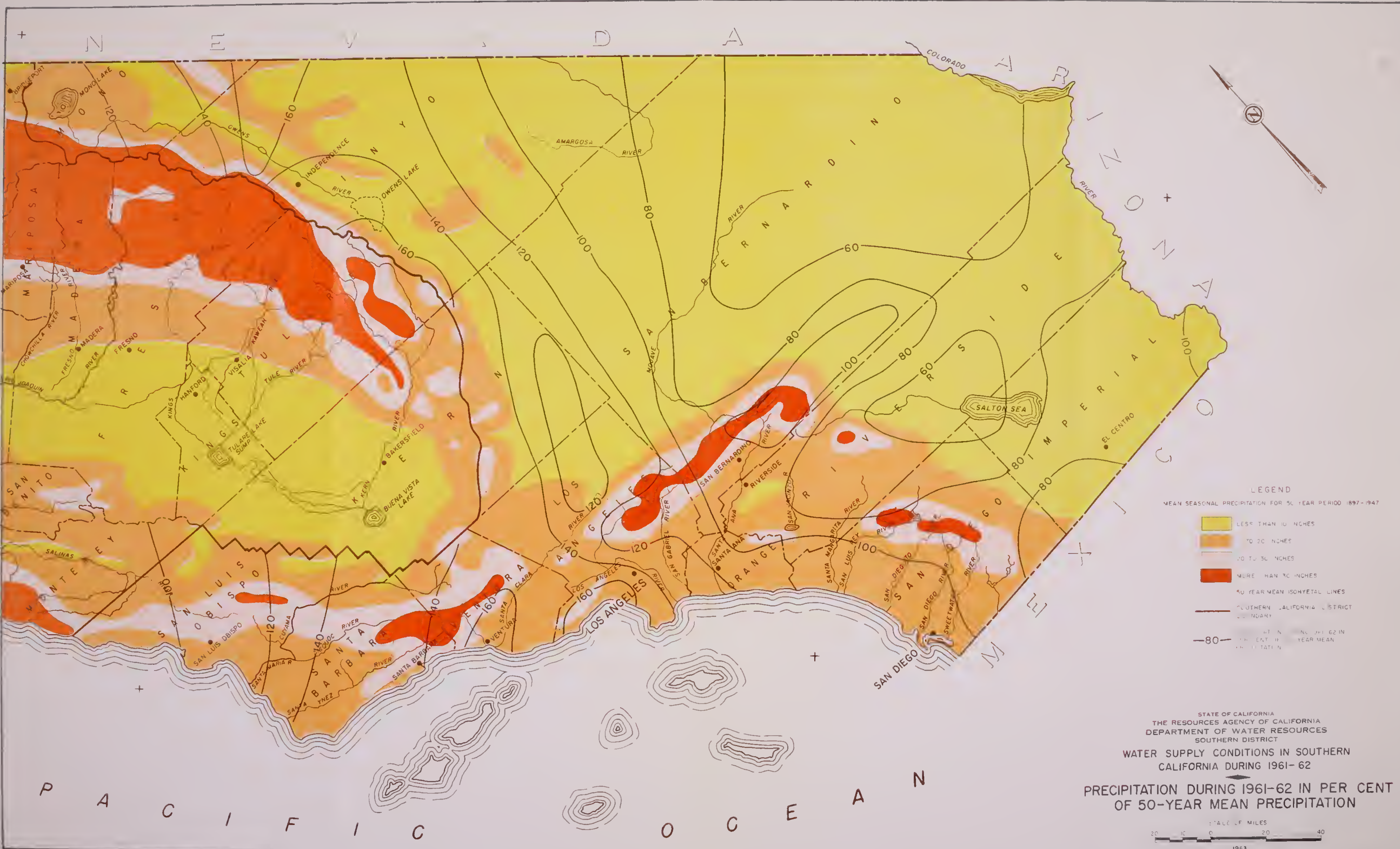
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961–62

PRECIPITATION DURING 1961–62 IN PER CENT OF 50-YEAR MEAN PRECIPITATION

SCALE OF MILES

20 10 0 20 40

1963



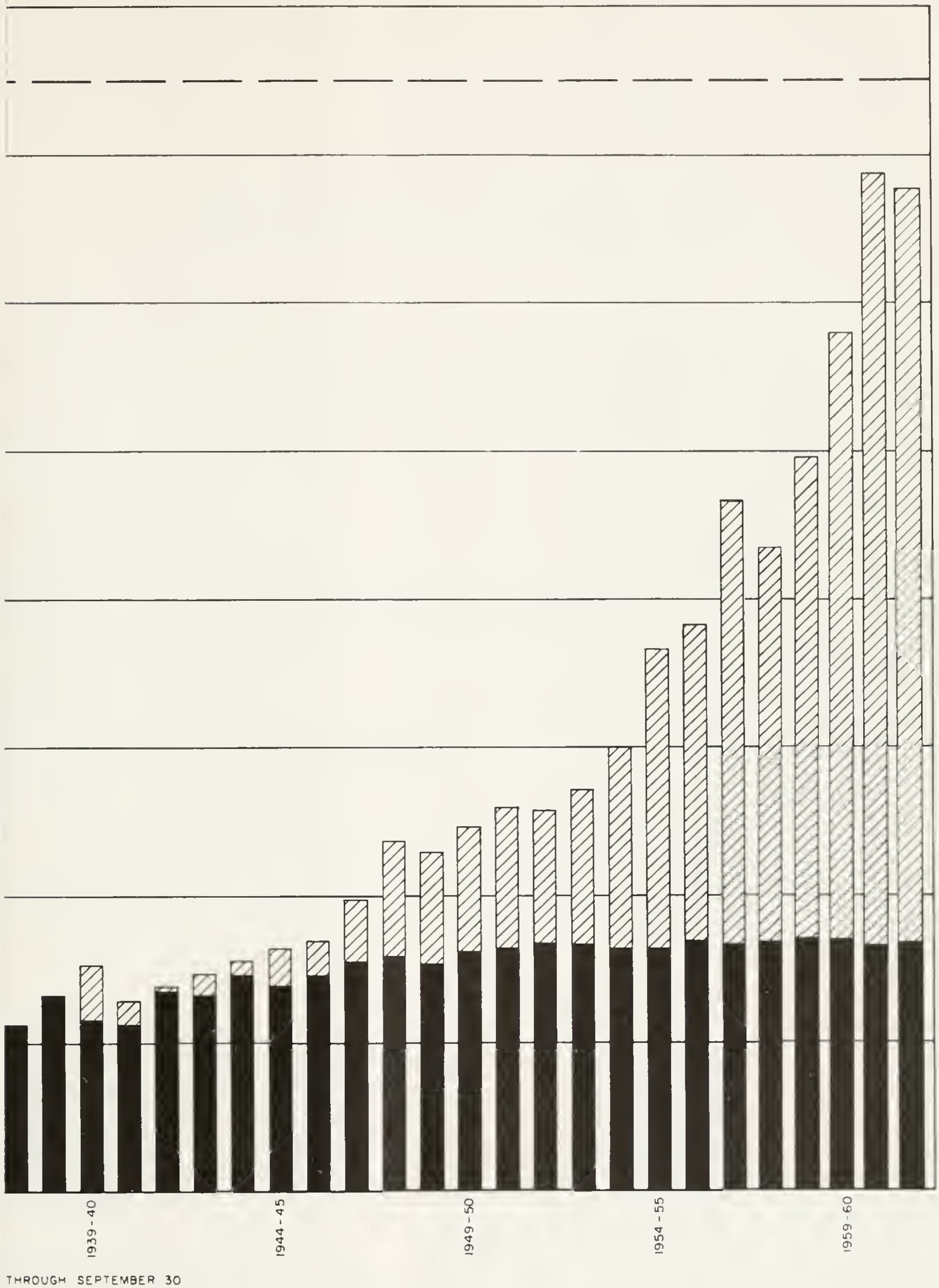
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

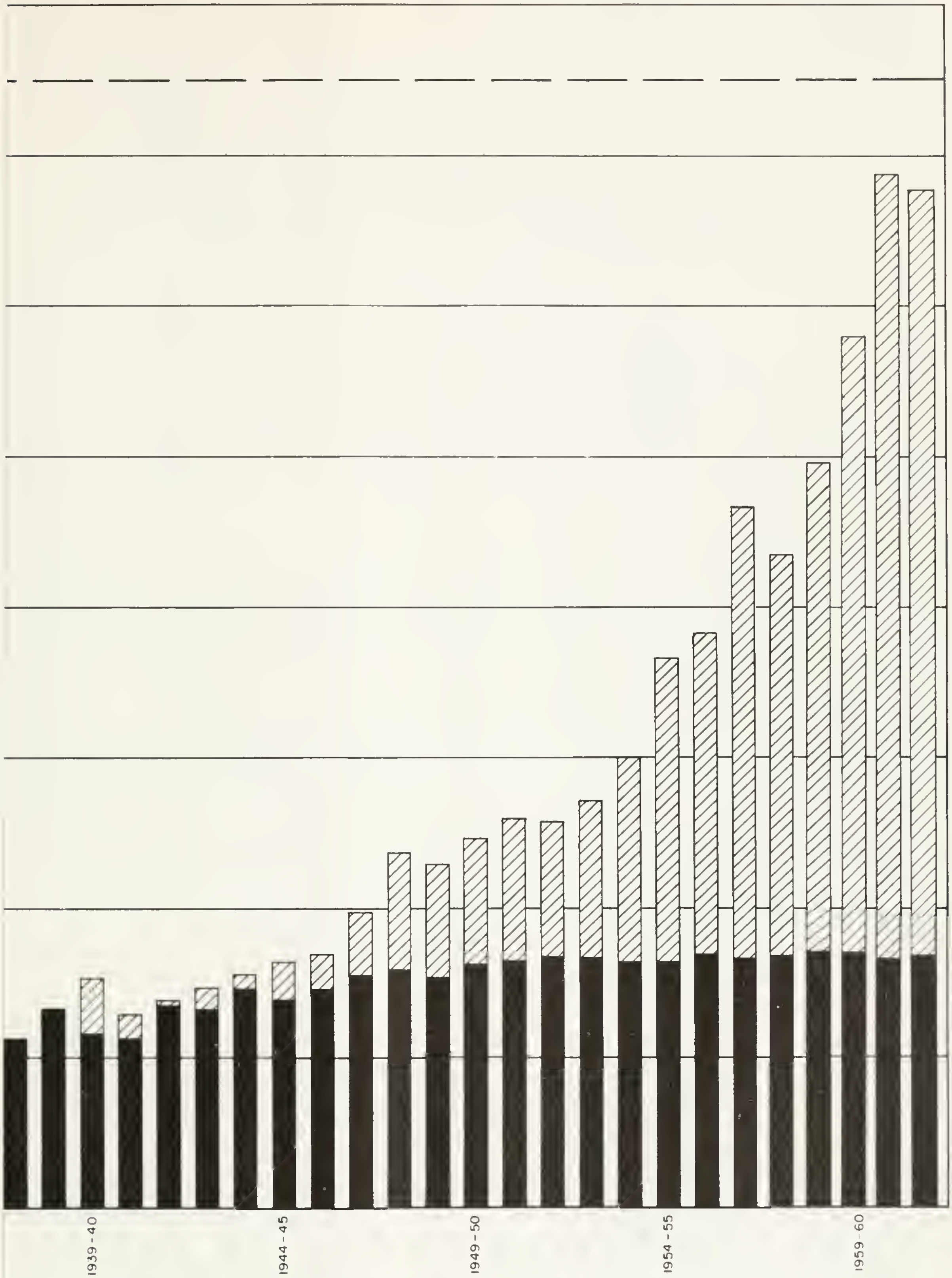
PRECIPITATION DURING 1961-62 IN PER CENT OF 50-YEAR MEAN PRECIPITATION

SCALE OF MILES

1963

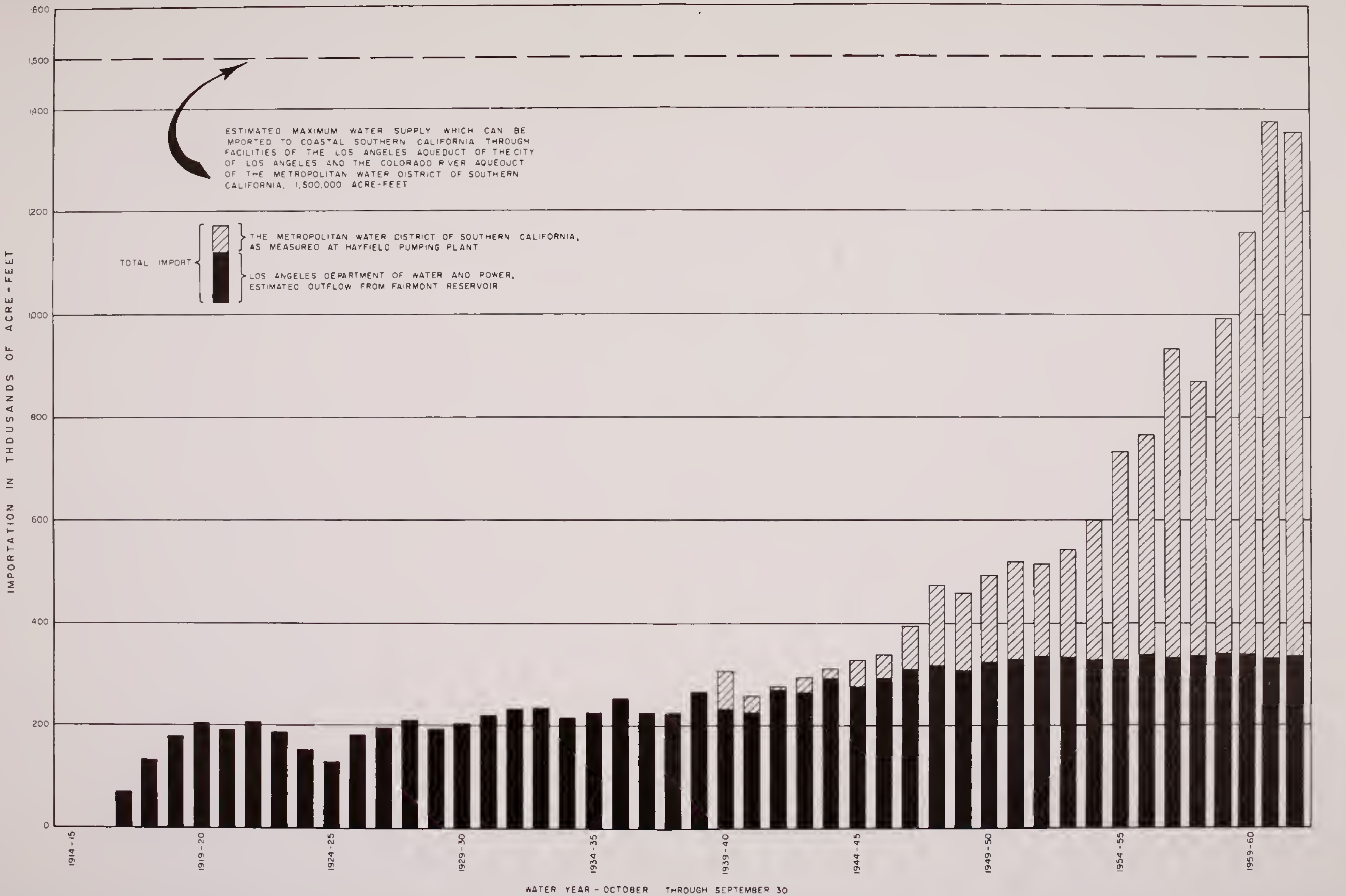


)F WATER TO COASTAL
ALIFORNIA



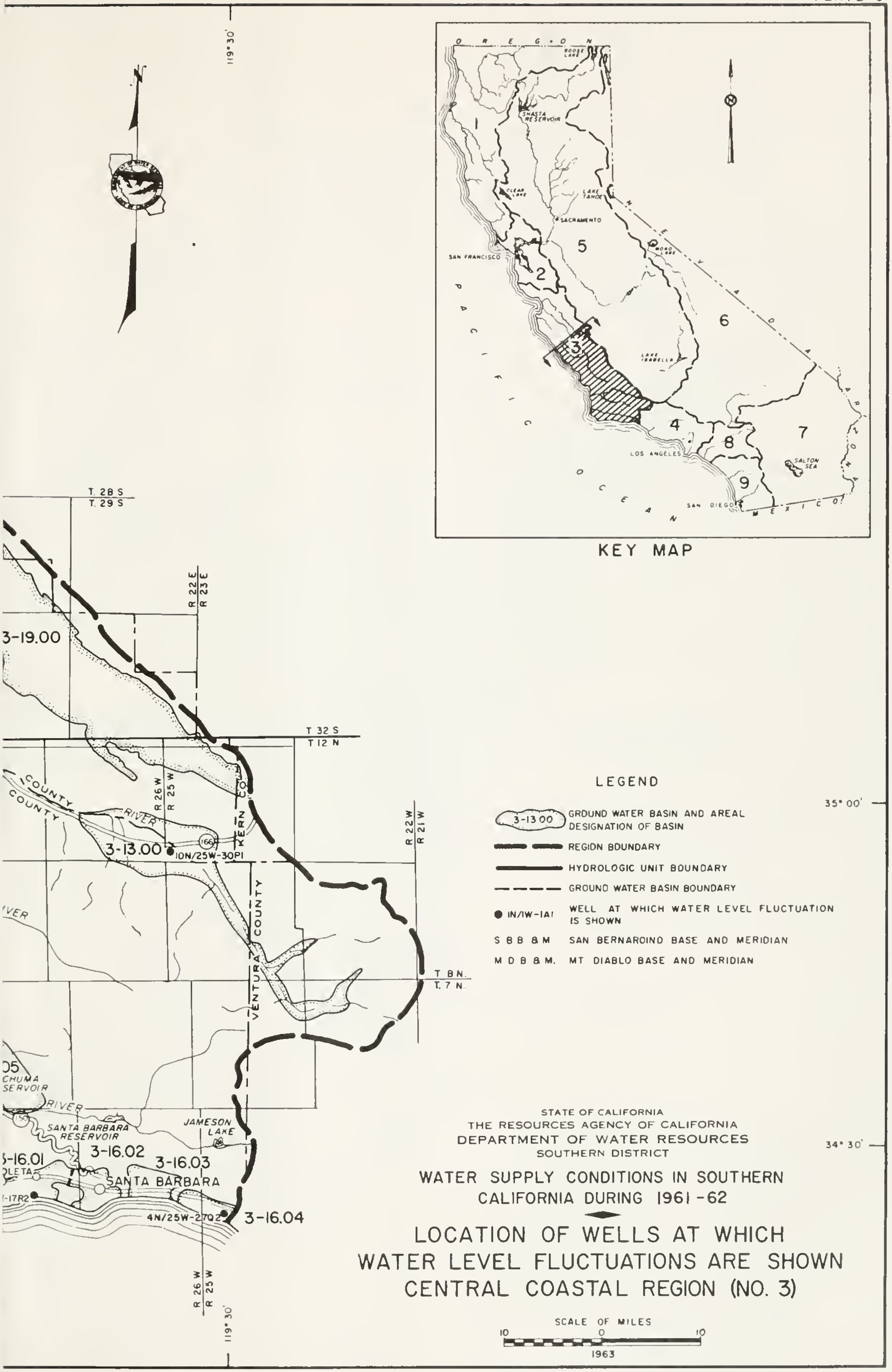
THROUGH SEPTEMBER 30

)F WATER TO COASTAL
ALIFORNIA



HISTORICAL IMPORTATIONS OF WATER TO COASTAL SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT 1963

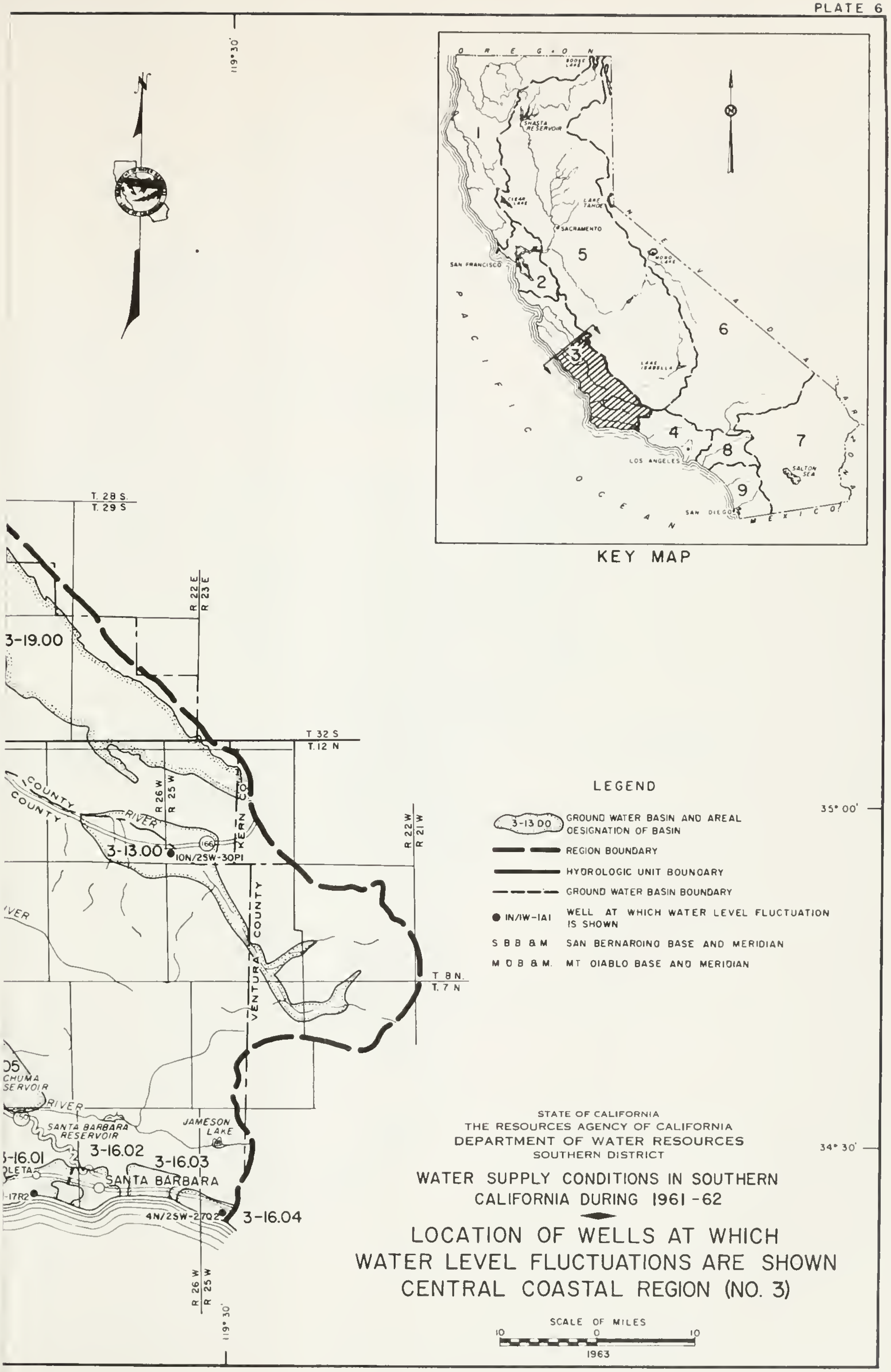


STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN CENTRAL COASTAL REGION (NO. 3)

PLATE 6



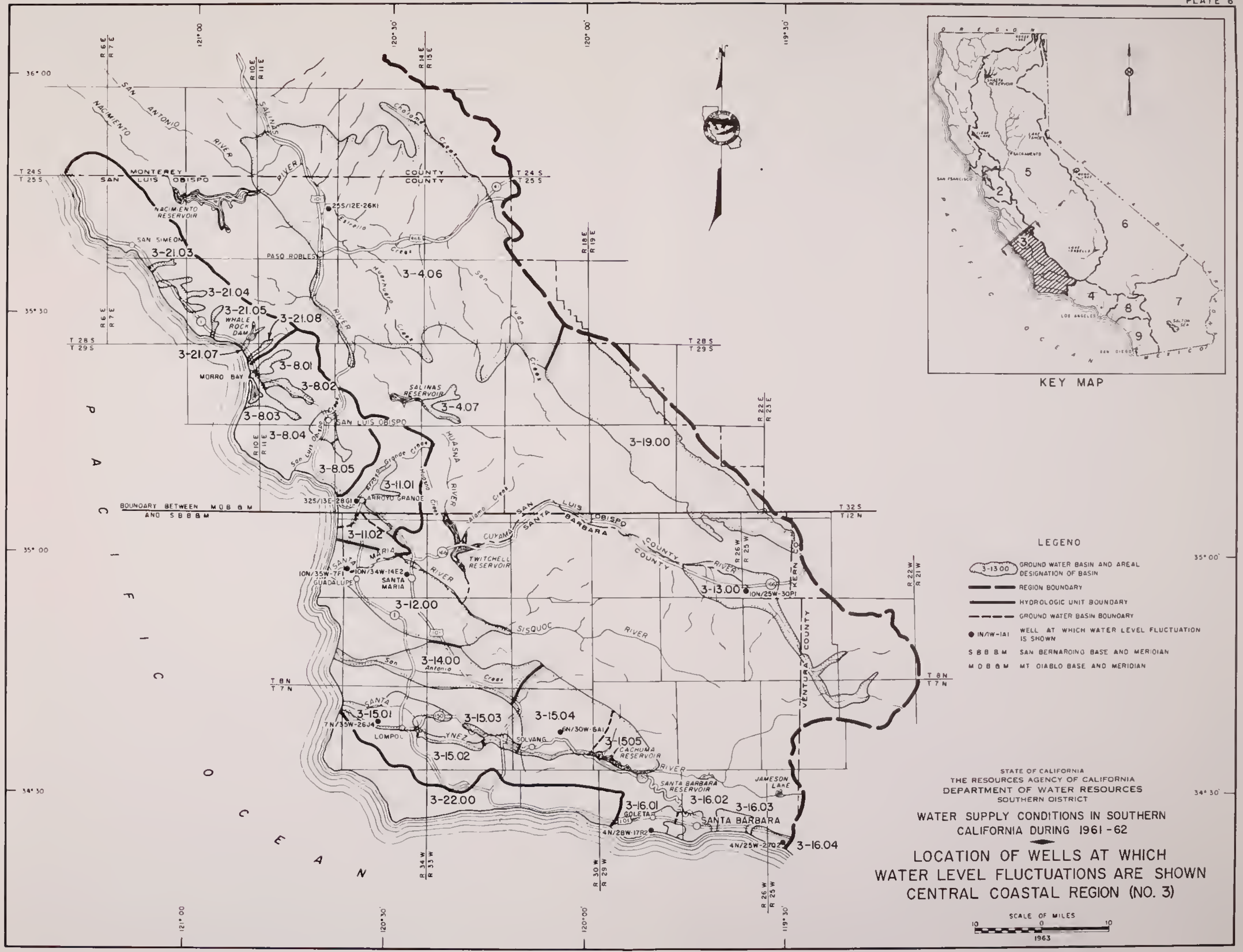
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

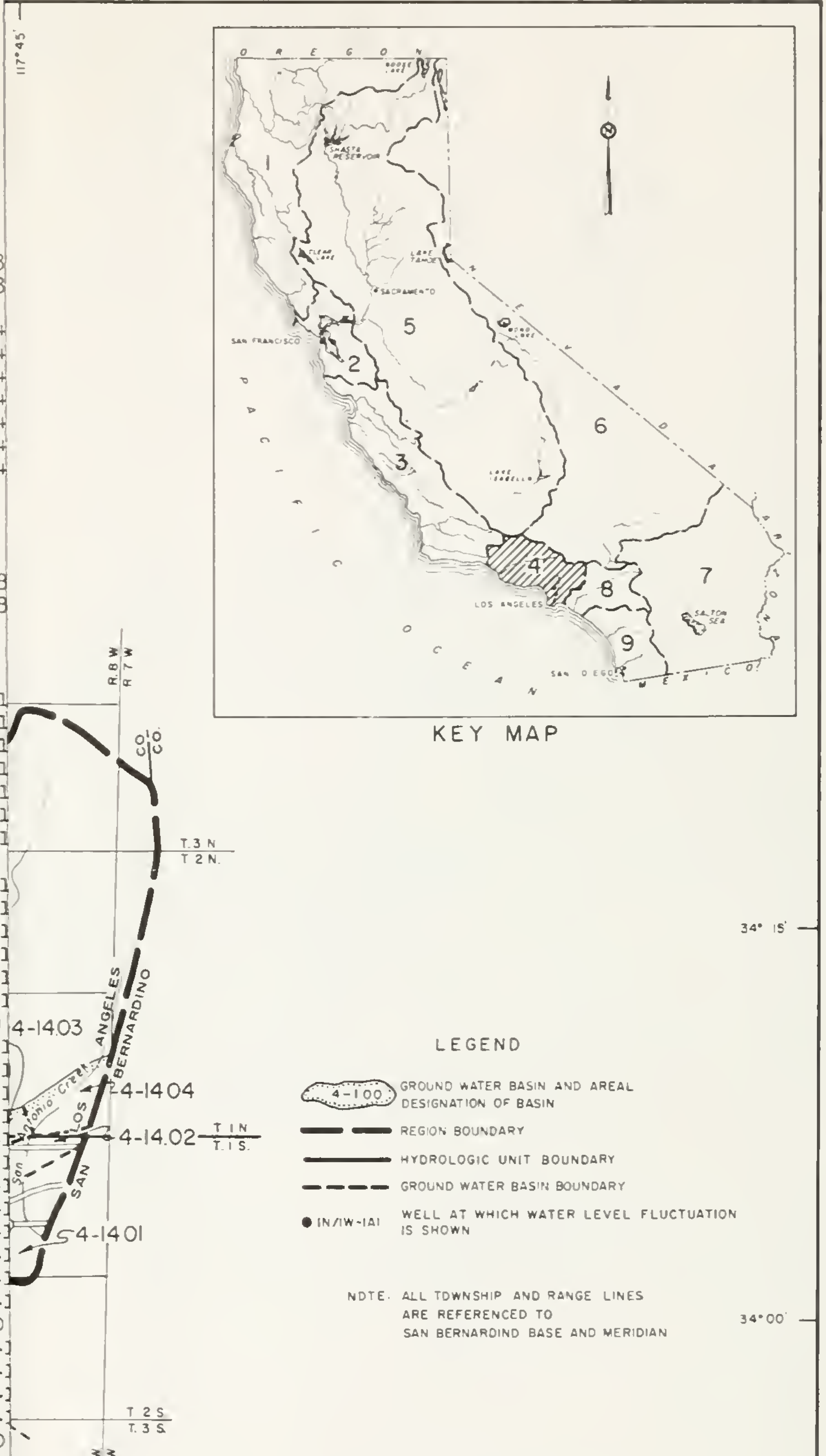
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN CENTRAL COASTAL REGION (NO. 3)

NUMERICAL DESIGNATIONS OF
GROUND WATER BASINS

3-4.00		Salinas Valley
	3-4.06	Paso Robles Basin
	3-4.07	Pozo Basin
3-8.00		San Luis Obispo Group
	3-8.01	Morro Basin
	3-8.02	Chorro Basin
	3-8.03	Los Osos Basin
	3-8.04	San Luis Obispo Basin
	3-8.05	Pismo Basin
3-11.00		Arroyo Grande Group
	3-11.01	Arroyo Grande Basin
	3-11.02	Nipomo Mesa Basin
3-12.00		Santa Maria River Valley
3-13.00		Cuyama River Valley
3-14.00		San Antonio Creek Valley
3-15.00		Santa Ynez River Valley
	3-15.01	Lompoc Subarea
	3-15.02	Santa Rita Subarea
	3-15.03	Buellton Subarea
	3-15.04	Santa Ynez Subarea
	3-15.05	Headwater Subarea
3-16.00		South Coast Basins (Santa Barbara County)
	3-16.01	Goleta Basin
	3-16.02	Santa Barbara Basin
	3-16.03	Montecito Subarea
	3-16.04	Carpinteria Basin
3-19.00		Carrizo Plain
3-21.00		Cambria Group
	3-21.03	San Simeon Basin
	3-21.04	Santa Rosa Basin
	3-21.05	Villa Basin
	3-21-07	Old Basin
	3-21.08	Toro Basin
3-22.00		Santa Barbara County Coastal Group





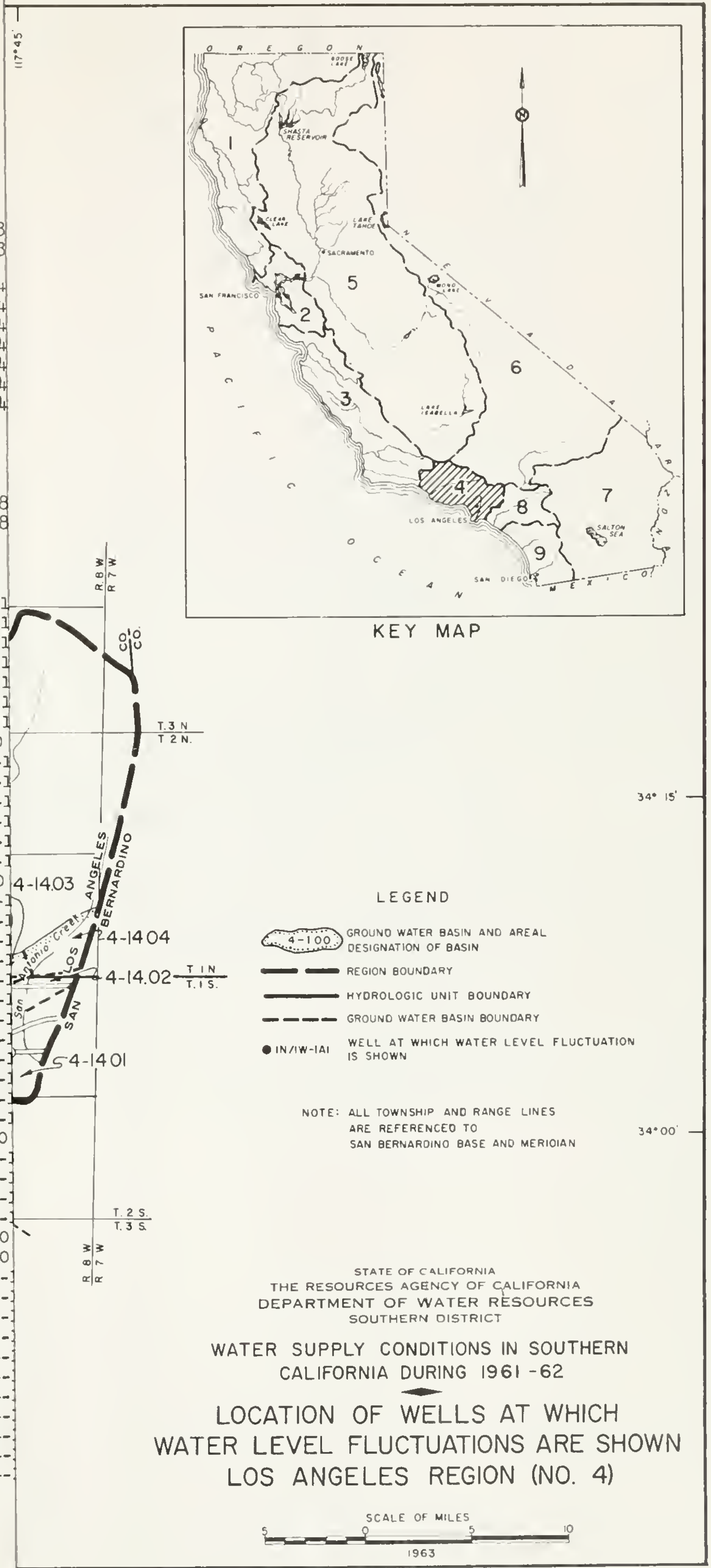
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN
LOS ANGELES REGION (NO. 4)

SCALE OF MILES
5 0 5 10

1963


KEY MAP
OREGON
GOOSE LAKE
SHASTA RESERVOIR
CLEAR LAKE
LAKE TAHOE
SACRAMENTO
SAN FRANCISCO
MONO LAKE
LAKE ISABELLA
LOS ANGELES
SALTON SEA
SAN DIEGO
PACIFIC OCEAN
NEVADA
ARIZONA
MEXICO
1
2
3
4
5
6
7
8
9
117°45'
34° 15'
34°00'
R 8 W
R 7 W
T. 3 N
T. 2 N.
T. 1 N
T. 1 S.
T. 2 S.
T. 3 S.
CO.
CO.
LOS ANGELES
SAN BERNARDINO
San Antonio Creek
4-14.03
4-14.04
4-14.02
4-14.01
LEGEND
4-100
GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
REGION BOUNDARY
HYDROLOGIC UNIT BOUNDARY
GROUND WATER BASIN BOUNDARY
IN/IW-IAI
WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN
NOTE: ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN
LOS ANGELES REGION (NO. 4)
SCALE OF MILES
5
0
5
10
1963

NUMERICAL DESIGNATIONS OF
GROUND WATER BASINS

4-1.00 Upper Ojai Valley
4-2.00 Ojai Valley
4-3.00 Ventura River Valley
- 4-3.01 Lower Ventura River Basin
- 4-3.02 Upper Ventura River Basin

4-4.00 Santa Clara River Valley
- 4-4.01 Oxnard Plain Pressure Area
- 4-4.02 Oxnard Plain Forebay Area
- 4-4.03 Mound Pressure Area
- 4-4.04 Santa Paula Basin
- 4-4.05 Fillmore Basin
- 4-4.06 Piru Basin
- 4-4.07 Eastern Basin

4-5.00 Acton Valley
4-6.00 Pleasant Valley
4-7.00 Arroyo Santa Rosa Valley
4-8.00 Las Posas Valley
- 4-8.01 West Las Posas Basin
- 4-8.02 East Las Posas Basin

4-9.00 Simi Valley
4-10.00 Conejo Valley
4-11.00 Coastal Plain (Los Angeles County)
- 4-11.01 Santa Monica Basin
- 4-11.02 West Coast Basin
- 4-11.03 Central Basin Pressure Area
- 4-11.04 Los Angeles Forebay Area
- 4-11.05 Montebello Forebay Area
- 4-11.06 Hollywood Basin
- 4-11.08 Whittier Area

4-12.00 San Fernando Valley
- 4-12.01 San Fernando Basin
- 4-12.02 Bull Canyon Basin
- 4-12.03 Sylmar Basin
- 4-12.05 Tujunga Basin
- 4-12.06 Little Tujunga Basin
- 4-12.07 Verdugo Basin

4-13.00 San Gabriel Valley
- 4-13.01 Main San Gabriel Basin
- 4-13.02 Monk Hill Basin
- 4-13.03 Pasadena Subarea
- 4-13.04 Santa Anita Subarea
- 4-13.05 Upper Canyon Basin
- 4-13.06 Lower Canyon Basin
- 4-13.07 Glendora Basin
- 4-13.08 Way Hill Basin
- 4-13.09 San Dimas Basin
- 4-13.10 Foothill Basin
- 4-13.11 Spadra Basin
- 4-13.12 Puente Basin

4-14.00 Upper Santa Ana Valley (Los Angeles County)
- 4-14.01 Chino Basin
- 4-14.02 Pomona Basin
- 4-14.03 Live Oak Basin
- 4-14.04 Claremont Heights Basin

4-15.00 Tierra Rejada Valley
4-16.00 Malibu Coastal Group
- 4-16.01 Hidden Valley Basin
- 4-16.02 Russell Basin
- 4-16.05 Arroyo Sequit Canyon Basin
- 4-16.09 Trancas Canyon Basin
- 4-16.10 Zuma Canyon Basin
- 4-16.11 Ramera Canyon Basin
- 4-16.14 Solstice Canyon Basin
- 4-16.16 Malibu Creek Basin
- 4-16.19 Las Flores Canyon Basin
- 4-16.20 Piedra Gorda Canyon Basin
- 4-16.25 Las Virgenes Canyon Basin

PLATE 7

35°00'

N

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6-57.00
6-58.00

T8N
T7N
R13E
R12E

SAN BERNARDINO MERIDIAN

KEY MAP

115°30'

116°00'

6°30'

LEGEND

6-9.00 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● IN/IW-1A1 WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

M D B. & M. MT DIABLO BASE AND MERIDIAN

S B B & M SAN BERNARDINO BASE & MERIDIAN

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961--62

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN LAHONTAN REGION (NO. 6)

SCALE OF MILES
10 0 10 20

1963

118°00'

35°00'

N

6-9.00
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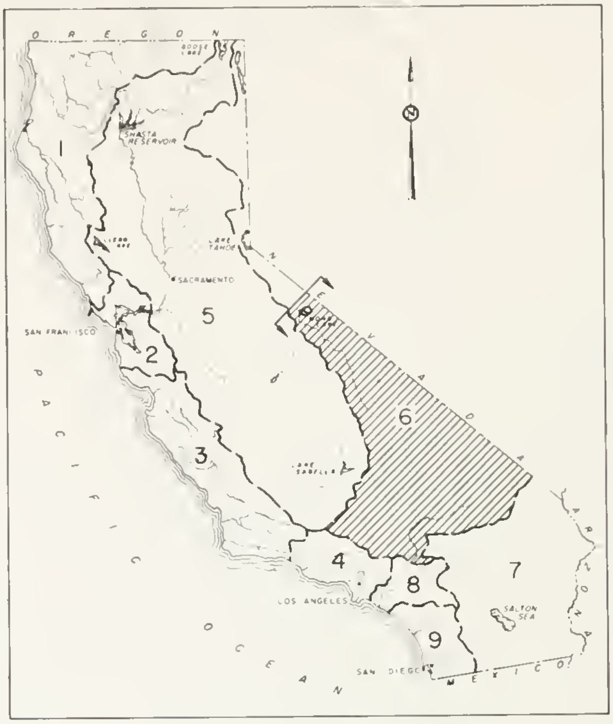
6-58.00

T8N T7N R13E R12E

BERNARDINO MERIDIAN



KEY MAP

115°30'

LEGEND

6-900 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
REGION BOUNDARY
HYDROLOGIC UNIT BOUNDARY
GROUND WATER BASIN BOUNDARY
● IN/IW-IAI WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN
M D B & M MT DIABLO BASE AND MERIDIAN
S B B & M SAN BERNARDINO BASE & MERIDIAN

116°00'

116°30'

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961--62

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN LAHONTAN REGION (NO. 6)

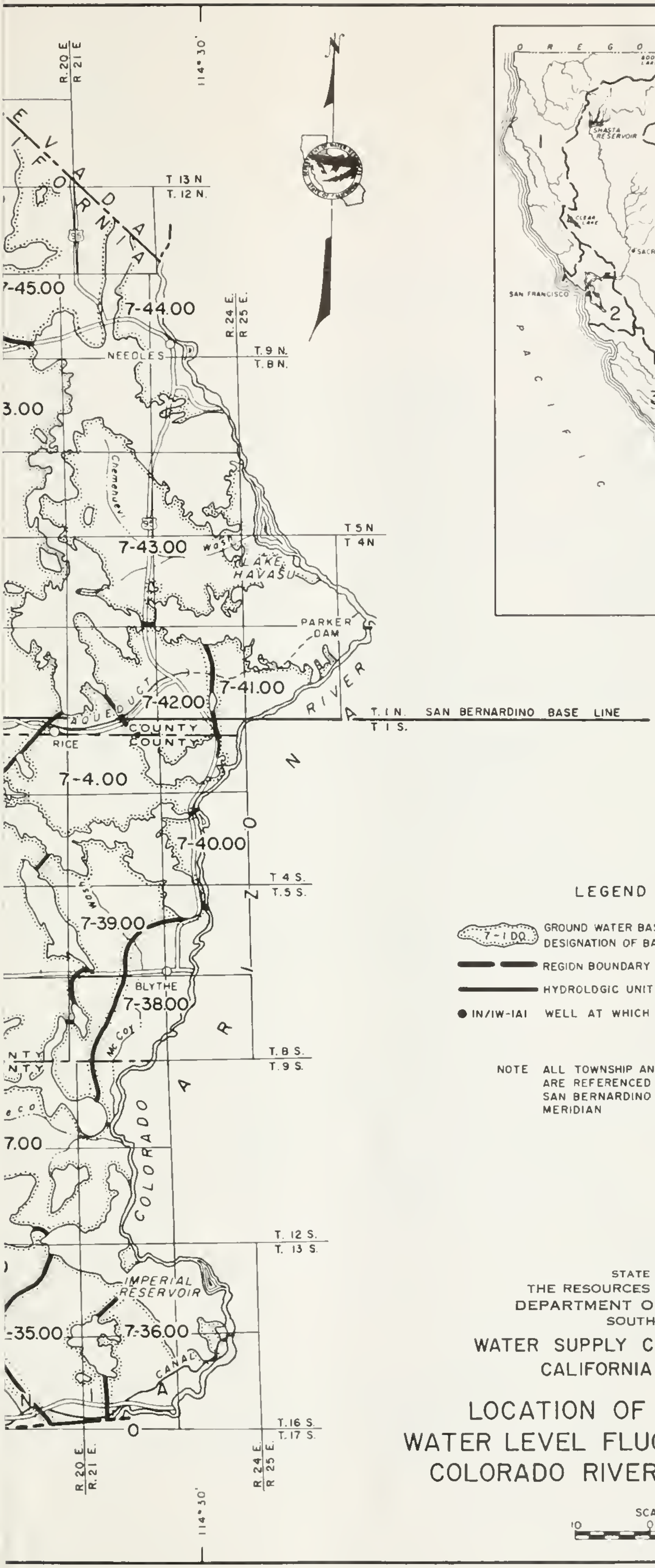
SCALE OF MILES
10 0 10 20

1963

118°00'

NUMERICAL DESIGNATIONS OF
GROUND WATER BASINS

6-9.00	Mono Valley
6-10.00	Adobe Lake Valley
6-11.00	Long Valley
6-12.00	Owens Valley
6-13.00	Black Springs Valley
6-14.00	Fish Lake Valley
6-15.00	Deep Springs Valley
6-16.00	Eureka Valley
6-17.00	Saline Valley
6-18.00	Death Valley
6-19.00	Wingate Valley
6-20.00	Middle Amargosa Valley
6-21.00	Lower Kingston Valley
6-22.00	Upper Kingston Valley
6-23.00	Riggs Valley
6-24.00	Red Pass Valley
6-25.00	Bicycle Valley
6-26.00	Avawatz Valley
6-27.00	Leach Valley
6-28.00	Pahrump Valley
6-29.00	Mesquite Valley
6-30.00	Ivanpah Valley
6-31.00	Kelso Valley
6-32.00	Broadwell Valley
6-33.00	Soda Lake Valley
6-34.00	Silver Lake Valley
6-35.00	Cronise Valley
6-36.00	Langford Valley
6-37.00	Coyote Lake Valley
6-38.00	Caves Canyon Valley
6-39.00	Troy Valley
6-40.00	Lower Mojave River Valley
6-41.00	Middle Mojave River Valley
6-42.00	Upper Mojave River Valley
6-43.00	El Mirage Valley
6-44.00	Antelope Valley
6-44.01	Neenach Basin
6-44.02	Willow Springs Basin
6-44.03	Gloster Basin
6-44.04	Chaffee Basin
6-44.05	Lancaster Basin
6-44.06	Buttes Basin
6-44.07	Rock Creek Basin
6-44.08	North Muroc Basin
6-45.00	Tehachapi Valley East
6-46.00	Fremont Valley
6-47.00	Harper Valley
6-48.00	Goldstone Valley
6-49.00	Superior Valley
6-50.00	Cuddeback Valley
6-51.00	Pilot Knob Valley
6-52.00	Searles Valley
6-53.00	Salt Wells Valley
6-54.00	Indian Wells Valley
6-55.00	Coso Valley
6-56.00	Rose Valley
6-57.00	Darwin Valley
6-58.00	Panamint Valley



KEY MAP

LEGEND

- 7-1.00 — GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN
- REGION BOUNDARY
- HYDROLOGIC UNIT BOUNDARY
- ● IN/IW-IAI — WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

NOTE ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

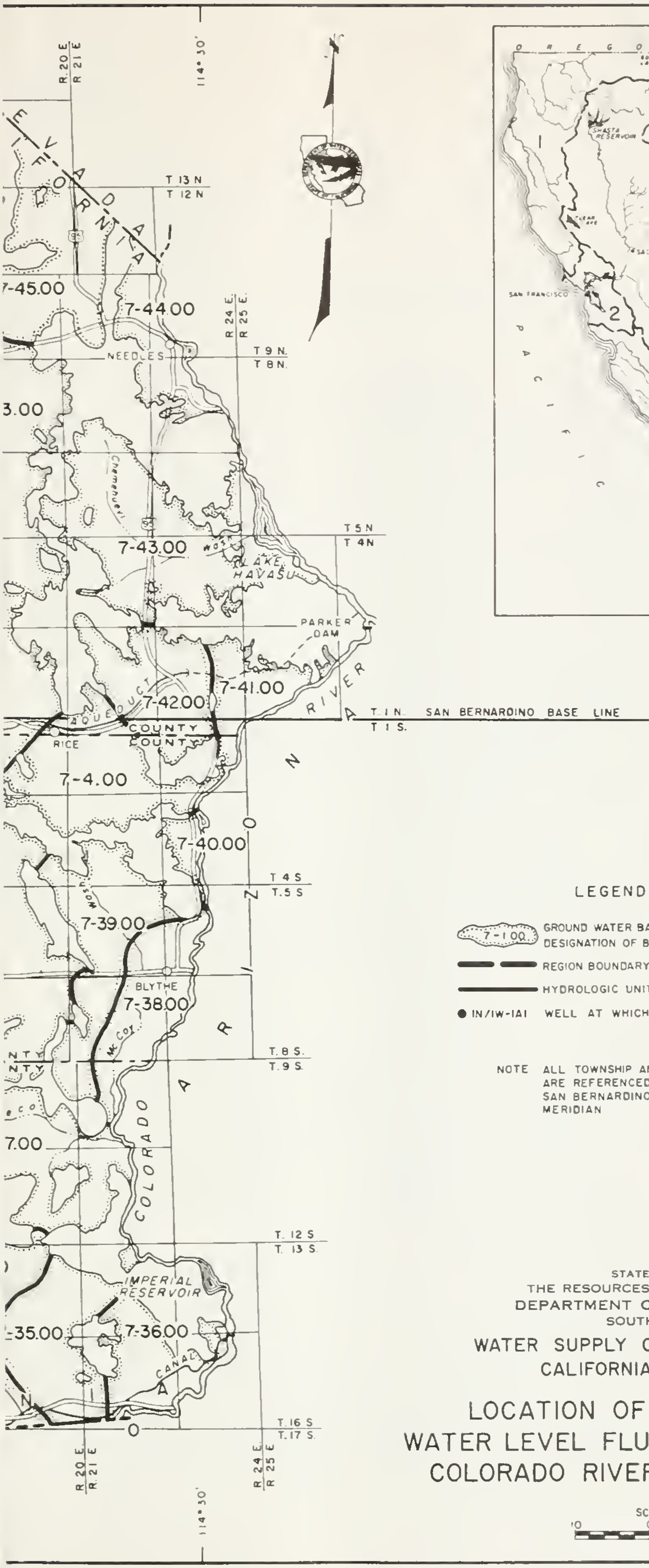
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961 -62

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN COLORADO RIVER BASIN REGION (NO. 7)

SCALE OF MILES
10 0 10 20

1963



KEY MAP

LEGEND

7-1.00 — GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

● 1N/1W-1A1 — WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

NOTE: ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961 -62

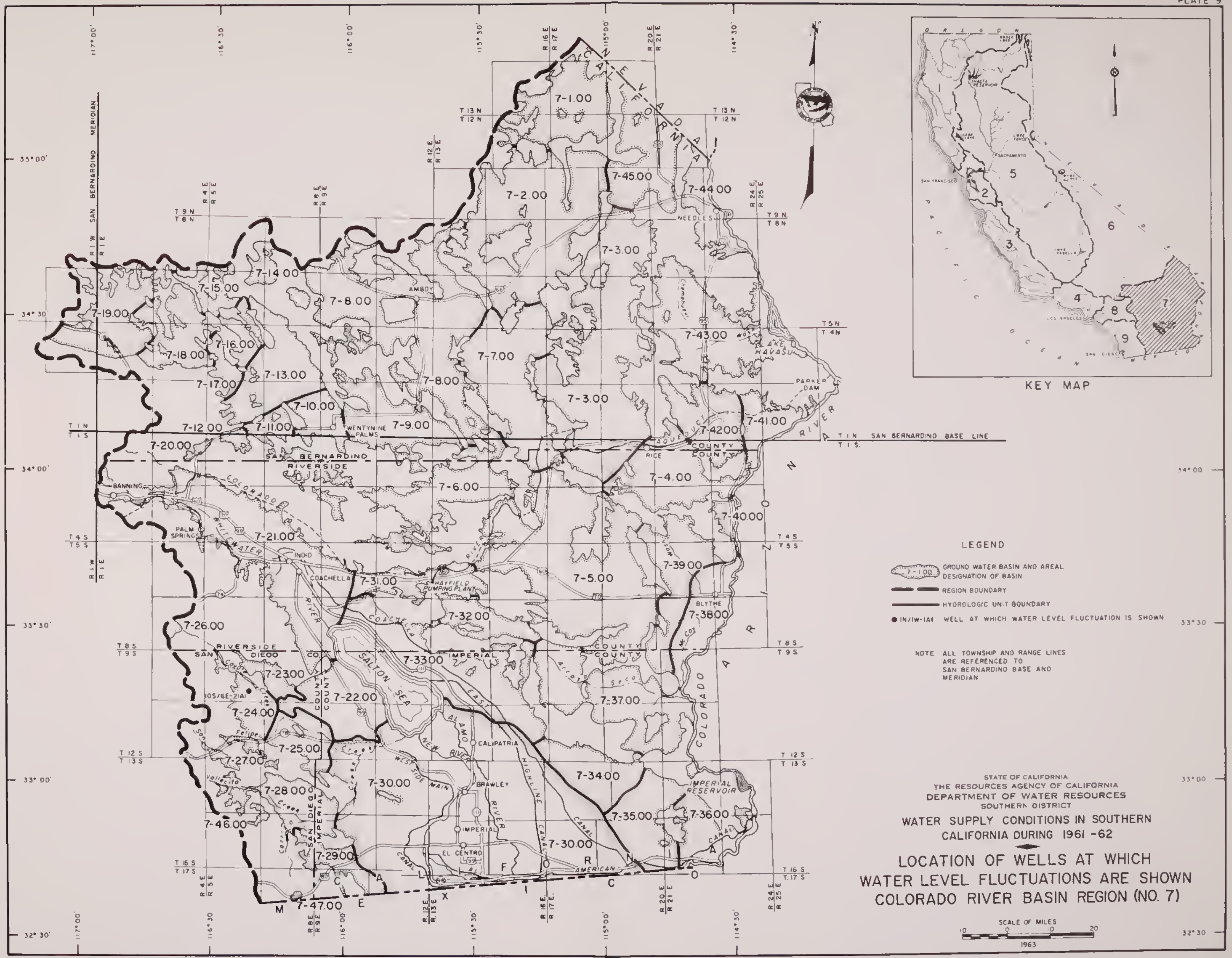
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN COLORADO RIVER BASIN REGION (NO. 7)

SCALE OF MILES
10 0 10 20

1963

NUMERICAL DESIGNATIONS OF GROUND WATER BASINS

7-1.00	Lanfair Valley
7-2.00	Fenner Valley
7-3.00	Ward Valley
7-4.00	Rice Valley
7-5.00	Chuckwalla Valley
7-6.00	Pinto Valley
7-7.00	Cadiz Valley
7-8.00	Bristol Valley
7-9.00	Dale Valley
7-10.00	Twentynine Palms Valley
7-11.00	Copper Mountain Valley
7-12.00	Warren Valley
7-13.00	Deadman Valley
7-14.00	Lavic Valley
7-15.00	Bessemer Valley
7-16.00	Ames Valley
7-17.00	Means Valley
7-18.00	Johnson Valley
7-19.00	Lucerne Valley
7-20.00	Morongo Valley
7-21.00	Coachella Valley
7-22.00	West Salton Sea Valley
7-23.00	Clark Valley
7-24.00	Borrego Valley
7-25.00	Ocotillo Valley
7-26.00	Terwilliger Valley
7-27.00	San Felipe Valley
7-28.00	Vallecito-Carrizo Valley
7-29.00	Coyote Wells Valley
7-30.00	Imperial Valley
7-31.00	Orcopia Valley
7-32.00	Chocolate Valley
7-33.00	East Salton Sea Valley
7-34.00	Amos Valley
7-35.00	Ogilby Valley
7-36.00	Yuma Valley
7-37.00	Arroyo Seco Valley
7-38.00	Palo Verde Valley
7-39.00	Palo Verde Mesa
7-40.00	Quien Sabe Point Valley
7-41.00	Calzona Valley
7-42.00	Vidal Valley
7-43.00	Chemehuevis Valley
7-44.00	Needles Valley
7-45.00	Piute Valley
7-46.00	Canebrake Valley
7-47.00	Jacumba Valley



NUMERICAL
GROUND

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8-2.18
8-2.19
8-2.20
8-3.00 Caj
8-4.00 Els
8-5.00 San
8-6.00 Hem
8-7.00 Big
8-8.00 Sev
8-9.00 Bea

KEY MAP

34°00'

LEGEND

8-2.12 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● IN/IW-IAI WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

33°45'

NOTE: ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961 -62

33°30'

LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN SANTA ANA REGION (NO. 8)

SCALE OF MILES

5 0 5 10

1963

NUMERICAL
GROUND

8-1.00 Coas
8-1.01
8-1.02
8-1.03
8-1.04
8-1.05
8-1.06
8-1.07
8-2.00 Uppe
8-2.01
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8-2.17
8-2.18
8-2.19
8-2.20
8-3.00 Caja
8-4.00 Elsi
8-5.00 San
8-6.00 Heme
8-7.00 Big
8-8.00 Seve
8-9.00 Bear

KEY MAP

34°00'

LEGEND

8-2.12 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● IN/IW-IAI WELL AT WHICH WATER LEVEL FLUCTUATION IS SHOWN

33°45'

NOTE: ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

33°30'

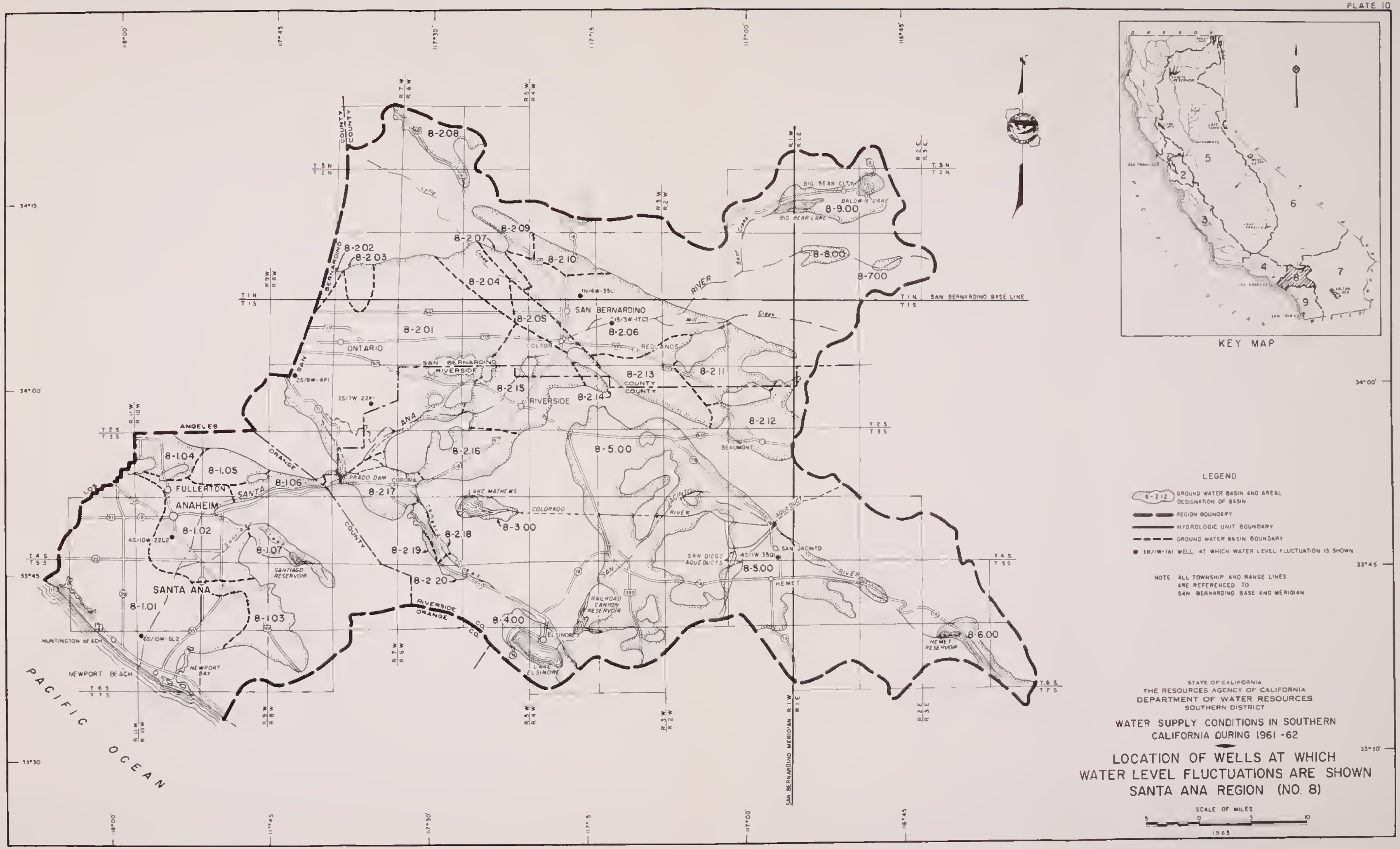
LOCATION OF WELLS AT WHICH WATER LEVEL FLUCTUATIONS ARE SHOWN SANTA ANA REGION (NO. 8)

SCALE OF MILES
5 0 5 10

1963

NUMERICAL DESIGNATIONS OF GROUND WATER BASINS

8-1.00	Coastal Plain (Orange County)
8-1.01	Anaheim Basin Pressure Area
8-1.02	Santa Ana Forebay Area
8-1.03	Irvine Area
8-1.04	La Habra Basin
8-1.05	Yorba Linda Basin
8-1.06	Santa Ana Narrows Basin
8-1.07	Santiago Basin
8-2.00	Upper Santa Ana Valley
8-2.01	Chino Basin
8-2.02	Claremont Heights Basin
8-2.03	Cucamonga Basin
8-2.04	Rialto Basin
8-2.05	Colton Basin
8-2.06	Bunker Hill Basin
8-2.07	Lytle Basin
8-2.08	Upper Cajon Basin
8-2.09	Lower Cajon Basin
8-2.10	Devil Canyon Basin
8-2.11	Yucaipa Basin
8-2.12	Beaumont Basin
8-2.13	San Timoteo Basin
8-2.14	Reche Canyon Basin
8-2.15	Riverside Basin
8-2.16	Arlington Basin
8-2.17	Temescal Basin
8-2.18	Bedford Basin
8-2.19	Coldwater Basin
8-2.20	Lee Lake Basin
8-3.00	Cajalco Valley
8-4.00	Elsinore Valley
8-5.00	San Jacinto Valley
8-6.00	Hemet Lake Valley
8-7.00	Big Meadows Valley
8-8.00	Seven Oaks Valley
8-9.00	Bear Valley



NUMERICAL D
GROUND W

9-1.00 San Jua
9-1.01 Al
9-1.02 Sa
9-2.00 San Mat
9-3.00 San Ono
9-4.00 Santa M
9-5.00 Temecul
9-5.01 Mu
9-5.02 Pa
9-5.03 Wo
9-6.00 Coahuil
9-7.00 San Lui
9-7.01 Mi
9-7.02 Bo
9-8.00 Warner
9-9.00 Escondi
9-10.00 San Pas
9-10.01 La
9-10.02 Sa
9-10.03 Fe
9-10.04 Gr
9-10.05 Hi
9-10.06 Pa
9-10.08 Sa
9-11.00 Santa M
9-11.01 Ra
9-11.02 Lo
9-11.03 Wa
9-11.04 Up
9-11.05 Sa
9-11.06 Ba
9-12.00 San Die
9-12.01 Sa
9-12.02 La
9-13.00 Poway V
9-14.00 Mission
9-15.00 San Die
9-16.00 El Cajo
9-17.00 Sweetwa
9-18.00 Otay Va
9-19.00 Tia Jua
9-20.00 Jamul V

PLATE II

KEY MAP

33° 15'

LEGEND

9-8 00 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● IN/IW-IAI WELL AT WHICH WHICH WATER LEVEL FLUCTUATION IS SHOWN

NOTE ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

33° 00'

32° 45'

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

LOCATION OF WELLS AT WHICH
ER LEVEL FLUCTUATIONS ARE SHOWN
SAN DIEGO REGION (NO. 9)

SCALE OF MILES
10 0 10

1963

32° 30'

NUMERICAL D
GROUND W

9-1.00	San Jua
9-1.01	Al
9-1.02	Sa
9-2.00	San Mat
9-3.00	San Ono
9-4.00	Santa M
9-5.00	Temecul
9-5.01	Mu
9-5.02	Pa
9-5.03	Wo
9-6.00	Coahuil
9-7.00	San Lui
9-7.01	Mi
9-7.02	Bo
9-8.00	Warner
9-9.00	Escondi
9-10.00	San Pas
9-10.01	La
9-10.02	Sa
9-10.03	Fe
9-10.04	Gr
9-10.05	Hi
9-10.06	Pa
9-10.08	Sa
9-11.00	Santa M
9-11.01	Ra
9-11.02	Lo
9-11.03	Wa
9-11.04	Up
9-11.05	Sa
9-11.06	Ba
9-12.00	San Die
9-12.01	Sa
9-12.02	La
9-13.00	Poway V
9-14.00	Missior
9-15.00	San Die
9-16.00	El Cajo
9-17.00	Sweetwa
9-18.00	Otay Va
9-19.00	Tia Jua
9-20.00	Jamul V

KEY MAP

33° 15'

LEGEND

9-8.00 GROUND WATER BASIN AND AREAL DESIGNATION OF BASIN

REGION BOUNDARY

HYDROLOGIC UNIT BOUNDARY

GROUND WATER BASIN BOUNDARY

● IN/IW-IAI WELL AT WHICH WHICH WATER LEVEL FLUCTUATION IS SHOWN

NOTE ALL TOWNSHIP AND RANGE LINES ARE REFERENCED TO SAN BERNARDINO BASE AND MERIDIAN

33° 00'

32° 45'

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

LOCATION OF WELLS AT WHICH
ER LEVEL FLUCTUATIONS ARE SHOWN
SAN DIEGO REGION (NO. 9)

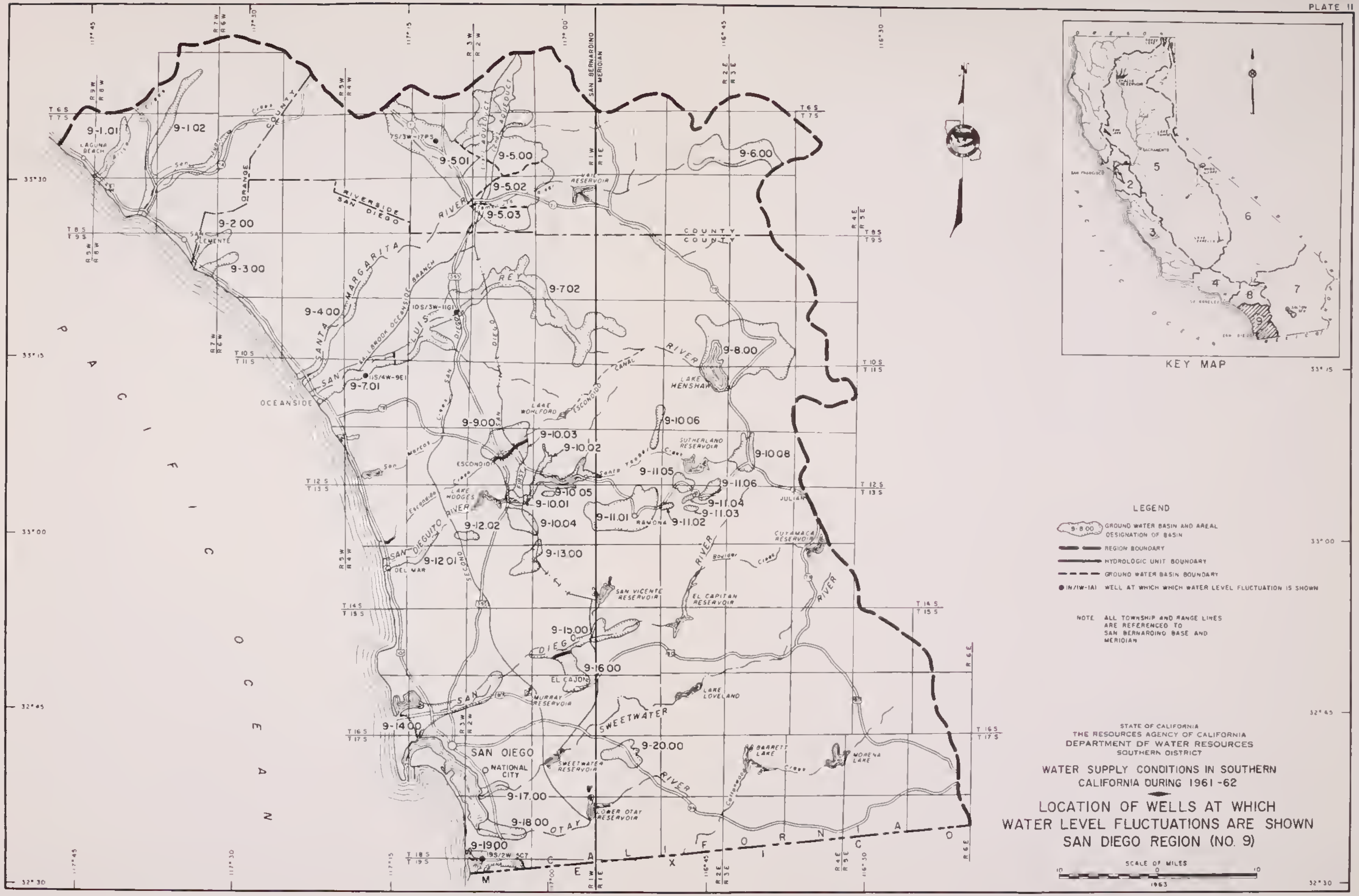
SCALE OF MILES
10 0 10

1963

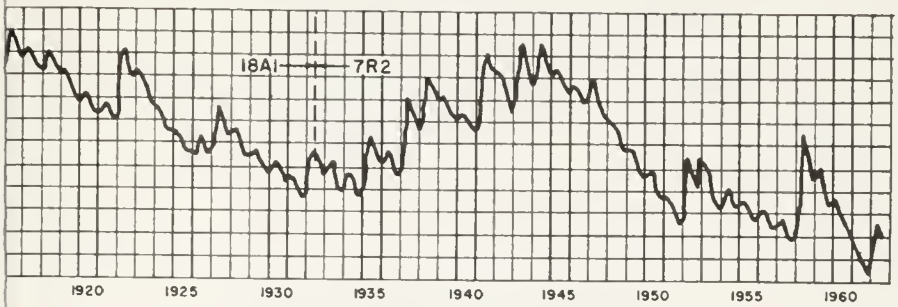
32° 30'

NUMERICAL DESIGNATIONS OF
GROUND WATER BASINS

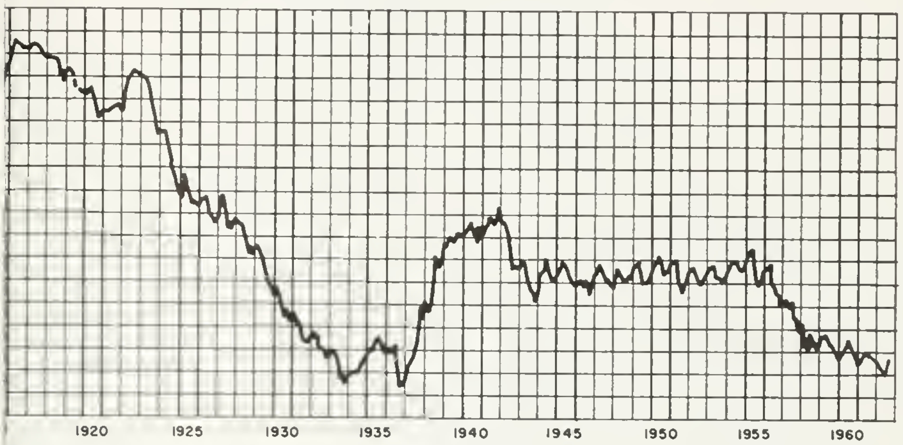
9-1.00	San Juan Valley
9-1.01	Aliso Creek Basin
9-1.02	San Juan Creek Basin
9-2.00	San Mateo Valley
9-3.00	San Onofre Valley
9-4.00	Santa Margarita Valley
9-5.00	Temecula Valley
9-5.01	Murrieta Basin
9-5.02	Pauba Basin
9-5.03	Wolf Basin (Pechanga)
9-6.00	Coahuila Valley
9-7.00	San Luis Rey Valley
9-7.01	Mission Basin
9-7.02	Bonsall Basin
9-8.00	Warner Valley
9-9.00	Escondido Valley
9-10.00	San Pasqual Valley
9-10.01	Lake Hodges Basin
9-10.02	San Pasqual Basin
9-10.03	Felicita Basin
9-10.04	Green Basin
9-10.05	Highland Basin
9-10.06	Pamo Basin
9-10.08	Santa Ysabel Basin
9-11.00	Santa Maria Valley
9-11.01	Ramona Basin
9-11.02	Lower Hatfield Basin
9-11.03	Wash Hollow Basin
9-11.04	Upper Hatfield Basin
9-11.05	Santa Teresa Basin
9-11.06	Ballena Basin
9-12.00	San Dieguito Valley
9-12.01	San Dieguito Basin
9-12.02	La Jolla Basin
9-13.00	Poway Valley
9-14.00	Mission Valley
9-15.00	San Diego River Valley
9-16.00	El Cajon Valley
9-17.00	Sweetwater Valley
9-18.00	Otay Valley
9-19.00	Tia Juana Valley
9-20.00	Jamul Valley



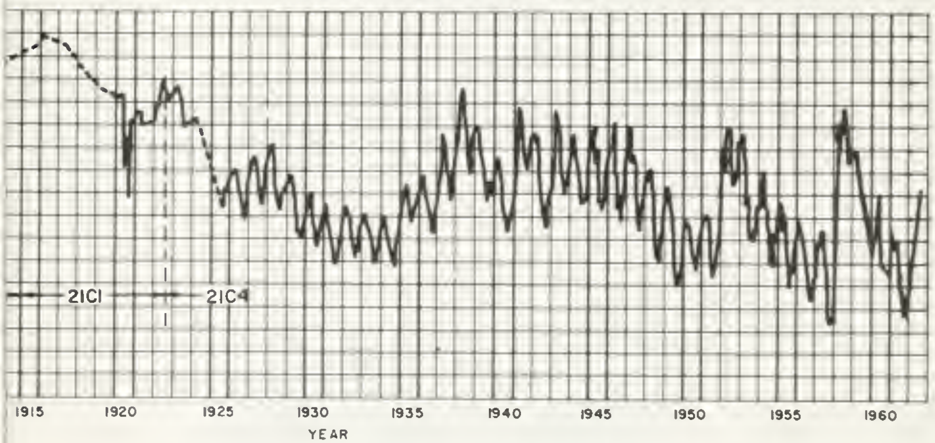
SAN GABRIEL VALLEY (4-13.00)
MAIN SAN GABRIEL BASIN (4-13.01)
WELLS 1S/10W-18A1, 7R2, S.B.B. & M.



PASADENA SUBAREA (4-13.03)
WELL 1N/12W-20B1, S.B.B. & M.



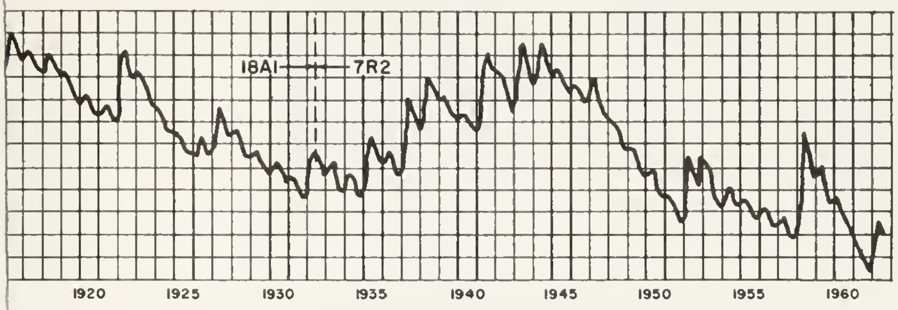
SANTA ANITA SUBAREA (4-13.04)
WELLS 1N/11W-21C2, C1, C4, S.B.B. & M.



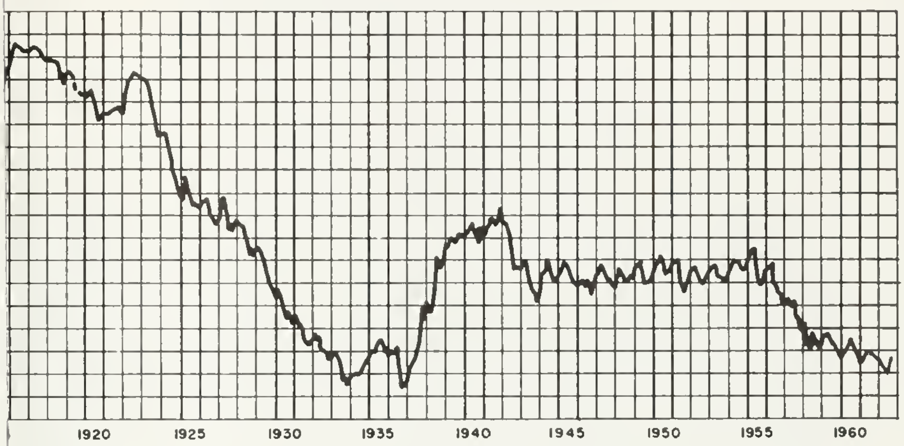
NOTE: LOCATION OF WELLS SHOWN ON PLATES 6 AND 7

FLUCTUATION OF WATER LEVELS
AT SELECTED WELLS IN SOUTHERN CALIFORNIA

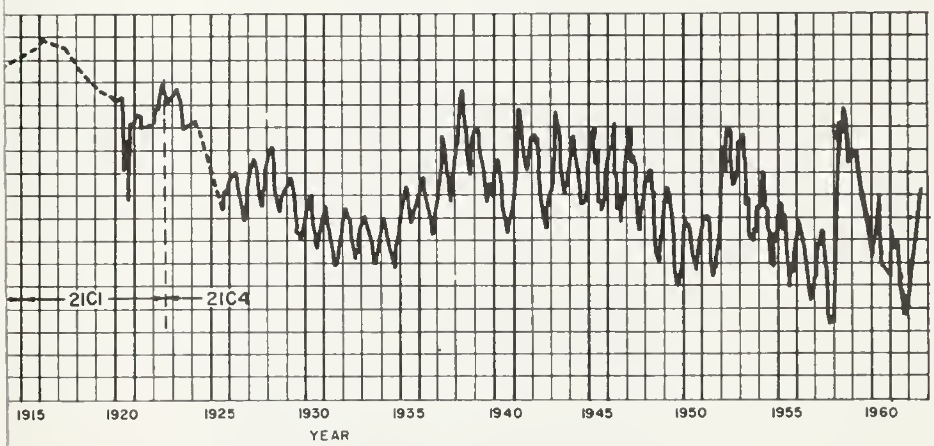
SAN GABRIEL VALLEY (4-13.00)
MAIN SAN GABRIEL BASIN (4-13.01)
WELLS 1S/10W-18A1, 7R2, S.B.B. & M.



PASADENA SUBAREA (4-13.03)
WELL 1N/12W-20B1, S.B.B. & M.

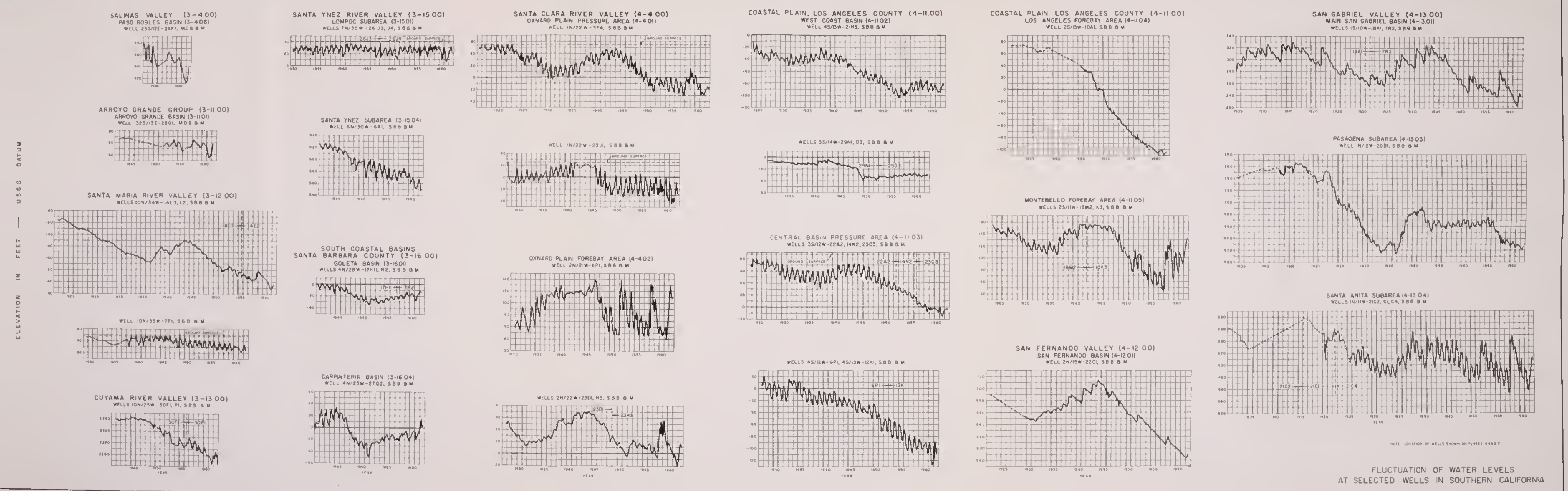


SANTA ANITA SUBAREA (4-13.04)
WELLS 1N/11W-21C2, C1, C4, S.B.B. & M.



NOTE: LOCATION OF WELLS SHOWN ON PLATES 6 AND 7

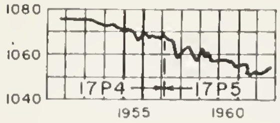
FLUCTUATION OF WATER LEVELS AT SELECTED WELLS IN SOUTHERN CALIFORNIA



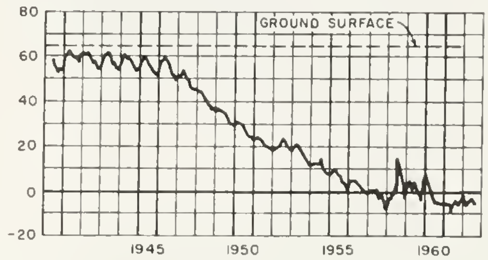
FLUCTUATION OF WATER LEVELS
AT SELECTED WELLS IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES SOUTHERN DISTRICT 1963

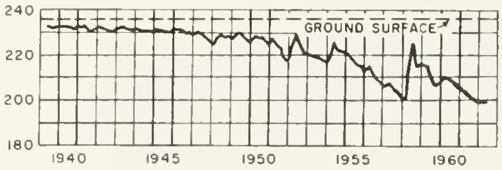
TEMECULA VALLEY (9-5.00)
MURRIETA BASIN (9-5.01)
WELLS 7S/3W-17P4, 17P5, S.B B. & M



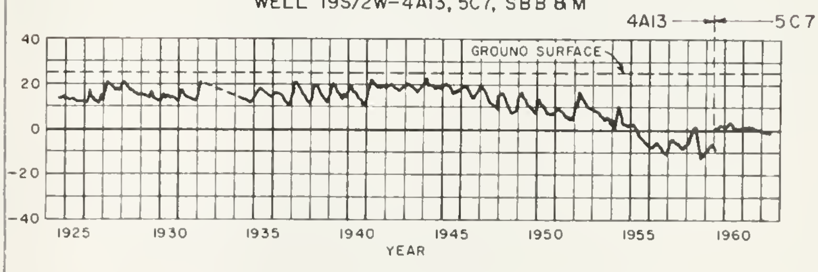
SAN LUIS REY VALLEY (9-7.00)
MISSION BASIN (9-7.01)
WELL 11S/4W-9E1, S B.B. & M.



BONSALL BASIN (9-7.02)
WELL 10S/3W-11G1, S.B B. & M.



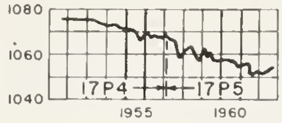
TIA JUANA VALLEY (9-19.00)
WELL 19S/2W-4A13, 5C7, SBB & M



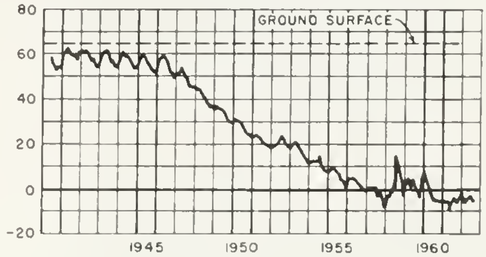
NOTE LOCATION OF WELLS SHOWN ON PLATES 8, 9, 10 AND 11

FLUCTUATION OF WATER LEVELS AT SELECTED WELLS IN SOUTHERN CALIFORNIA

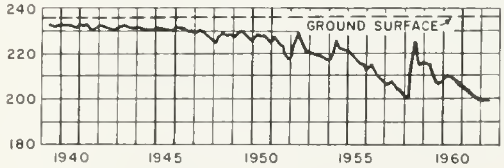
TEMECULA VALLEY (9-5.00)
MURRIETA BASIN (9-5.01)
WELLS 7S/3W-17P4, 17P5, S.B B. & M



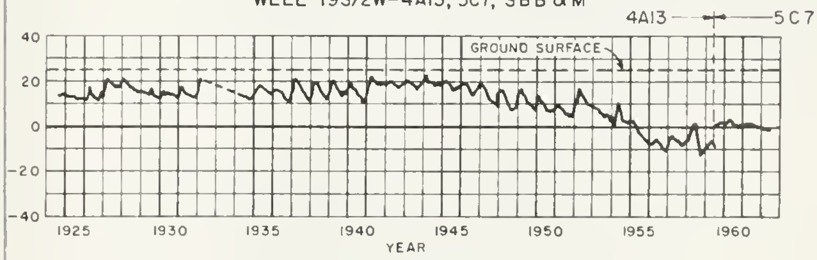
SAN LUIS REY VALLEY (9-7.00)
MISSION BASIN (9-7.01)
WELL 11S/4W-9E1, S.B.B. & M.



BONSALL BASIN (9-7.02)
WELL 10S/3W-11G1, S.B.B. & M.

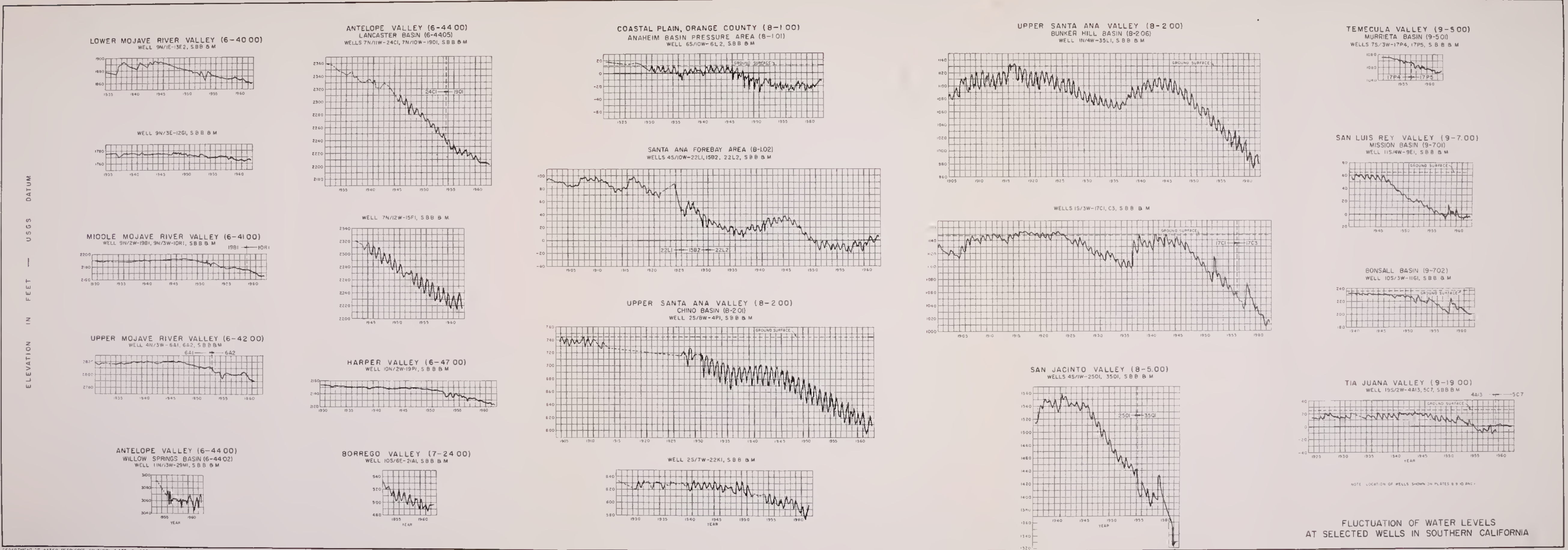


TIA JUANA VALLEY (9-19.00)
WELL 19S/2W-4A13, 5C7, S.B.B. & M



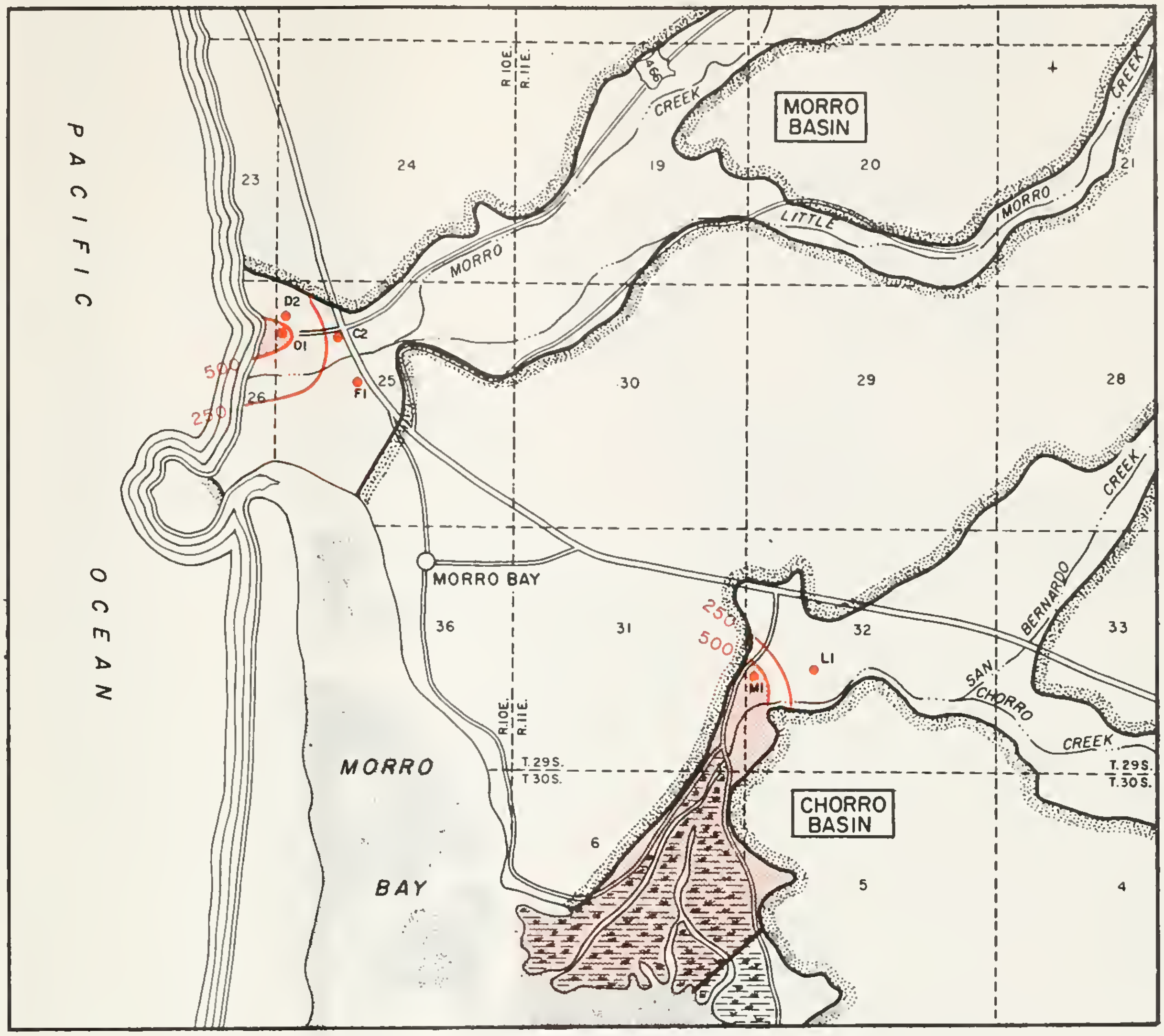
NOTE LOCATION OF WELLS SHOWN ON PLATES 8, 9, 10 AND 11

FLUCTUATION OF WATER LEVELS
AT SELECTED WELLS IN SOUTHERN CALIFORNIA



FLUCTUATION OF WATER LEVELS
AT SELECTED WELLS IN SOUTHERN CALIFORNIA

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1963



BASIN BOUNDARY

WELL USED FOR WATER QUALITY CONTROL

LINE OF EQUAL CHLORIDE ION CONCENTRATION, SPRING 1962

AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962

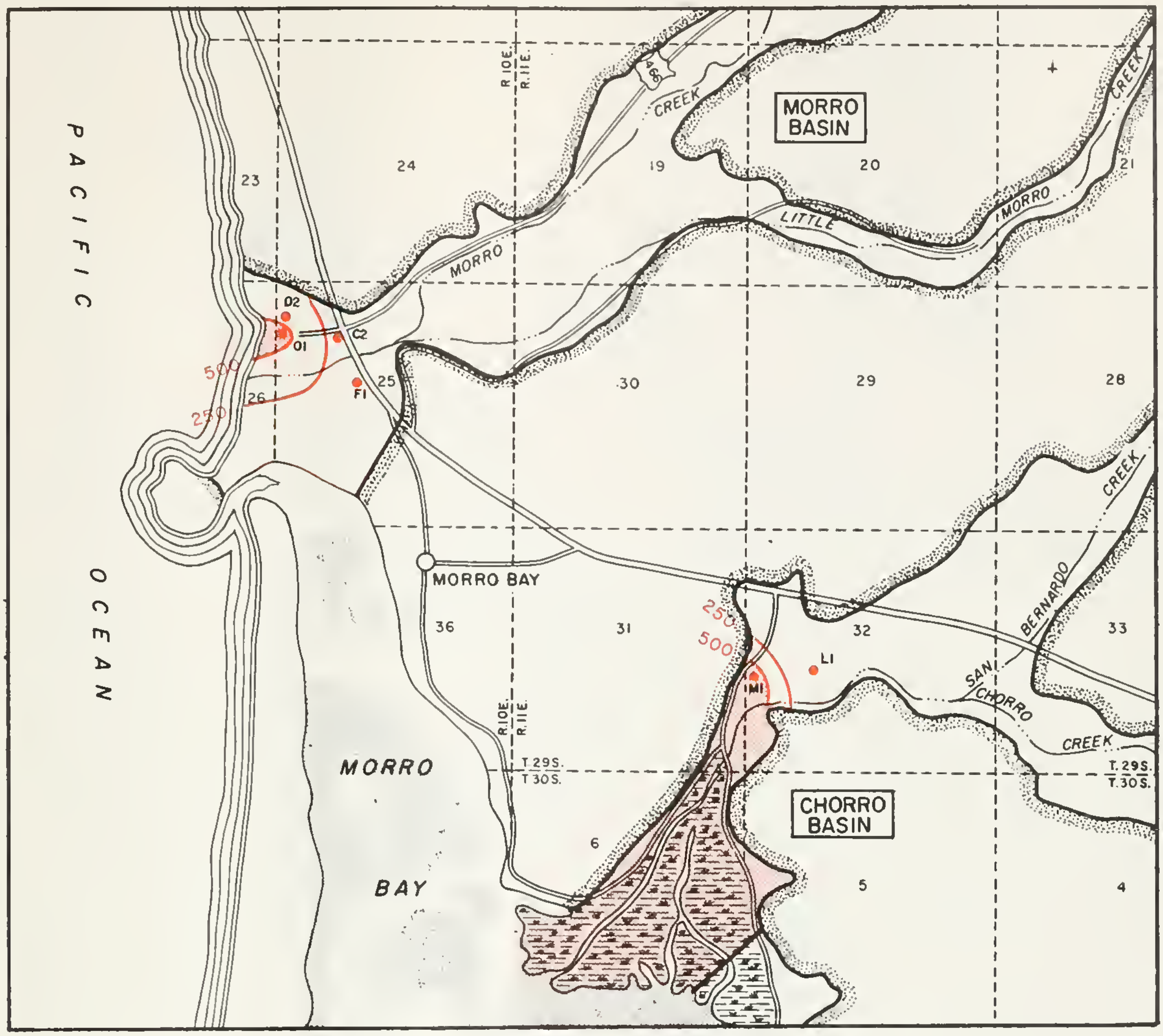
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION IN GROUND WATER BASINS, SAN LUIS OBISPO COUNTY SPRING 1962

SCALE OF MILES
1/2 0

1963



BASIN BOUNDARY

WELL USED FOR WATER QUALITY CONTROL

LINE OF EQUAL CHLORIDE ION CONCENTRATION, SPRING 1962

AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962

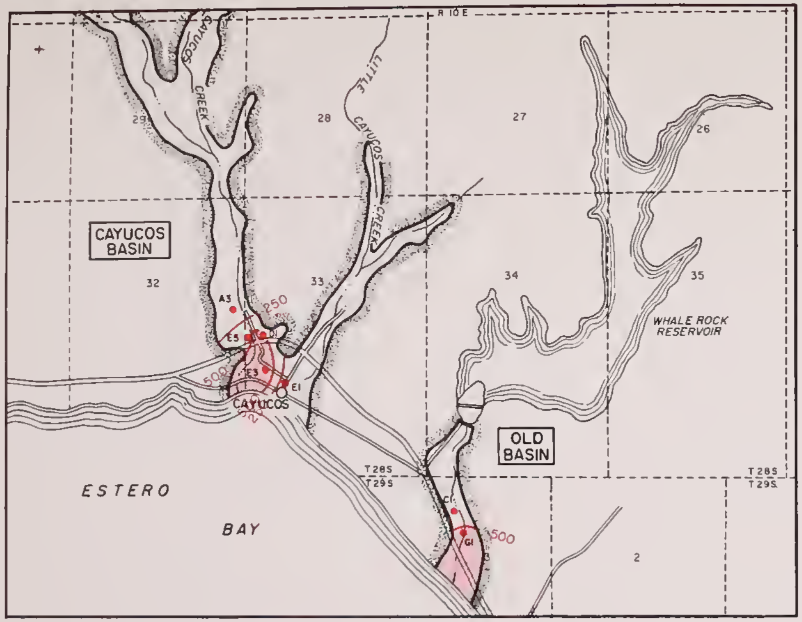
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

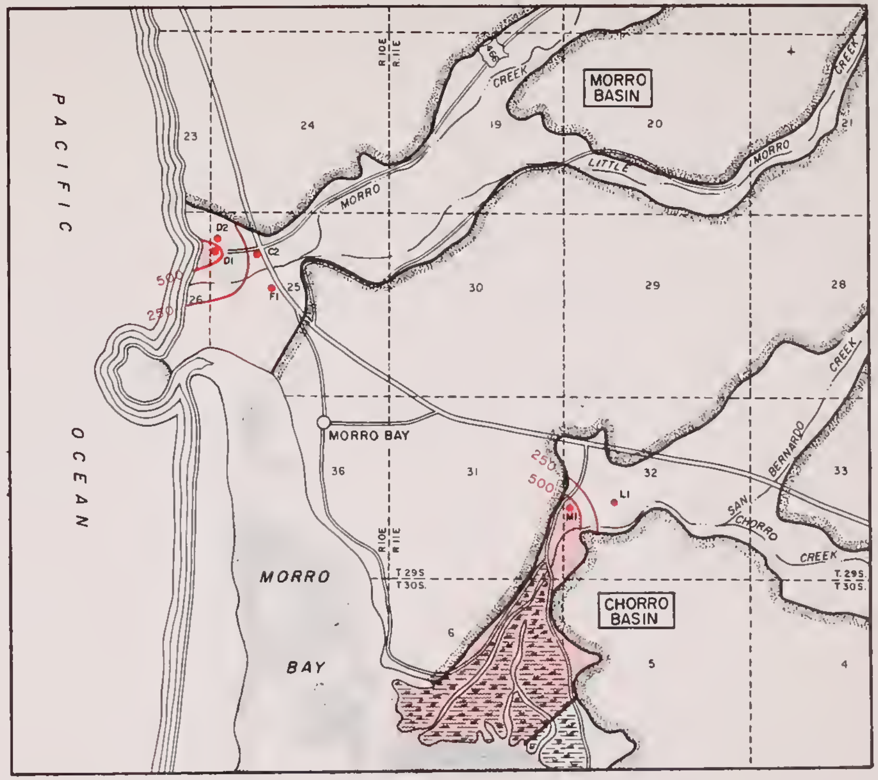
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

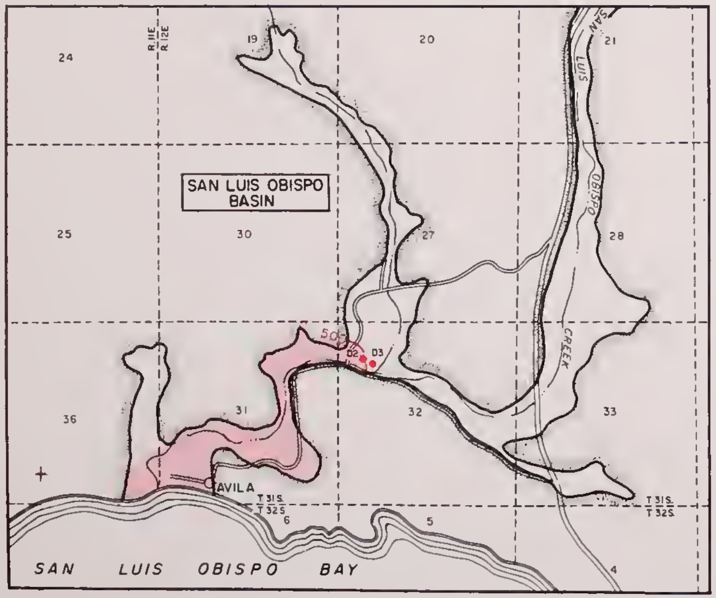
GENERALIZED STATUS OF SEA WATER INTRUSION IN GROUND WATER BASINS, SAN LUIS OBISPO COUNTY SPRING 1962

SCALE OF MILES
1/2 0 1

1963







BASIN BOUNDARY

WELL USED FOR WATER QUALITY CONTROL

—250— LINE OF EQUAL CHLORIDE ION CONCENTRATION, SPRING 1962

AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

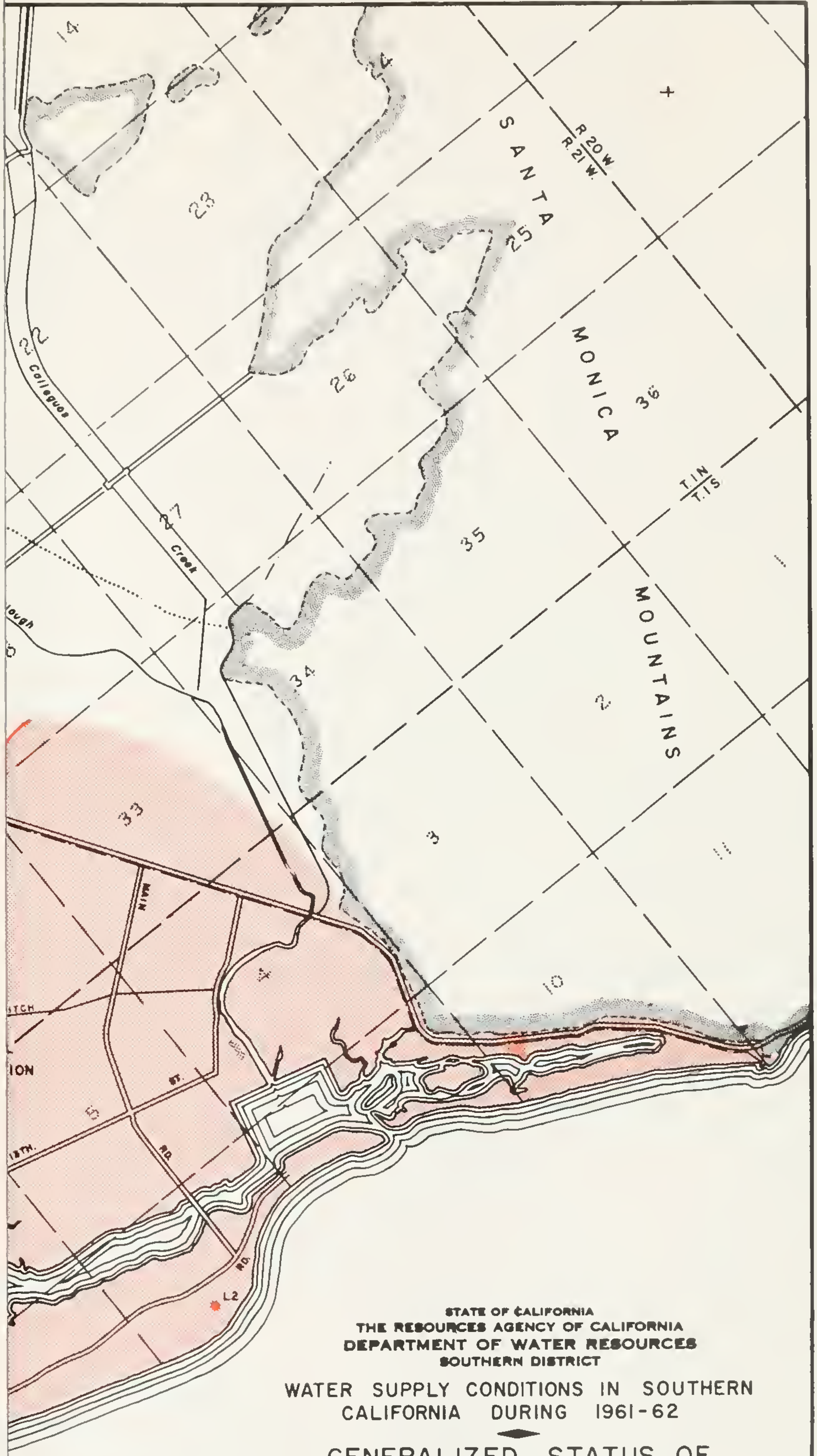
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION IN GROUND WATER BASINS, SAN LUIS OBISPO COUNTY SPRING 1962

SCALE OF MILES
1/2 0 1

1963

PLATE 14



STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION OXNARD PLAIN PRESSURE AREA SPRING 1962

SCALE OF MILES
1 1/2 0 1

1963

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

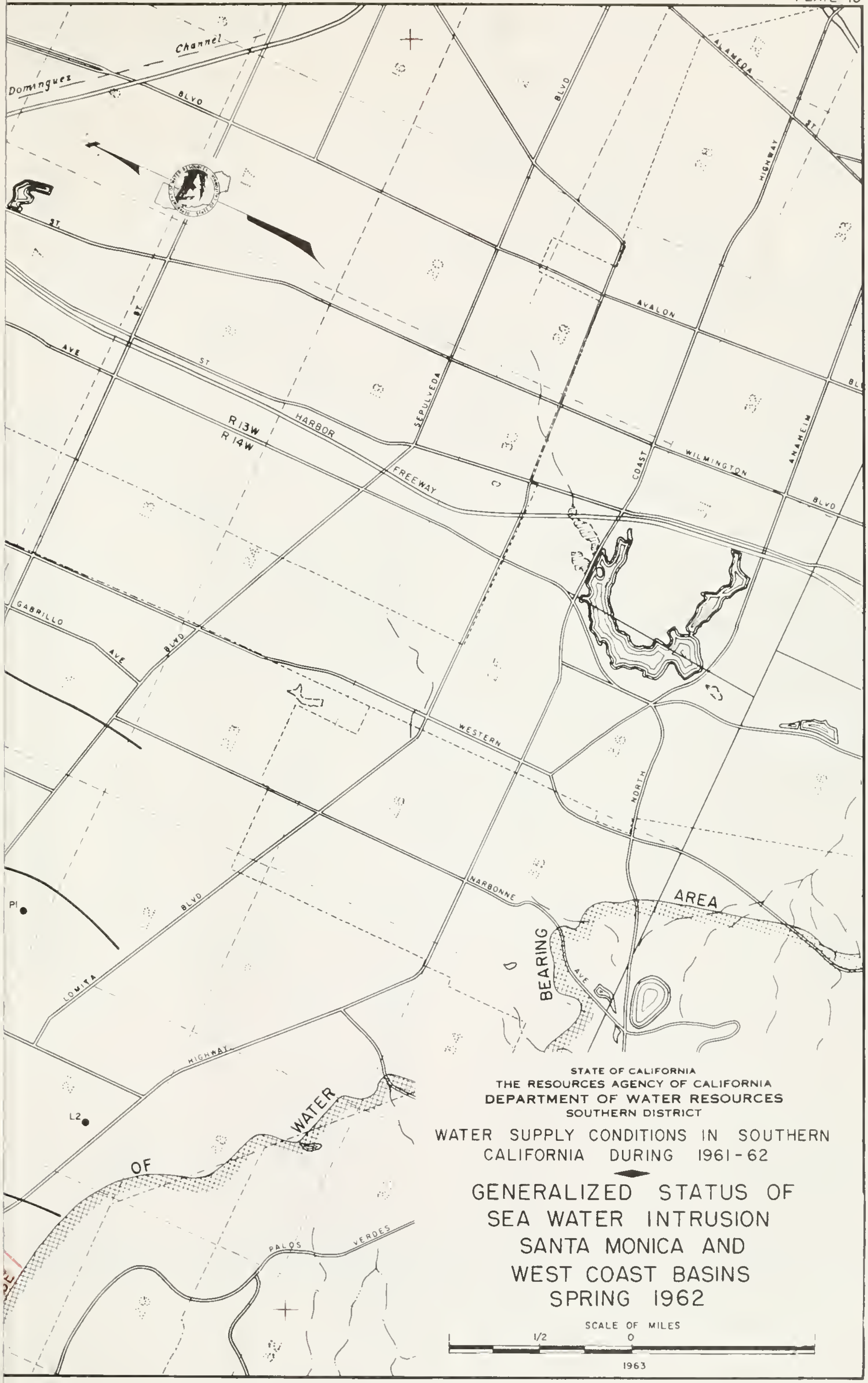
GENERALIZED STATUS OF SEA WATER INTRUSION OXNARD PLAIN PRESSURE AREA SPRING 1962

SCALE OF MILES

1 1/2 0 1

1963


LEGEND
EDGE OF NONWATER—BEARING AREA (HILLS)
WELL USED FOR WATER QUALITY CONTROL
WELL USED FOR WATER LEVEL CONTROL
WELL USED FOR BOTH WATER QUALITY AND WATER LEVEL CONTROL
-15 LINES OF EQUAL ELEVATION OF GROUND WATER AT WELLS IN THE OXNARD AQUIFER, JUNE 1962
100 LINE OF EQUAL CHLORIDE ION CONCENTRATION IN WELLS IN THE OXNARD AQUIFER, JUNE 1962
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62
GENERALIZED STATUS OF SEA WATER INTRUSION
OXNARD PLAIN PRESSURE AREA
SPRING 1962
SCALE OF MILES
1/2
0
1963
SANTA CLARA RIVER
SANTA MONICA MOUNTAINS
PORT HUENEME
NAVAL RESERVATION
RESERVATION
EL RIO SPREADING GROUND
T2N T1N
R22W R23W
R21W R22W
R20W R21W
T1N T1S



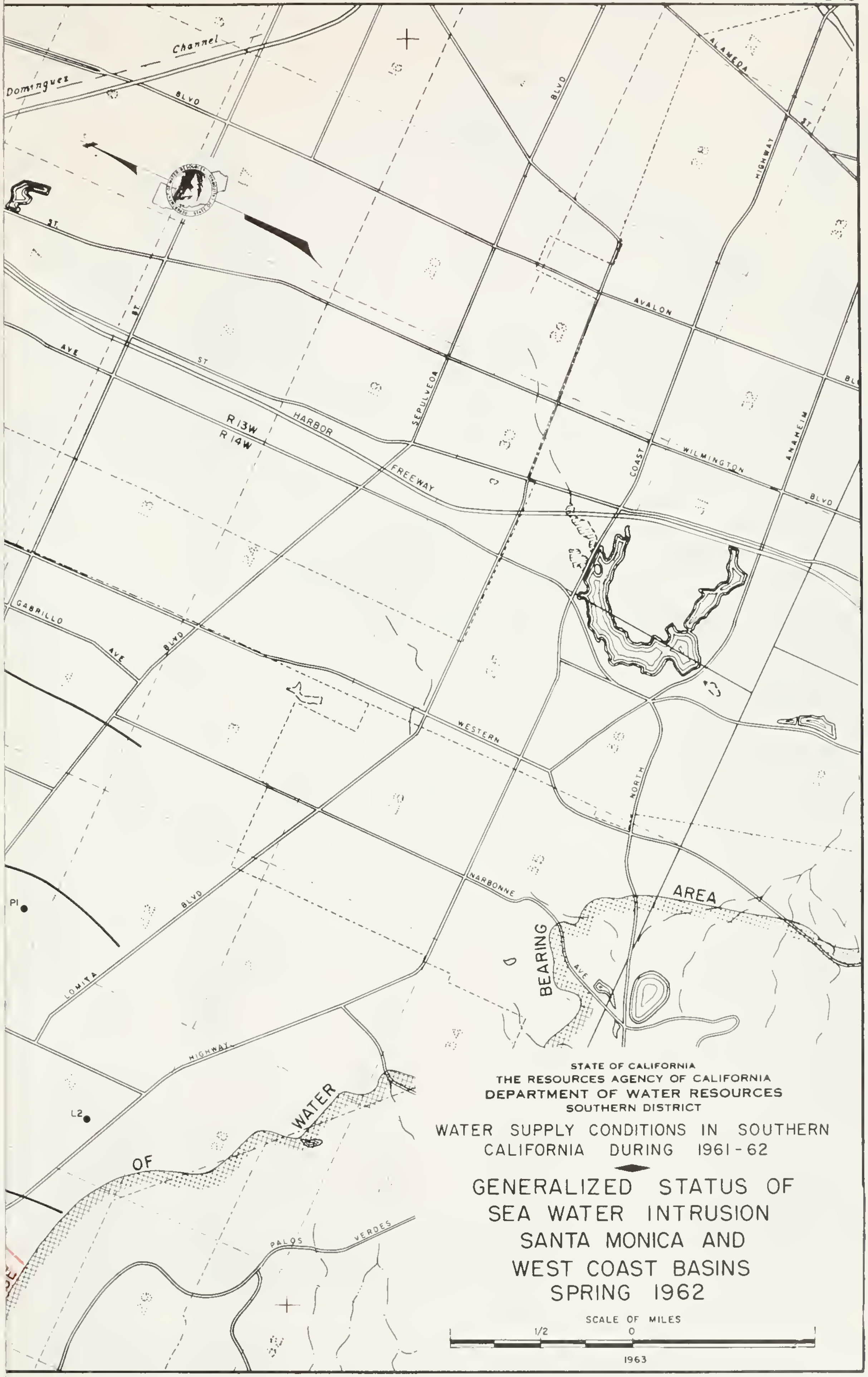
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION SANTA MONICA AND WEST COAST BASINS SPRING 1962

SCALE OF MILES
1/2 0

1963



STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

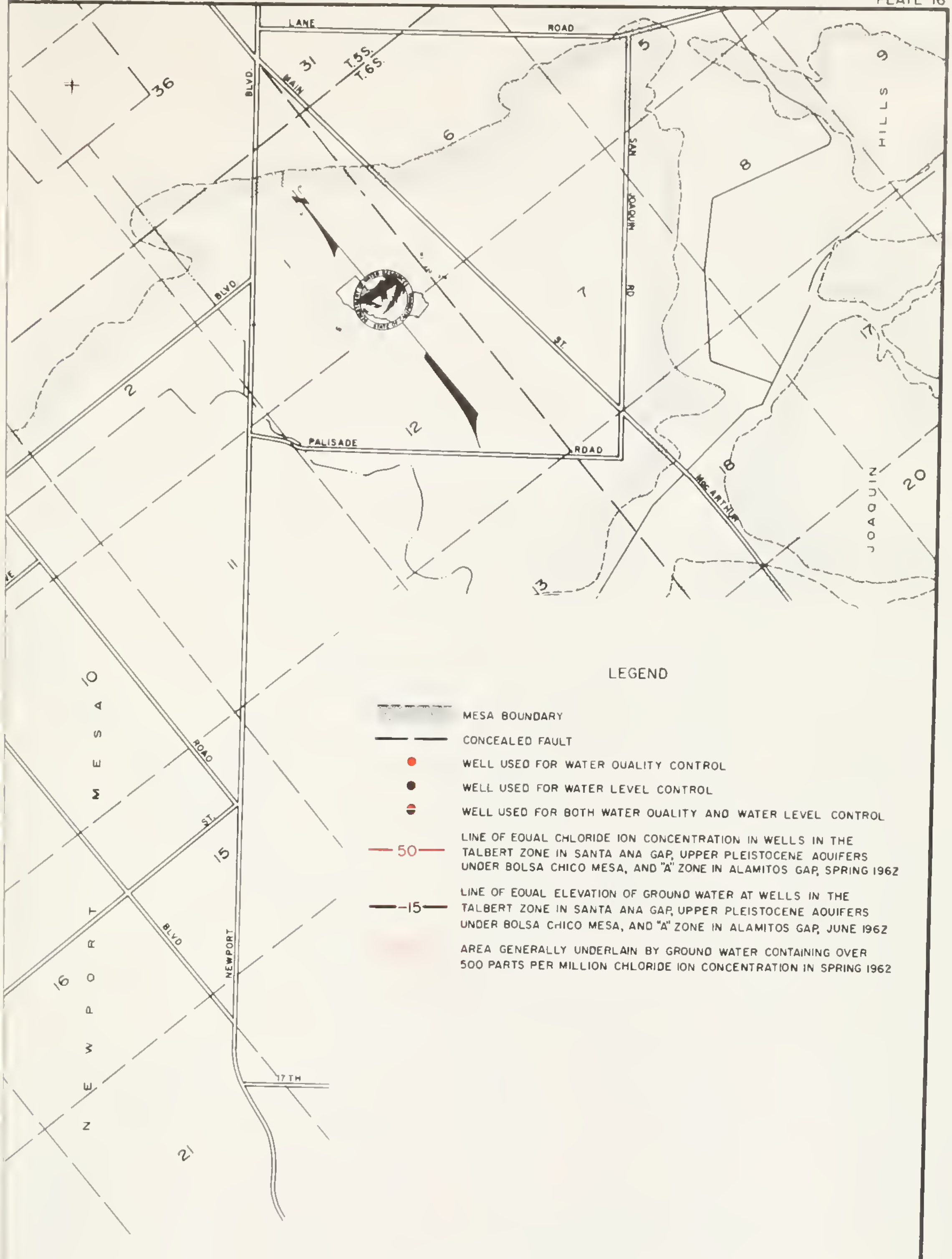
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION SANTA MONICA AND WEST COAST BASINS SPRING 1962

SCALE OF MILES
1/2 0

1963


CULVER CITY
INGLEWOOD
HAWTHORNE
LAWNDALE
GARDENA
TORRANCE
REDONDO BEACH
HERMOSA BEACH
MANHATTAN BEACH
EL SEGUNDO
LOS ANGELES INTERNATIONAL AIRPORT
CHARNOCK FAULT
BALDWIN HILLS RES.
LAGUNA DOMINGUEZ
BEARING AREA
EDGE OF WATER
PACIFIC OCEAN
LEGEND
WELL USED FOR WATER QUALITY CONTROL
WELL USED FOR WATER LEVEL CONTROL
WELL USED FOR BOTH WATER QUALITY AND WATER LEVEL CONTROL
—-10— LINE OF EQUAL ELEVATION OF GROUND WATER AT WELLS IN THE PRINCIPAL AQUIFERS, SPRING 1962
—500— LINE OF EQUAL CHLORIDE ION CONCENTRATION IN WELLS IN THE PRINCIPAL AQUIFERS, SPRING 1962
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 1000 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62
GENERALIZED STATUS OF SEA WATER INTRUSION SANTA MONICA AND WEST COAST BASINS SPRING 1962
SCALE OF MILES
1963



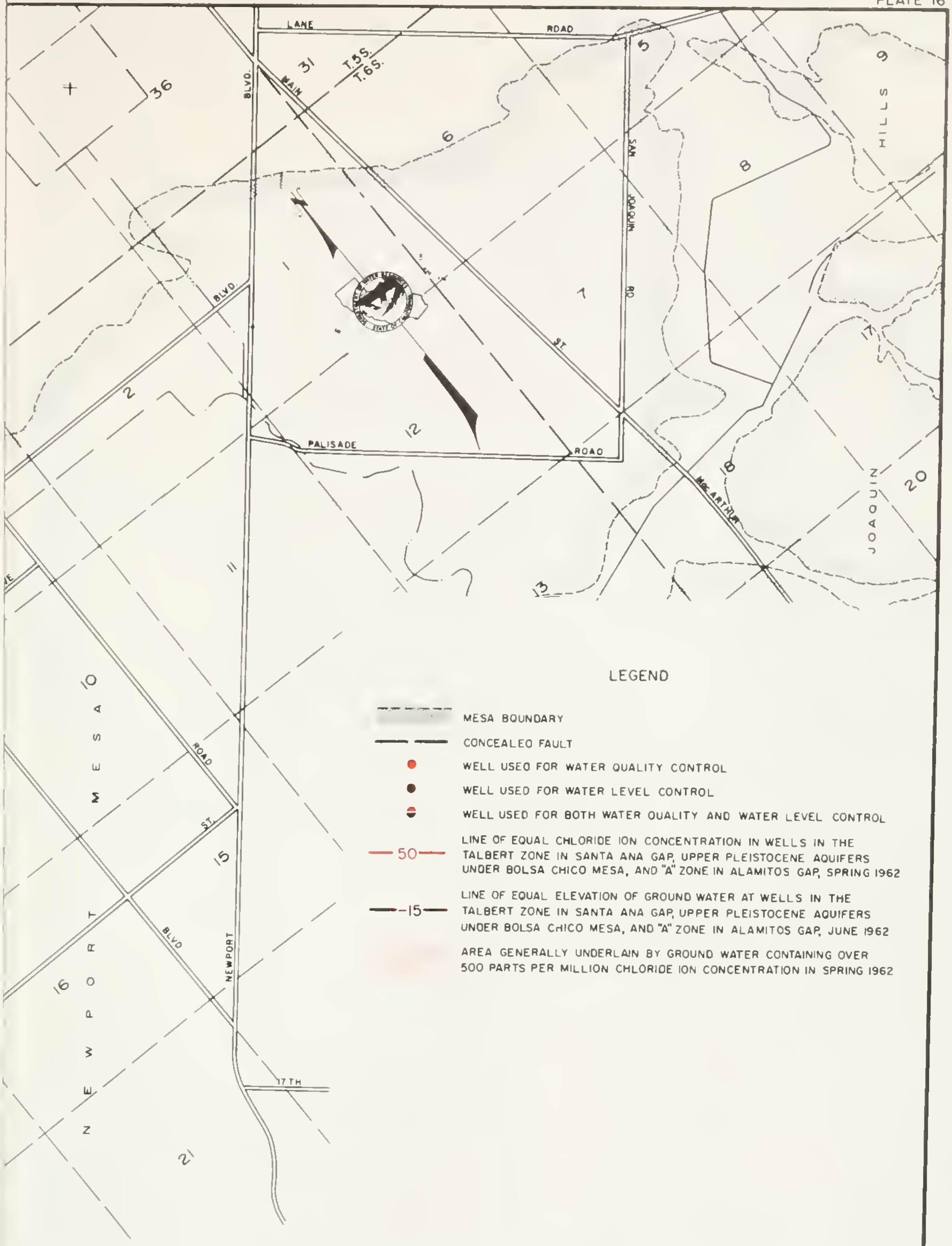
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION SANTA ANA AND ALAMITOS GAPS, AND BOLSA CHICA MESA, ORANGE AND LOS ANGELES COUNTIES SPRING 1962

SCALE OF MILES
1/2 0

1963



STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATER SUPPLY CONDITIONS IN SOUTHERN CALIFORNIA DURING 1961-62

GENERALIZED STATUS OF SEA WATER INTRUSION SANTA ANA AND ALAMITOS GAPS, AND BOLSA CHICA MESA, ORANGE AND LOS ANGELES COUNTIES SPRING 1962

SCALE OF MILES
1/2 0 1

1963

LEGEND
MESA BOUNDARY
CONCEALED FAULT
WELL USED FOR WATER QUALITY CONTROL
WELL USED FOR WATER LEVEL CONTROL
WELL USED FOR BOTH WATER QUALITY AND WATER LEVEL CONTROL
50 LINE OF EQUAL CHLORIDE ION CONCENTRATION IN WELLS IN THE TALBERT ZONE IN SANTA ANA GAP, UPPER PLEISTOCENE AQUIFERS UNDER BOLSA CHICO MESA AND "A" ZONE IN ALAMITOS GAP, SPRING 1962
-15 LINE OF EQUAL ELEVATION OF GROUND WATER AT WELLS IN THE TALBERT ZONE IN SANTA ANA GAP UPPER PLEISTOCENE AQUIFERS UNDER BOLSA CHICO MESA AND "A" ZONE IN ALAMITOS GAP JUNE 1962
AREA GENERALLY UNDERLAIN BY GROUND WATER CONTAINING OVER 500 PARTS PER MILLION CHLORIDE ION CONCENTRATION IN SPRING 1962
PACIFIC
OCEAN
HUNTINGTON BEACH
SEAL BEACH
SUNSET BEACH
SANTA ANA RIVER
SAN GABRIEL RIVER
ORANGE
LOS ANGELES
LOS ALAMITOS
WESTMINSTER
NAVAL RESERVATION
NAVAL RESERVATION
NAVAL 20 RESERVATION
LANDING HILL
BOLSA CHICA
HUNTINGTON MESA
NEWPORT INGLEWOOD FAULT ZONE
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
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