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ANNUAL REPORT ON GROUND WATER IN ARIZONA SPRING 1966 TO SPRING 1967

BY

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PREPARED BY THE GEOLOGICAL SURVEY
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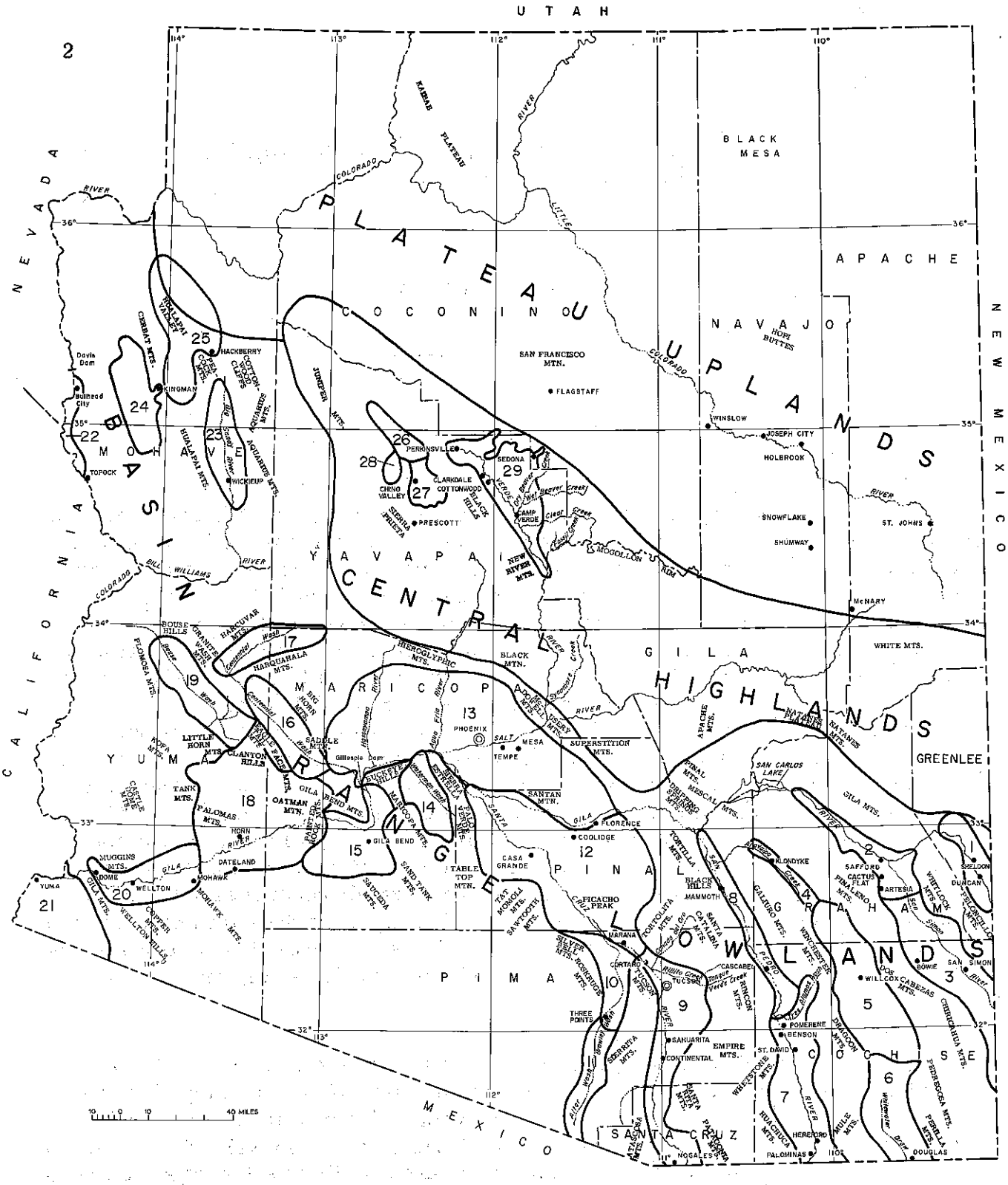
INTRODUCTION

Nearly two-thirds of Arizona's water supply is withdrawn from the ground-water reservoirs; the remaining one-third is from the surface-water reservoirs. Solutions to the problems that arise where ground water is withdrawn in large quantities require a comprehensive knowledge of the storage capacity of the aquifers and of the factors that control the transmission of water through them. In July 1939 the State of Arizona began a program for the collection of ground-water data in order to obtain this knowledge. Since 1942, a cooperative agreement that provides for equal financial participation in a planned program of ground-water studies has been in effect between the U.S. Geological Survey and the Arizona State Land Department; prior to 1942 the State was represented by the State Water Commissioner. The current program of ground-water studies is under the immediate supervision of H. M. Babcock, district chief of the Water Resources Division of the U.S. Geological Survey in Arizona; the program includes the collection of geologic and hydrologic data necessary to evaluate the ground-water resources of the State. More important, it includes compilation and analysis of the data and research into new and more advanced methods of analysis that provide quantitative solutions to the problems of availability, effects of withdrawal, and changes in chemical quality of the water.

This report includes graphs showing water levels in selected wells and estimated annual ground-water pumpage in most of the developed areas in Arizona. The report includes maps showing (1) depth to water in selected wells in spring 1967, (2) change in water level in selected wells from 1962 to 1967, and (3) potential well production by areas. Figure 1 shows the areas for which ground-water data are given; the well-numbering system used in Arizona is explained and illustrated in figure 2. Table 1 shows estimated annual ground-water pumpage by areas in the State for the entire period of record.

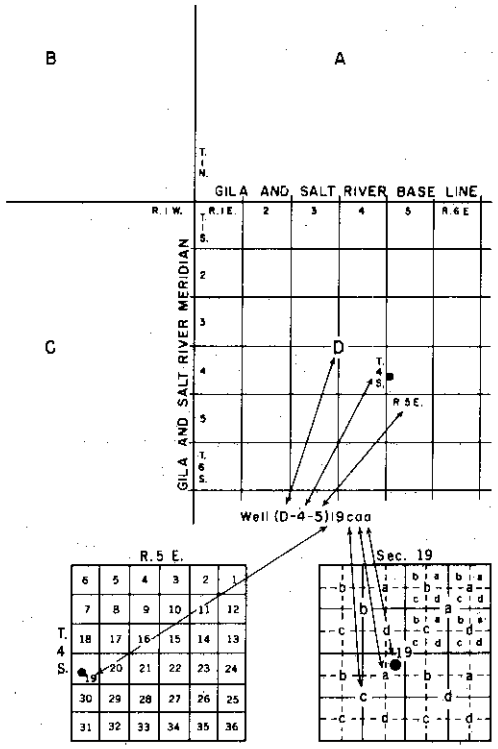


EXPLANATION

AREAS

1. DUNCAN BASIN
2. SAFFORD BASIN
3. SAN SIMON BASIN
4. ARAVAIPA VALLEY
5. WILLCOX BASIN
6. DOUGLAS BASIN
7. UPPER SAN PEDRO BASIN
8. LOWER SAN PEDRO BASIN
9. UPPER SANTA CRUZ BASIN
10. AVRA VALLEY
11. ALTAR VALLEY
12. LOWER SANTA CRUZ BASIN
13. SALT RIVER VALLEY
14. WATERMAN WASH
15. GILA BEND AREA
16. HARQUAHALA PLAINS AREA
17. McMULLEN VALLEY
18. PALOMAS PLAIN-SENTINEL PLAIN-DENDORA VALLEY AREA
19. RANEGRAS PLAIN AREA
20. WELLTON-MOHAWK AREA
21. YUMA AREA
22. COLORADO RIVER FLOOD PLAIN BELOW DAVIS DAM
23. BIG SANDY VALLEY
24. SACRAMENTO VALLEY
25. HUALAPAI VALLEY
26. BIG CHINO VALLEY
27. LITTLE CHINO VALLEY
28. WILLIAMSON VALLEY
29. VERDE VALLEY

Figure 1.—— Areas for which ground-water data are given.



The well numbers used by the Geological Survey in Arizona are in accordance with the Bureau of Land Management's system of land subdivision. The land survey in Arizona is based on the Gila and Salt River meridian and base line, which divide the State into four quadrants. These quadrants are designated counterclockwise by the capital letters A, B, C, and D. All land north and east of the point of origin is in A quadrant, that north and west in B quadrant, that south and west in C quadrant, and that south and east in D quadrant. The first digit of a well number indicates the township, the second the range, and the third the section in which the well is situated. The lowercase letters a, b, c, and d after the section number indicate the well location within the section. The first letter denotes a particular 160-acre tract, the second the 40-acre tract, and the third the 10-acre tract. These letters also are assigned in a counterclockwise direction, beginning in the northeast quarter. If the location is known within the 10-acre tract, three lowercase letters are shown in the well number. In the example shown, well number (D-4-5)19caa designates the well as being in the $NE\frac{1}{4}NE\frac{1}{4}SW\frac{1}{4}$ sec. 19, T. 4 S., R. 5 E. Where there is more than one well within a 10-acre tract, consecutive numbers beginning with 1 are added as suffixes.

Figure 2. --Well-numbering system in Arizona.

Scope of the Federal-State Cooperative Ground-Water Program

The Federal-State cooperative ground-water program in Arizona consists of three major parts: (1) statewide ground-water survey, (2) comprehensive ground-water investigations in selected areas, and (3) studies related to specific hydrologic problems. The three parts of the program are related closely and to a large extent are interdependent. The statewide ground-water survey provides the long-term basic records necessary to any type of ground-water investigation. The work includes well inventories, periodic water-level measurements and well-discharge measurements, collection of water samples for chemical analysis, and collection and cataloging of drill cuttings from recently completed wells. Some of these data are summarized in the "Annual Report on Ground Water in Arizona." The report is published by the Arizona State Land Department, and copies are available to the public. An additional phase of the statewide ground-water survey provides for a more detailed analysis of current ground-water conditions in selected areas on a periodic basis. The reports that result from these analyses relate water-level changes to ground-water pumpage, and, where possible, give estimates of the amount of ground water remaining in storage. Comprehensive ground-water investigations in selected areas are made where special interest or problems exist. These more comprehensive investigations result in an overall evaluation of the ground-water resources of the area. Studies related to specific hydrologic problems include a more specialized type of analysis of the geologic and hydrologic environment. Included in this part of the program are: studies related to some specific phase of the hydrologic cycle, studies of subsidence and earth cracks as related to the compaction of sediments due to dewatering, and research into new and better methods of data collection and analysis.

Summary of Current Ground-Water Programs in Arizona

In addition to the statewide ground-water survey, field investigations were in progress for 3 projects, and reports were in different stages of completion for 12 projects under the Federal-State cooperative program in 1966. Work also was in progress under agreements with several other cooperators in 1966. Studies were being conducted in cooperation with the University of Arizona, the city of Tucson, the city of Flagstaff, the Salt River Valley Water Users' Association, the city of Scottsdale, the Navajo Tribe, and the Maricopa County Municipal Water Conservation District. Cooperation with other Federal agencies included projects for the U. S. Army, Bureau of Sport Fisheries and Wildlife, Bureau of Reclamation, Bureau of Indian Affairs, and National Park Service. Figure 3 is a pictorial summary of the status of current ground-water work in Arizona.

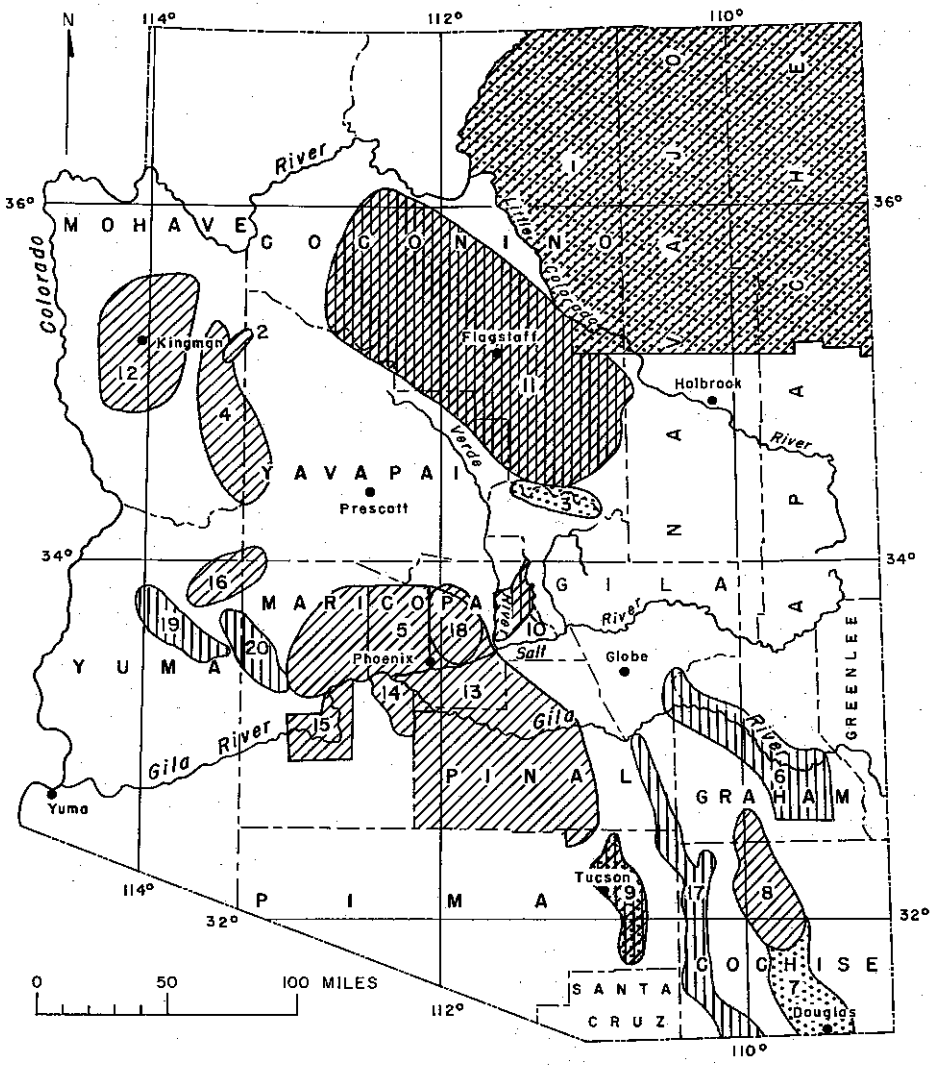
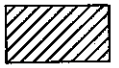


Figure 3.--Summary of current ground-water programs.

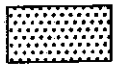
SUMMARY OF GROUND-WATER PROGRAMS

1. Navajo-Hopi Indian Reservations
2. Cottonwood Wash
3. East Verde River
4. Big Sandy Valley
5. Western part of the Salt River Valley (Beardsley area)
6. Arid-lands study (Safford Valley)
7. Douglas basin
8. Willcox basin
9. Tucson basin
10. Sycamore Creek
11. Southern Coconino County
12. Sacramento and Hualapai Valleys (Kingman area)
13. Part of central Arizona
14. Waterman Wash area
15. Gila Bend area
16. McMullen Valley
17. San Pedro River valley
18. Paradise Valley
19. Ranegras Plain area
20. Harquahala Plains area

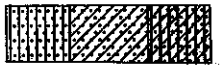
Area where field investigation is in progress
(As of June 1967)



Area for which a report is in preparation
(as of June 1967)



Area for which a report was released
July 1966-June 1967



A multiple pattern indicates that, although a report was released in the prescribed period, further work and (or) reports also are in progress

Current Publications of the Arizona District

The following reports on the water resources and geology of Arizona were published or released to the open file from July 1, 1966, through June 30, 1967.

Water-resources data for Arizona, 1965—Part 1: Surface-water records, by U. S. Geological Survey: U. S. Geol. Survey open-file report, 1965. 212 p., 2 figs.

Glaciation, erosion, and sedimentation in the basin-and-range country [abs.], by M. E. Cooley: Boulder and Denver, Internat. Assoc. Quaternary Research, 7th Internat. Cong., Gen. Sessions, August 30-September 5, 1965. p. 73.

Floods of December 1965 to January 1966 in the Salt and Gila Rivers downstream from Granite Reef Dam, Arizona, by B. N. Aldridge: U. S. Geol. Survey open-file report, October 1966. 78 p., 13 figs., 4 tables.

Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part IV, Maps showing locations of wells, springs, and stratigraphic sections, by M. E. Cooley and others: Arizona State Land Dept. Water-Resources Rept. 12-D, October 1966. 2 sheets.

Geohydrologic data in the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah—Part I-A—Supplemental records of ground-water supplies, by E. H. McGavock, R. J. Edmonds, E. L. Gillespie, and P. C. Halpenny: Arizona State Land Dept. Water-Resources Rept. 12-E, November 1966. 55 p., 4 figs.

Anticipated changes in the flow regimen caused by the addition of water to the East Verde River, Arizona, by H. W. Hjalmarson and E. S. Davidson: Arizona State Land Dept. Water-Resources Rept. 28, November 1966. 10 p., 3 figs.

Infiltration and recharge from the flow of April 1965 in the Salt River near Phoenix, Arizona, by P. C. Briggs and L. L. Werho: Arizona State Land Dept. Water-Resources Rept. 29, November 1966. 12 p., 7 figs.

Ground water in Arizona, with special reference to the lower Santa Cruz basin and the Salt River Valley, by R. H. Musgrove: Arizona Water and Pollution Control Assoc. Bull., v. 26, no. 1, 1966. p. 40-52, 7 figs.

Activities of Water Resources Division in Arizona, by U. S. Geological Survey: U. S. Geol. Survey open-file report, 1967. 13 p., 1 fig.

Floods from small drainage areas in Arizona, by D. E. Click and B. N. Aldridge: U. S. Geol. Survey open-file report, March 1967. 26 p., 1 pl., 3 figs., 2 tables.

Streamflow and flood characteristics, Pima County, Arizona (A progress report), by Alberto Condes de la Torre: U. S. Geol. Survey open-file report, March 1967. 24 p., 7 figs., 2 tables.

Geomorphology of the Tucson basin, Arizona [abs.], by E. F. Pashley, Jr.: Tucson, Am. Assoc. Adv. Sci., 43d ann. mtg., 1967. p. 21.

Water resources of Arizona under constant investigation, by U.S. Geological Survey: Arizona Prof. Engineer, v. 19, no. 5, May 1967. p. 8-9, 2 figs.

Hydrologic conditions in the Douglas basin, Cochise County, Arizona, by N. D. White and Dallas Childers: Arizona State Land Dept. Water-Resources Rept. 30, May 1967. 26 p., 9 figs.

Stream gaging by continuous injection of tracer elements, by W. L. Werrell: U.S. Geol. Survey open-file report, May 1967. 85 p., 11 figs., 1 table.

Post-Pleistocene alluviation and erosion in the lower San Juan drainage area, by Deric O'Bryan, M. E. Cooley, and T. C. Winter: Am. Geophys. Union Trans., v. 48, no. 2, June 1967. p. 795-797, 3 figs.

Compilation of flood data for Maricopa County, Arizona, through September 1965, by L. L. Werho: Arizona State Land Dept. Water-Resources Rept. 31, June 1967. 36 p., 1 fig., 3 tables.

Annual report on ground water in Arizona, spring 1965 to spring 1966, by E. B. Hodges and others: Arizona State Land Dept. Water-Resources Rept. 32, June 1967. 61 p., 22 figs.

GROUND-WATER CONDITIONS BY AREAS

Arizona is divided into three water provinces in which the occurrence of ground water differs because of differences in the geologic environment. These provinces are (1) the Basin and Range lowlands province in the southern part of the State, (2) the Plateau uplands province in the northern part of the State, and (3) the Central highlands province, which is transitional between the other two provinces.

The Basin and Range lowlands province consists of broad valleys and basins and high isolated mountain ranges. The basins are filled with unconsolidated or weakly consolidated deposits, which may be several thousands of feet thick. The pore spaces in the deposits store large amounts of ground water and yield the water freely to wells. The climate is arid to semiarid, growing seasons are long, and the environment is favorable for crops and light industry. In general, the streams are ephemeral and flow only during and immediately following heavy rainstorms.

In the Plateau uplands province, water-bearing sandstone units store large amounts of water but well yields are small. In general, the openings where ground water may be stored are small and poorly connected, and water cannot be transmitted freely. In a few areas, however, faults and fractures increase the permeability of the sandstone units, permitting water to move more freely. The climate in the Plateau uplands province is generally hot and dry below 4,500 feet and cool and moist above 7,000 feet above mean sea level. A few perennial streams are present in the area, and their flow is sustained by ground-water discharge.

The Central highlands province consists mostly of rugged mountain masses made up of igneous, metamorphic, and well-consolidated sedimentary rocks. These materials contain little space for the storage of ground water, although in many places fractured and faulted zones in the rocks store and transmit appreciable amounts of water. The few small valleys in the area contain unconsolidated deposits that store some ground water. Of the three provinces, the Central highlands province receives the largest amount of precipitation. A large part of the water in the perennial streams in the Central highlands flows into the Salt River; the water is impounded in storage reservoirs in the Central highlands and is released for use in the Basin and Range lowlands.

Basin and Range Lowlands Province

The Basin and Range lowlands is the most highly developed of the three provinces from the standpoint of ground-water use. The extensive development of the ground-water supply, which is the main source of water used for the irrigation of about 1 million acres of land, has resulted in a decline in water levels in a large part of the province.

The two largest agricultural areas in the State are the Salt River Valley and the lower Santa Cruz basin; it is in these areas that the greatest water-level declines have taken place since development began in Arizona. In the Stanfield-Maricopa area of the lower Santa Cruz basin, the average water-level decline has amounted to more than 180 feet since 1940.

In a few areas the rate of decline of water levels was less in 1966 than in recent years. The lesser declines are due to several factors that affected water levels, either directly or indirectly. Widespread intense rains throughout the Basin and Range lowlands province provided more moisture for crops; more surface runoff was available for storage and irrigation use; and crops that require less water were planted in some places. Slight rises in groundwater levels occurred in and near the flood plains of the Gila, Santa Cruz, Salt, and San Pedro Rivers. These rises were in response to recharge from floodflow.

Figures 4, 10, 14, 19, and 24 show the depth to water for spring 1967 and the change in water level for the 5-year period 1962-67 in selected wells in the province. Graphs (figs. 5-9, 11, 12, 17, 18, 20-23, and 25) showing the depth to water in wells and estimated annual pumpage are included for most areas in the province; graphs showing cumulative average change in water level for areas in the Salt River Valley and lower Santa Cruz basin and annual pumpage are shown in figures 13, 15, and 16.

Plateau Uplands Province

Agricultural development in the Plateau uplands province is minor, and the amount of ground water withdrawn for irrigation or other uses is small. Therefore, no large water-level declines have taken place in most of this province.

In 1966 about 32,000 acres of land was under cultivation in the province. About half the acreage, which is mainly in Navajo County, is irrigated with ground water; the remaining half is irrigated mostly with surface water from small reservoirs, although some dryland farming is practiced. Although the amount of cultivated acreage has remained about the same since 1964, some additional ground-water supplies have been developed near Tuba City, near Snowflake, and in the Flagstaff area.

Measurements of depth to water made in observation wells throughout the province show both rises and declines in water level from spring 1966 to spring 1967; however, the changes were minor. The largest water-level rise of 6 feet occurred in a well in the Woody Mountain area near Flagstaff, and the largest decline of about 2 feet occurred in a well near Snowflake. From 1962 to 1967 a slight decline in water level occurred in all observation wells except in two wells near St. Johns, where the water level rose about 1 foot in an artesian well and about 15 feet in a water-table well. Water-level declines for the 5-year period ranged from about half a foot in a well southeast of Flagstaff to nearly 22 feet in a well near Snowflake.

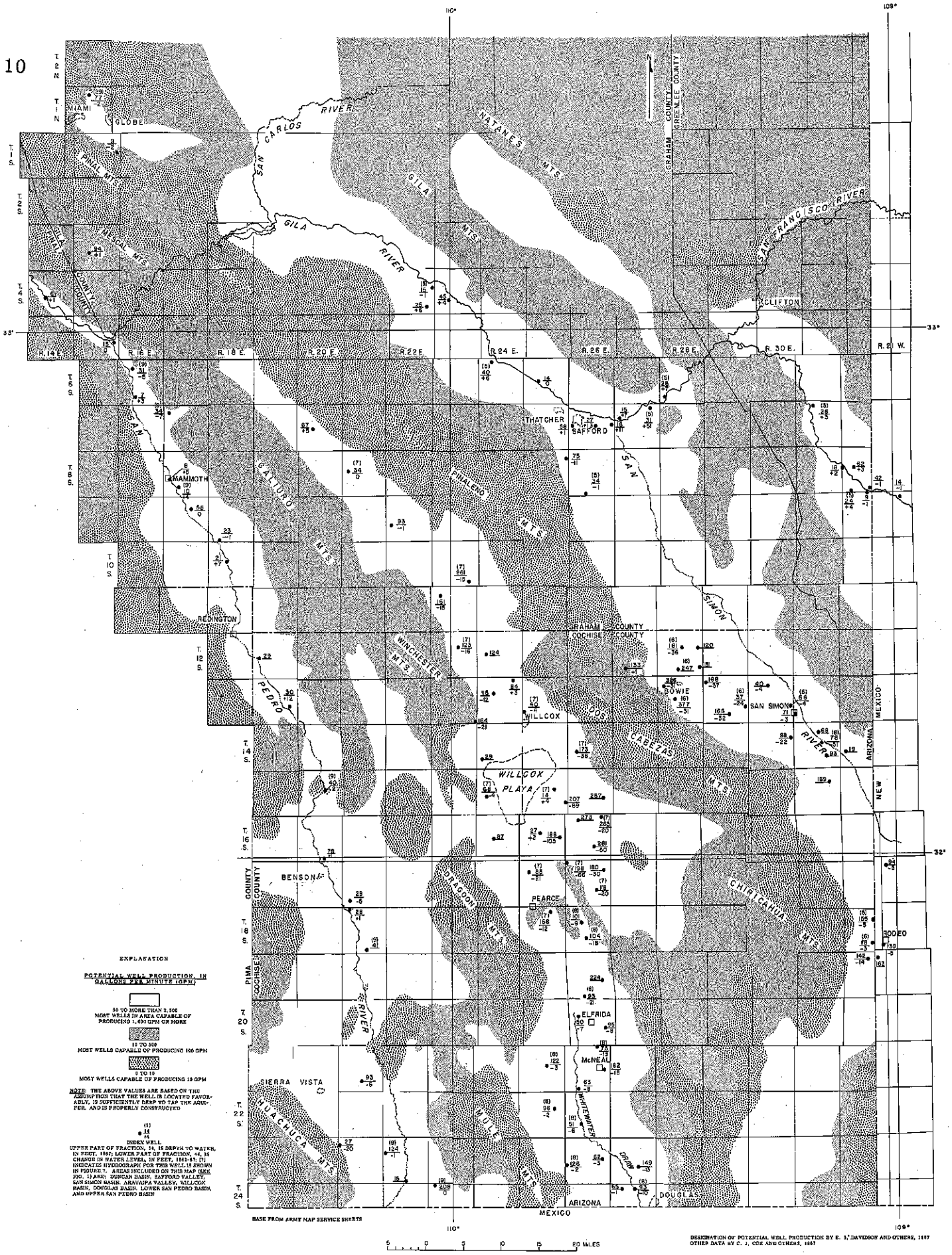


Figure 4.-- Depth to water, 1967, and change in water level, 1962-67, in selected wells in the southeast part of the Basin and Range lowlands province.

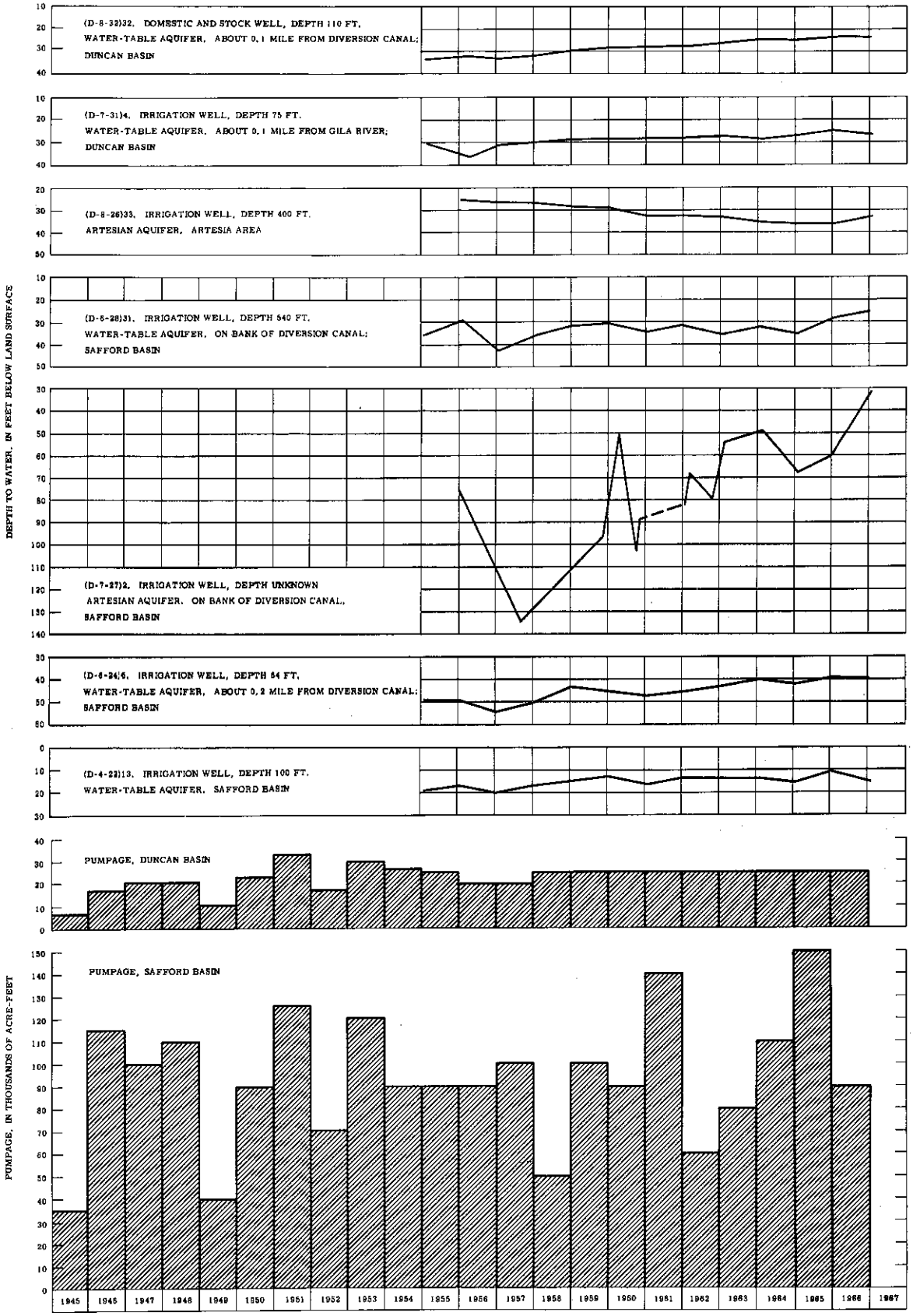


FIGURE 5.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE DUNCAN AND SAFFORD BASINS.

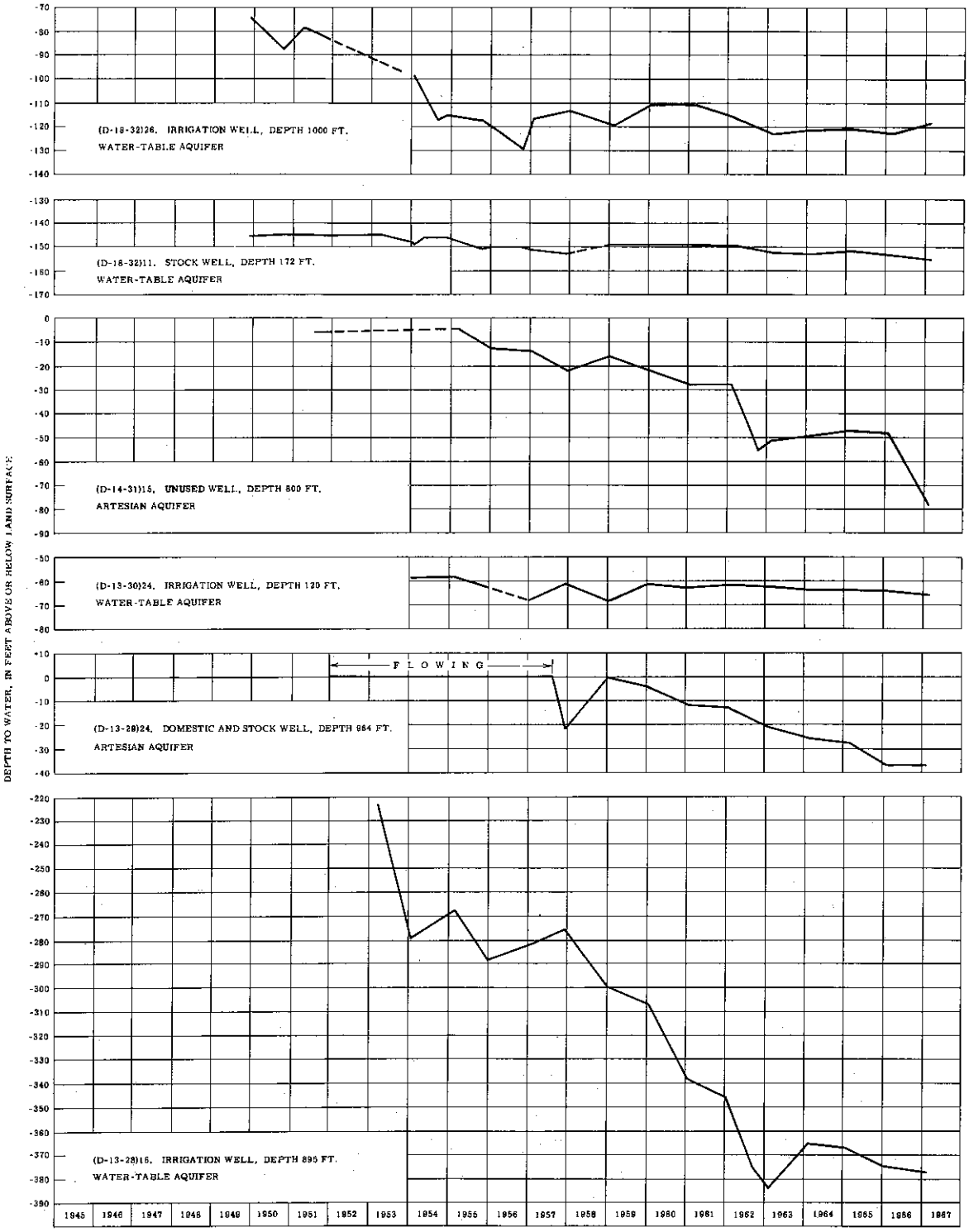


FIGURE 6.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN SAN SIMON BASIN. (IN TWO SHEETS.)
SHEET 1 OF FIGURE 6

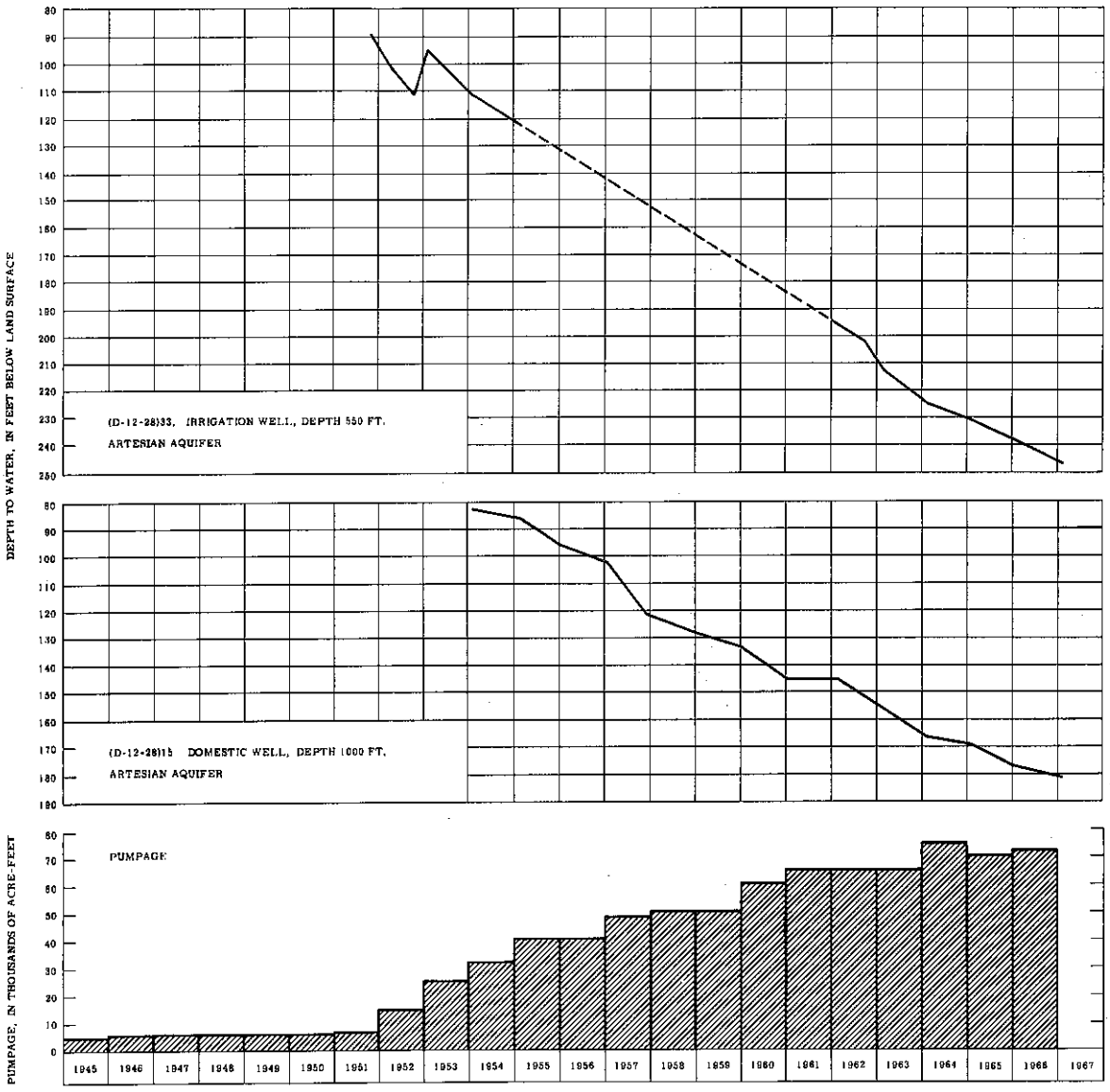


FIGURE 6.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN SAN SIMON BASIN. (IN TWO SHEETS.)
SHEET 2 OF FIGURE 6

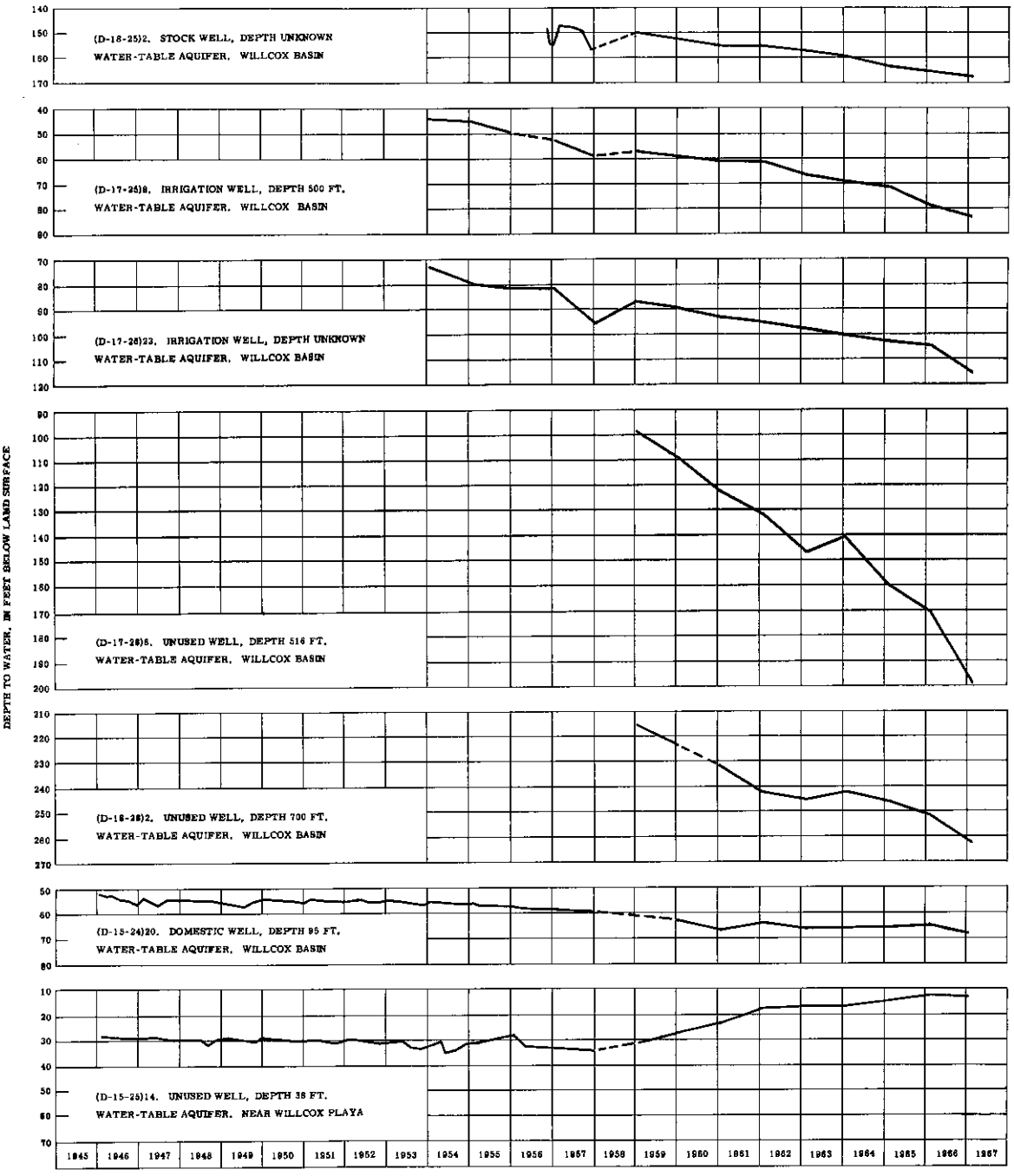


FIGURE 7.--DEPTH TO WATER IN SELECTED WELLS IN WILLCOX BASIN AND ARAVAIPA VALLEY AND ESTIMATED ANNUAL PUMPAGE IN WILLCOX BASIN. (IN TWO SHEETS.)

SHEET 1 OF FIGURE 7

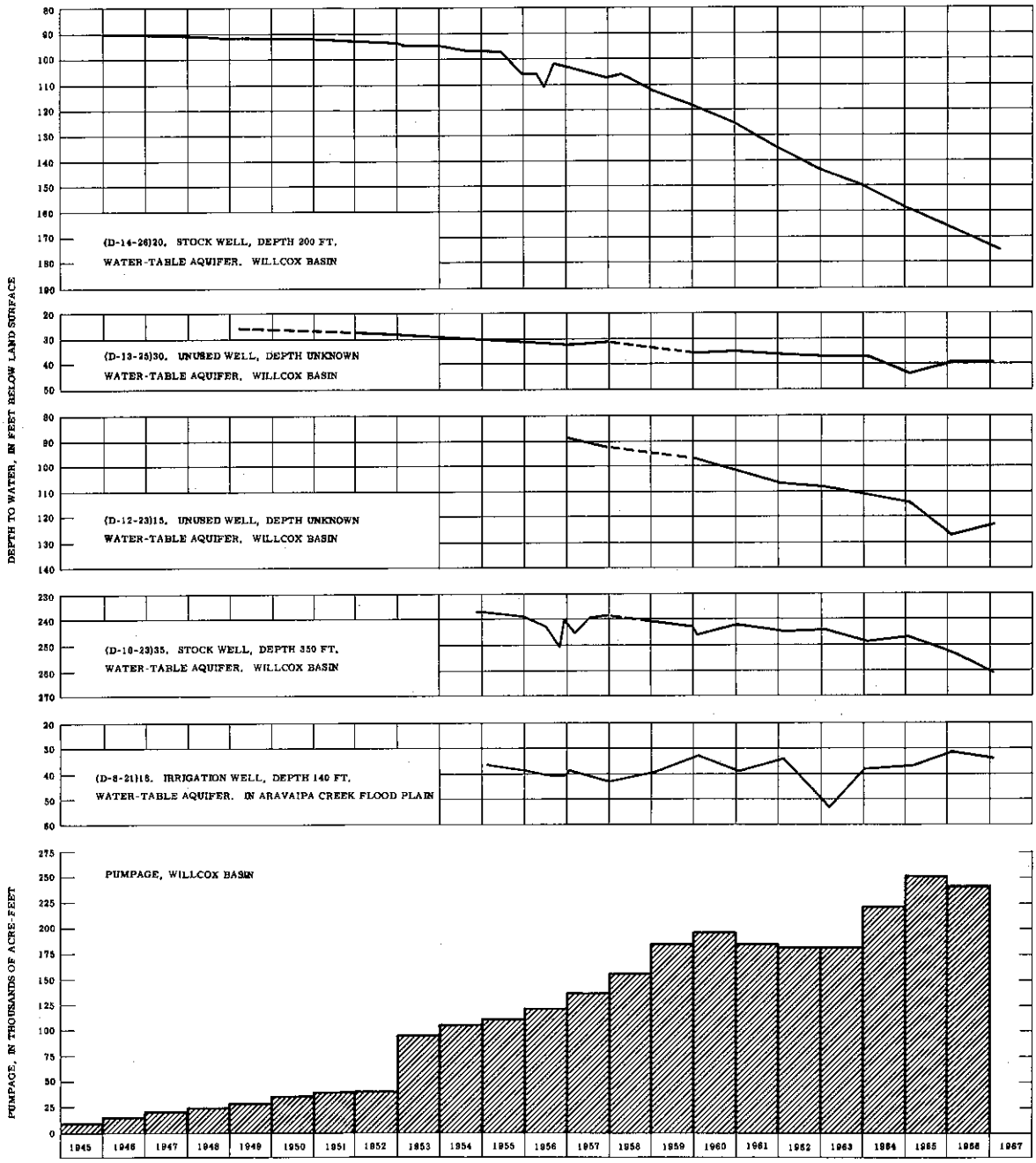


FIGURE 7.--DEPTH TO WATER IN SELECTED WELLS IN WILLCOX BASIN AND ARAVAIPA VALLEY AND ESTIMATED ANNUAL PUMPAGE IN WILLCOX BASIN. (IN TWO SHEETS.)

SHEET 2 OF FIGURE 7

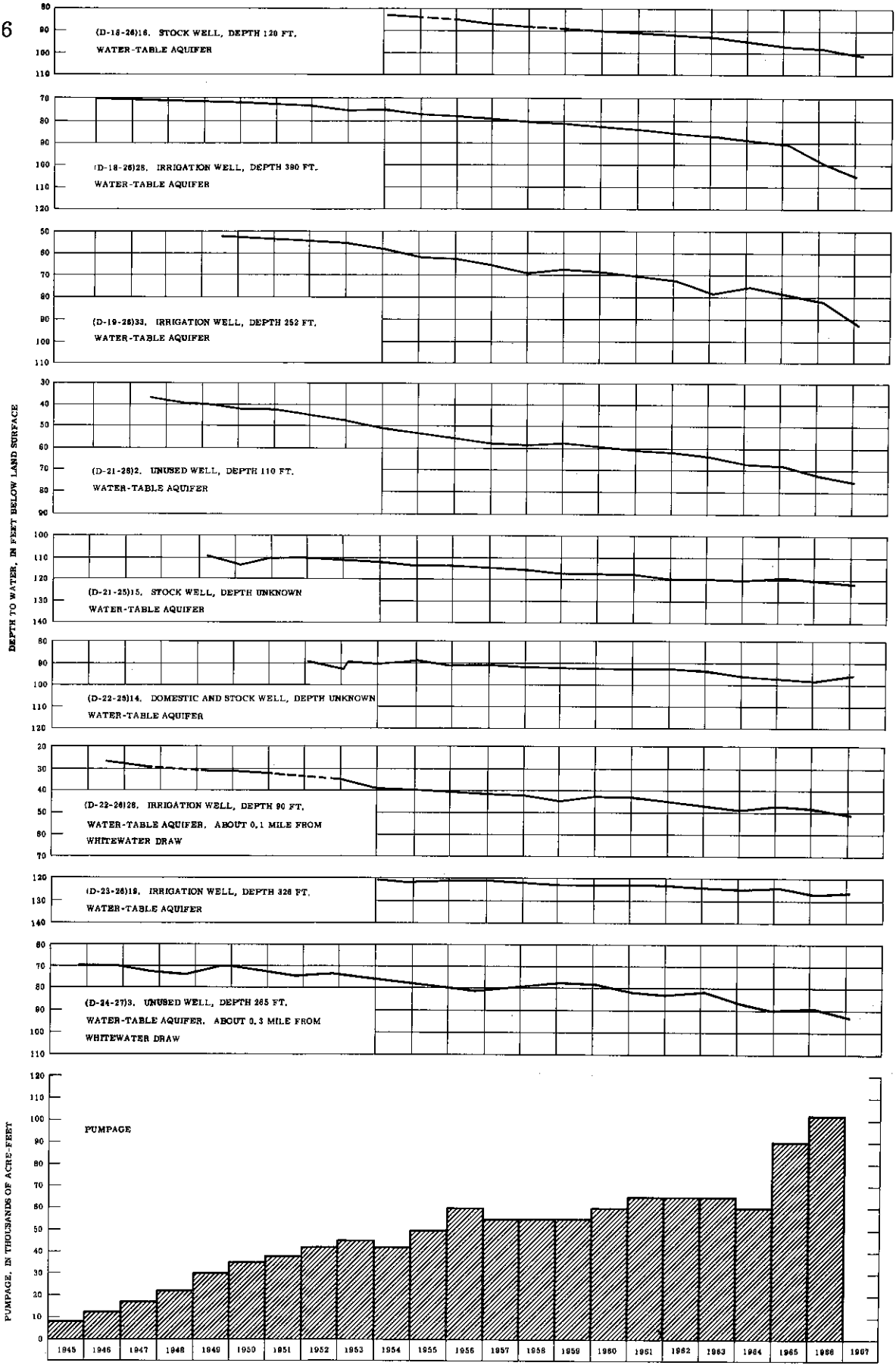


FIGURE 8.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN DOUGLAS BASIN.

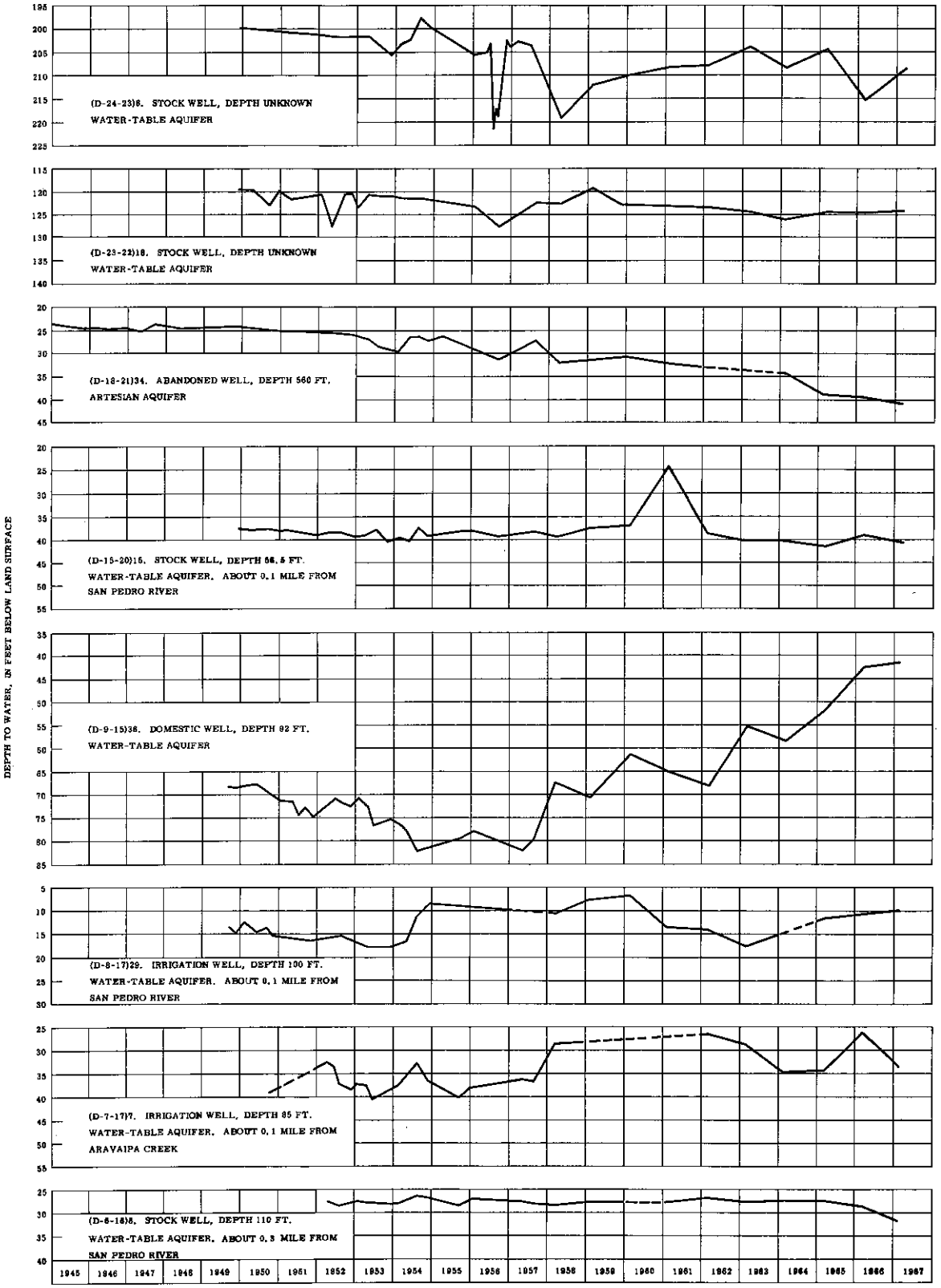


FIGURE 9.--DEPTH TO WATER IN SELECTED WELLS IN THE SAN PEDRO RIVER VALLEY.

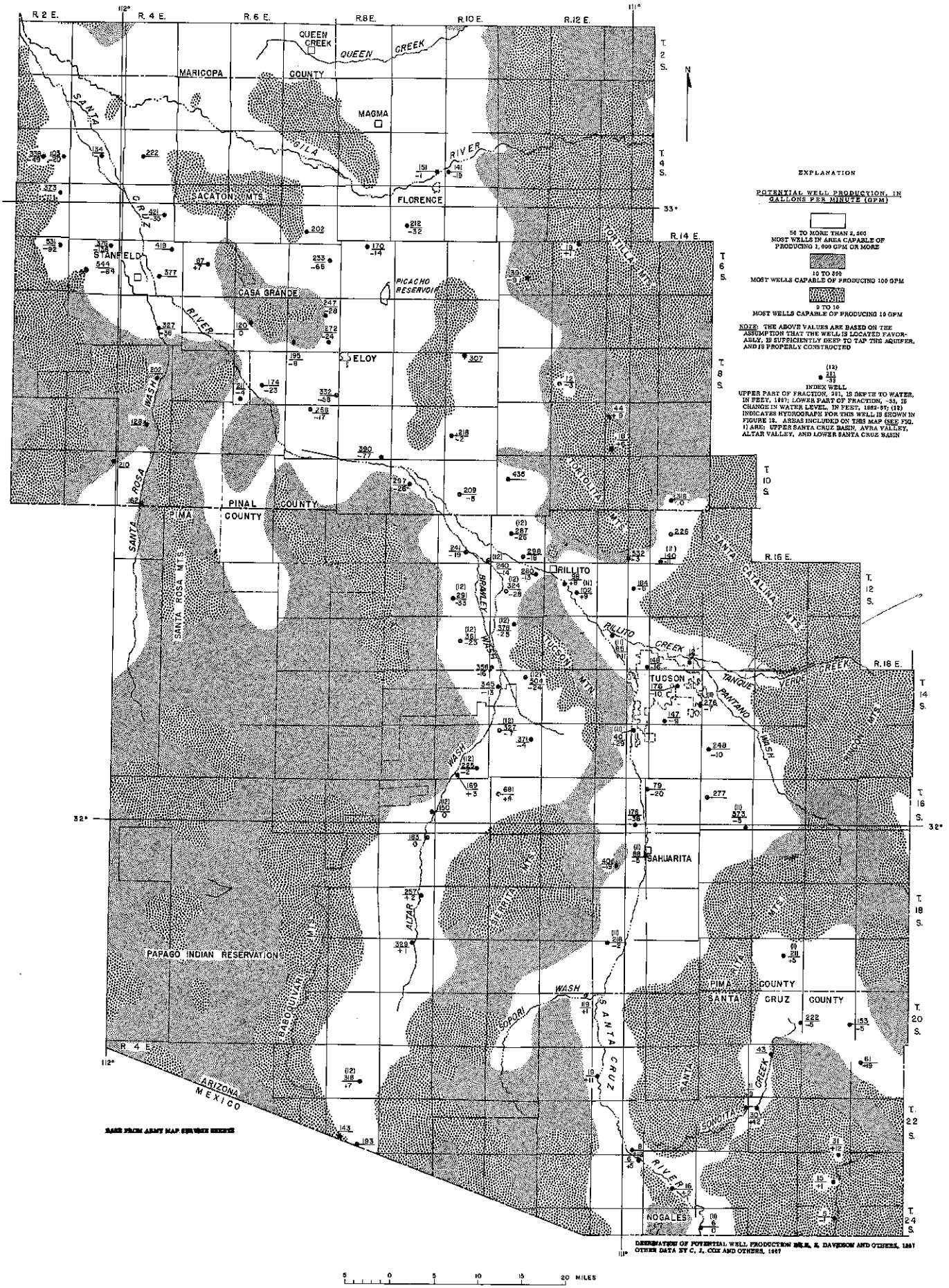


Figure 10.--Depth to water, 1967, and change in water level, 1962–67, in selected wells in the south-central part of the Basin and Range lowlands province.

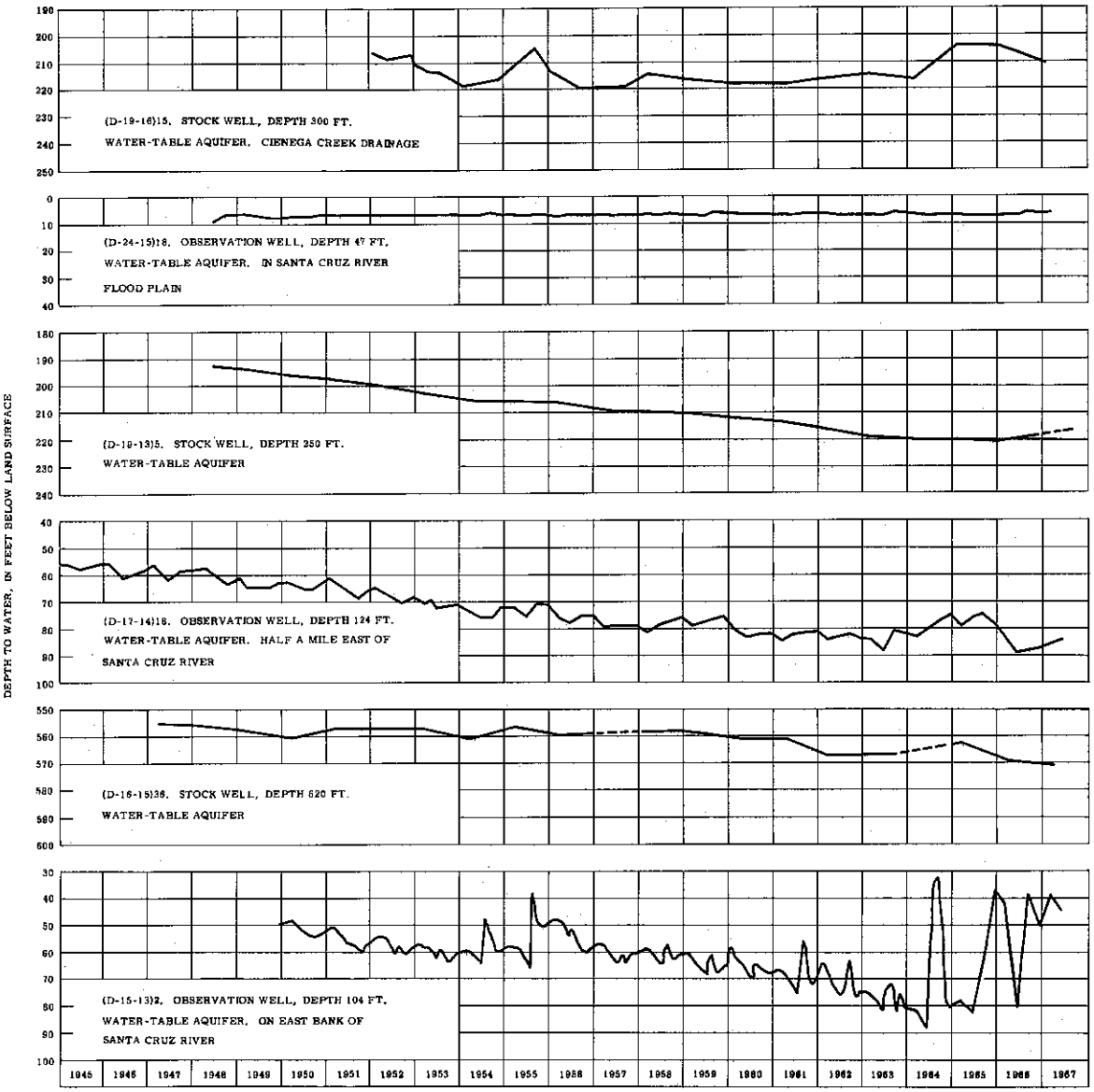


FIGURE 11.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE UPPER SANTA CRUZ BASIN. (IN TWO SHEETS.)
SHEET 1 OF FIGURE 11

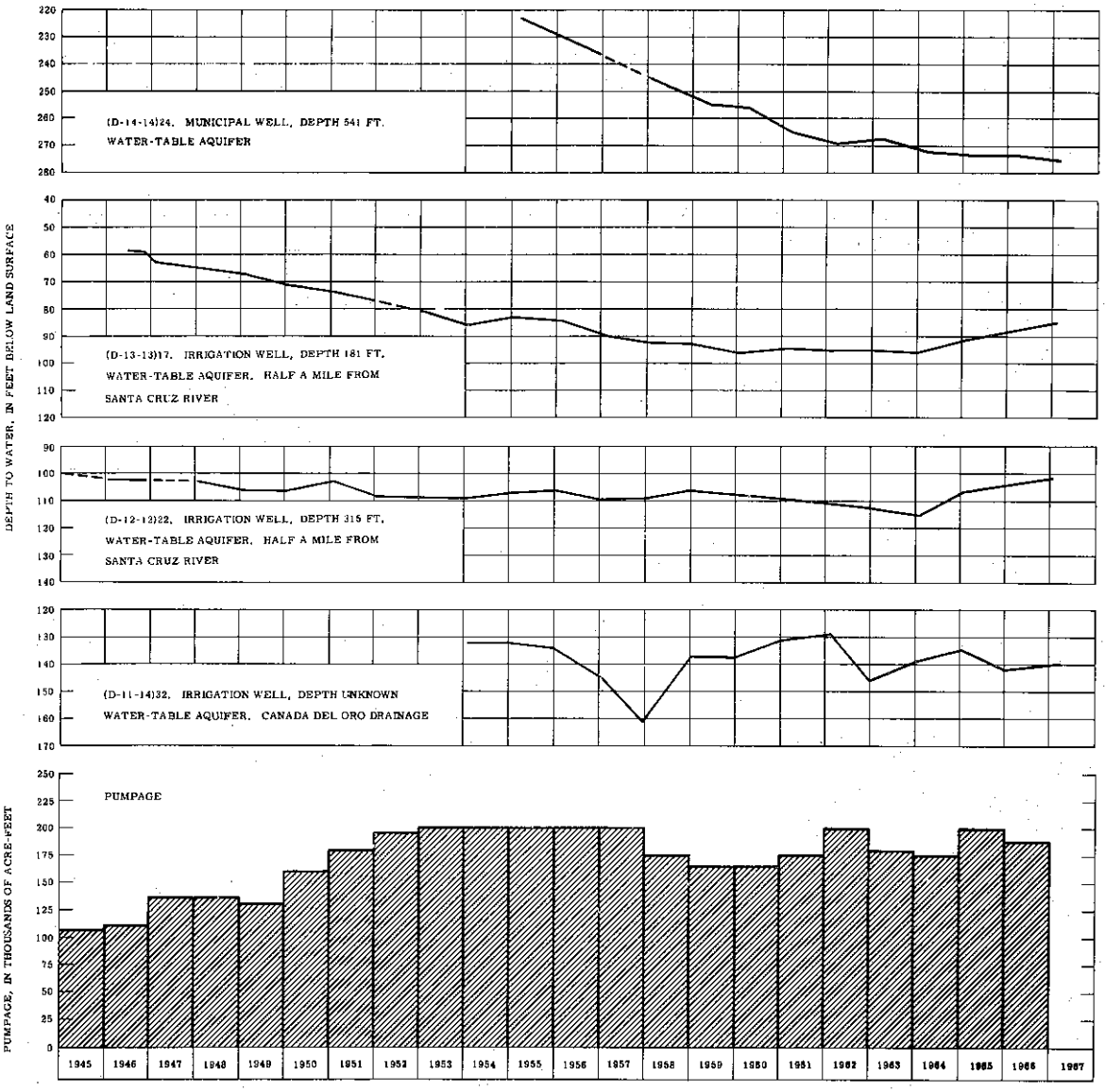


FIGURE 11.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE UPPER SANTA CRUZ BASIN. (IN TWO SHEETS.)
SHEET 2 OF FIGURE 11

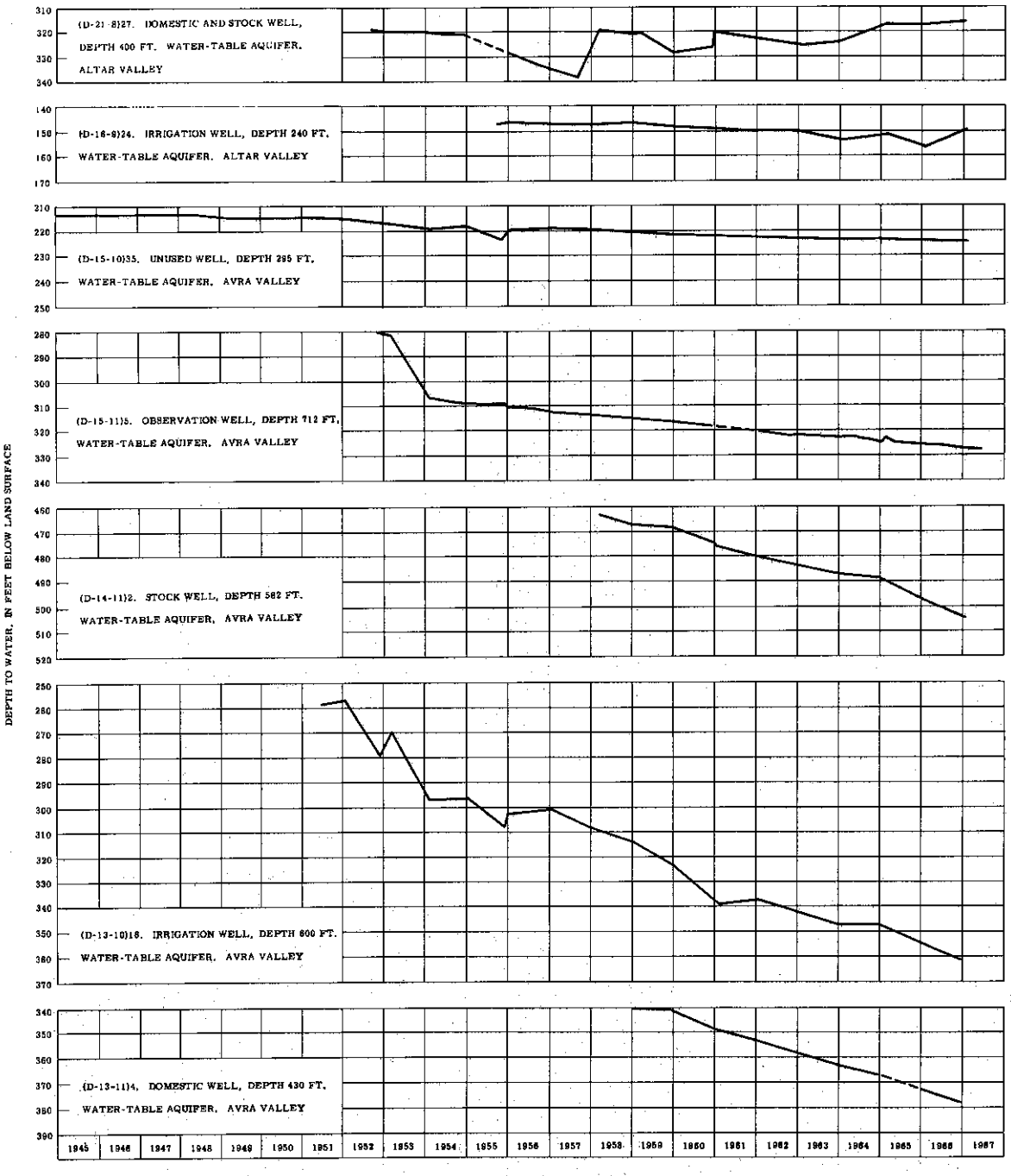


FIGURE 12.--DEPTH TO WATER IN SELECTED WELLS IN ALTAR AND AVRA VALLEYS AND ESTIMATED ANNUAL PUMPAGE IN AVRA VALLEY, (IN TWO SHEETS.)

SHEET 1 OF FIGURE 12

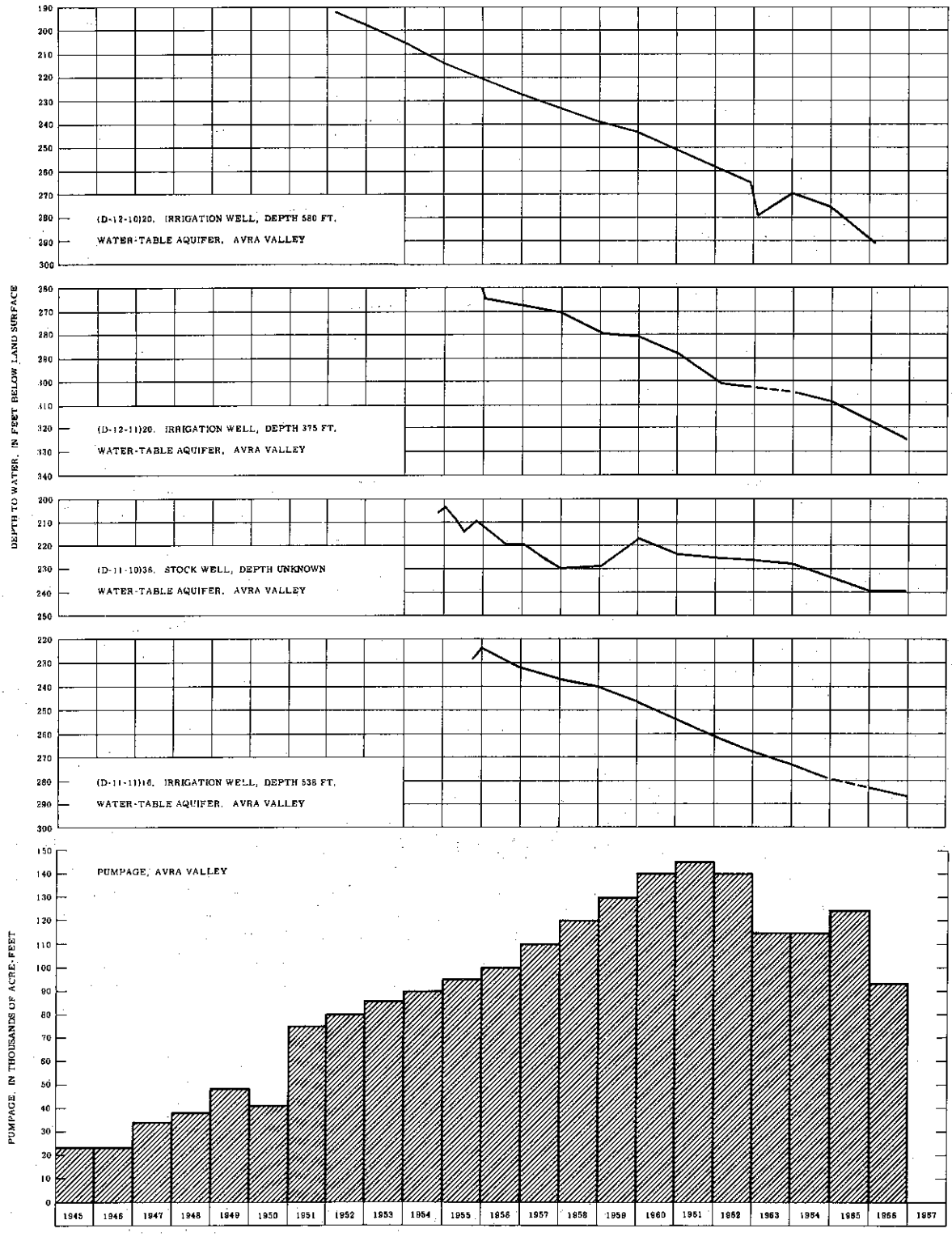


FIGURE 12.--DEPTH TO WATER IN SELECTED WELLS IN ALTAR AND AVRA VALLEYS AND ESTIMATED ANNUAL PUMPAGE IN AVRA VALLEY. (IN TWO SHEETS.)

SHEET 2 OF FIGURE 12

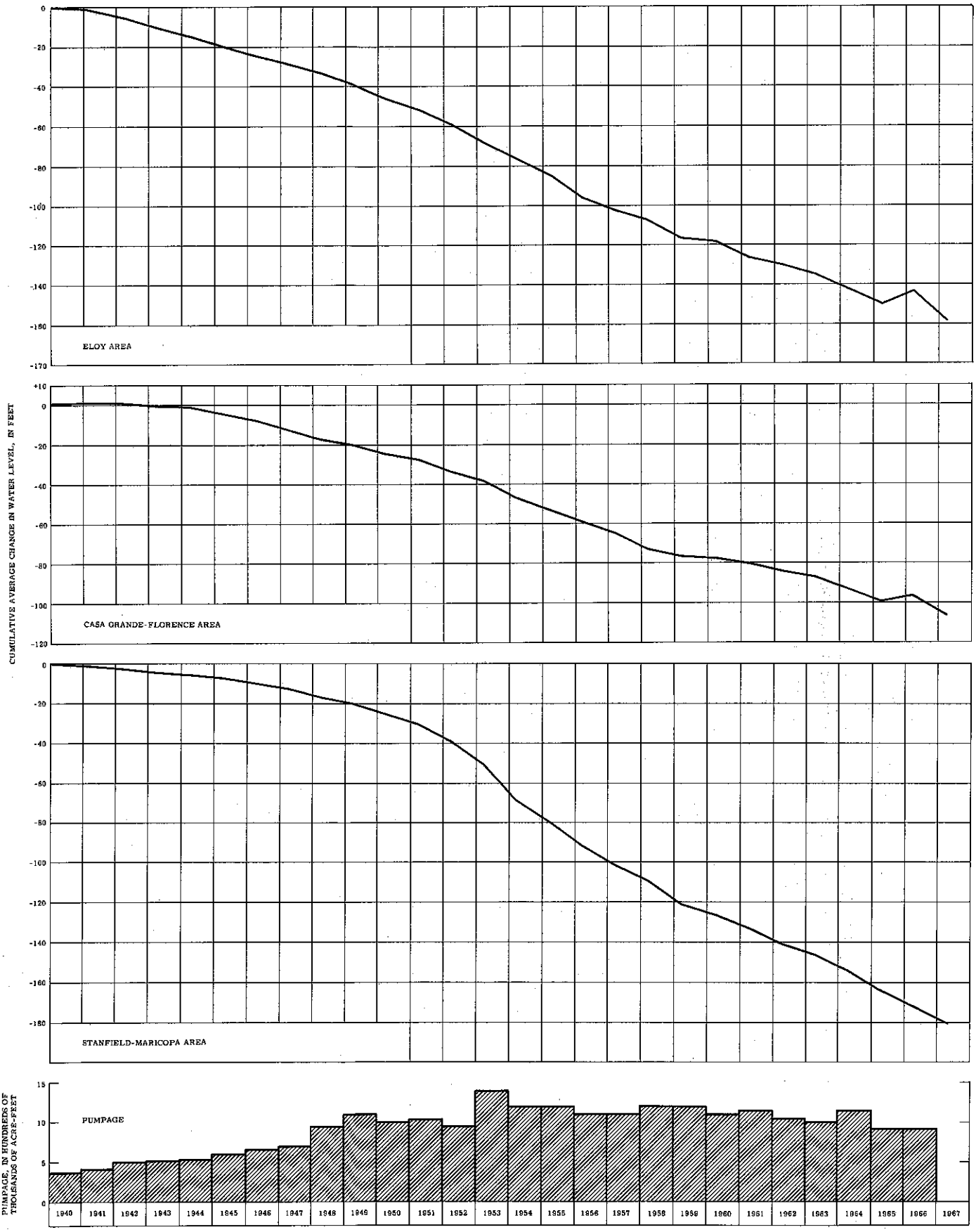


FIGURE 13.--CUMULATIVE AVERAGE CHANGE IN WATER LEVEL BY AREAS AND ESTIMATED ANNUAL PUMPAGE IN THE LOWER SANTA CRUZ BASIN.

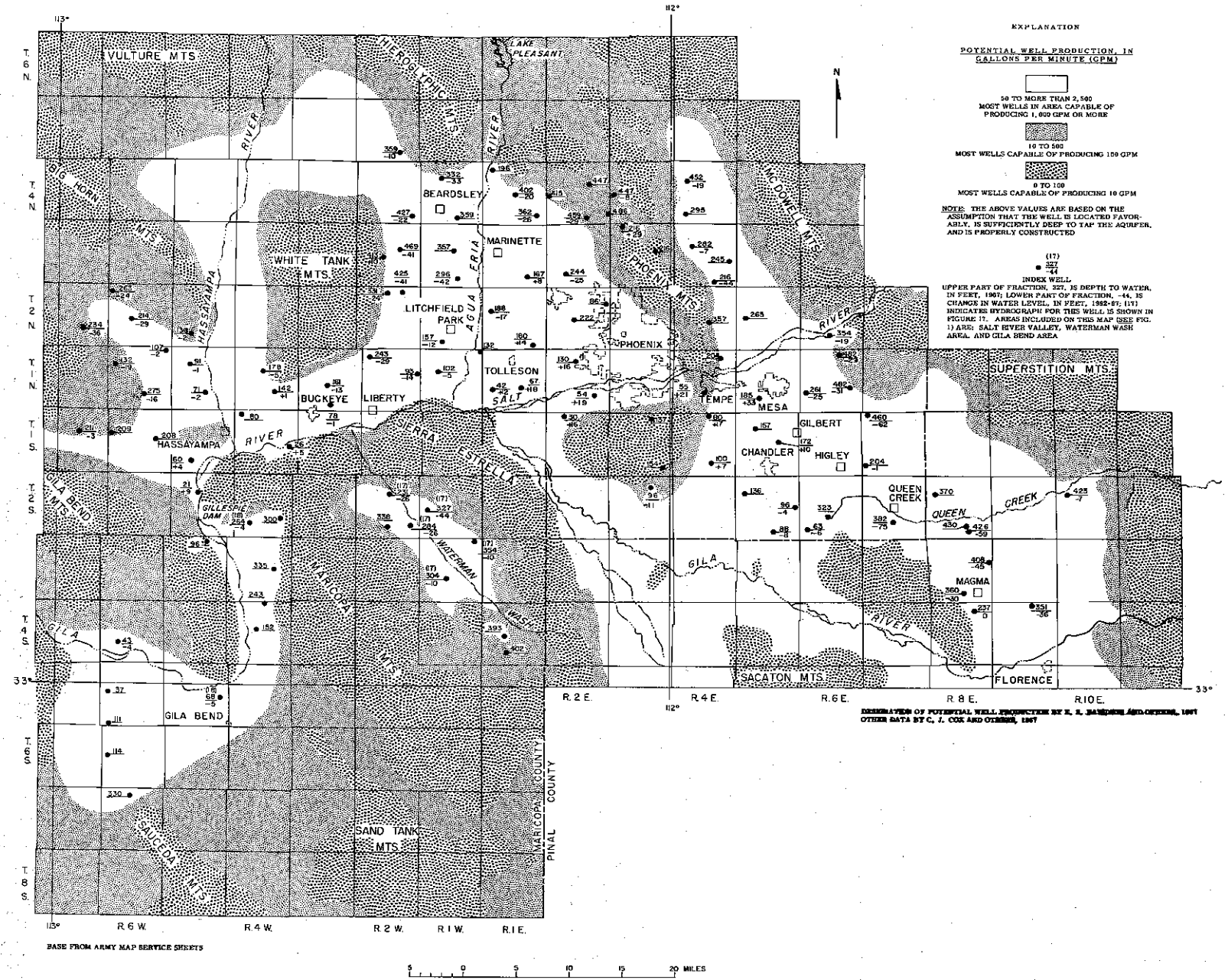


Figure 14.--Depth to water, 1967, and change in water level, 1962-67, in selected wells in the central part of the Basin and Range lowlands province.

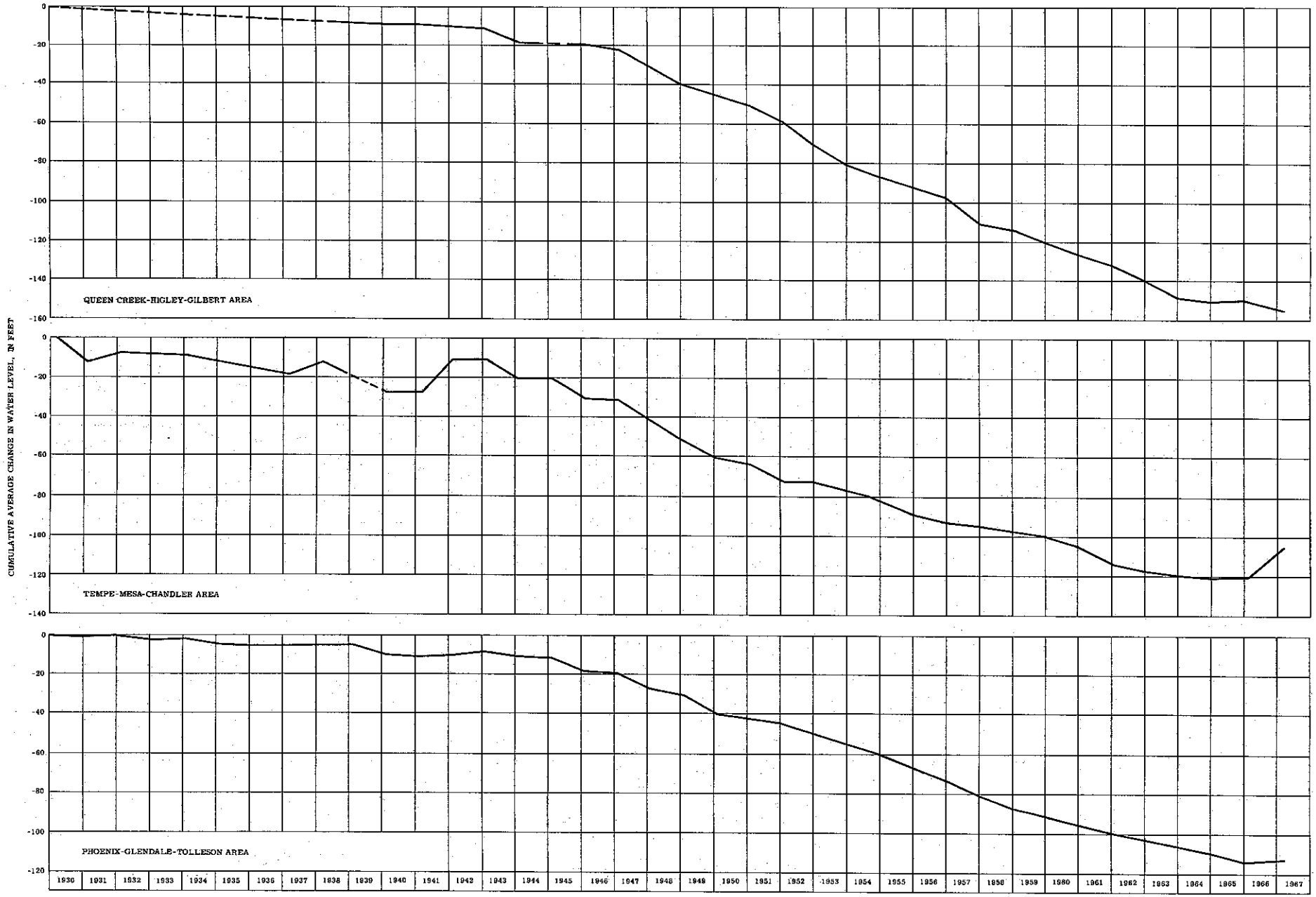


FIGURE 15.--CUMULATIVE AVERAGE CHANGE IN WATER LEVEL IN THE QUEEN CREEK-HIGLEY-GILBERT, TEMPE-MESA-CHANDLER, AND PHOENIX-GLENDALE-TOLLESON AREAS OF THE SALT RIVER VALLEY.

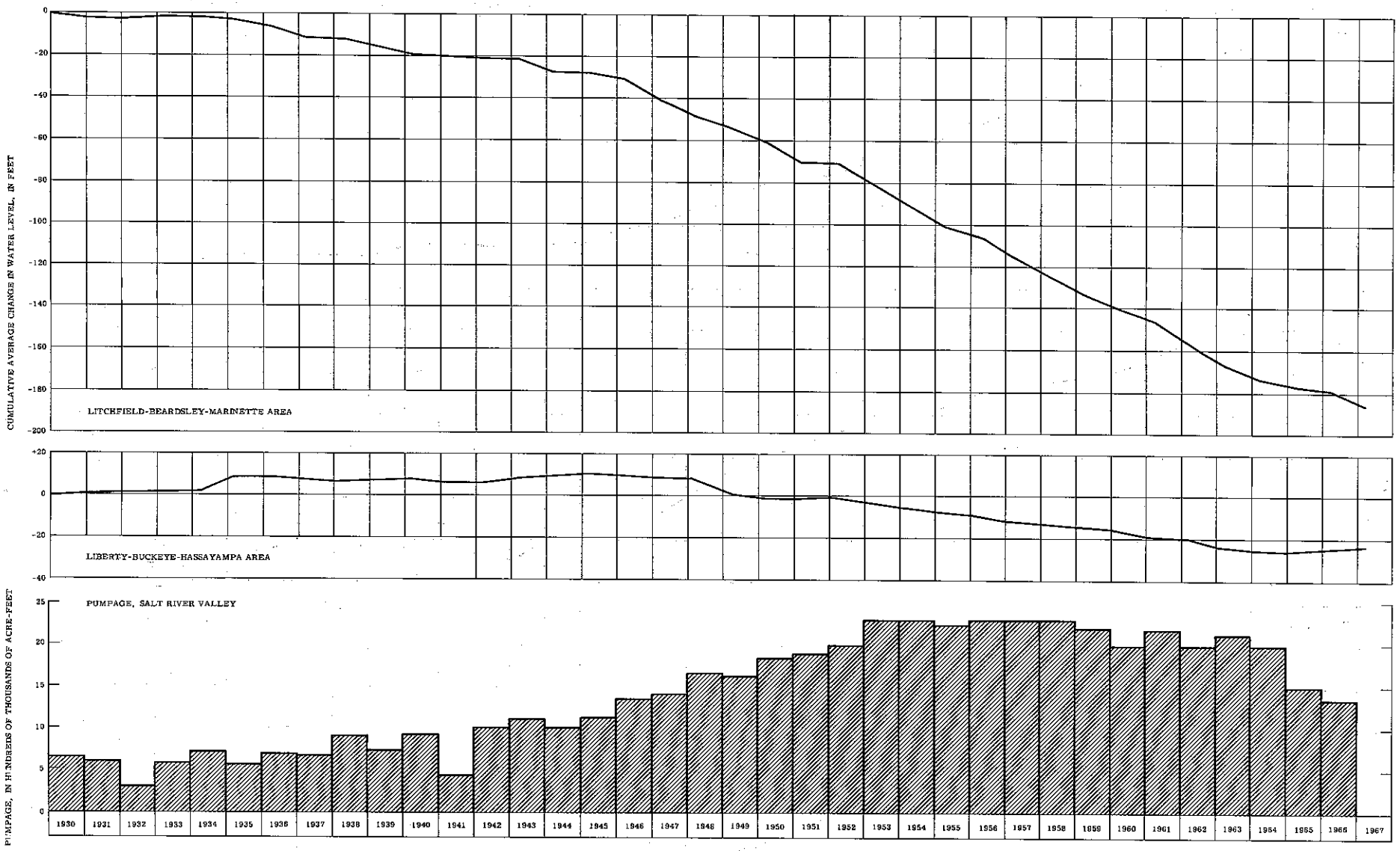


FIGURE 16.--CUMULATIVE AVERAGE CHANGE IN WATER LEVEL IN THE LITCHFIELD-BEARDSLEY-MARINETTE AND LIBERTY-BUCKEYE-HASSAYAMPA AREAS AND ESTIMATED ANNUAL PUMPAGE IN THE SALT RIVER VALLEY.

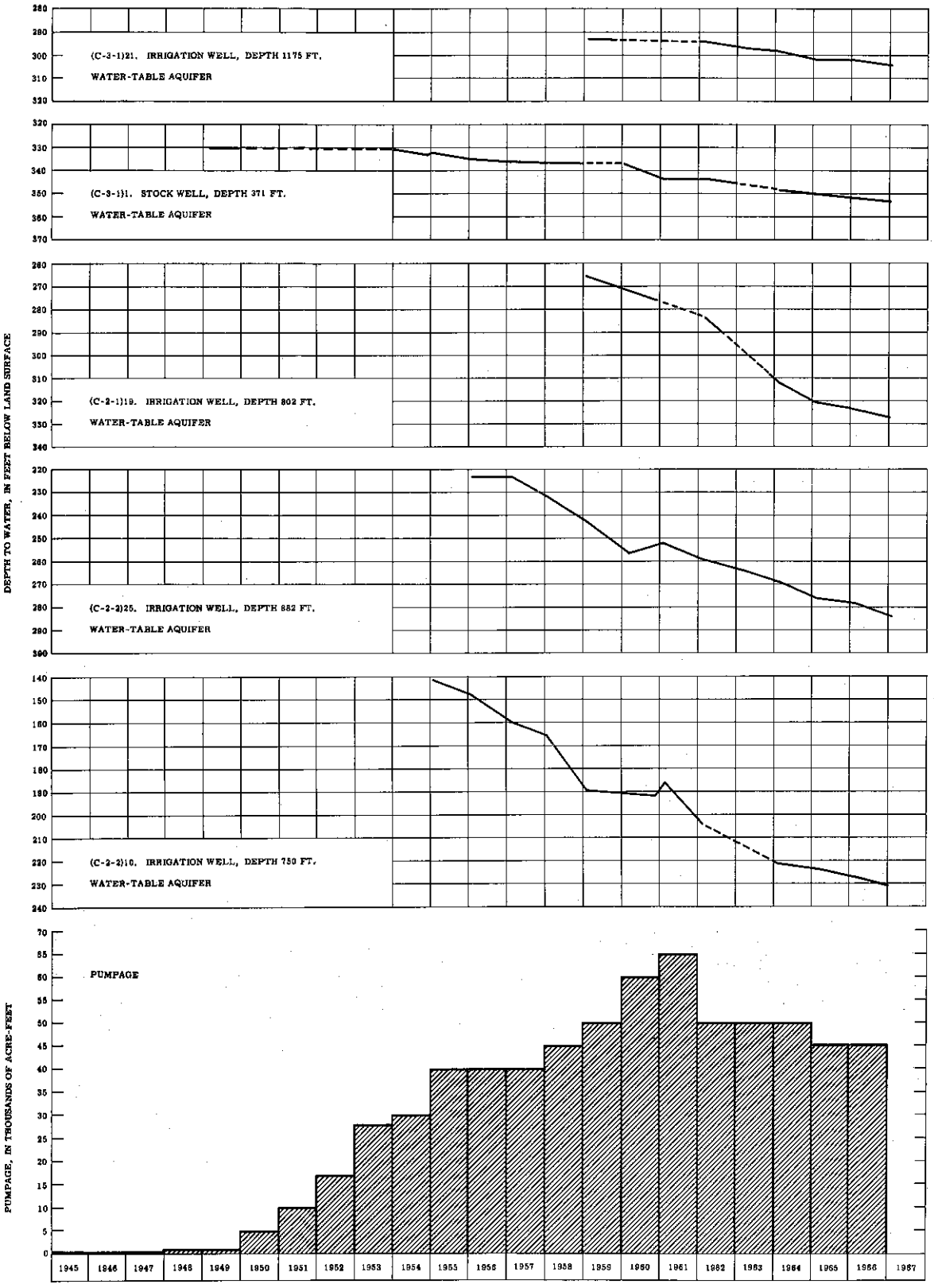


FIGURE 17.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE WATERMAN WASH AREA.

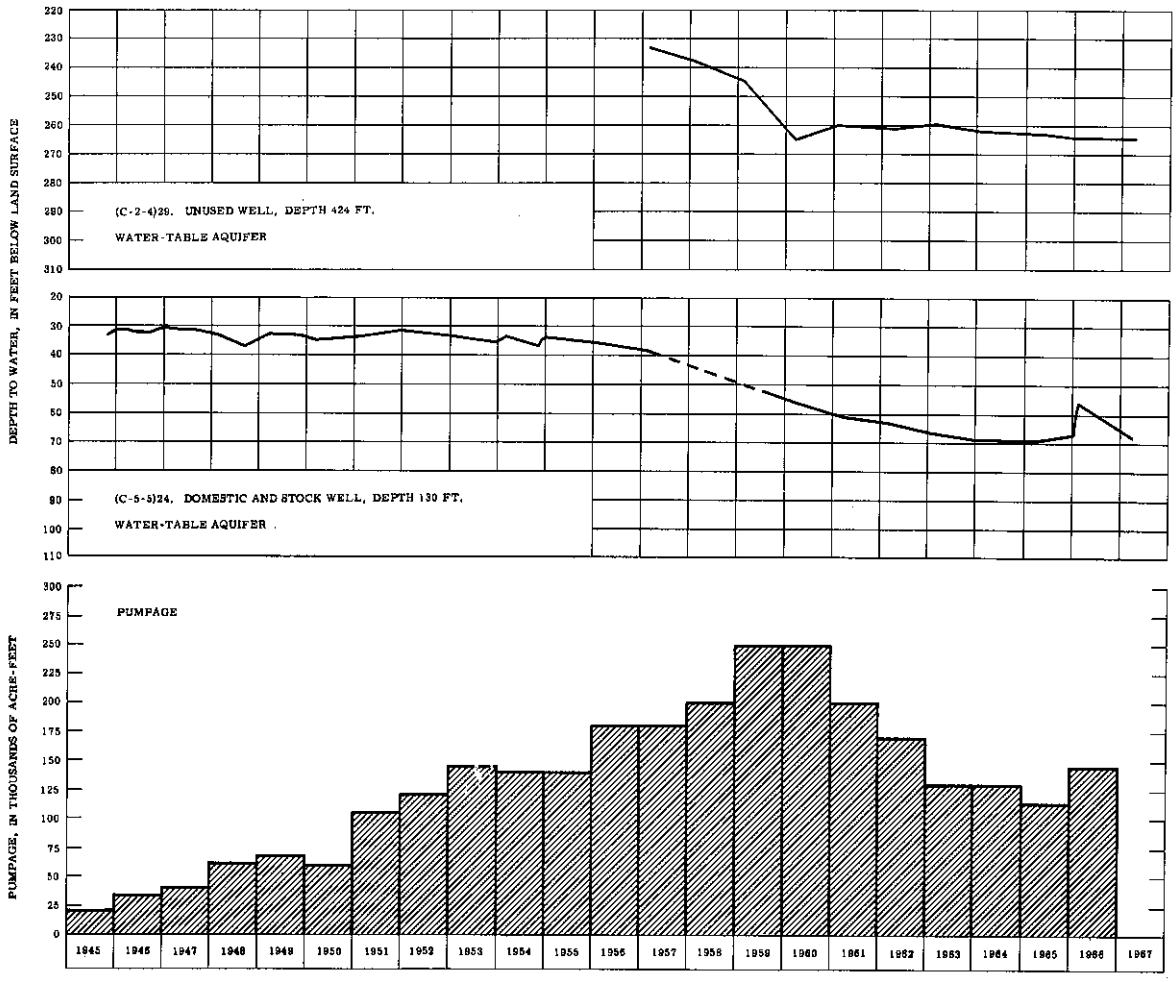


FIGURE 18.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE GILA BEND AREA.

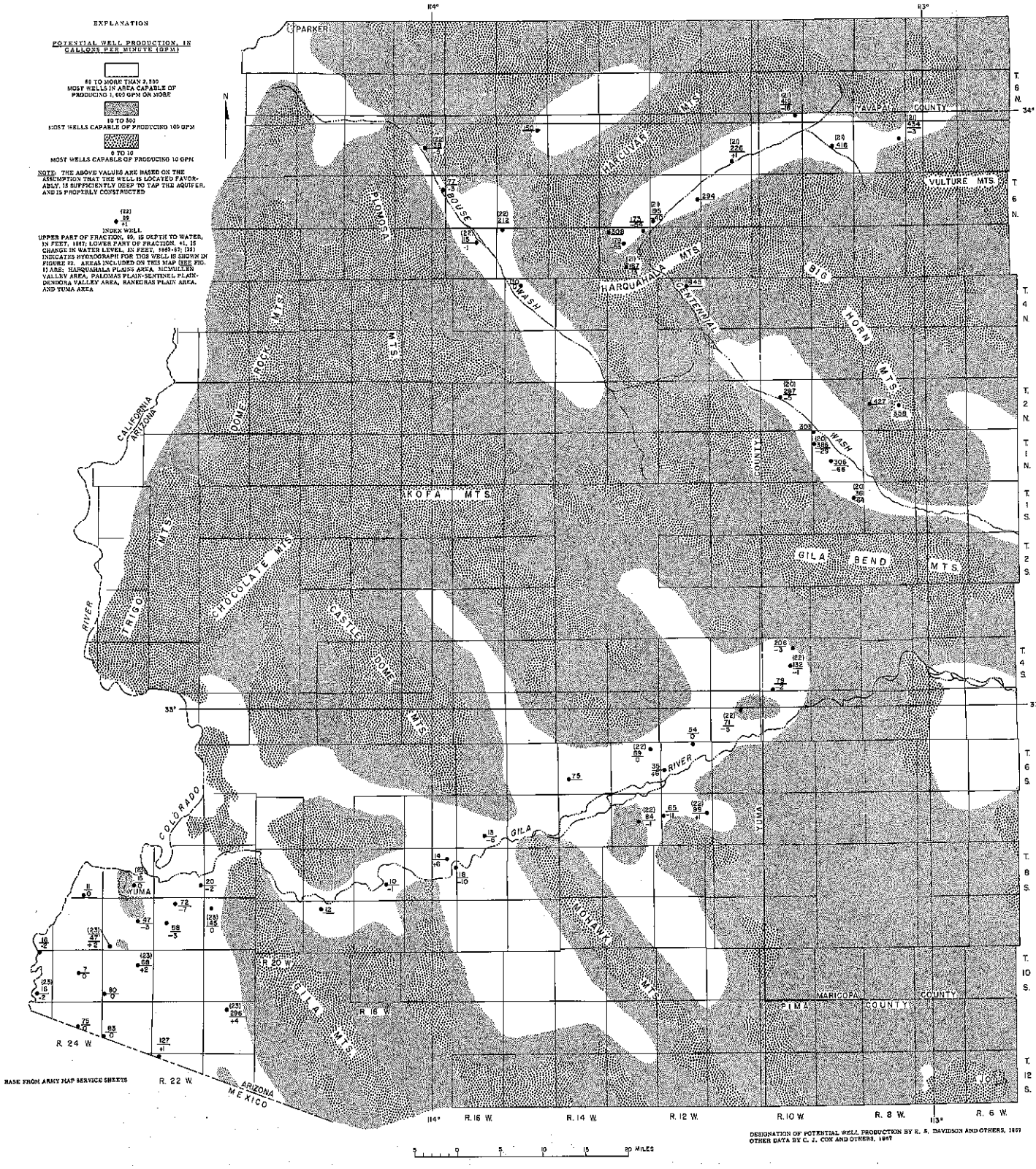


Figure 19.--Depth to water, 1967, and change in water level, 1962-67, in selected wells in the southwest part of the Basin and Range lowlands province.

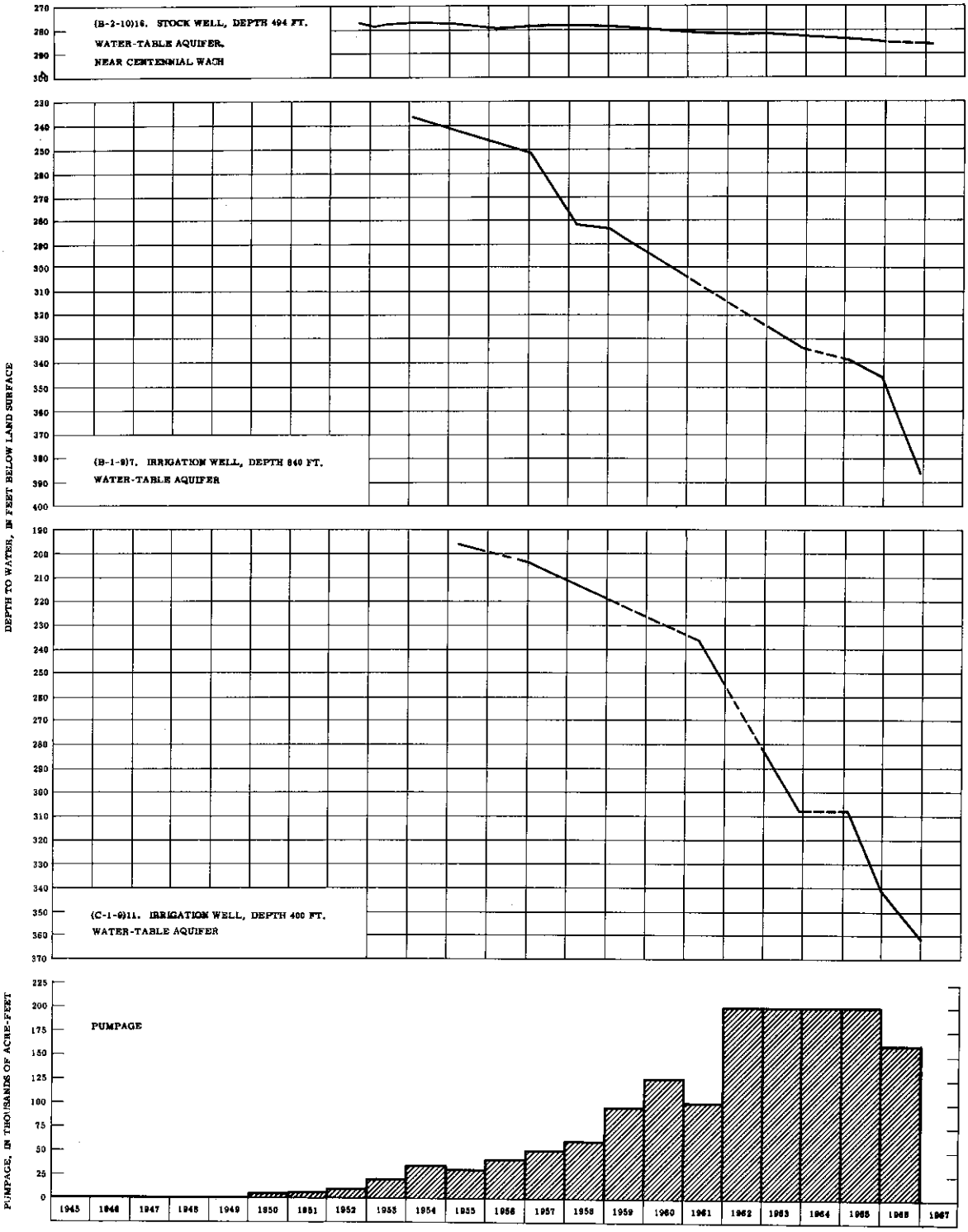


FIGURE 20.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE HARQUAHALA PLAINS AREA.

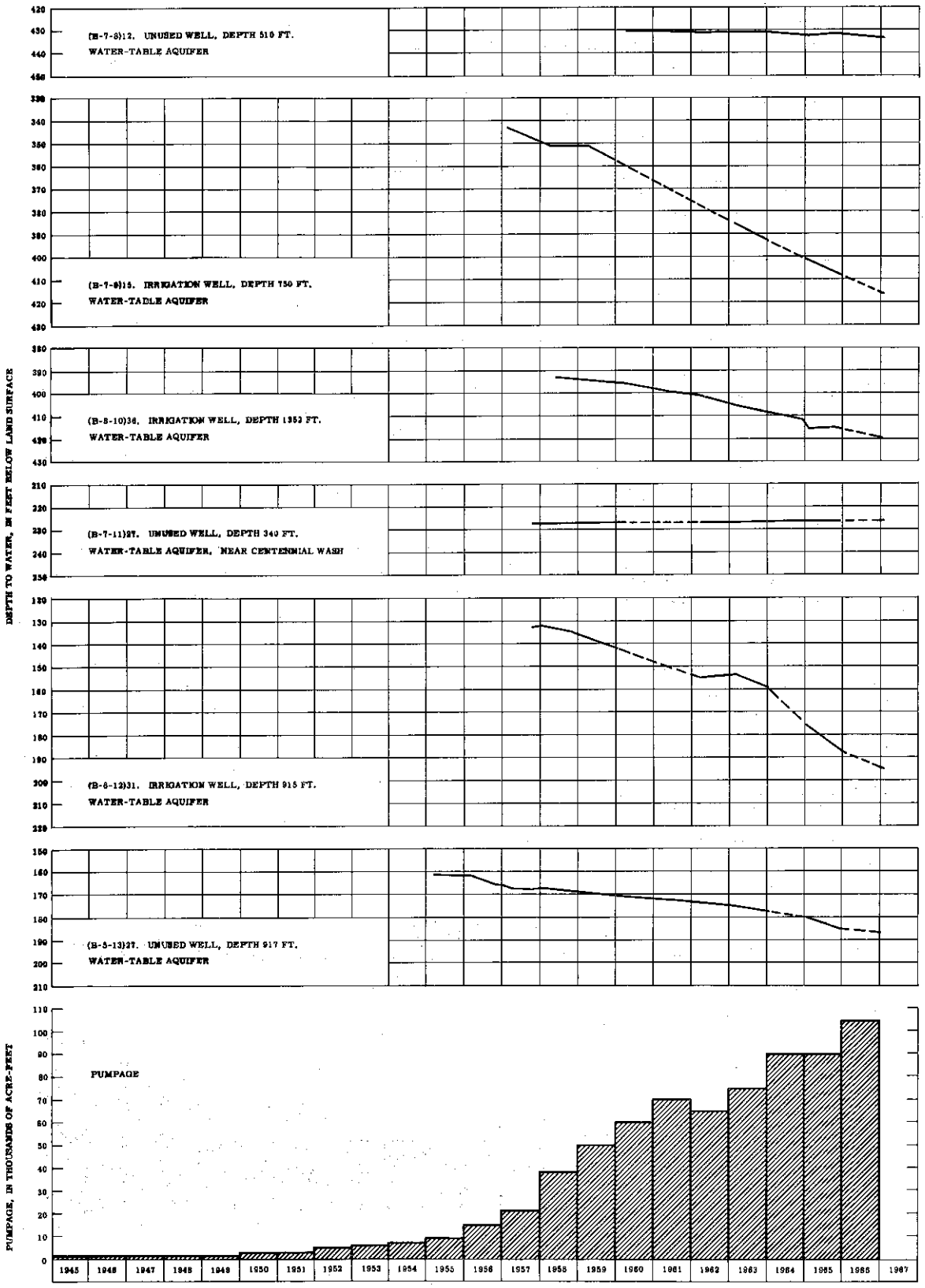


FIGURE 21.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN MCMULLEN VALLEY.

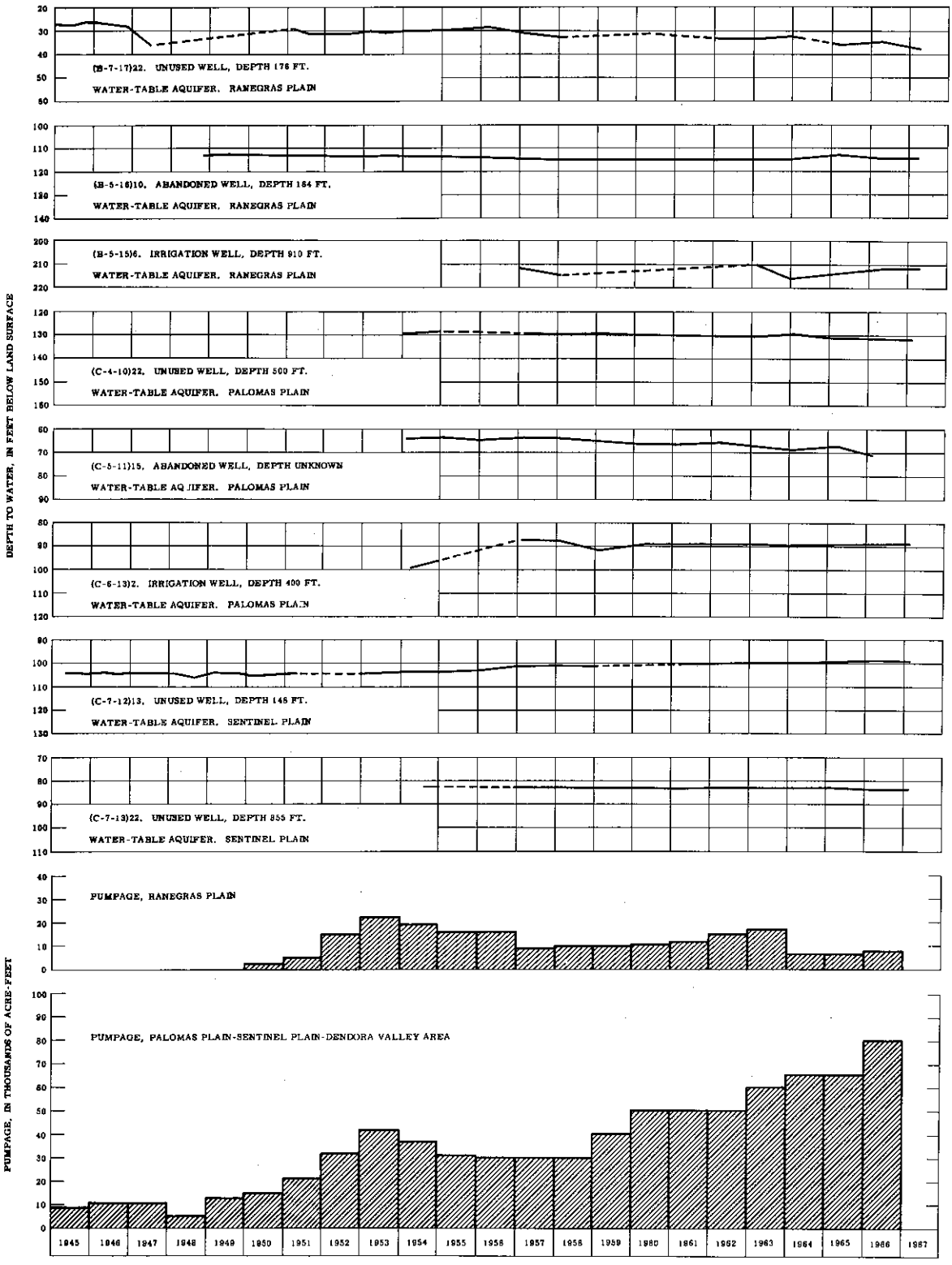


FIGURE 22.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE RANEGRAS PLAIN AREA AND THE PALOMAS PLAIN-SENTINEL PLAIN-DENDORA VALLEY AREA.

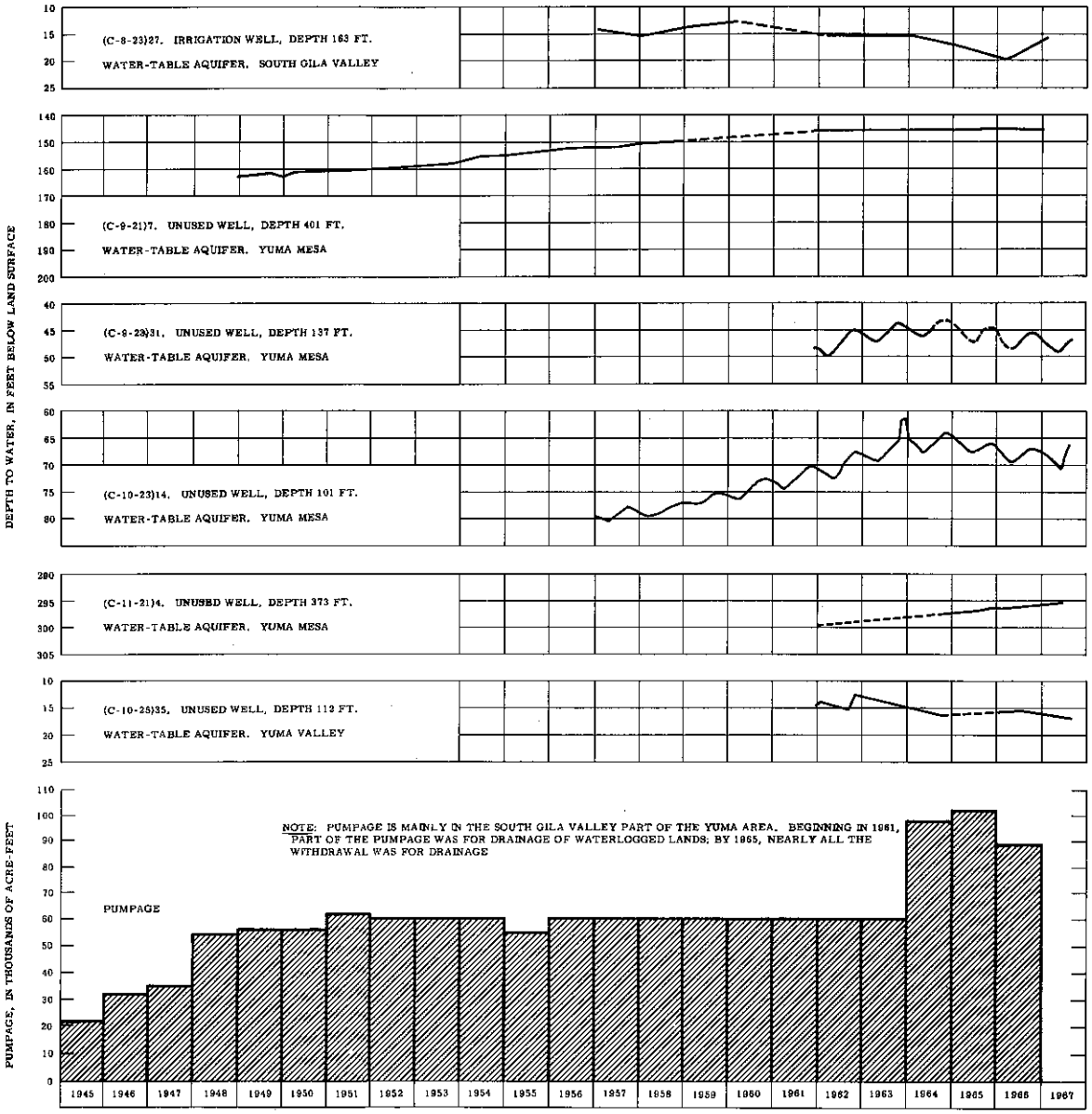


FIGURE 23.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN THE YUMA AREA.

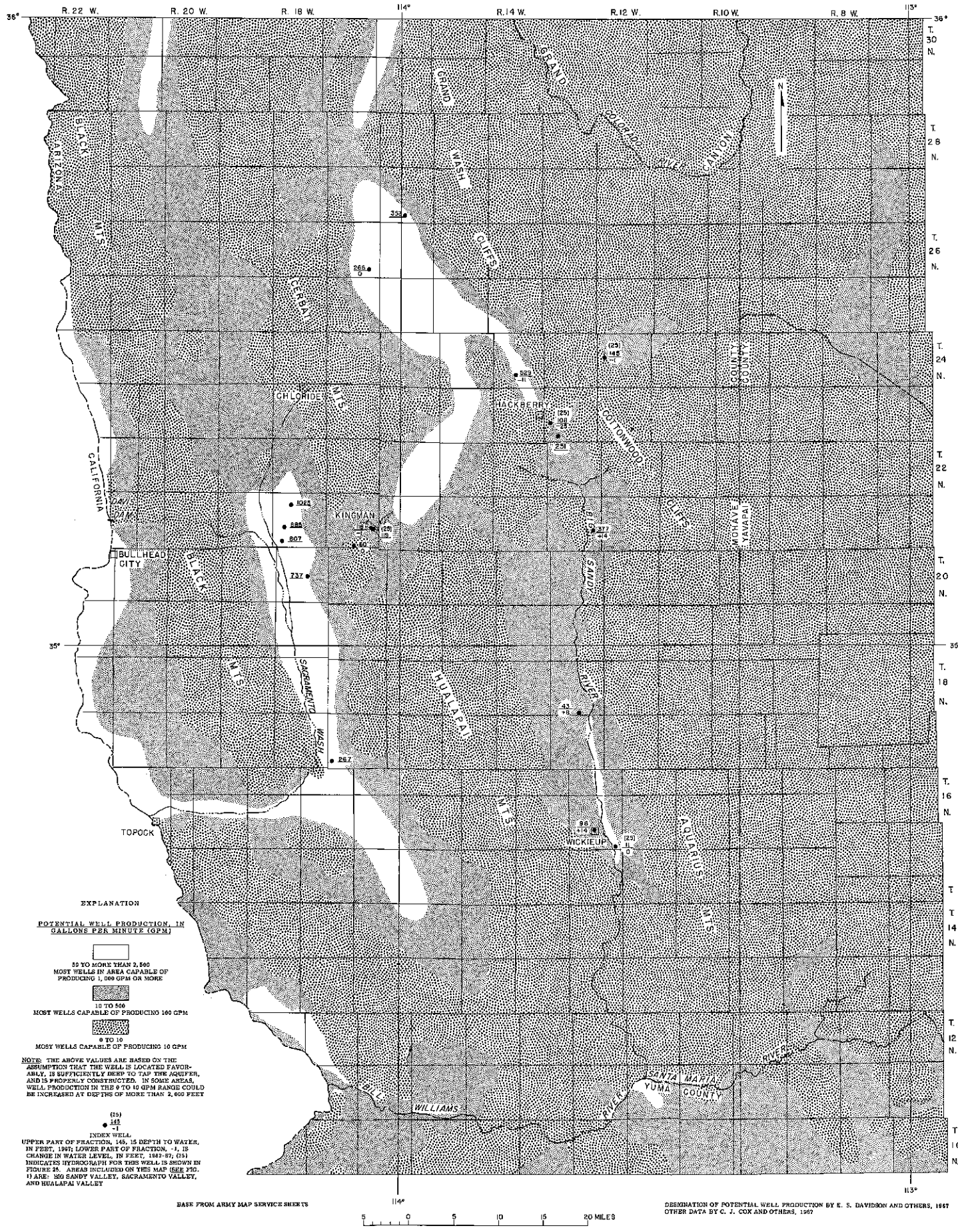


Figure 24.--Depth to water, 1967, and change in water level, 1962-67, in selected wells in the northwest part of the Basin and Range lowlands province.

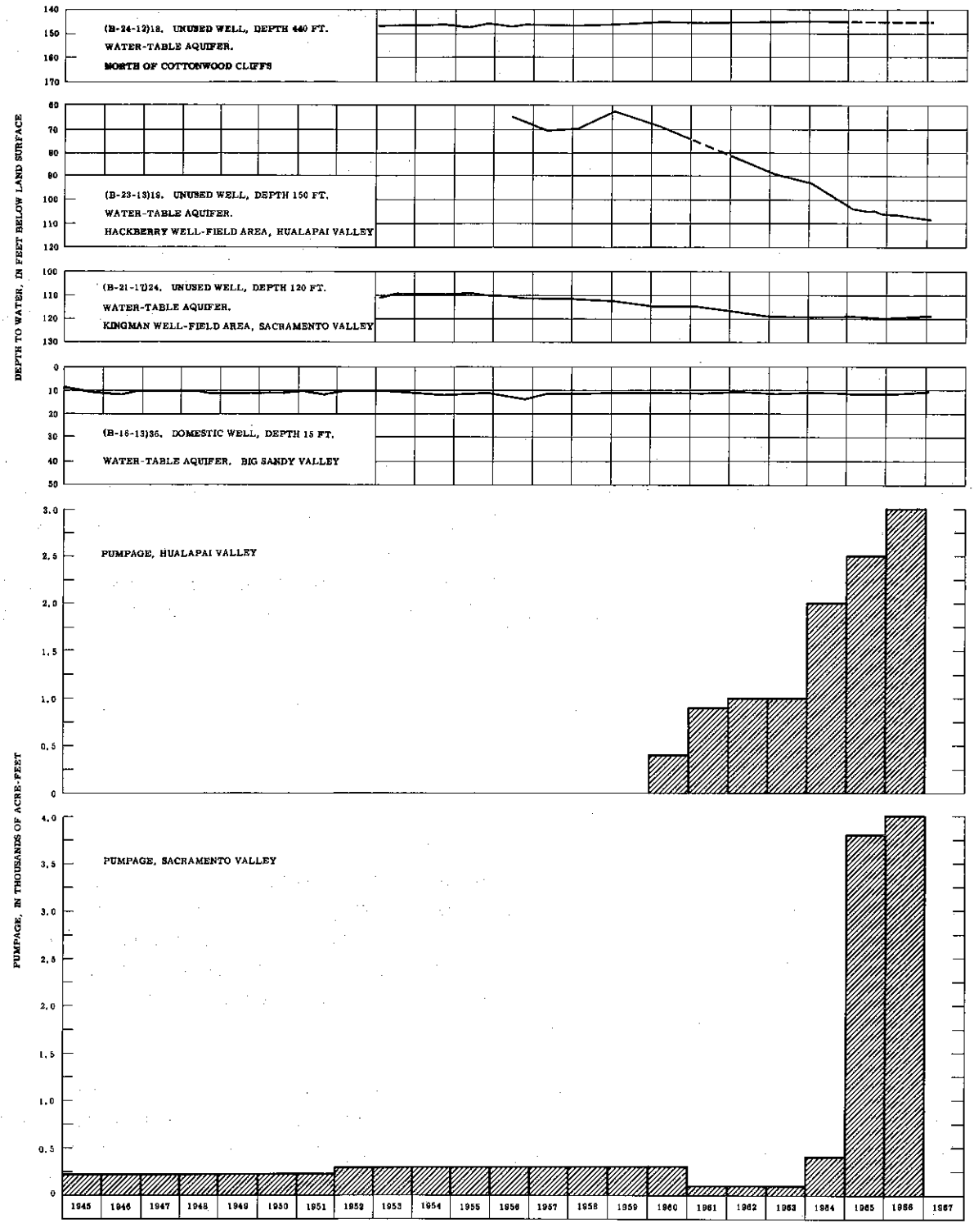


FIGURE 25.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN HUALAPAI AND SACRAMENTO VALLEYS IN THE NORTHWEST PART OF THE BASIN AND RANGE LOWLANDS PROVINCE.

The depth to water for spring 1967 and the change in water level from 1962 to 1967 in selected wells are shown in figure 26; the figure also shows the depth to water in some wells for previous years in areas where there has been essentially no change in the water level. Graphs showing the water levels in selected wells are given in figure 27.

Central Highlands Province

In 1966 about 10,000 acres of land was under cultivation in the Central highlands province. The cultivated acreage is concentrated mainly in Chino and Verde Valleys and along the flood plains of tributaries of the Salt and Gila Rivers in Gila County. Ground water and surface water are used for irrigation in the province.

Ground-water withdrawal is small and water-level declines are slight in the Central highlands province. The rate of decline of the water level in Little Chino Valley has averaged about 2 feet per year for the last 15 years. In Big Chino and Williamson Valleys the overall decline has been less than a foot a year; however, during some years, when more ground water was withdrawn, greater declines took place. Water levels have remained essentially unchanged in Verde Valley except near McGuireville where water levels have declined about 1 to 2 feet per year during the last 5 years.

Figures 28 and 29 show ground-water levels and annual pumpage for several areas in the Central highlands province.

USE OF GROUND WATER

About 4.2 million acre-feet of ground water was withdrawn from the underground reservoirs in Arizona in 1966——only slightly less than in 1965 but about half a million acre-feet less than in any year during the 1953-64 period (table 1). The decrease in pumpage in 1965 and 1966 is attributable, in part, to the planting of crops that require less water and, in part, to more precipitation and surface-water runoff.

Table 1 shows estimated annual ground-water pumpage in Arizona by areas for the entire period of record. The estimated pumpage was obtained by one of the following methods: computed using well-discharge measurements, power-consumption records, and cultivated acreage; estimated using power-consumption records and cultivated acreage; or reported by other agencies. In some instances, revisions of previously published figures were made on the basis of better acreage figures and old power-consumption records. Annual figures are given beginning in 1915 for some areas; in a few

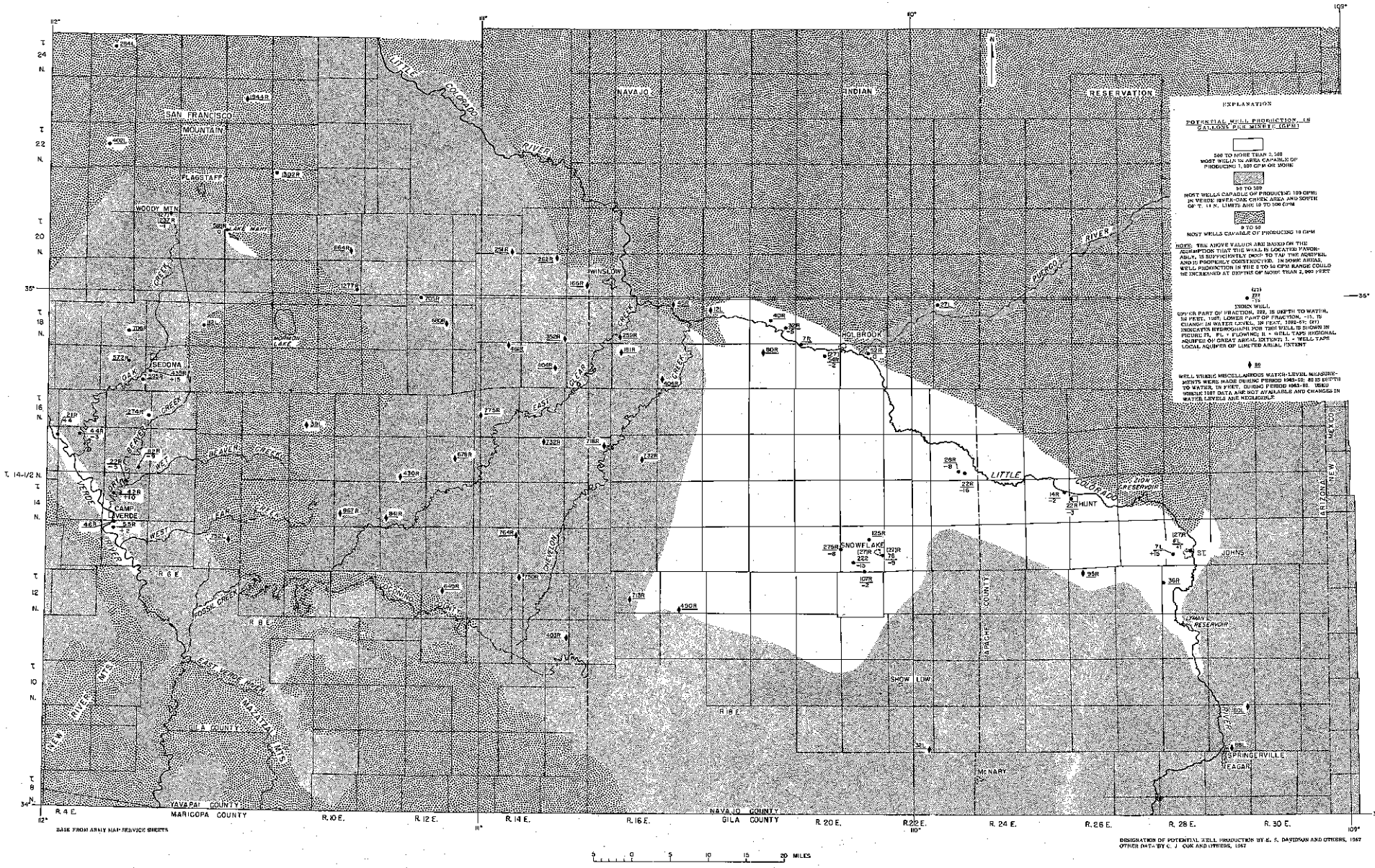


Figure 26.--Depth to water, 1967, and change in water level, 1962-67, in selected wells in the Plateau uplands province.

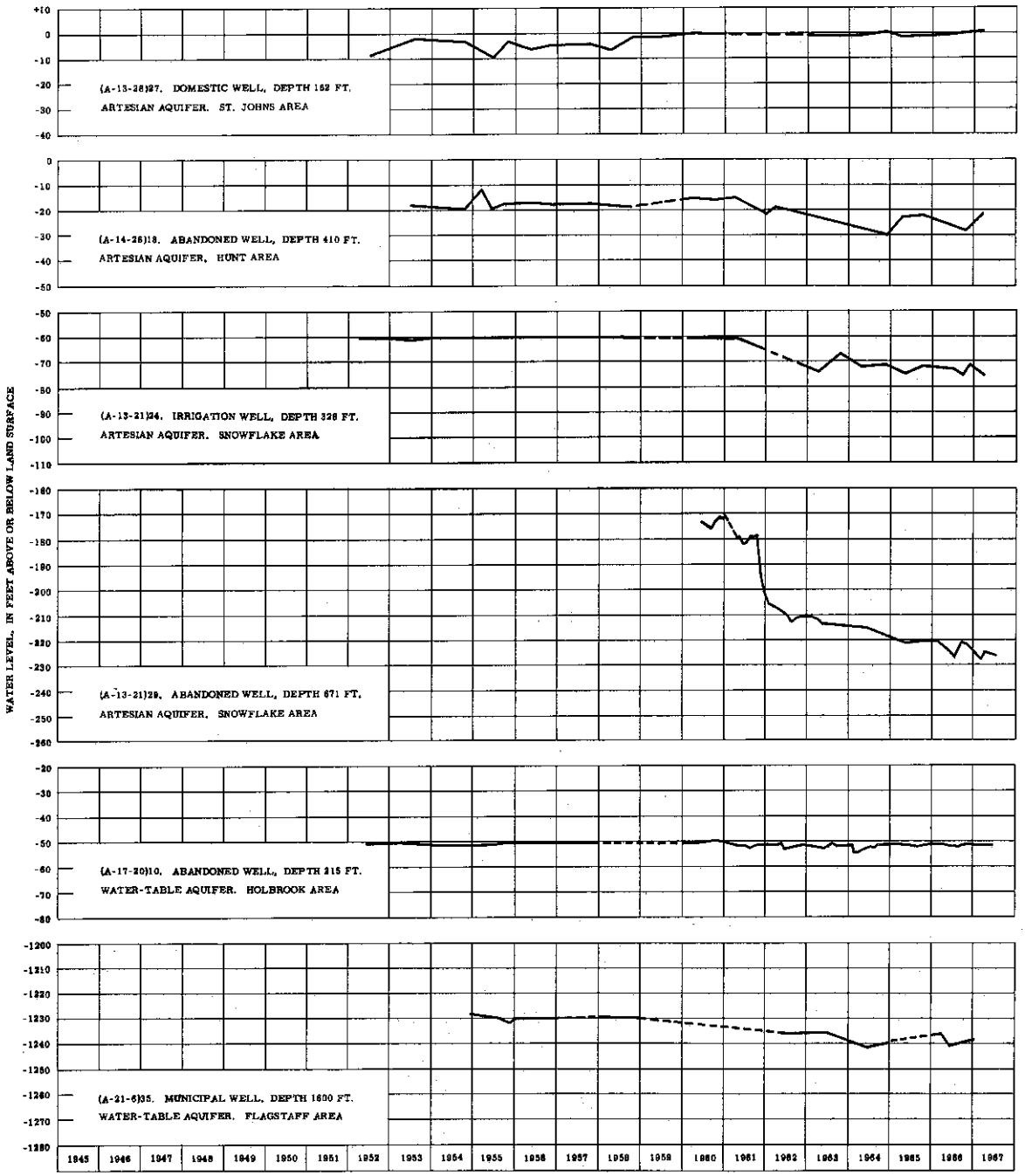
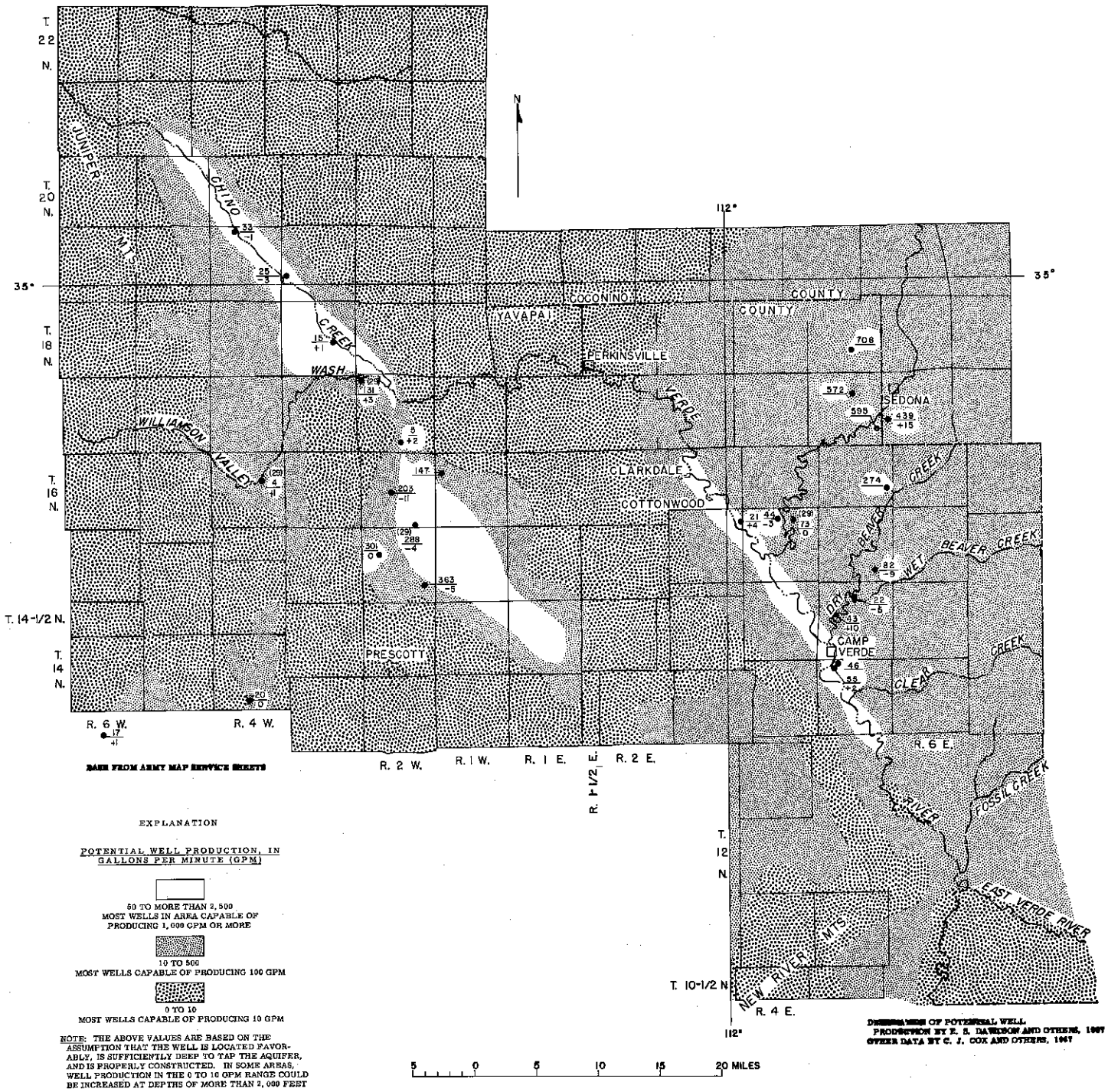


FIGURE 27. --DEPTH TO WATER IN SELECTED WELLS IN THE PLATEAU UPLANDS PROVINCE.



EXPLANATION

POTENTIAL WELL PRODUCTION, IN GALLONS PER MINUTE (GPM)

50 TO MORE THAN 2,500
MOST WELLS IN AREA CAPABLE OF PRODUCING 1,000 GPM OR MORE

10 TO 500
MOST WELLS CAPABLE OF PRODUCING 100 GPM

0 TO 10
MOST WELLS CAPABLE OF PRODUCING 10 GPM

NOTE: THE ABOVE VALUES ARE BASED ON THE ASSUMPTION THAT THE WELL IS LOCATED FAVORABLY, IS SUFFICIENTLY DEEP TO TAP THE AQUIFER, AND IS PROPERLY CONSTRUCTED. IN SOME AREAS, WELL PRODUCTION IN THE 0 TO 10 GPM RANGE COULD BE INCREASED AT DEPTHS OF MORE THAN 2,000 FEET

(29)
288
-4

INDEX WELL
UPPER PART OF FRACTION, 288, IS DEPTH TO WATER, IN FEET, 1967; LOWER PART OF FRACTION, -4, IS CHANGE IN WATER LEVEL, IN FEET, 1962-67; (29) INDICATES HYDROGRAPH FOR THIS WELL IS SHOWN IN FIGURE 29. AREAS INCLUDED ON THIS MAP (SEE FIG. 1) ARE: BIG CHINO VALLEY, LITTLE CHINO VALLEY, WILLIAMSON VALLEY, AND VERDE VALLEY

Figure 28.--Depth to water, 1967, and change in water level, 1962-67, in selected wells in the Central highlands province.

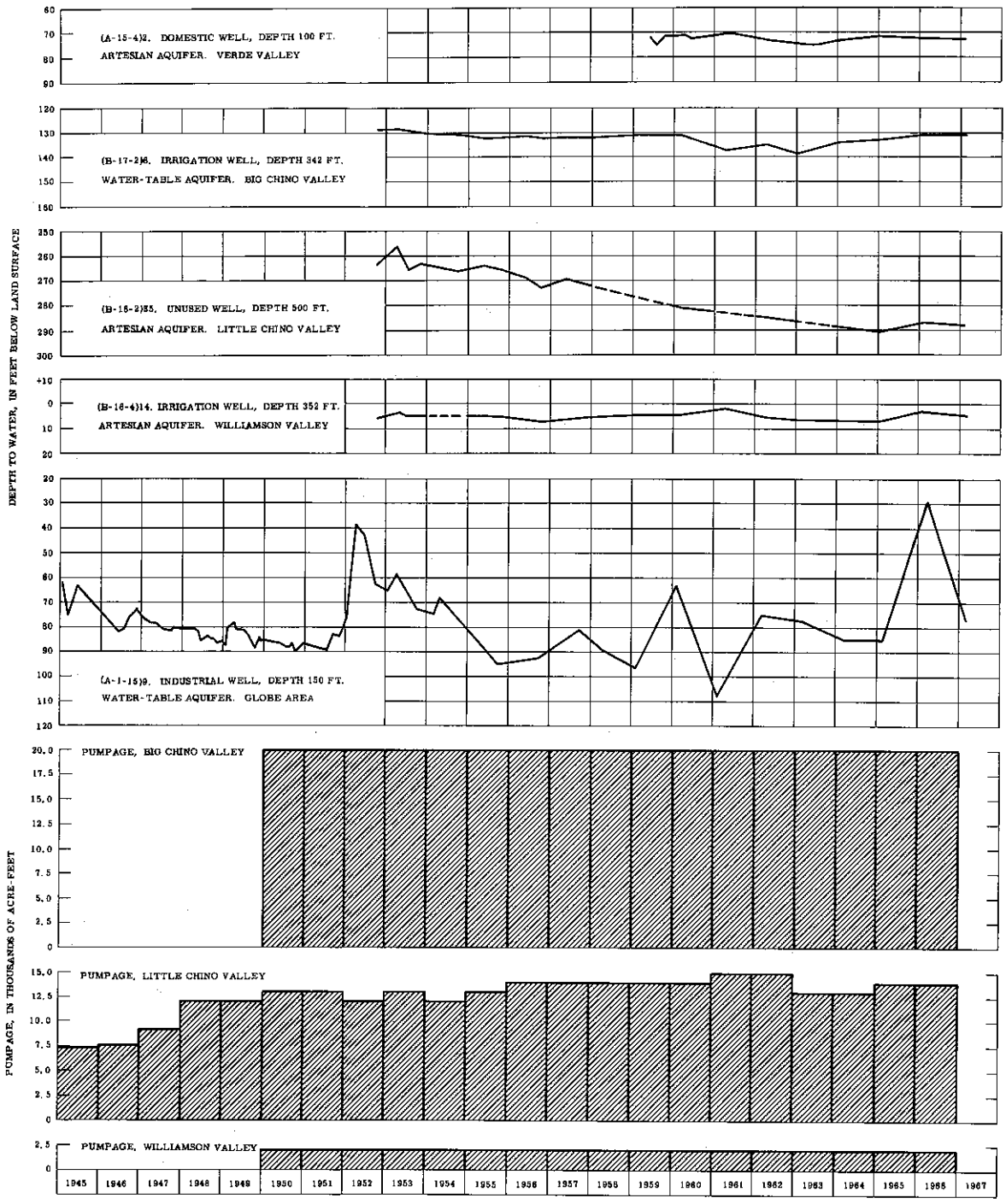


FIGURE 29.--DEPTH TO WATER IN SELECTED WELLS AND ESTIMATED ANNUAL PUMPAGE IN SEVERAL AREAS IN THE CENTRAL HIGHLANDS PROVINCE.

Table 1.--Estimated annual ground-water pumpage, in thousands of acre-feet, in Arizona, by areas

[Numbers rounded to nearest thousand acre-feet. Area: See figure 1 for location. Other areas: Aravaipa Valley, Big Sandy Valley, Cactus Flat-Artesia area, Date Creek area, Peeples Valley, Skull Valley, upper San Pedro basin, lower San Pedro basin, Verde Valley, Little Colorado River basin, areas in the Plateau uplands, and small areas not identifiable with any particular basin. X, pumpage of 500 acre-feet or less]

Year	Area																							Total
	Duncan basin	Safford Valley	San Simon basin	Willcox basin	Douglas basin	Upper Santa Cruz basin	Avra Valley	Lower Santa Cruz basin	Salt River Valley	Waterman Wash area	Gila Bend basin	Harquahala Plains area	McMullen Valley	Palomas Plain-Sentinel Plain-Dendora Valley area	Ranegras Plain area	Yuma area[1/]	Sacramento Valley	Hualapai Valley	Big Chino Valley	Little Chino Valley	Williamson Valley	Wellton-Mohawk area	Colorado River flood plain below Davis Dam	Other areas	
Prior to 1915	--	--	5	--	--	80	--	1,200	57	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	1,347
1915	--	--	10	2	1	7	--	82	15	--	--	--	--	--	--	2	--	--	--	--	--	4	--	--	123
1916	--	--	8	2	1	7	--	83	15	--	--	--	--	--	--	2	--	--	--	--	--	4	--	--	122
1917	--	--	8	1	X	8	--	84	15	--	--	--	--	--	--	2	--	--	--	--	--	4	--	--	122
1918	--	--	6	X	X	8	--	85	40	--	--	--	--	--	--	3	--	--	--	--	--	4	--	--	146
1919	--	--	6	X	X	10	--	86	60	--	--	--	--	--	--	4	--	--	--	--	--	6	--	--	172
1920	--	--	5	X	X	35	--	88	95	--	--	--	--	--	--	4	--	--	--	--	--	6	--	--	233
1921	--	--	5	X	X	20	--	90	100	--	--	--	--	--	--	4	--	--	--	--	--	3	--	--	222
1922	--	--	5	X	X	30	--	93	200	--	--	--	--	--	--	4	--	--	--	--	--	3	--	--	335
1923	--	--	5	X	X	37	--	96	400	--	--	--	--	--	--	4	--	--	--	--	--	10	--	--	552
1924	--	--	5	X	X	45	--	99	500	--	--	--	--	--	--	4	--	--	--	--	--	15	--	--	668
1925	--	--	5	X	X	42	--	101	500	--	--	--	--	--	--	5	--	--	--	--	--	15	--	--	668
1926	--	--	4	1	X	40	--	104	500	--	--	--	--	--	--	6	--	--	--	--	--	20	--	--	675
1927	--	--	4	1	X	40	--	106	500	--	--	--	--	--	--	7	--	--	--	--	--	20	--	--	678
1928	--	--	4	2	X	45	--	109	500	--	--	--	--	--	--	8	--	--	--	--	--	20	--	--	688
1929	--	--	4	2	X	40	--	111	600	--	--	--	--	--	--	9	--	--	--	--	--	10	--	--	776
1930	--	--	4	1	1	38	--	135	650	--	--	--	--	--	--	10	--	--	--	--	--	15	--	--	854
1931	--	--	4	1	1	25	--	160	600	--	--	--	--	--	--	11	--	--	--	--	--	20	--	--	822
1932	--	--	3	1	2	20	--	185	300	--	--	--	--	--	--	12	--	--	--	--	--	20	--	--	543
1933	--	--	3	1	2	16	--	210	572	--	--	--	--	--	--	13	--	--	--	--	--	15	--	--	832
1934	--	--	3	1	2	30	--	235	711	--	--	--	--	--	--	14	--	--	--	--	--	15	--	--	1,011
1935	X	20	3	1	2	28	1	260	554	--	2	--	--	--	--	15	--	--	--	--	--	20	--	5	911
1936	X	20	3	1	2	32	1	285	684	--	2	--	--	--	--	16	--	--	--	--	--	20	--	5	1,071
1937	X	20	3	1	2	35	4	305	665	--	2	--	--	--	--	17	--	--	--	2	--	25	--	10	1,091
1938	1	20	3	2	2	40	8	325	905	--	2	--	--	--	--	18	--	--	--	3	--	25	--	10	1,364
1939	1	20	3	2	2	50	9	352	738	--	2	--	--	--	--	19	--	--	--	4	--	25	--	20	1,247
1940	2	25	3	2	5	62	12	372	943	X	19	1	X	1	--	19	X	--	--	4	--	25	--	25	1,520
1941	1	9	3	5	5	70	10	421	444	X	19	1	X	1	--	20	X	--	--	4	--	25	--	25	1,063
1942	2	19	4	5	5	94	6	500	1,004	X	19	1	X	2	--	21	X	--	--	5	--	30	--	25	1,742
1943	7	35	4	5	5	95	20	515	1,104	X	20	1	X	2	--	22	X	--	--	6	--	35	--	25	1,901
1944	8	52	4	5	5	100	19	530	1,017	X	20	1	X	6	--	20	X	--	--	7	--	37	--	25	1,856
1945	6	35	5	9	8	106	23	610	1,143	X	20	1	2	9	--	22	X	--	--	7	--	35	--	25	2,066
1946	17	115	6	15	12	109	23	660	1,360	X	33	1	2	11	--	32	X	--	--	8	--	38	--	30	2,472
1947	21	100	6	20	17	136	34	700	1,406	X	40	1	2	11	--	35	X	--	--	9	--	43	--	30	2,611
1948	21	110	6	23	22	135	38	950	1,670	1	61	1	2	7	--	54	X	--	--	12	--	50	--	35	3,198
1949	11	40	6	28	30	132	48	1,100	1,644	1	67	1	2	13	--	56	X	--	--	12	--	45	--	35	3,271
1950	23	90	6	35	35	160	41	1,000	1,852	5	59	5	2	15	2	56	X	--	20	13	2	46	--	40	3,507
1951	33	125	6	38	38	180	75	1,030	1,910	10	104	7	2	21	5	62	X	--	20	13	2	50	--	50	3,781
1952	17	70	15	39	42	195	80	950	2,020	17	120	10	5	32	15	60	X	--	20	12	2	40	--	50	3,811
1953	30	120	25	94	45	200	85	1,400	2,300	28	145	20	6	42	22	60	X	--	20	13	2	16	--	50	4,723
1954	27	90	32	105	42	200	90	1,200	2,300	30	139	33	7	37	19	60	X	--	20	12	2	9	--	50	4,504
1955	25	90	40	110	50	200	95	1,200	2,240	40	140	30	9	31	16	55	X	--	20	13	2	8	--	50	4,464
1956	20	90	40	120	60	200	100	1,100	2,300	40	180	40	15	30	16	60	X	--	20	14	2	5	--	60	4,512
1957	20	100	48	135	55	200	110	1,100	2,300	40	180	50	21	30	9	60	X	--	20	14	2	5	--	60	4,559
1958	25	50	50	155	55	175	120	1,200	2,300	45	200	60	38	30	10	60	X	--	20	14	2	2	5	60	4,676
1959	25	100	50	183	55	165	130	1,200	2,206	50	250	95	50	40	10	60	X	--	20	14	2	2	10	60	4,777
1960	25	90	60	195	60	165	140	1,100	2,005	60	250	125	60	50	11	60	X	X	20	14	2	2	36	75	4,605
1961	25	140	65	184	65	175	145	1,150	2,178	65	200	100	70	50	12	60	X	1	20	15	2	2/140	35	90	4,987
1962	25	60	65	180	65	200	140	1,050	1,976	50	170	200	65	50	15	60	X	1	20	15	2	2/215	35	110	4,769
1963	25	80	65	180	65	180	115	1,000	2,134	50	130	200	75	60	17	60	X	1	20	13	2	2/201	35	110	4,818
1964	25	110	75	220	60	175	115	1,150	1,972	50	130	200	90	65	7	98	X	2	20	13	2	2/181	38	120	4,918
1965	25	150	70	250	90	200	125	910	1,500	45	115	200	90	65	6	102	4	2	20	14	2	2/186	36	150	4,357
1966	25	90	72	240	105	190	95	915	1,350	45	145	160	105	80	7	89	4	3	20	14	2	2/217	43	165	4,181
Total	518	2,285	952	2,603	1,121	5,007	2,057	30,082	57,054	672	2,985	1,545	720	791	199	1,636	8	10	340	313	34	2,037	273	1,680	114,922

1/ Pumpage is mainly for the South Gila Valley part of the Yuma area. Beginning in 1961, part of the pumpage was for drainage of waterlogged lands; by 1965, nearly all the withdrawal was for drainage.

2/ Withdrawal for drainage purposes only.

instances, where some information was available, estimates were made for the period "prior to 1915." Figure 30 shows estimated annual ground-water pumpage in Arizona. To date (through 1966) ground-water withdrawal in Arizona has amounted to about 115 million acre-feet. More than 57 million acre-feet of ground water has been withdrawn from aquifers in the Salt River Valley, and more than 30 million acre-feet has been withdrawn in the lower Santa Cruz basin.

The areas of greatest decrease in ground-water pumpage in 1966 were the Salt River and Safford Valleys, where greater amounts of surface water were available for irrigation. Significant increases in pumpage occurred in Douglas basin, Gila Bend basin, McMullen Valley, and the Palomas Plain area, largely because of increases in cultivated acreage and planting and irrigation of winter crops.

The chief use of ground water in Arizona is for the irrigation of crops. Slightly more than a million acres of land was cultivated in Arizona in 1966, and most of the land was irrigated entirely with ground water. In places, however, ground water is used as a supplement to the surface-water supply; about 2.4 million acre-feet of surface water was diverted for use in the State during 1966 in addition to the 4.2 million acre-feet of ground water used. The greatest water use is in the Basin and Range lowlands province; the Salt River Valley and the lower Santa Cruz basin are the areas of greatest withdrawal. For several years the amount of ground water withdrawn annually in these two areas has amounted to nearly 70 percent of the total withdrawal in the State; in 1966 it amounted to only about 60 percent.

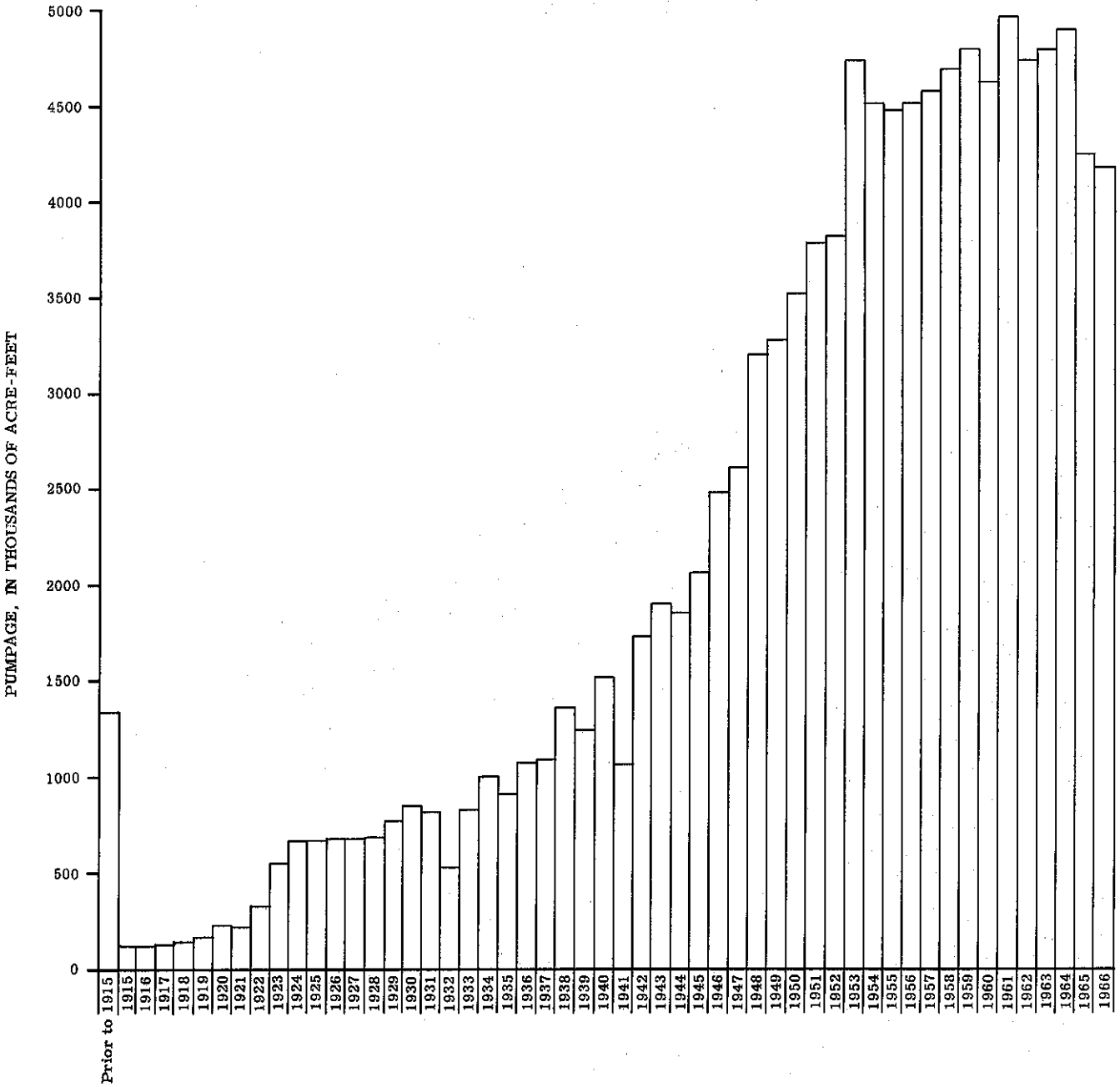


FIGURE 30. --ESTIMATED ANNUAL GROUND-WATER PUMPAGE IN ARIZONA.