State of California
Department of Public Works
Division of Water Resources

EARL WARREN, Governor
C. H. PURCELL, Director of Public Works
EDWARD HYATT, State Engineer

REPORT TO THE ASSEMBLY OF THE STATE LEGISLATURE ON WATER SUPPLY OF ANTELOPE VALLEY IN LOS ANGELES AND KERN COUNTIES

PURSUANT TO

HOUSE RESOLUTION NUMBER 101

OF FEBRUARY 16, 1946

May 1947

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EDWARD HYATT, STATE ENGINEER
CHIEF OF DIVISION

EARL WARREN
GOVERNOR OF CALIFORNIA

C. H. PURCELL
DIRECTOR

STATE OF CALIFORNIA
Department of Public Works
SACRAMENTO (5)

DIVISION OF WATER RESOURCES
401 PUBLIC WORKS BUILDING

May 7, 1947

Assembly of California State Legislature
Sacramento, California

Gentlemen:

In response to House Resolution No. 101, dated February 16, 1946, the report on Water Supply of Antelope Valley prepared by the Division of Water Resources, State Department of Public Works, is submitted herewith.

Very truly yours,

EDWARD HYATT
State Engineer.

Approved:

C. H. PURCELL

Director of Public Works.

ORGANIZATION

STATE DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

C. H. Purcell . . . . Director of Public Works

Edward Hyatt . . . . State Engineer

A. D. Edmonston . . . . Assistant State Engineer

Gordon Zander
Principal Hydraulic Engineer

This report was prepared by

George B. Gleason
Supervising Hydraulic Engineer

Assisted by

H. C. Kelly . . . . Senior Hydraulic Engineer
J. J. Heacock . . . . Associate Hydraulic Engineer
Norman J. Tanguay . . . . Assistant Hydraulic Engineer
Raymond C. Richter . . . . Assistant Geologist
Laurence B. James . . . . Junior Geologist
John A. Parenti . . . . Senior Delineator

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George T. Gunston, Administrative Assistant


KEY TO AREA INVESTIGATED
OREGON
NEVADA
ARIZONA
MEXICO
PACIFIC OCEAN
ANTELOPE VALLEY
STATE OF CALIFORNIA
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

INTRODUCTION

A progressive decline in ground water levels, now averaging approximately three feet per year over the portion of Antelope Valley from which extractions are heavy, has prompted a request that the State of California initiate an investigation of the situation. This decline is delineated on Plate 1, "Elevation of Water Table at Wells". On February 16, 1946, the Assembly of the State Legislature adopted House Resolution No. 101 which directs the Division of Water Resources of the State Department of Public Works to conduct a survey of the water supply of Antelope Valley and to submit a report thereon including recommendations as to means of assuring an adequate water supply. This report is in response to that resolution.

In the preparation of the report, data and information furnished in bulletins and reports, on maps and verbally by the Soil Conservation Service of the United States Department of Agriculture, the United States Geological Survey, Los Angeles County Flood Control District, Los Angeles County Regional Planning Commission, Los Angeles County Agricultural Commissioner, the University of California through the County Farm Advisor, and by others were freely utilized. Residents of Antelope Valley contributed valuable data and suggestions. Numerous well logs and other information of value were received from the well drillers of the region.

ANTELOPE VALLEY

Location and General Description

Antelope Valley, as outlined on the frontispiece, is located at the southwestern extremity of the Mojave Desert region, mainly in Los Angeles County, but partly in Kern County.

The floor of the valley comprises some 800 square miles, roughly 80 square miles of which are now irrigated, a large part of this area being devoted to alfalfa, a crop which requires an ample supply of not too costly water. The area presently irrigated is shown on Plate 2, "Culture Map". An additional area of 280 square miles is good land suitable for irrigation. Of the latter, roughly 75 square miles are now dry farmed. Lancaster, the largest trading center, has a population of 3,800 and is situated about 75 miles north of Los Angeles by highway, and about 32 miles by air. Elevation above sea level in the valley ranges from about 2,300 to 4,000 feet, and surface slopes vary between almost flat and 125 feet per mile.

Surrounding the valley floor are topographic and structural features composed almost wholly of impervious igneous and metamorphic rock. They are of no importance from the standpoint of agricultural yield but serve as a tributary area, collecting the snow and rainfall in which a very large part of the water supply for the valley originates. They occupy approximately 700 square miles.

The San Gabriel Mountains and their westerly extension, the Sierra Pelona Range, border Antelope Valley on the south. Along the eastern crest of these rugged mountains a maximum elevation exceeding 9,000 feet is attained. Snow caps these peaks throughout most of the winter months, but with the onset of summer all but a few are bare. Big and Little Rock Creeks, flowing out of these mountains, are perennial and they, together with smaller intermittent streams from these mountains, provide the bulk of the water supply.

The Tehachapi Mountains border the valley on the northwest. These mountains, though not so lofty as the San Gabriels, attain altitudes surpassing 6,000 feet. All streams from these mountains are intermittent.

The northern extent of Antelope Valley is marked by an inconspicuous fault scarp and several small hills which comprise a region known as the Soledad Upland, Soledad Mountain being the most prominent topographic feature of this northern margin. A volcanic cone of 4,183 feet elevation, it is dwarfed by the ranges lying to the west and to the south. With the exception of sparse desert plants, vegetation is lacking, and runoff from this area is insignificant.

A low discontinuous chain of granitic buttes establishes the eastern boundary. No streams originate in this locality and runoff is negligible.

Climate

On the valley floor a typical desert climate prevails. High summer temperatures, low humidity and scant rainfall are characteristic. Summer temperatures exceed 100°F and frequently reach 110°F. Winter minimums are usually a few degrees below freezing, the lowest temperature recorded at Lancaster being 12°F. The growing season extends generally from April to October, inclusive.

Estimated mean annual rainfall in Lancaster is 7.3 inches. In Palmdale, which is approxim tely 300 feet higher in elevation it is 8.4 inches. About 75 per cent of the precipitation has occurred in the months of November to March, inclusive, the major portion from January through March. In the westerly part of the valley, which ranges in elevation from 2,500 to 2,700 feet, annual rainfall averages around nine inches. Dry farming is profitable here and is practiced extensively and almost exclusively.

Strong westerly winds prevail in the spring and fall, making windbreaks desirable in some locations.

Geology and Ground Water Basins

Plate 3, "Geologic Map", protrays the geology of Antelope Valley. Its purpose is to convey a general picture of the geology rather than to delineate with great accuracy the contacts between geologic formations.

Several million years ago, early in the Pleistocene period, the region now known as Antelope Valley was a land of moderate relief. The mountain ranges and hills, which form the present valley flanks, were non-existent. At this time Southern California commenced to experience a series of crustal disturbances from which were formed mountain ranges and other geological features. The topographical boundaries of Antelope Valley are results of these disturbances to date. Uplift along the San Andreas Fault formed the San Gabriel Mountains and their westerly extension, the Sierra Pelona Range. The Tehachapi Mountains were similarly created by displacement along the Garlock Fault. A northern flank to the valley was contemporaneously formed by movement along the Rosamond Fault, which in conjunction with volcanic activity produced what is known as the Soledad Upland. The eastern boundary appears to be the result of flexure rather than of faulting.

The effect of the geologic activity mentioned was as though an immense block of land hinged along its eastern edge were depressed and offset along its southern, northwestern and northern edges by faulting. Such a depressed region is designated as a structural basin. Erosion accompanied the uplift of the surrounding lands and sediments derived from the newly formed mountains were transported and deposited over the irregular floor of the new basin. The lowermost valleys and stream beds which existed in the region prior to faulting were first filled and finally only the summits of a few scattered peaks have been left unburied. These remanants of the old pre-existing land surface are the buttes of today. A large quantity of sediment has been deposited to form what is now regarded as the valley floor. The log of one well drilled to a depth in excess of 2,000 feet fails to reveal other than sedimentary deposits. It is within the void spaces of this sedimentary mantle that the ground water of Antelope Valley is stored. Near the eastern end of the valley the thickness of sediments is not believed so great. Here the buried canyons and ridges of the old land surface may to some extent influence the movements of ground water.

In the mountains, the rocks from which the sediments were derived are principally either of the igneous or metamorphic type. The metamorphics are rich in feldspar and consequently have yielded sediments containing a high percentage of this mineral. Such sediments are known as arkoses and are characterized by a repid weathering to clay. It is to the prevalence of such feldspar-rich, metamorphic rocks in the surrounding highlands that the abundance of clay in the valley is attributed.

The vast bulk of the valley fill was derived from the San Gabriel and Tehachapi Mountains. Sediments from these sources were deposited in typical alluvial fans which grew and overlapped to form the gentle slopes stretching from the mountains to the playas. The coarser detritus was deposited near the mouths of the canyons. The fine particles of clay and silt, being more readily transported, were carried far down the slopes, ultimately to the playas. Following torrential rains, floods carried gravels and coarse sand far out on the basin floor. These coarse materials overlapped the clay, and in times of normal sedimentation were in turn overlapped by subsequent layers of clay. In this manner, a series of alternating lenticular beds of clay and sand were deposited. The logs of wells reveal a monotonous repetition of clay and sand layers which continues for hundreds of feet below the present land surface. Logs of various wells penetrating to several hundred feet show that the deeper sediments are not unlike those encountered near the surface. Typical logs are presented graphically on Plate 4, their location being shown on Plate 9, "Location of Wells".

Thayer[1] divides Antelope Valley into seven ground water basins which he designates Lancaster, Buttes, Rock Creek, Neenach, Pallet Creek, Valyermo and Armagosa basins. In this report only the first four are considered, the last three being treated only as tributary to the others. The boundaries between the basins are determined by discontinuity or by steepening of the water table as disclosed by measurements at wells, rather than by surface evidence of faults or flexures.

Reference to the ground water contours of Plate 5, "Contours of Water Table - Fall 1946", indicates that the boundaries between Rock Creek and Buttes basins and between Buttes and Lancaster basins, are more sharply defined than is that between Neenach and Lancaster basins. Whether or not a physical barrier to free flow exists at the last named boundary is of little moment from the standpoint of this report. The relative steepness of the water table throughout Neenach Basin, to which the supply is relatively small, indicates that movement of ground water there must be slow as compared with that in Lancaster Basin. Experience at King's Canyon spreading grounds (Plate 5) bears this out. For this reason, and because there is little irrigation development

[1] Los Angeles County Flood Control District Report, Geologic Features of Antelope Valley, California, by Warren B. Thayer, October, 1946.

there, the area herein designated as Neenach Basin should be treated separately from Lancaster Basin without regard to the existence of an intervening barrier.

Water Supply

The present water supply to Antelope Valley consists of precipitation on the valley, water wasted from Los Angeles Aqueduct and inflow from adjacent mountains and hills. Precipitation on the valley is small, so it is probable that virtually all of it is consumed by dry farmed crops or by natural vegetation. Its contribution to the ground water is negligible.

With the exception of the precipitation which is consumed directly by dry farmed crops, and diversions from surface streams probably not exceeding 10,000 acre-feet per year, all of the water supply of Antelope Valley is utilized by pumping from the ground water. The ground water moves slowly through Rock Creek and Buttes basins into the easterly portion of Lancaster Basin and through Neenach Basin into the westerly portion, generally in a direction downslope at right angles to the ground water contours of Plate 5. The steep slopes at the boundaries between the basins indicate the existence of restricting barriers there, but since no ground water rises to the surface above them, there must, over a long period of time, be movement either over or through these barriers sufficient to carry away that portion of the supply to the upper basins which is not consumed there. The fact that the slope continues downward away from the barriers also indicates the passage of some water.

The flatness of the slope in the lower portion of Lancaster Basin, the relatively narrow section in which the slope is toward the boundary and the preponderance of impervious clay in this section all indicate that underflow out of the basin here is relatively small. There may, however, also be some underflow to the east out of Rock Creek Basin and possibly Buttes Basin following a series of wet years when the water table there is high.

The existence of flowing wells over a large part of Antelope Valley in early days, as indicated by the boundary of artesian flow for 1908 shown on Plate 3, indicates continuity of impervious strata over considerable areas. This suggests the possibility that a part of the excess of applied water over that consumed, remains perched on clay strata above the aquifers from which any water is pumped and therefore wastes. However, if all the excess from the large acreage of alfalfa which has been irrigated for many years, had remained in these upper strata, it seems likely that more evidence of its disposal through evaporation and transpiration in the lower portions of the basin would have appeared. R. D. Perry, District Conservationist with the Soil Conservation Service, states that their investigations indicate that areas where perched water lies close enough to the ground surface to threaten water-logging of the soil, are localized.' Furthermore, if it were true that a major portion of the excess applied water wastes, the discordance between the estimates of overdraft under two procedures, as discussed in a later section, would be much larger.

With respect to the water wasted from the Los Angeles aqueduct the capacity of the facilities for spreading such water near King's Canyon (Plate 5) is approximately 50 second-feet. It is estimated that in a wet year water is now available to waste and spread at that rate for about 100 days, resulting in a possible contribution to the ground water of 10,000 acre-feet*. In drier years less is available and in some, none at all. The probable average lies between 5,000 and 7,000 acre-feet annually. However, in 1945-46 the aqueduct delivered 284,000 acre-feet out of an estimated possible delivery of 307,000 acre-feet to San Fernando Valley. The city is under no compulsion or obligation to release this water in Antelope Valley, and when anticipated increases in

*In 1946-47 between 6,000 and 7,000 acre-feet were spread in 82 days.

demand materialize, little if any waste will be available for spreading in Antelope Valley.

All but a negligible part of the inflow to the valley from adjacent tributary areas comes from the mountains lying to the south and west. Records[1] of runoff in Big Rock Creek are available for the period, 1923-24 to 1945-46, inclusive, with exception of 1937-38 during most of which year the station was inoperative. Records for Little Rock Creek cover the period from 1930-31 to 1945-46, inclusive, except for 1937-38 and 1938-39. Runoff for these missing years for both Big and Little Rock Creeks was estimated by comparison with Big Tujunga Creek. Runoff in Little Rock Creek during 1923-24 to 1929-30, inclusive, was estimated by comparison with Big Rock Creek. Average annual flow in both streams during the period, 1923-24 to 1941-42, inclusive, is assumed to equal the long-time mean annual.

For convenience, the mountain area tributary to Antelope Valley is divided into 11 parts. Long-time mean annual precipitation on each part is estimated from an isohyetal map[2] prepared by the Los Angeles County Flood Control District. In order to estimate runoff from the unmetered areas, a curve of mean annual precipitation vs. mean annual runoff was constructed using the data for Big and Little Rock Creeks as controlling points and is delineated on Plate 6, "Relation Between Long-Time Mean Precipitation and Depth of Runoff for Mountain Watersheds - Antelope Valley". Runoff values obtained from the curve were converted to acre-feet by multiplying by the number of acres contained within each area as set forth in Table 1.

Inflow to the valley determined in this manner is somewhat larger than would have resulted had the procedure employed in the South Coastal Basin Investigation[3] been used.

[1]Published by U. S. Geological Survey. Measurements furnished by Los Angeles County Flood Control District.
[2]Mean for the 70-year period, 1872-1942.
[3]Division of Water Resources, Bulletin No. 53, now in process of printing.

TABLE 1

ESTIMATE OF MOUNTAIN RUNOFF REACHING ANTELOPE VALLEY

Area	Precipitation, Inches	Runoff, Feet	Area, Acres	Runoff, Acre-Feet
Area East of Rock Creek	17	0.17	28,800	4,896
*Rock Creek (Above Gaging Station)	33	.79	14,720	11,720
Rock Creek (Below Gaging Station)	20	.21	17,280	3,628
Between Rock Creek and Little Rock Creek	16	.15	12,800	1,920
*Little Rock Creek above Gaging Station	27	.39	31,360	12,080
Little Rock Creek below Gaging Station	19	.20	14,080	2,816
Between Little Rock Creek and Amargosa Creek	10	.07	25,600	1,792
Leonis Valley-Amargosa Creek	15	.14	25,600	3,584
Portal Ridge	13	.11	16,000	1,760
West Side. Sawmill, Liebre and Tehachapi Ranges. No including Oak, Cottonwood and a few other small creeks.	15	.14	128,000	17,920
North Side. Oak, Cottonwood, Minetos and other small creeks.	12	.10	42,880	4,288
			TOTAL	66,404

* Runoff based on stream-flow measurements.

CHANGE IN GROUND WATER STORAGE

One of the two procedures for evaluating overdraft, discussed later in the report, is based on change in ground water storage. In a surface reservoir, all of the volume is occupied by water and the amount going into or out of storage is determined by change in water table elevation and the average area of water surface at the two levels. In a ground water basin the water occupies only the interstices between solid particles of gravel, sand and clay and a portion of even this is retained against gravity, the retention varying with the fineness of the material. The ratio between the volume of water which is free to drain out under the force of gravity, and the total volume occupied by solid material and water, expressed as a percentage, is called the specific yield. This is the factor by which the product of change in water table elevation and average area must be multiplied to determine change in storage in a ground water basin.

In the estimate of overdraft, change in storage in Lancaster Basin alone is involved. On plate 7, "Contours Showing Changes in Elevation of Water Table" are shown the changes in elevation of the ground water from end of irrigation season in 1943 to end of irrigation season in 1945. On Plate 8, "Specific Yields in Subsurface Sediments" are shown lines of equal specific yield. Within the area in which wells flowed in 1908, it is assumed that changes in water level in the deeper wells represented changes in pressure rather than changes in storage, so recession in the few wells less than 250 feet deep, at which levels were recorded, are used as the basis for that portion of Plate 7. Changes in the deeper wells were greater throughout. It is believed that, in general, the lines of Plate 8 represent the average specific yield in the zone through which the water table receded in the period considered. From these two maps the average change in water table elevation and specific yield for each of the several increments of area into which the basin is divided are estimated, and the products are totaled to determine the change in storage in the basin.

The lines of equal change in water level on Plate 7 are based on measurements. A detailed discussion of the principles involved in the preparation of Plate 8 has been published by the Division of Water Resources in Bulletin 45, "South Coastal Basin Investigation, Geology and Ground Water Storage Capacity of Valley Fill". A brief resume of the procedure used in Lancaster Basin follows.

(1) Each of 170 well logs was separated into 100-foot intervals and the number of feet of each sedimentary type* in each interval determined.

(2) The logs were assembled in groups, and a composite log for each group obtained by averaging values from step 1.

(3) A value of specific yield was assigned to each type for each group. In the South Coastal Basin studies it was found that specific yield of unweathered gravels varied with distance from the mountains, the rate of variation depending primarily upon the slope. The values assigned in Lancaster Basin were those previously determined for comparable points in San Fernando Valley, the comparison being based on profiles of ground surface.

(4) For each 100-foot interval of each composite log, the number of feet of each sedimentary type was multiplied by the value of specific yield assigned to it. The total of these products for each interval in each composite log is the estimated specific yield for that interval at the center of the group represented by the composite log.

(5) Lines of equal specific yield were drawn on Plate 8 by interpolation between group centers. The values at these controlling points are

* These include sand rock, cement, clay sand, gravelly clay, tight gravel, tight sand, gravel and sand.

in each case those established in step 4 for the 100-foot interval which includes the present water table.

Wells at which water level data and drillers' logs were used in the evaluation of change in storage are shown on Plate 9.

OVERDRAFT ON GROUND WATER BASINS

The ground water basins of Antelope Valley, in common with all ground water basins in the west, serve as regulating reservoirs for the widely varying supply which reaches them. Before there was any development in the valley, the water table alternately rose and declined as water went into or came out of storage in alternating wet and dry periods. Over a long period of time, these changes in storage balanced and the total outflow and other wastes equaled the total supply. Here, as in other basins where outflow and wastes are related to ground water elevation, both varied as the water table rose and fell, but not so widely as did the supply.

With development in the valley, extractions from storage were increased through pumping and the water table was thus lowered. This lowering in turn after some delay brought about a reduction in the outflow and other wastes equivalent over a long period of time to the net* amount artificially extracted. The recession of the water table during the period of adjustment did not represent an overdraft, because following this period, had there been no further increase in consumption, net change in water table elevation would have gain been zero over a long period of time just as it was under natural conditions, but with the average level lower.

* A part of the pumped water generally returns to the ground water.

Obviously, there is a limit to the amount by which outflow and other waste can be reduced. When this limit is reached, any further increase in extraction from storage by pumping results in a progressive lowering of the water table until finally extraction of the full demand is no longer feasible. When this condition exists the progressive lowering of the water table does indicate an overdraft. In Antelope Valley, the water table has continued to decline during a period considerably wetter than the average, there is no surface outflow and subsurface outflow is believed to be so small in comparison with the indicated overdraft that any possible further reduction in its amount can have little significance. Waste resulting from uncontrolled flow from artesian wells was unquestionably larger in the past than at present, but the reduction since the period upon which the estimate of overdraft is based, or any possible future reduction through further lowering of the water table, is small as compared with the indicated overdraft. There is little indication that evaporation from the ground surface or wasteful transpiration resulting from a too high water table has been large in recent years. Surface flow wasting onto the playas or dry lakes is relatively small. Insofar as Antelope Valley is concerned then, the current decrease in water table elevation, is to a large degree, due to overdraft.

In Antelope Valley, from which no water is exported, and where a large part of any unconsumed applied water becomes available for reuse, the amount by which annual consumptive use exceeds the mean annual net supply to the area, constitutes the overdraft. This overdraft is evidenced by a fall in ground water levels such that the amount withdrawn from storage each year makes up the difference between supply to the area and consumptive use on it. Thus there are two procedures adapted to an evaluation of the overdraft; (1) subtracting the total mean annual net supply to the area from the total annual consumption and (2) estimating from measured change in water table elevation, the average amount which would have come from storage annually had consumption been that of the present, and had the average annual supply, during the period of measurement been equal to the long-time mean annual supply.

The supply to the valley includes precipitation on the valley, stream flow into the valley and imported water. The net supply is the difference between the sum of the foregoing and the waste out of the area in which the water can be utilized. Precipitation on the valley averages only about eight inches annually and it is therefore probable that a very small part of it wastes, and that the remainder is consumed. This being true, inclusion of precipitation as a part of the supply and consumed rainwater as a part of the consumption, in no way affects the result. Because of this, precipitation on the valley is neglected and the value used for consumptive use is that from applied water only. On this basis the net supply, in addition to imported water, is the difference between stream flow into the valley and waste into the playas. Based on discharges in Big and Little Rock Creek, measured near the points where they enter the valley, and unit percolation rates established by experience elsewhere, it is estimated that the mean annual net supply from mountain runoff is about 95 per cent of the inflow to the valley or 63,000 acre-feet.

Had present facilities for spreading Los Angeles Aqueduct water been available during the period from 1905-06 to 1940-41, inclusive, it is estimated that the maximum possible supply to Antelope Valley from this source would have averaged less than 7,000 acre-feet annually. In 1945-46, water delivered to San Fernando Valley through the aqueduct was only about 20,000 acre-feet less than its estimated capacity, and the demand has been increasing rapidly. Because of this, and the fact that waste elsewhere might prove more feasible from the standpoint of the city, water from this source cannot be considered a firm supply for Antelope Valley. While it is possible that for some indeterminate but probably not very long time in the future, some aqueduct water can be spread, it is not here included as a part of the supply in estimating overdraft.

As the result of a field survey conducted in 1945, the Soil Conservation Service reports 42,210 acres of irrigation field crops, and 2,260 acres of orchard in the Los Angeles County portion of Antelope Valley in that year. For the same year, the Los Angeles County Agricultural Commissioner reported 28,500 bearing acres of alfalfa hay, 2,100 acres of alfalfa seed, 2,600 acres of orchard and about 600 acres of miscellaneous garden crops. To reconcile these values from the standpoint of consumption it is assumed that 10 per cent of the irrigated field crops reported by the Soil Conservation Service, or 4,200 acres, was lying fallow and used no irrigation water, that 30,000 acres were alfalfa, consuming three acre-feet per acre or 90,000 acre-feet, that 3,000 acres were orchard and miscellaneous crops consuming two acre-feet per acre or 6,000 acre-feet, and that the remainder of about 9,000 acres was irrigated grain or other crops consuming one acre-feet per acre or 9,000 acre-feet. In addition there were an estimated 4,000 acre-feet consumed in Kern County. With a supply then of 63,000 acre-feet and consumptive use of irrigation water totaling 109,000 acre-feet, the overdraft as of 1945 on the basis of this procedure was 46,000 acre-feet.

Under the second procedure, based upon historic change in ground water storage, estimated overdraft as of 1945 was about 41,000 acre-feet. The period during which sufficient water level measurements are available for a reasonably dependable evaluation of change in storage under this procedure, does not extend back far enough to include a period of even approximately mean supply. The period which has been used, namely 1944 to 1945, inclusive, was one of about 130 per cent normal precipitation and 170 per cent normal stream flow. Because of this, it is probable that the actual overdraft with culture as of 1945 was somewhat larger than the estimate. However, since a large part of the excess supply in wet years enters and moves through the outlying basins, the assumption that the effect of the excess did not reach the ground water of Lancaster Basin in large amount during the period is reasonable. Moreover, since development in the outlying basins is limited, it can be assumed that they are not overdrawn and that fluctuations of the water table there are due solely to variations in the weather. Thus, for purposes of this estimate, the average annual decrease in storage in Lancaster Basin alone, during the period 1944 to 1945, inclusive, is considered to be the overdraft as of 1945.

Since 1945, roughly 8,000 acres have been added to the area irrigated or prepared for irrigation. Assuming that 50 per cent of this will consume three acre-feet per acre and the remainder one acre-foot per acre, 16,000 acre-feet will be added to the 1945 value, making estimated overdraft as of 1947 equal 62,000 acre-feet under the first procedure and 57,000 acre-feet under the second.

In all of Antelope Valley, there are about 6,000 acres of unirrigated good land* under which static water level is less than 50 feet below ground surface and roughly 26,000 acres under which it lies between 50 and 100 feet below. Assuming that half this land is to be planted to alfalfa, this alone will almost double the present estimated overdraft. In addition there are more than 100,000 acres of good land under which the water table lies farther

*This includes lands in Lancaster Basin in Los Angeles County, surveyed in 1945 by the Soil Conservation Service and recommended by them as suitable for cropping. Estimates for Kern County are based on old soil surveys by the U. S. Bureau of Soils and the University of California. In Neenach Basin the classification is largely on the basis of topography alone.

from the ground surface but which are susceptible to development of some type which might justify the greater pumping costs.

Throughout this study every effort has been made to avoid assumptions which would result in an estimate of overdraft larger than its probable value. Under the first procedure, it is assumed that about half the water applied returns to the ground water for reuse, and subsurface outflow and waste from uncapped flowing wells is neglected. If any considerable part of the excess of applied water over consumptive use remains perched near the surface and is wasted, or if the neglected outflow is significant, the actual overdraft is greater than the estimate by a corresponding amount. The assumption, under the second procedure, that change in storage during the wet period 1944 to 1945 inclusive, is identical with what the change would be during a period of average supply including both wet and dry periods, may result in an estimate of overdraft somewhat below the probable but certainly does not introduce an error in the opposite direction.

It has been suggested that considerable quantities of water enter the valley underground from distant sources. No evidence has been found that this is true, but if it were it would decrease the overdraft as evaluated under the second procedure, only if more water enters during a period of mean supply than entered during the two year period of measured change in storage. No reason appears for believing that this would be the case under natural conditions or that such underflow if it existed could be increased artificially.

It is recognized that the procedures used here, and any others which might be devised, require estimates of considerable magnitude involving factors not susceptible to exact evaluation and that the results derived are in themselves, therefore, not exact. The present studies do, however, establish beyond reasonable doubt that an overdraft far in excess of any possible salvage or additional supply available in the foreseeable future already exists and that it is increasing rapidly.

The cumulative effect of the overdraft is that the ground water level with pumping plants idle now lies less than 50 feet below ground surface under only about 3,500 acres of land presently irrigated or prepared for irrigation in the immediate future; under about 19,000 acres it lies between 50 and 100 feet below ground surface, and under about 29,000 acres the depth to water exceeds 100 feet. The water table is now falling about three feet per year and pumping drawdown probably adds 30 feet more to the pumping lift required.

CONCLUSIONS

(1) Antelope Valley is a structural basin. Its present water supply is limited to precipitation on the valley, runoff from immediately adjacent tributary areas, and waste from Los Angeles Aqueduct. Precipitation on the valley is so small that little of it reaches the ground water so its use is limited to consumption by dry farmed crops. Of stream flow from adjacent mountains and hills, an estimated five per cent wastes, leaving 63,000 acre-feet per annum for direct diversion and for percolation to the ground water. The maximum which can be supplied from Los Angeles Aqueduct in a wet year with present spreading facilities is about 10,000 acre-feet and the estimated average with present Los Angeles demand, is from 5,000 to 7,000 acre-feet per year. The demands of the City are increasing rapidly so this is not a dependable or permanent source of supply.

(2) An estimated 52,000 acres of land will be irrigated in 1947 (Plate 2), a large part of it devoted to alfalfa which is a high consumer

of water. In addition, an estimated 180,000 acres of good land are available for irrigation.

(3) Extractions in 1947 will exceed the mean annual recharge to the ground water by more than 50,000 acre-feet and consumptive use is now increasing at a rate of 8,000 acre-feet or more per year.

(4) No new source of outside water which might become available to Antelope Valley in the foreseeable future has been found.

(5) Salvageable waste is small and justifiable costs for that purpose are therefore limited. If spreading of Big or Little Rock Creek water is resorted to it should be at or near the upper margin of Lancaster Basin, in order to assure percolation to the ground water and at the same time avoid possible subsurface waste to the east from Rock Creek and Buttes basins.

(6) The only way to eliminate the overdraft in the foreseeable future is to drastically reduce the amount of water consumed. This can be accomplished (1) by substituting a type of culture which consumes less water and (2) by reducing the area of land using water.

(7) That improved irrigation practice on present crops will greatly affect the overdraft is doubtful. Improved irrigation efficiency will, however, extend the time during which profitable operation can continue because, with less water applied, unit pumping costs can be greater.

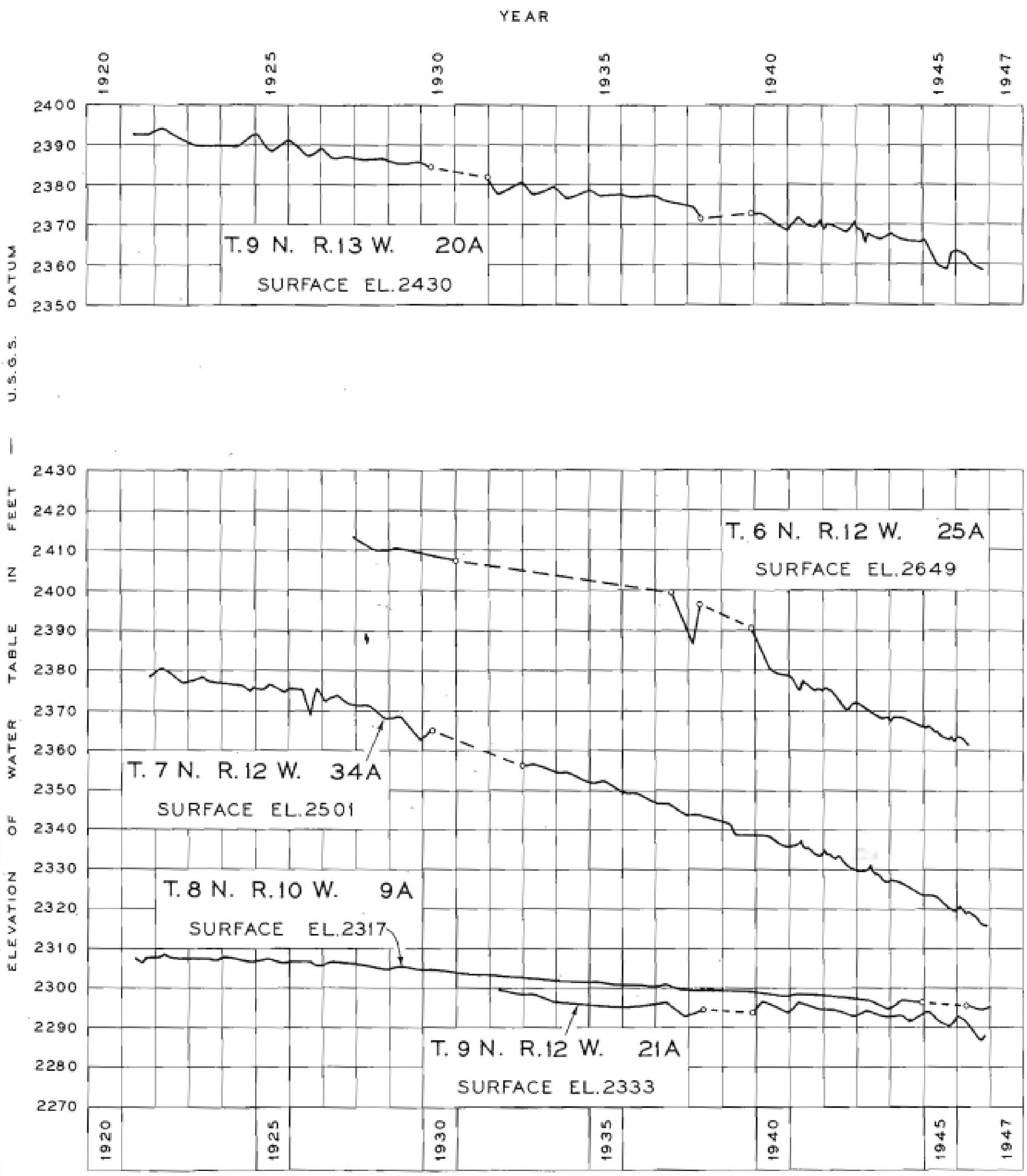
RECOMMENDATIONS

(1) Every effort should be made to reduce consumptive use in the valley through the substitution of higher duty crops. Studies with this end in view now being carried out by the Soil Conservation Service, County Farm Advisors and others and the efforts of influential local organizations should be continued.

(2) Studies by the Soil Conservation Service and the University of California relative to improved irrigation practices and possible salvage of waste should be encouraged. The fact that this waste may be small does not justify neglecting it if it can be salvaged at a cost commensurate with the benefits derived.

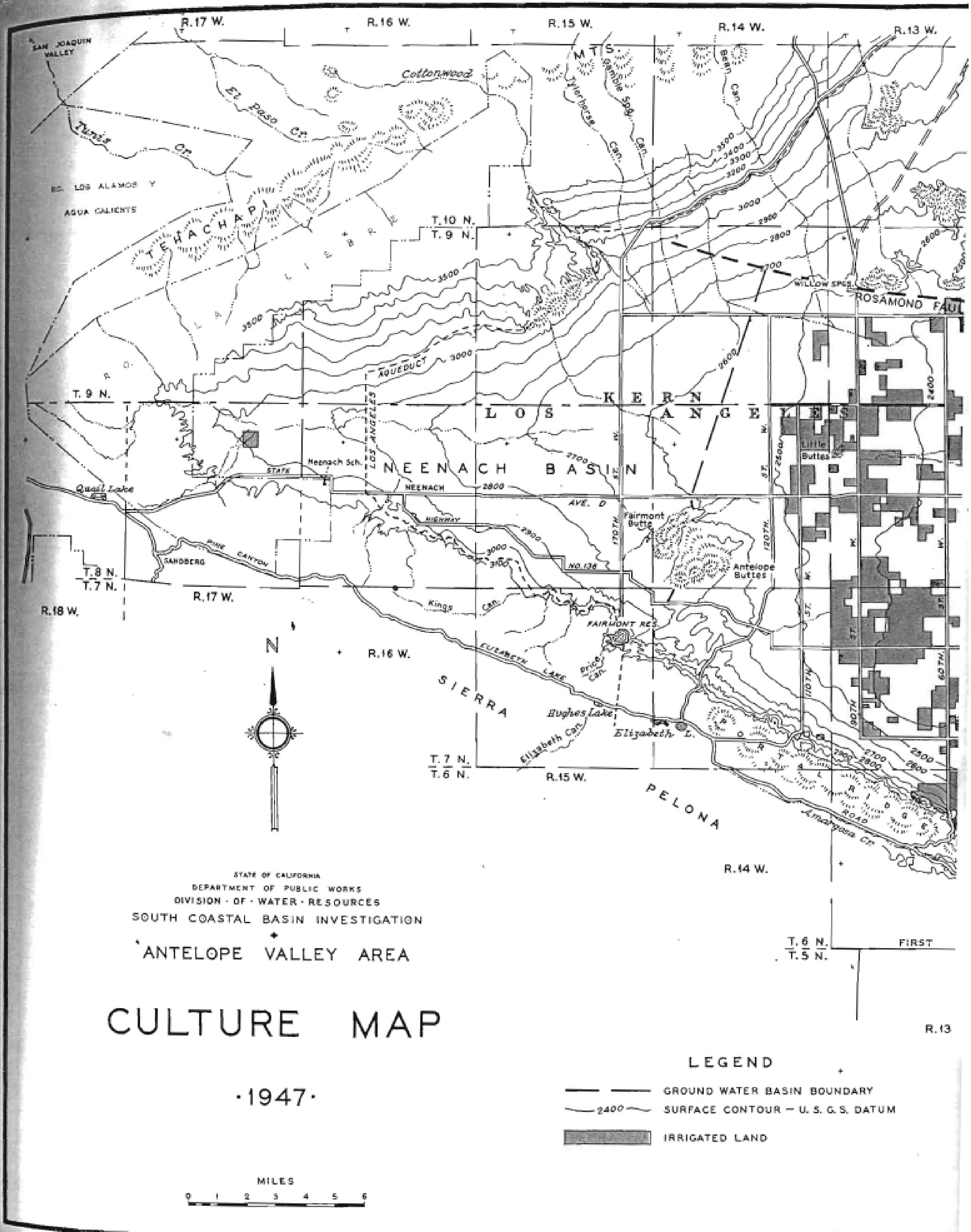
(3) Measurements of depth to ground water made by the United States Geological Survey and Los Angeles County Flood Control District, and analyses by the Division of Water Resources based on these measurements should be continued, to augment crop data presented annually by the County Agricultural Commissioner in a periodic appraisal of the situation.

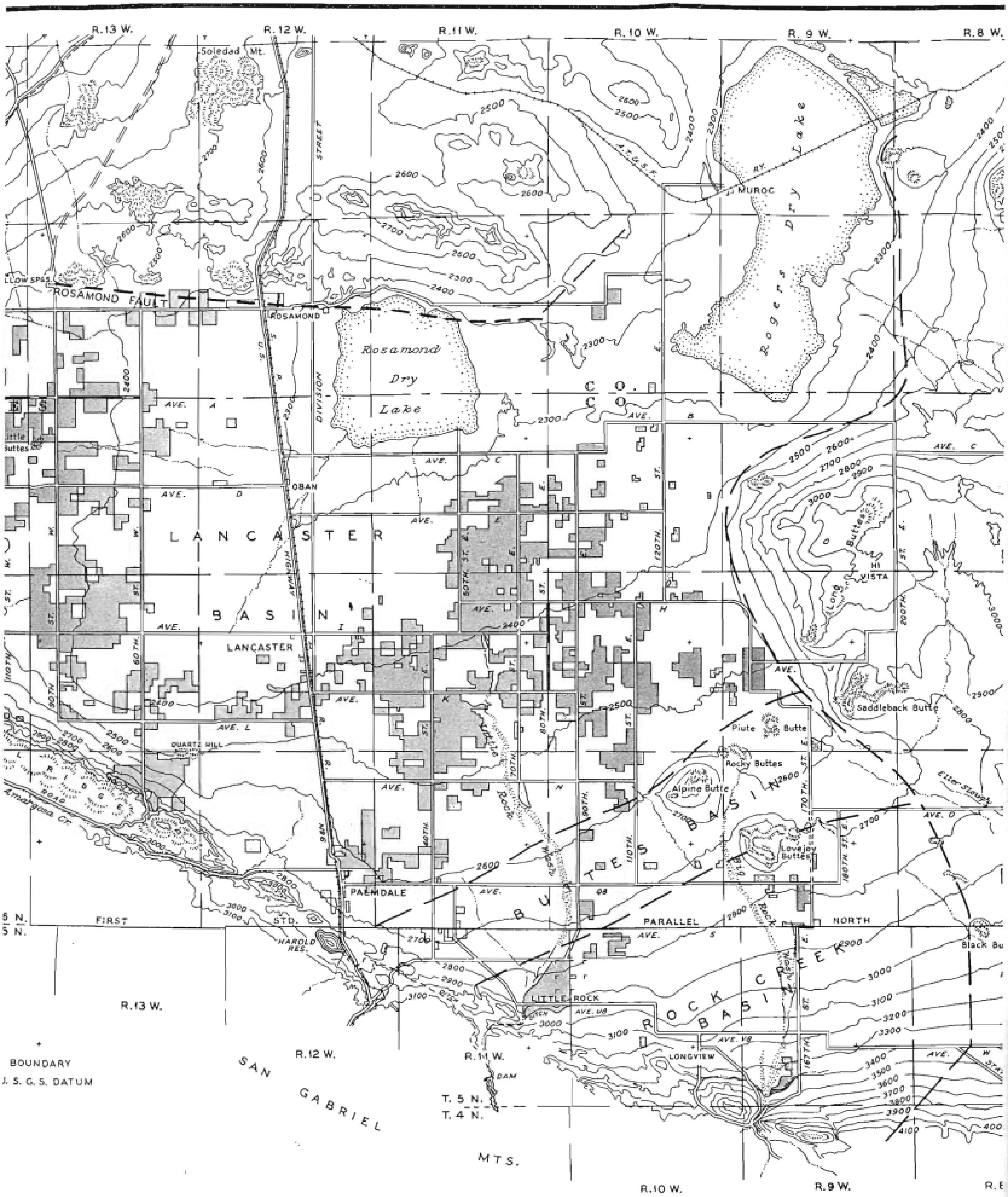
(4) As lands go out of production because of economic pressure or from other causes, they should be acquired and held by a properly constituted public agency. Lands sold to the State for taxes should not again be put on the open market. If publicly owned, these lands could still be used under lease or permit, but with cropping and water use restricted.



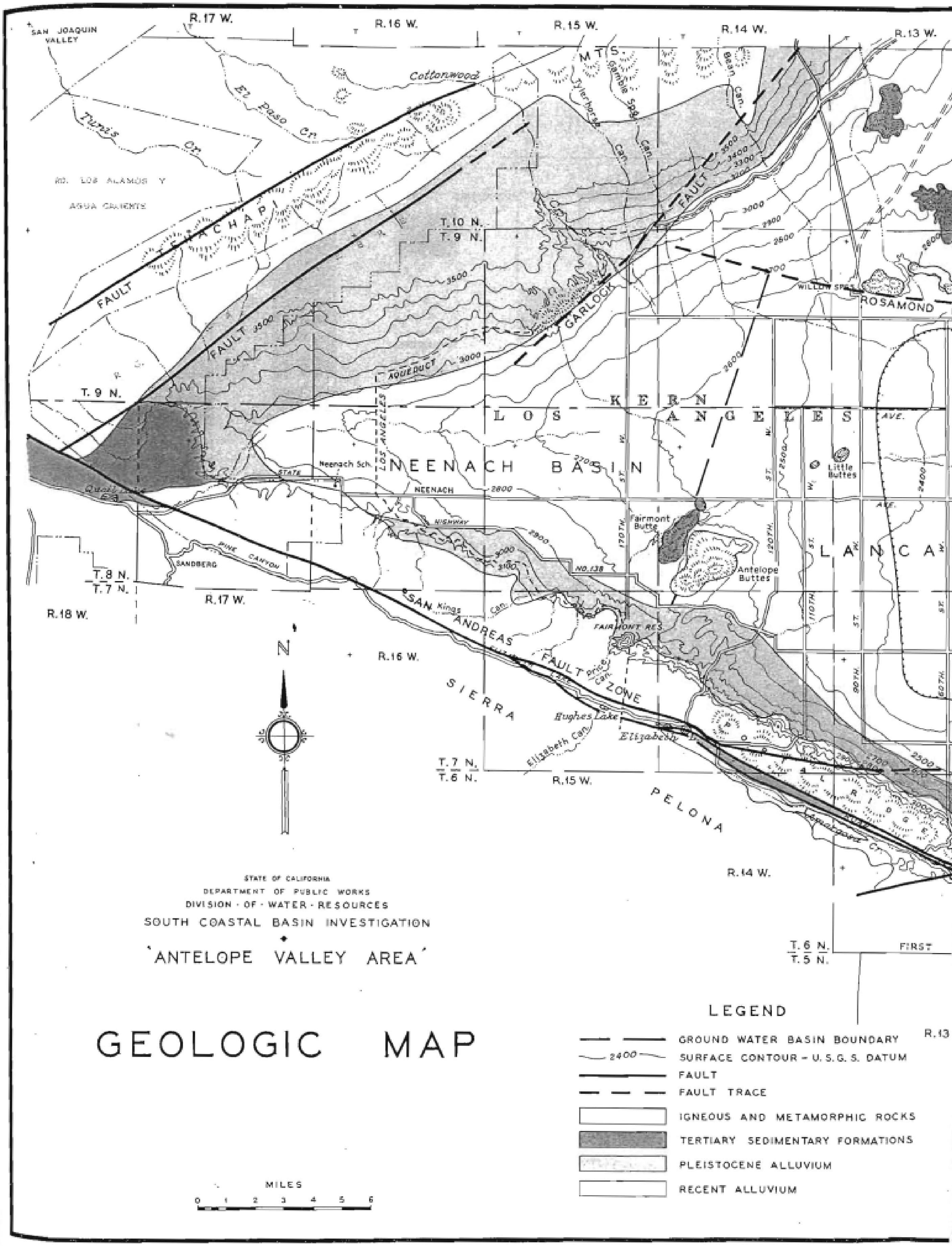
ELEVATION OF WATER TABLE AT WELLS

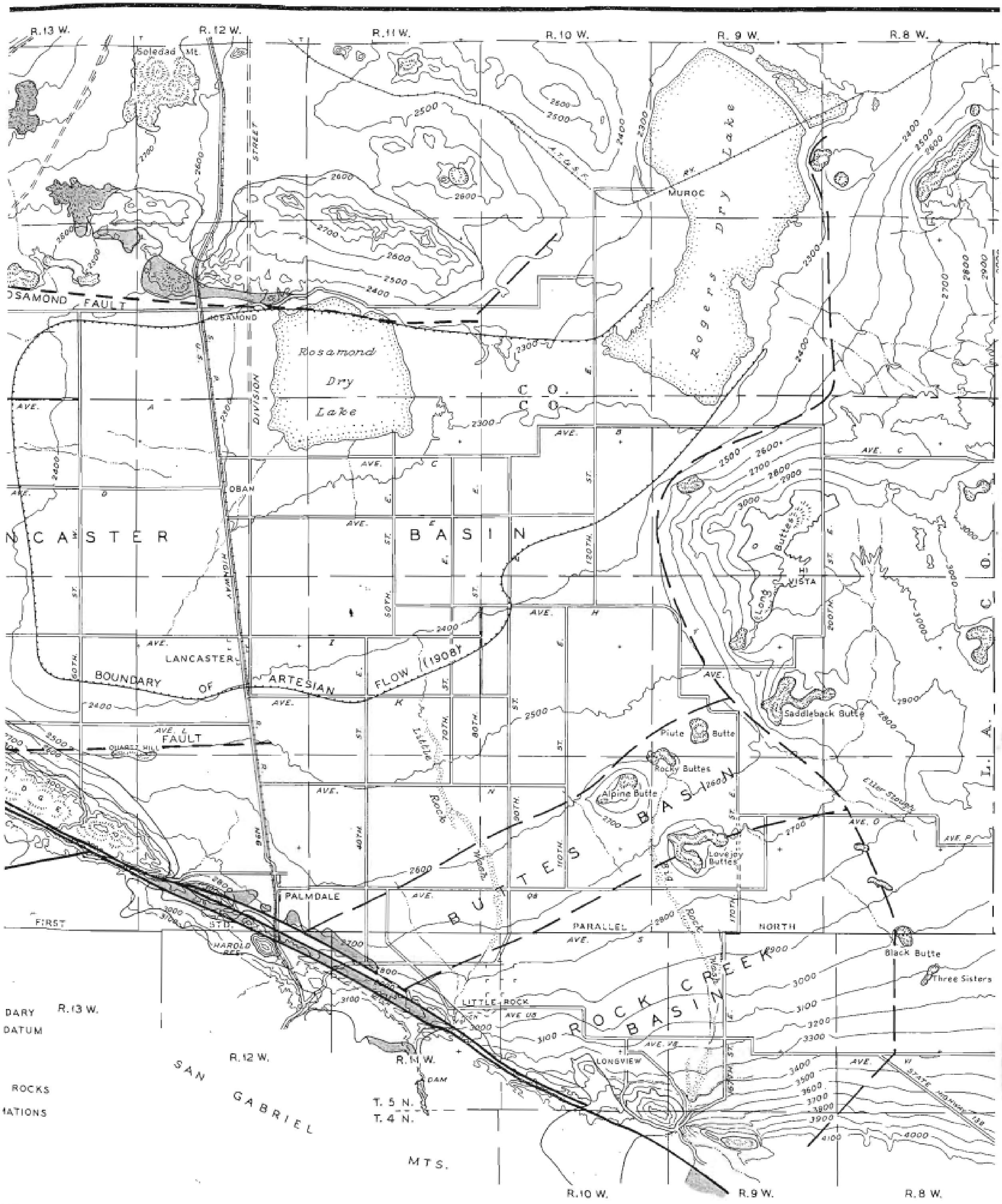
REFER TO PLATE 9 FOR LOCATION OF WELLS

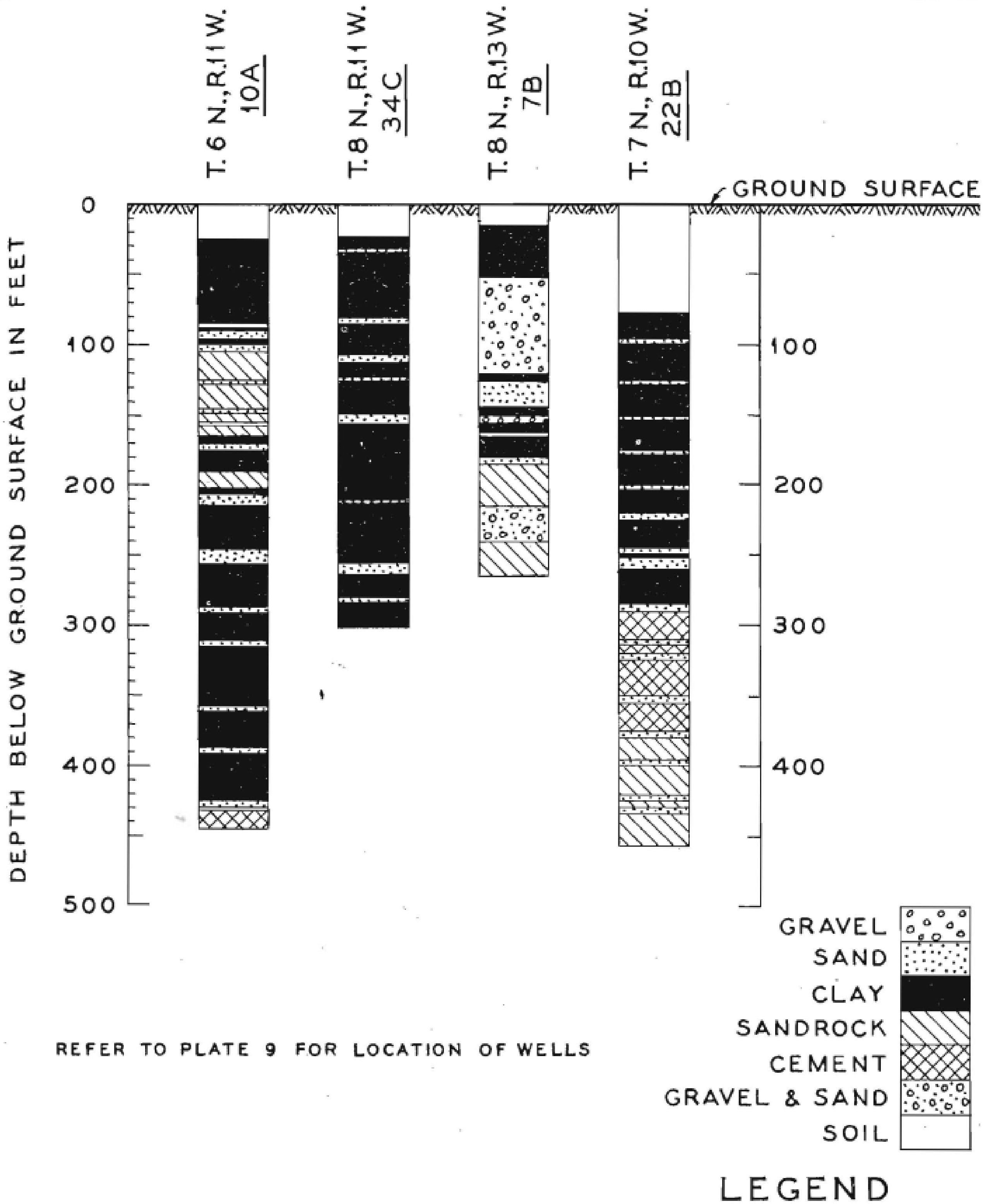

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION · OF · WATER · RESOURCES
SOUTH COASTAL BASIN INVESTIGATION
ANTELOPE VALLEY AREA
CULTURE MAP
·1947·
LEGEND
GROUND WATER BASIN BOUNDARY
2400 SURFACE CONTOUR — U. S. G. S. DATUM
IRRIGATED LAND
MILES
0 1 2 3 4 5 6
R.17 W.
R.16 W.
R.15 W.
R.14 W.
R.13 W.
R.18 W.
T.10 N.
T.9 N.
T.8 N.
T.7 N.
T.6 N.
T.5 N.
SAN JOAQUIN VALLEY
TEHACHAPI
MTS.
Cottonwood
El Paso Cr.
Tunis Cr.
RO. LOS ALAMOS Y AGUA CALIENTE
AQUEDUCT
LOS ANGELES
KERN
NEENACH BASIN
Neenach Sch.
NEENACH
STATE
HIGHWAY
NO. 138
AVE. D
Quail Lake
SANDBERG
PINE CANYON
Kings Can.
Fairmont Butte
Antelope Buttes
FAIRMONT RES.
Little Buttes
ROSAMOND FAULT
WILLOW SPGS.
ELIZABETH LAKE
Hughes Lake
Elizabeth L.
Elizabeth Can.
Price Can.
SIERRA PELONA
PORTAL RIDGE
Amargosa Cr.
FIRST
N



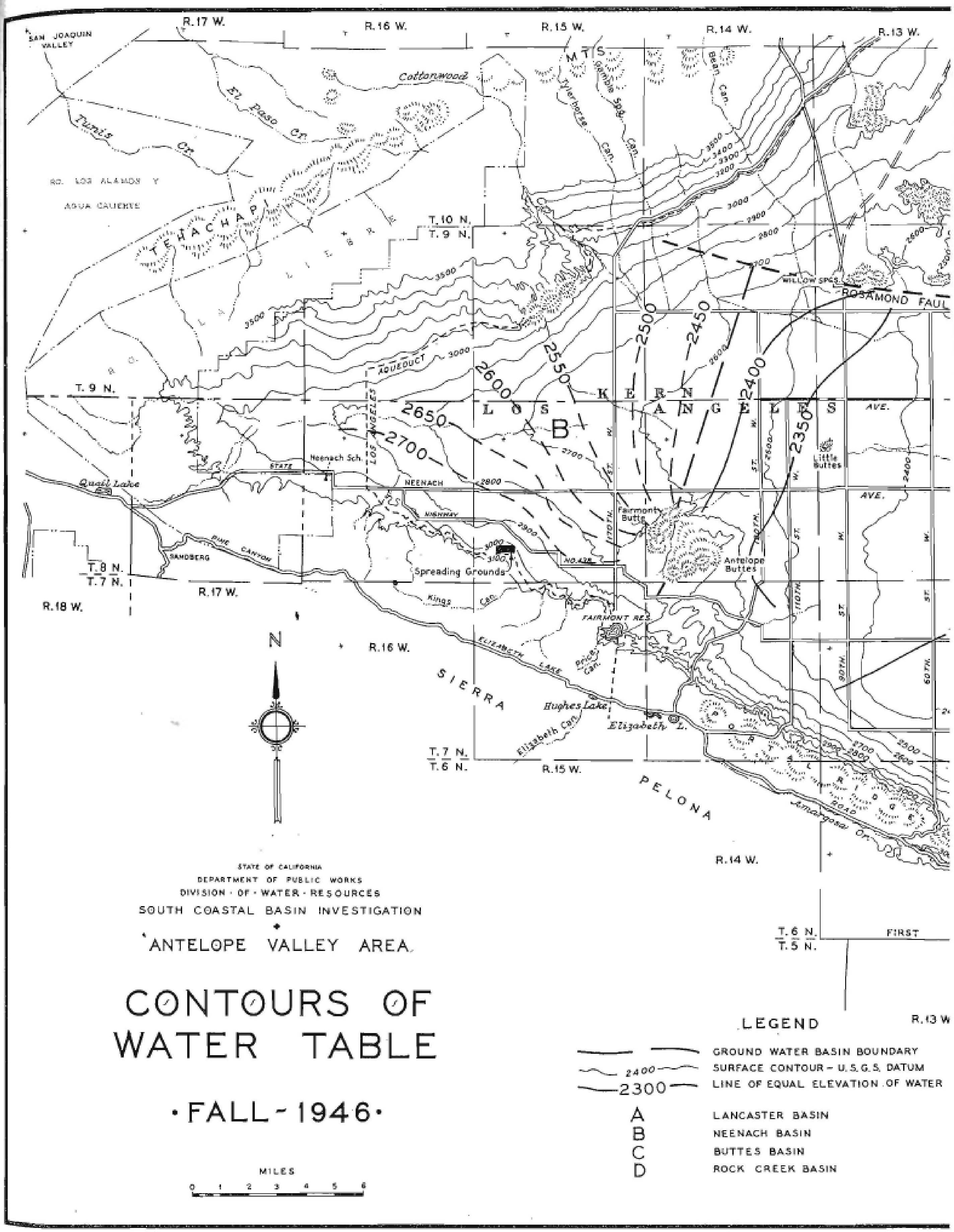
R.13 W.
R.12 W.
R.11 W.
R.10 W.
R.9 W.
R.8 W.
Soledad Mt.
MUROC
Rogers Dry Lake
A.T. & S.F. RY.
ROSAMOND FAULT
ROSAMOND
Rosamond Dry Lake
DIVISION STREET
CO.
AVE. A
AVE. B
AVE. C
AVE. D
AVE. E
AVE. I
AVE. L
AVE. O
OBAN
LANCASTER BASIN
LANCASTER
QUARTZ HILL
HIGHWAY
Little Buttes
Buttes
Long Buttes
HI VISTA
Saddleback Butte
Piute Butte
Rocky Buttes
Alpine Butte
Lovejoy Buttes
BUTTES BASIN
Elder Slough
Amargosa Cr.
PALMDALE
FIRST STD. PARALLEL NORTH
HAROLD RES.
Black Bu
LITTLE ROCK
ROCK CREEK BASIN
LONGVIEW
DAM
T. 5 N.
T. 4 N.
SAN GABRIEL MTS.
BOUNDARY
U. S. G. S. DATUM

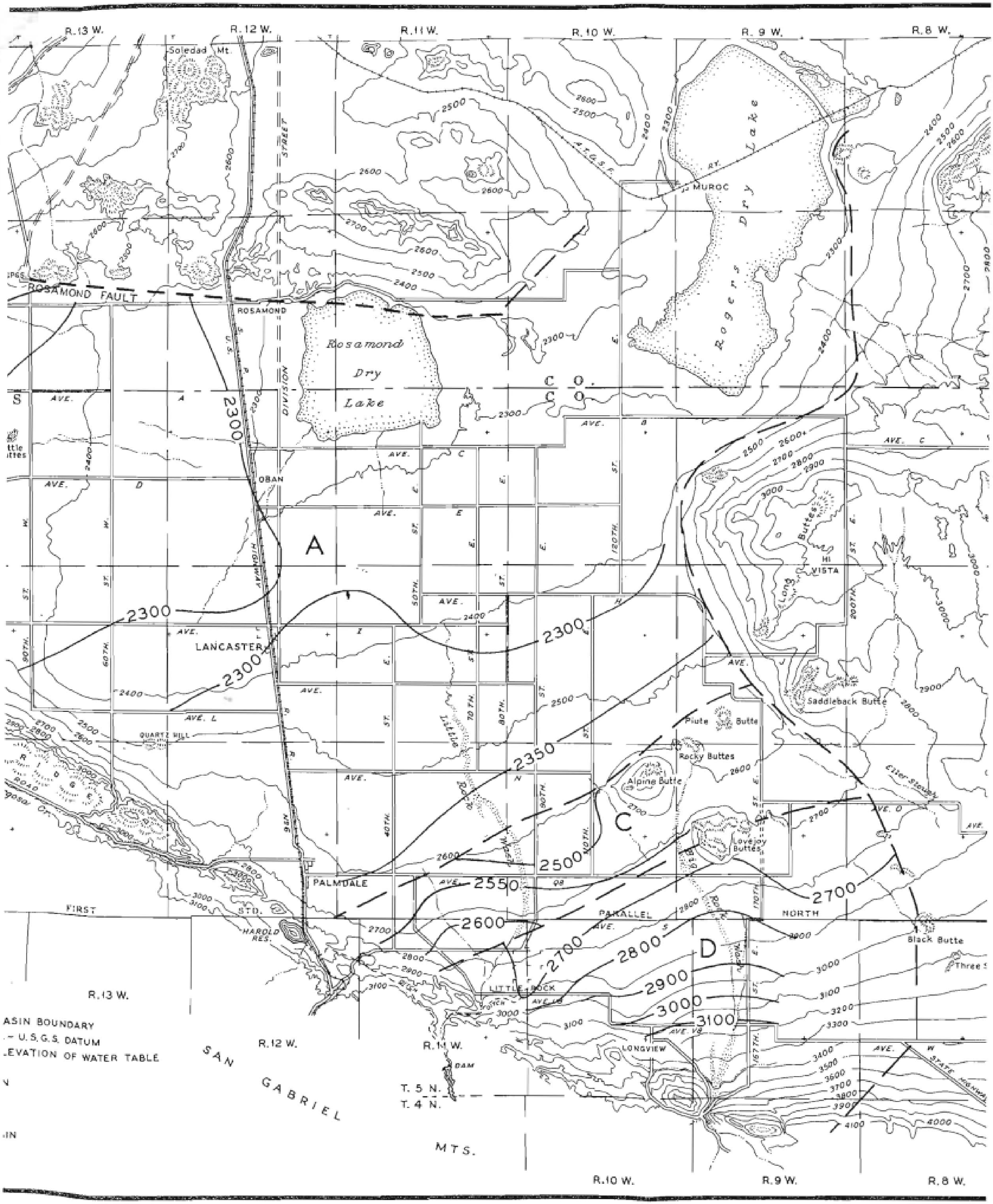

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES
SOUTH COASTAL BASIN INVESTIGATION
"ANTELOPE VALLEY AREA"
GEOLOGIC MAP
LEGEND
GROUND WATER BASIN BOUNDARY
2400 SURFACE CONTOUR - U. S. G. S. DATUM
FAULT
FAULT TRACE
IGNEOUS AND METAMORPHIC ROCKS
TERTIARY SEDIMENTARY FORMATIONS
PLEISTOCENE ALLUVIUM
RECENT ALLUVIUM
MILES
0 1 2 3 4 5 6
SAN JOAQUIN VALLEY
R.17 W.
R.16 W.
R.15 W.
R.14 W.
R.13 W.
R.18 W.
T.10 N.
T.9 N.
T.8 N.
T.7 N.
T.6 N.
T.5 N.
Cottonwood
El Paso Cr.
Tunis Cr.
TEHACHAPI
FAULT
GARLOCK
ROSAMOND
WILLOW SPGS.
KERN
LOS ANGELES
NEENACH BASIN
Neenach Sch.
NEENACH
AQUEDUCT
HIGHWAY
NO. 138
Fairmont Butte
Antelope Buttes
Little Buttes
LANCAS
FAIRMONT RES.
SANDBERG
PINE CANYON
SAN ANDREAS FAULT ZONE
Kings Can.
Price Can.
SIERRA
PELONA
Hughes Lake
Elizabeth Can.
Elizabeth L.
Amargosa Cr.
Tylerhorse Can.
Gamble Spg. Can.
Bean Can.
FIRST
R.13

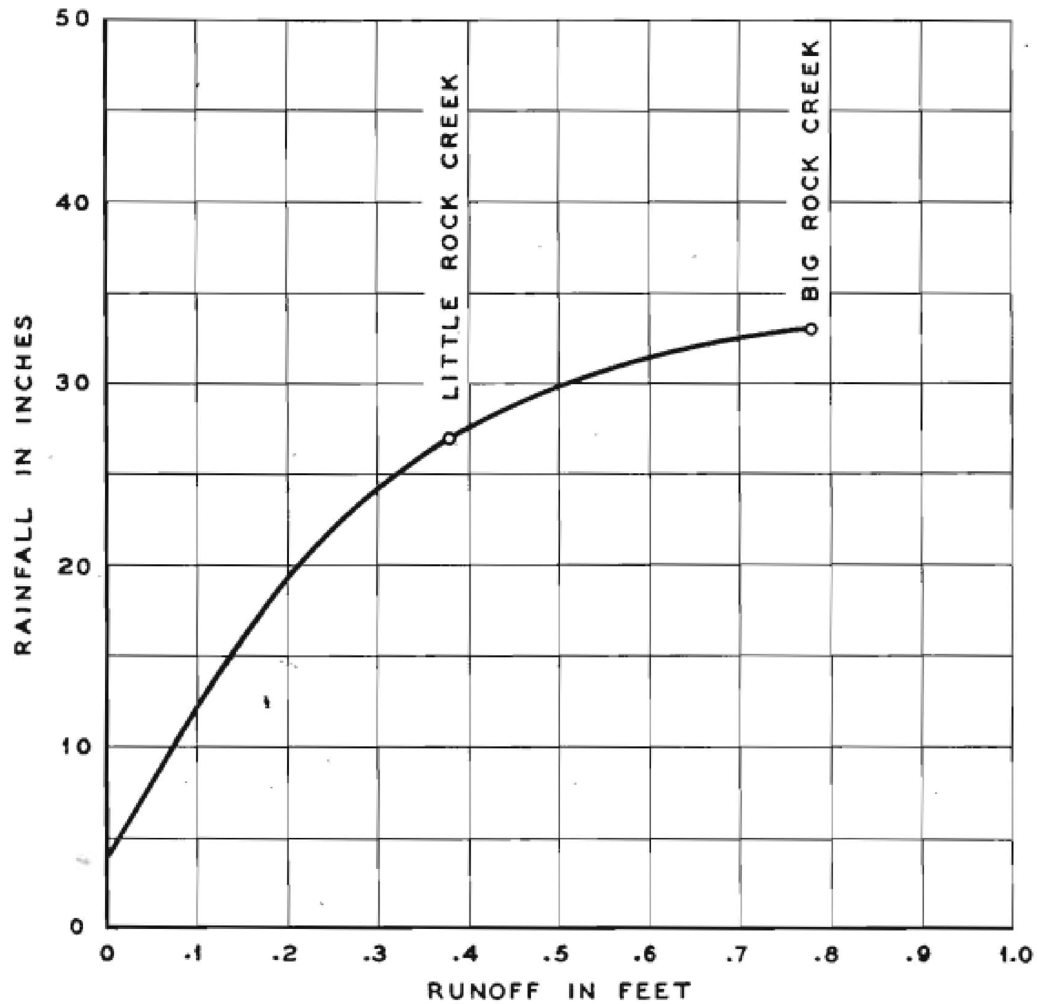

R.13 W.
R.12 W.
R.11 W.
R.10 W.
R.9 W.
R.8 W.
Soledad Mt.
ROSAMOND FAULT
ROSAMOND
Rosamond Dry Lake
MUROC
Rogers Dry Lake
A.T.&S.F. RY.
DIVISION STREET
CO.
LANCASTER BASIN
OBAN
LANCASTER
BOUNDARY OF ARTESIAN FLOW (1908)
AVE. L FAULT
QUARTZ HILL
Little Rock Wash
Long Buttes
HI VISTA
Saddleback Butte
Piute Butte
Rocky Buttes
Alpine Butte
Lovejoy Buttes
BUTTES BASIN
Elder Slough
L. A. CO.
PALMDALE
FIRST STD. PARALLEL NORTH
HAROLD RES.
Black Butte
Three Sisters
ROCK CREEK BASIN
LITTLE ROCK
LONGVIEW
STATE HIGHWAY 138
SAN GABRIEL MTS.
T. 5 N.
T. 4 N.
DAM
DARY
DATUM
ROCKS
MATIONS



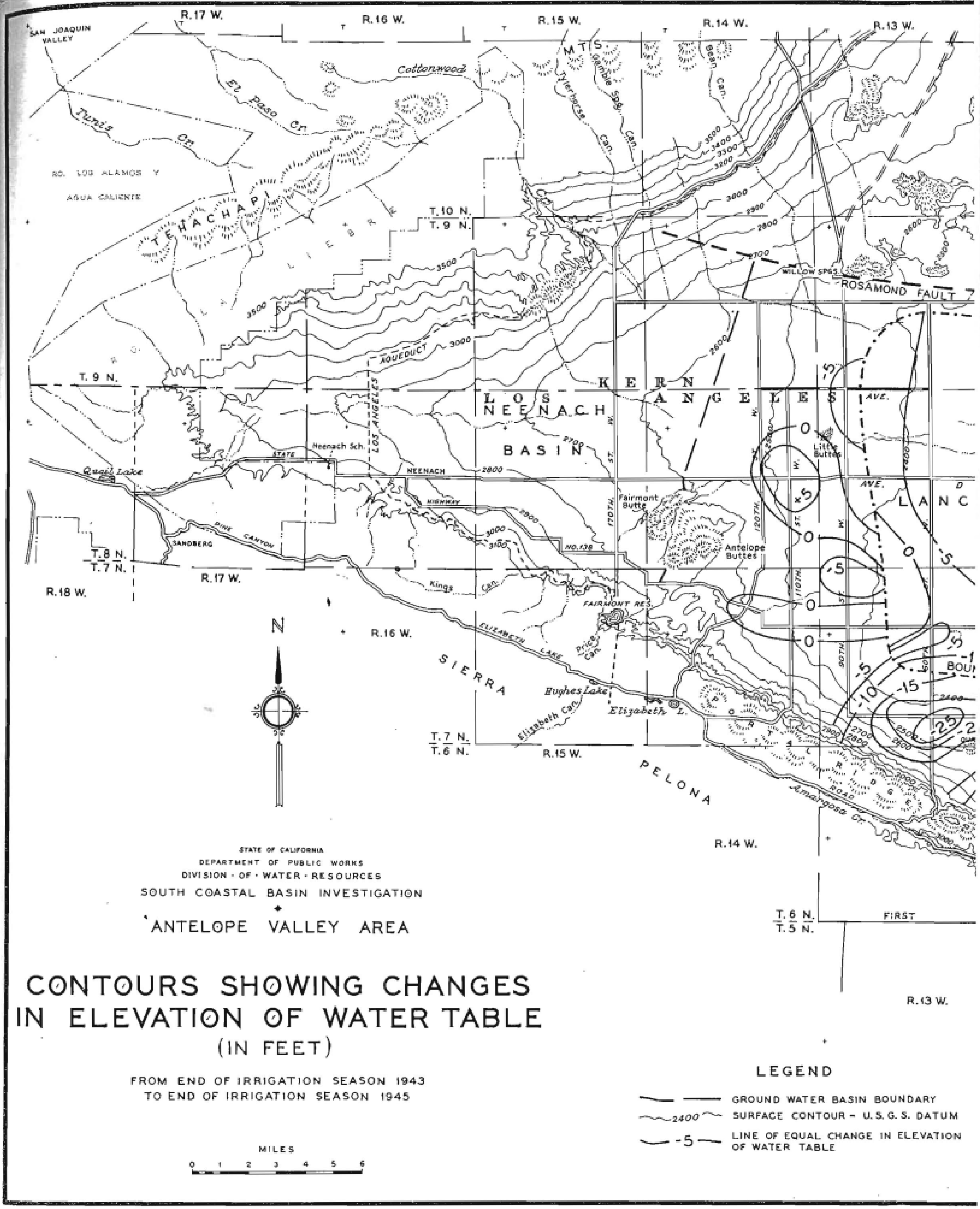
GRAPHIC LOGS OF TYPICAL WELLS IN ANTELOPE VALLEY


STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION · OF · WATER · RESOURCES
SOUTH COASTAL BASIN INVESTIGATION
ANTELOPE VALLEY AREA
CONTOURS OF WATER TABLE
·FALL-1946·
MILES
0 1 2 3 4 5 6
LEGEND
GROUND WATER BASIN BOUNDARY
2400 SURFACE CONTOUR – U.S.G.S. DATUM
2300 LINE OF EQUAL ELEVATION OF WATER
A LANCASTER BASIN
B NEENACH BASIN
C BUTTES BASIN
D ROCK CREEK BASIN
R.17 W.
R.16 W.
R.15 W.
R.14 W.
R.13 W.
R.18 W.
T.10 N.
T.9 N.
T.8 N.
T.7 N.
T.6 N.
T.5 N.
SAN JOAQUIN VALLEY
Cottonwood
El Paso Cr.
Tunis Cr.
TEHACHAPI
MTS.
RO. LOS ALAMOS Y AGUA CALIENTE
AQUEDUCT
LOS ANGELES
KERN
Neenach Sch.
NEENACH
STATE HIGHWAY
Quail Lake
PINE CANYON
SANDBERG
Spreading Grounds
Kings Can.
FAIRMONT RES.
Fairmont Butte
Antelope Buttes
Little Buttes
WILLOW SPGS.
ROSAMOND FAUL
Bean Can.
Hughes Lake
Elizabeth L.
Elizabeth Can.
ELIZABETH LAKE
SIERRA
PELONA
RIDGE
Amargosa Cr.
FIRST
AVE.
N


R. 13 W.
R. 12 W.
R. 11 W.
R. 10 W.
R. 9 W.
R. 8 W.
Soledad Mt.
ROSAMOND FAULT
ROSAMOND
Rosamond Dry Lake
Rogers Dry Lake
MUROC
A.T.&S.F. RY.
DIVISION STREET
U.S. HIGHWAY
OBAN
LANCASTER
QUARTZ HILL
PALMDALE
HAROLD RES.
LITTLE ROCK
LONGVIEW
Long Buttes
HI VISTA
Saddleback Butte
Piute Butte
Rocky Buttes
Alpine Butte
Lovejoy Buttes
Black Butte
Little Rock Wash
El Mirage
A
C
D
FIRST STD. PARALLEL NORTH
SAN GABRIEL MTS.
T. 5 N.
T. 4 N.
DAM
2300
2350
2500
2550
2600
2700
2800
2900
3000
3100
ASIN BOUNDARY
- U.S.G.S. DATUM
LEVATION OF WATER TABLE



RELATION BETWEEN
LONG-TIME MEAN PRECIPITATION AND DEPTH
OF RUNOFF FOR MOUNTAIN WATERSHEDS
ANTELOPE VALLEY

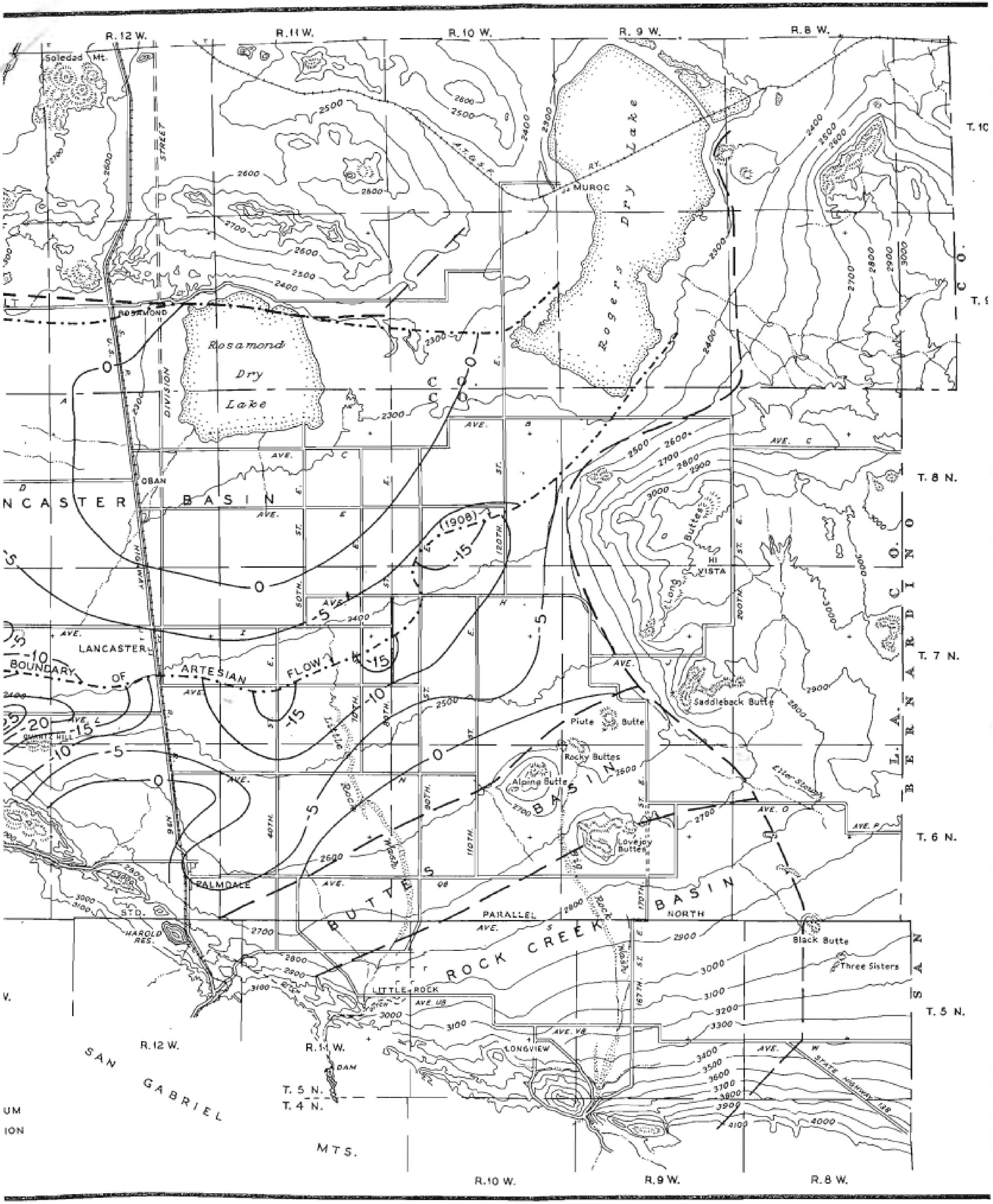


STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION · OF · WATER · RESOURCES
SOUTH COASTAL BASIN INVESTIGATION

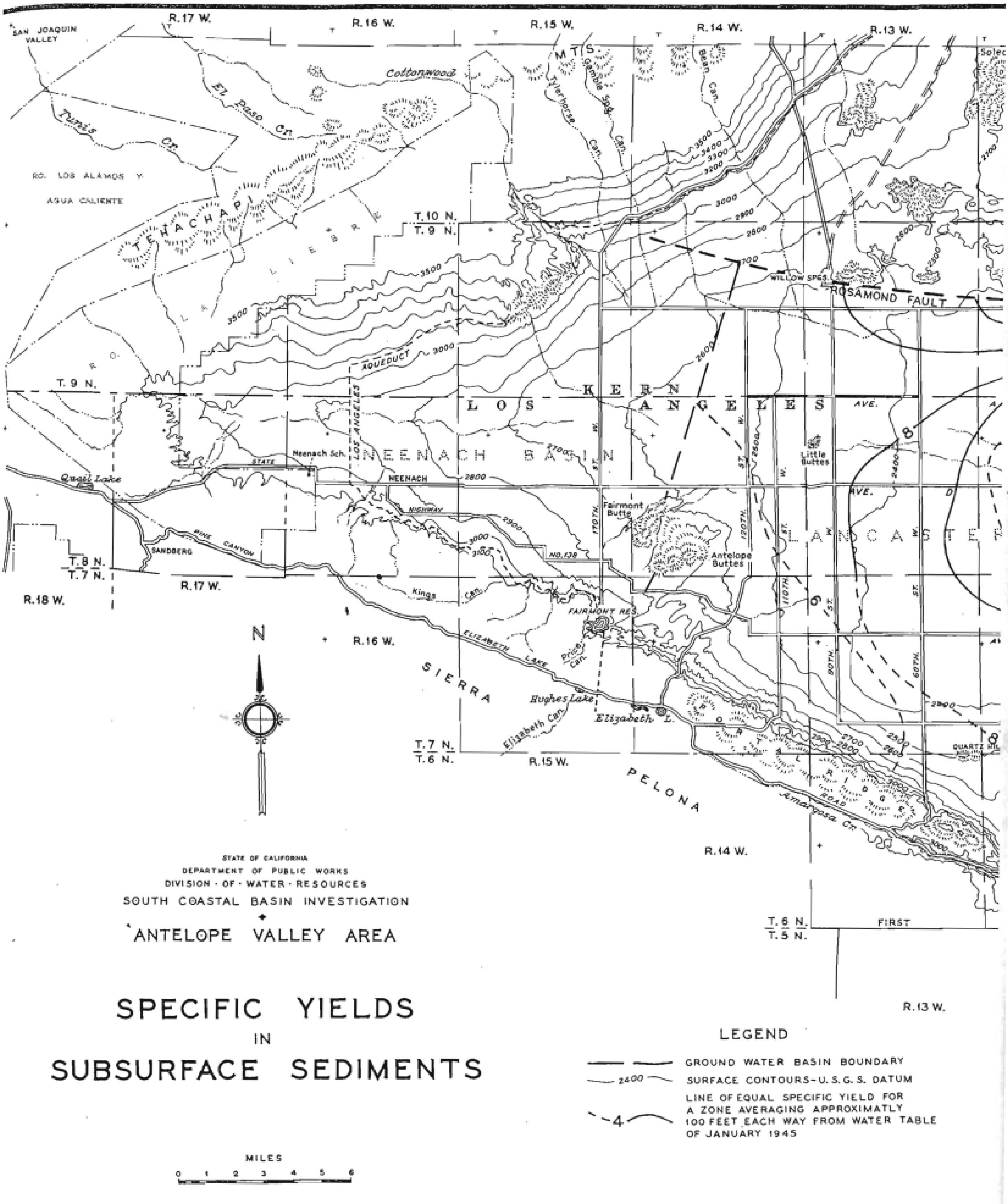
ANTELOPE VALLEY AREA

CONTOURS SHOWING CHANGES IN ELEVATION OF WATER TABLE (IN FEET)

FROM END OF IRRIGATION SEASON 1943
TO END OF IRRIGATION SEASON 1945



PWS-0051-0037



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION · OF · WATER · RESOURCES
SOUTH COASTAL BASIN INVESTIGATION

ANTELOPE VALLEY AREA

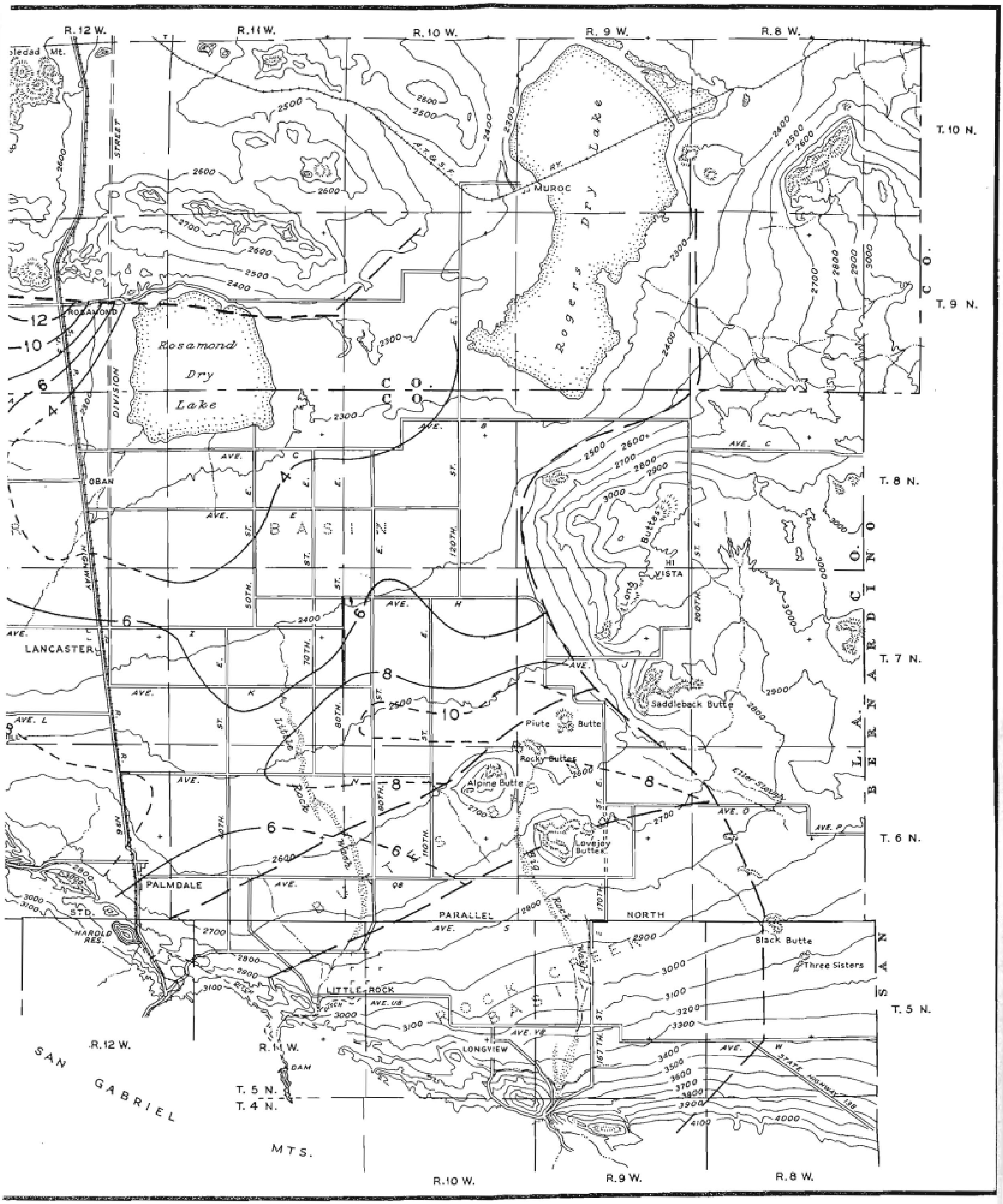
SPECIFIC YIELDS IN SUBSURFACE SEDIMENTS

LEGEND

GROUND WATER BASIN BOUNDARY

2400 SURFACE CONTOURS - U. S. G. S. DATUM

4 LINE OF EQUAL SPECIFIC YIELD FOR A ZONE AVERAGING APPROXIMATLY 100 FEET EACH WAY FROM WATER TABLE OF JANUARY 1945



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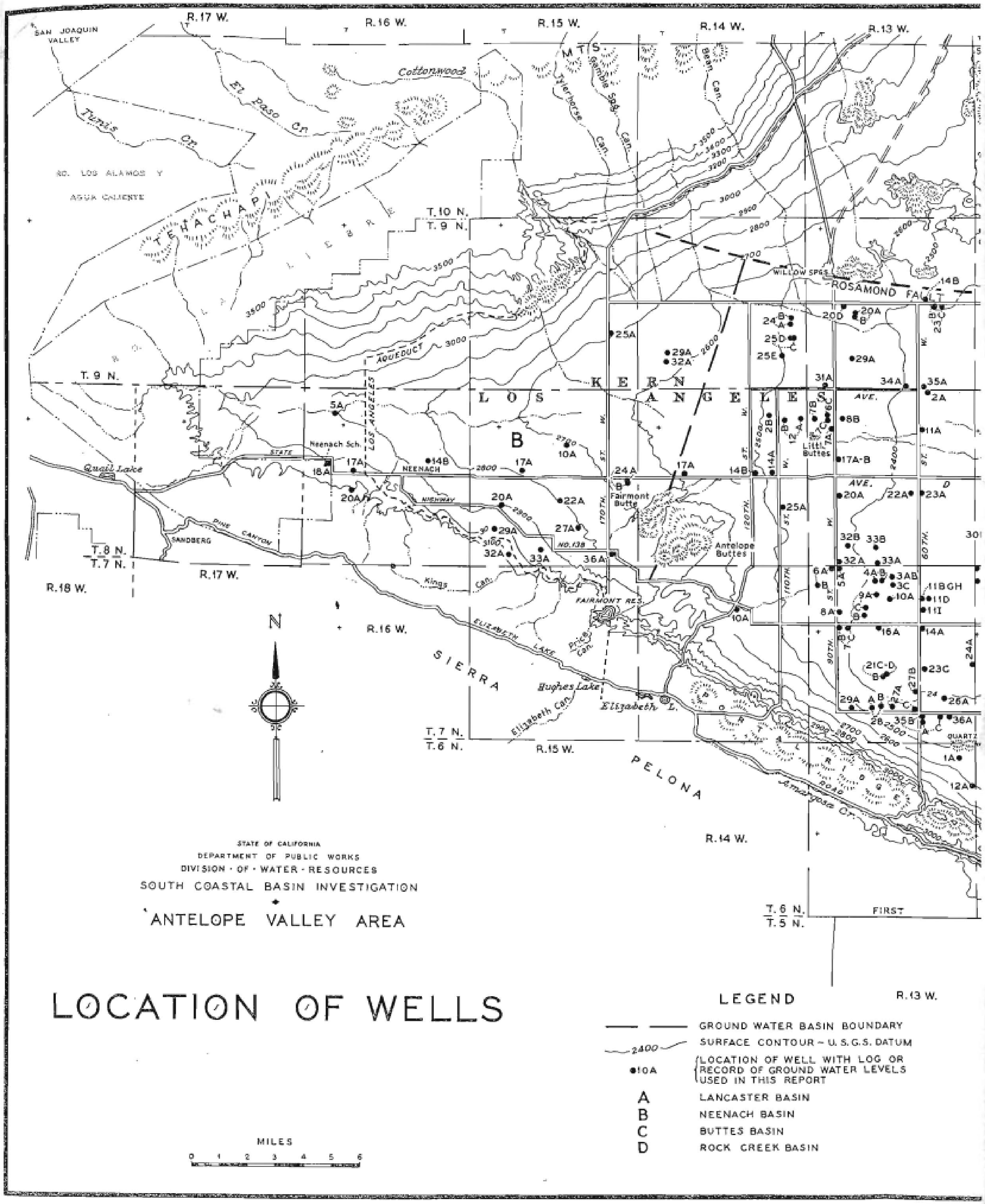
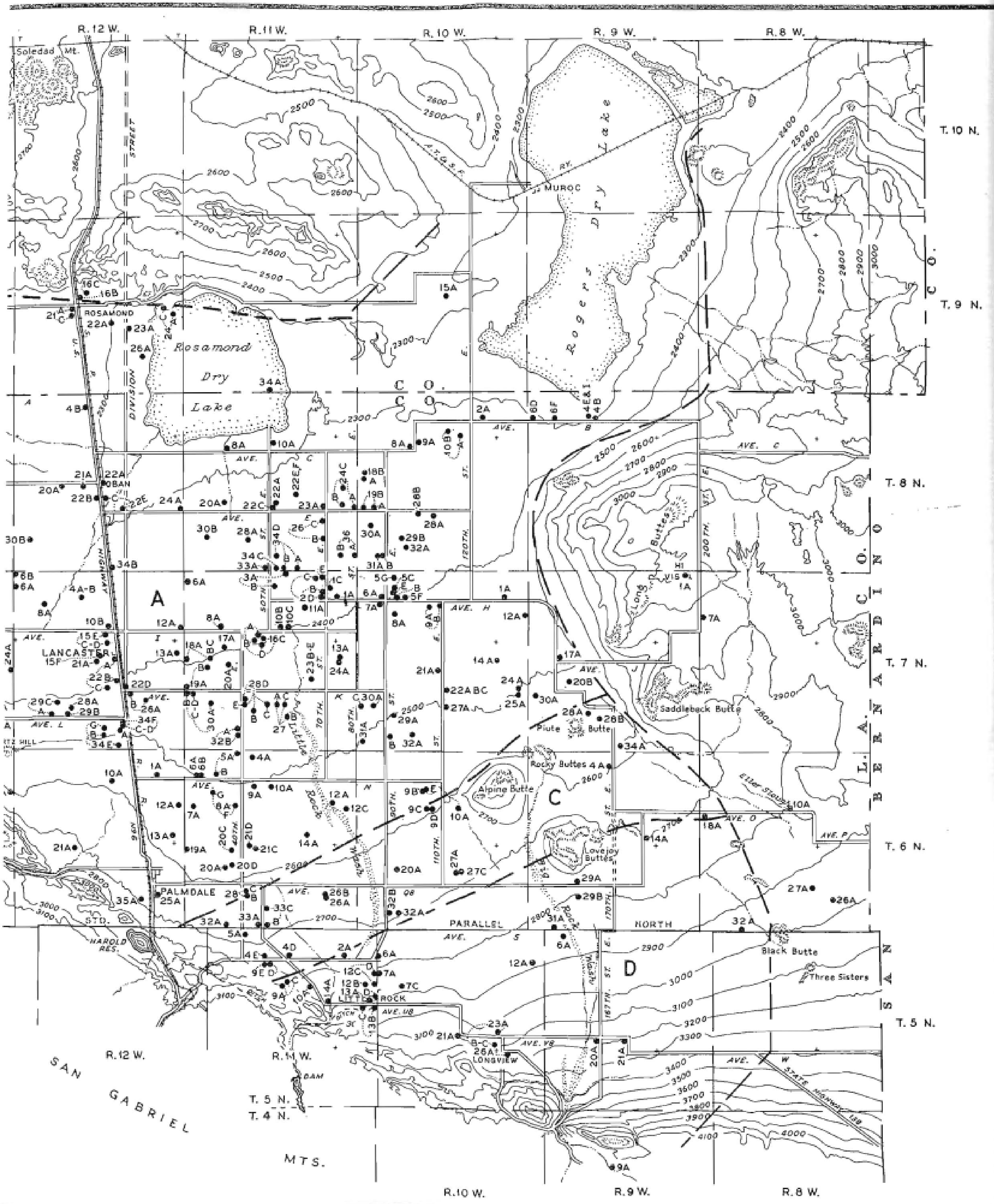


LOCATION OF WELLS


R. 12 W.
R. 11 W.
R. 10 W.
R. 9 W.
R. 8 W.
T. 10 N.
T. 9 N.
T. 8 N.
T. 7 N.
T. 6 N.
T. 5 N.
T. 4 N.
Soledad Mt.
Rosamond
Rosamond Dry Lake
Muroc
Rogers Dry Lake
A.T.G.S.F. RY.
Division Street
Highway
Lancaster
Palmdale
Little Rock
Longview
Harold Res.
Buttes
Long View
Saddleback Butte
Piute Butte
Rocky Buttes
Alpine Butte
Lovejoy Buttes
Black Butte
Three Sisters
Little Rock Wash
Big Rock
Ave. C
Ave. H
Ave. L
Ave. O
Ave. P
Ave. W
Standard Parallel North
State Highway 138
San Gabriel Mts.
Kern Co.
L. A. Co.
San Bernardino Co.
A
C
D
R. 12 W.
R. 11 W.
R. 10 W.
R. 9 W.
R. 8 W.

APPENDIX

House Resolution No. 101

Relative to a survey of the water supply available to Antelope Valley.

WHEREAS, The Antelope Valley lying in the northern portion of Los Angeles Lounty and the southeastern portion of Kern County, consisting of approximately 15 by 30 miles of rich agricultural land, furnishes a large portion of the high quality vegetable and fruit produce sold on the Los Angeles market; and

WHEREAS, In early days irrigation in the Antelope Valley was possible from artesian wells, but through the years 1910 to 1925 the artesian wells disappeared and the general water level fell to approximately 70 to 75 feet below the surface of the valley on the average, and in the 20 years since 1925 has fallen to approximately 160 to 165 feet below the level of the valley; and

WHEREAS, The recharge to the underground water table in Antelope Valley is insufficient to maintain a static level and the present serious water shortage in the valley would be further aggravated by any year or years in which rainfall would be below normal; and

WHEREAS, Much of the water available to the valley is from the melting snows in the higher mountains, the runoff from which in some years is wasted by virtue of its flash flood nature; now, therefore, be it

RESOLVED BY THE ASSEMBLY OF THE STATE OF CALIFORNIA, That the Division of Water Resources in the Department of Public Works and the State Water Resources Board are hereby requested to make such surveys of the water supply of the Antelope Valley as will enable them to report to the Legislature thereon at its next regular session, together with recommendations as to the means of assuring an adequate water supply and underground water table to the Antelope Valley; and be it further

RESOLVED, That the Chief Clerk of the Assembly is directed to transmit copies of this resolution to the State Engineer and to the Chairman of the State Water Resources Board.

Resolution read and adopted February 16, 1946.