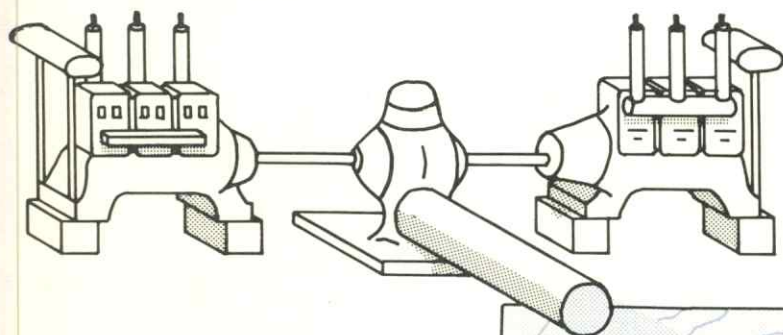
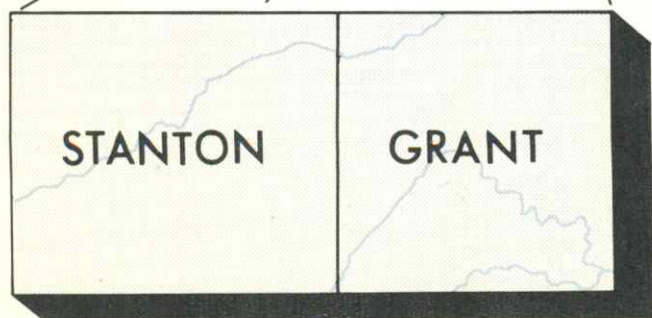
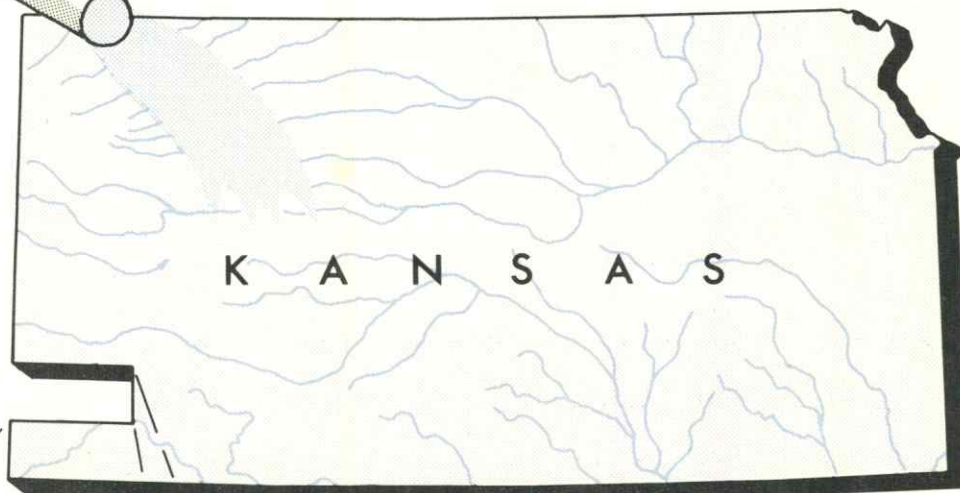


WATER - LEVEL CHANGES IN GRANT AND STANTON COUNTIES 1939 - 1964



By John D. Winslow
Carl E. Nuzman
Stuart W. Fader



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The University of Kansas
Lawrence, Kansas

1964

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Prepared as part of the cooperative ground-water program in Kansas conducted by the U.S. Geological Survey, the State Geological Survey of Kansas, the Division of Water Resources of the Kansas State Board of Agriculture, and the Environmental Health Services of the Kansas State Department of Health.

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by

John D. Winslow^{1/}, Carl E. Nuzman^{2/}, and Stuart W. Fader^{1/}

INTRODUCTION

Ground-water levels are declining in most of the 1,260 square-mile area of Grant and Stanton counties in southwestern Kansas. The decline of water level is in response to the rapidly increasing use of ground water for irrigation. According to Fader (Fader and others, 1964), the present rate of pumping is far in excess of the natural recharge to the ground-water reservoir. Fader states that the natural recharge is less than 10 percent of the 1959 rate of withdrawal; therefore, most of the water pumped is removed from storage in the ground-water reservoir, and each year the amount of water remaining in storage for future use becomes smaller.

The amount and distribution of pumping will determine the number of years that irrigation with ground water will remain economical. If the present rate of water-level decline continues, the quantity of ground water in storage will be depleted within a few years to the extent that irrigation will become economically unfeasible in parts of the area.

The purpose of this publication is to present the pertinent data collected to date for the information and consideration of all concerned with ground-water supplies in the two counties. The graphs and illustrations are self-indicative of the potential seriousness of the growing water-supply problem in Grant and Stanton counties. These data were collected as part of the cooperative water-resources investigation of Kansas being conducted by the U.S. Geological Survey, the State Geological Survey of Kansas, the Division of Water Resources of the Kansas State Board of Agriculture, and the Environmental Health Services of the Kansas State Department of Health. The nomenclature and classification of the geologic units described in this report are those of the State Geological Survey of Kansas. They differ somewhat from the usage adopted by the U.S. Geological Survey.

^{1/} Branch of Ground Water, U.S. Geological Survey.

^{2/} Division of Water Resources, Kansas State Board of Agriculture.

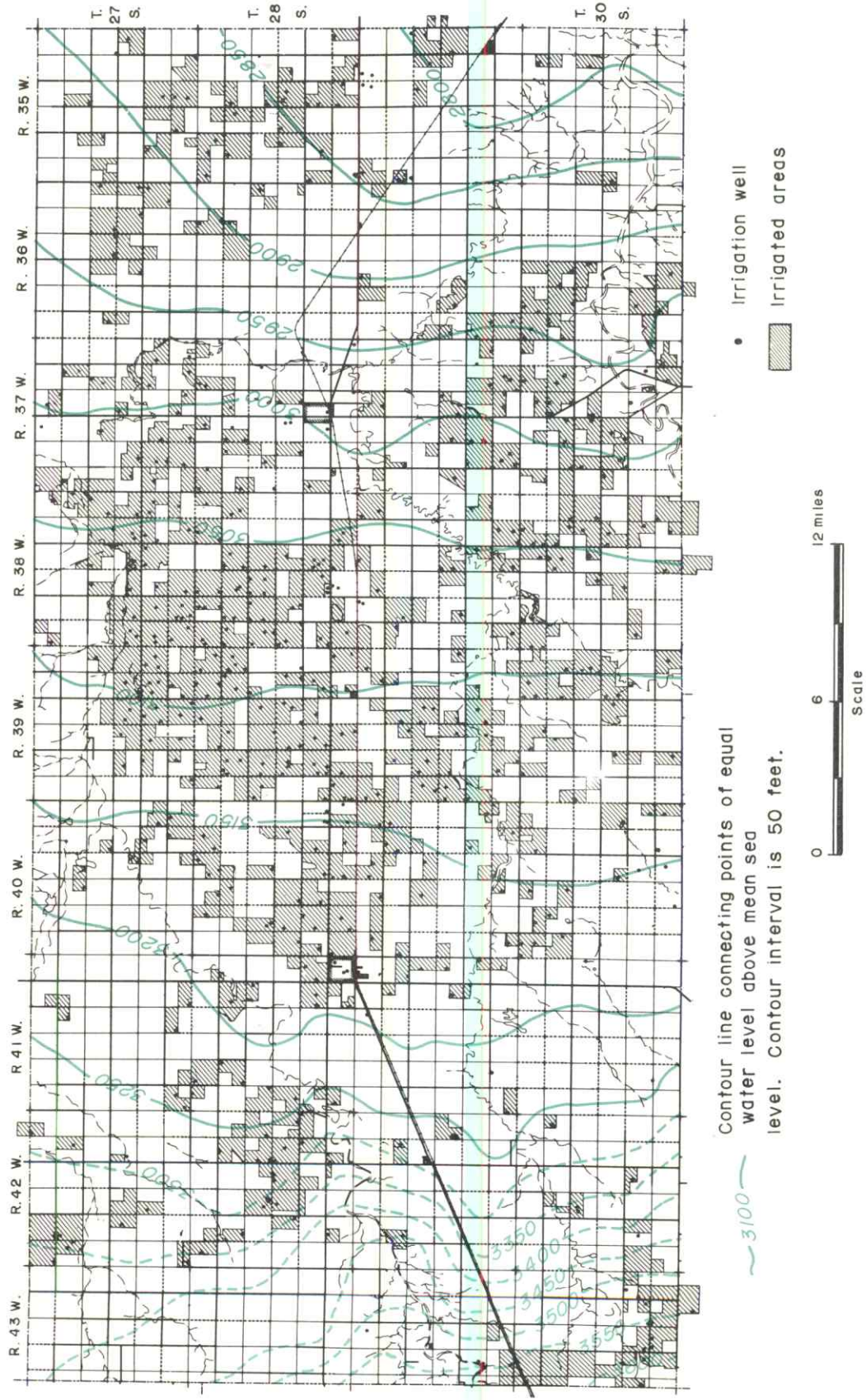


Figure 1.--Map showing irrigated areas as of December 1963, and water-level contours for the base period 1939-42. (Modified after Fader and others, 1964; Latta, 1941; and McLaughlin, 1946.)

DEVELOPMENT OF WATER USE

In 1940, approximately 15 irrigation wells were in use in Grant and Stanton counties. As of December 1963 the number of wells had increased to approximately 550. The drought between 1953 and 1956 was a significant factor contributing to the great increase in ground-water irrigation in the area.

The water-bearing zones penetrated by most of the wells are in the unconsolidated sand and gravel deposits of Neogene age (illustration on back cover). For a detailed description of the geology of the area, see Latta (1941), McLaughlin (1946), and Fader and others (1964). Increasing numbers of wells are being drilled through the Neogene sediments and the Kiowa Shale into the underlying sandstones. The wells are constructed so that water is obtained from all significant water-bearing zones.

The locations of wells and irrigated areas in Grant and Stanton counties are shown in Figure 1. This map was compiled from data on file at the Division of Water Resources of the Kansas State Board of Agriculture. Approximately 90 percent of the water users in the area have filed for water rights and, therefore, the records on file provide a reliable guide to the annual increase of water use (Fig. 2). The present authorized annual water use for both counties is 389,620 acre-feet as of December 1963. The irrigated area totals 186,221 acres.

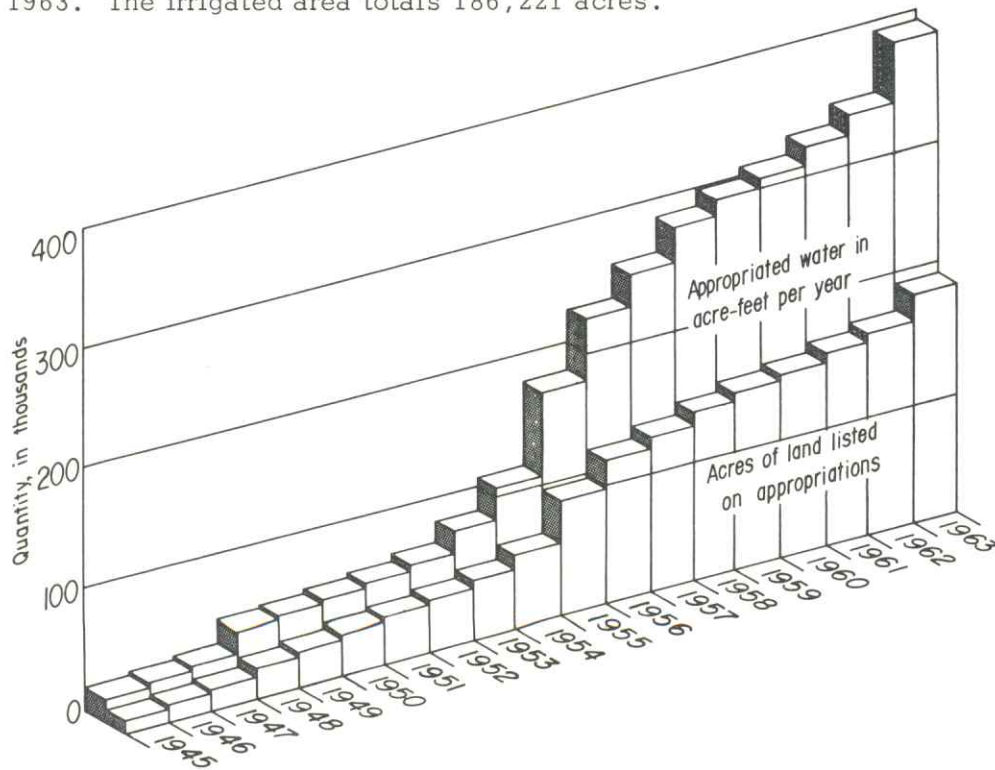
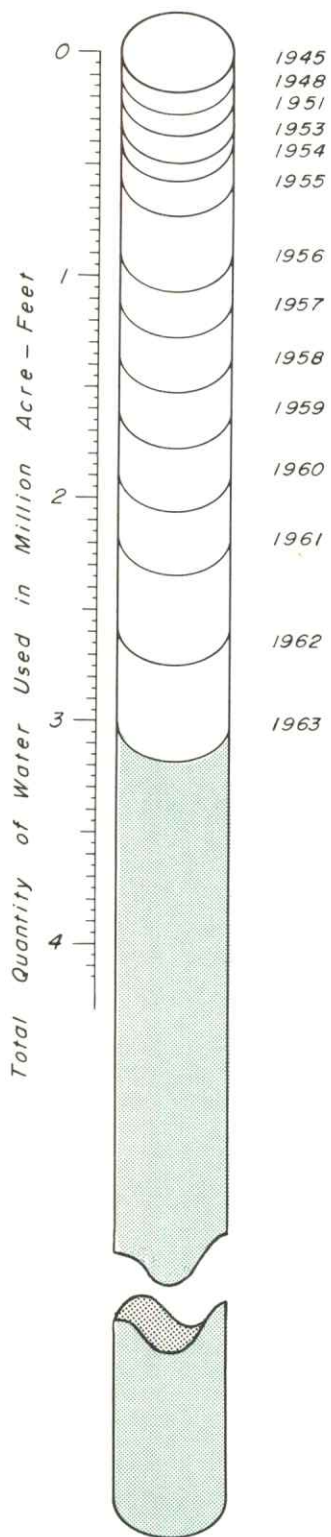


Figure 2.--Increase in irrigation, 1945-63. (Data on file at the Division of Water Resources, Kansas State Board of Agriculture.)



The Division of Water Resources requested that, beginning in 1958, each water user report annually his best estimate of the water pumped for irrigating his land. The sum of these annual estimates is shown in Figure 3. The use of water in 1963 was approximately 400,000 acre-feet which is more than the total quantity used for irrigation in all the years prior to 1955.

DECLINE OF WATER LEVEL

Ground-water levels in the area have been measured intermittently since 1939. A compilation of water-level data collected in the period 1939-42 was used to construct the water-level contours shown in Figure 1. The map also shows the location of wells and irrigated areas. The change of water levels between the base period (1939-42) and the spring of 1960 is shown in Figure 4. From the decline of water levels in the few observation wells, it became obvious that additional information was needed. In January 1963, the water level was measured in approximately 270 wells and the water-level contour map shown in Figure 5 was constructed from the data accumulated. The change in water levels from the base period is also shown in Figure 5. The water levels in approximately 300 wells were measured in January 1964. The resulting water-level contour map with the change in water levels

Figure 3.--Accumulated total water used for irrigation 1945-63. (Data on file at the Division of Water Resources, Kansas State Board of Agriculture.)

from the base period is shown in Figure 6. By January 1964, the water levels had declined as much as 90 feet below 1939-42 levels in a small area, and as much as 40 feet in an area of 220 square miles. The progressive decline of water levels below 1939-42 levels with respect to the area in square miles affected is shown by the table below and by the areal decline curves (Fig. 7).

Area in square miles in which water-level decline exceeded:

Time interval	10 feet	40 feet	80 feet
1939-42 to 1960	350	3	0
1939-42 to 1963	660	170	0
1939-42 to 1964	790	220	5

Most of the decline of water levels has occurred since 1955 as is shown by hydrographs of water levels in specific wells (Broeker and Winslow, 1963).

The extensive pumping of water for irrigation during the growing season causes considerable seasonal decline of water levels. During the irrigation season pumping levels in individual wells have been measured as much as 250 feet below the 1939-42 water levels. However, as shown by the individual hydrographs in Figure 8, water levels recover to some extent during the winter. Water-level measurements made during the winter serve to reveal the net annual water-level decline and the net reduction of the ground water in storage. The cumulative total quantity of water withdrawn for irrigation in both Grant and Stanton counties through December 1963 is illustrated in Figure 3.

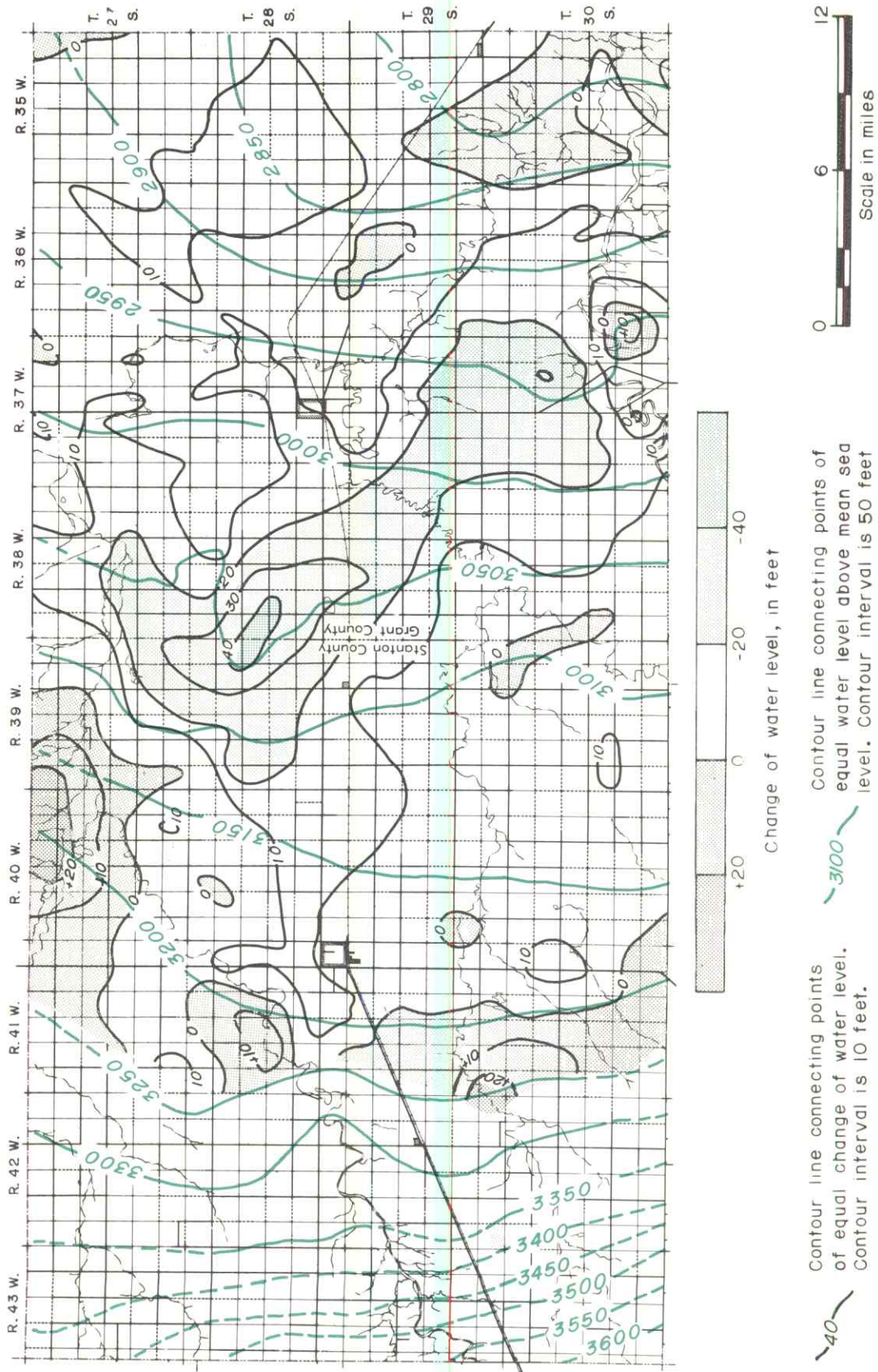


Figure 4.--Map showing lines of equal change in water level between 1939-42 and 1960, and water-level contours as of March-April 1960. (Modified after Broecker and Fishel, 1962; and Fader and others, 1964.)

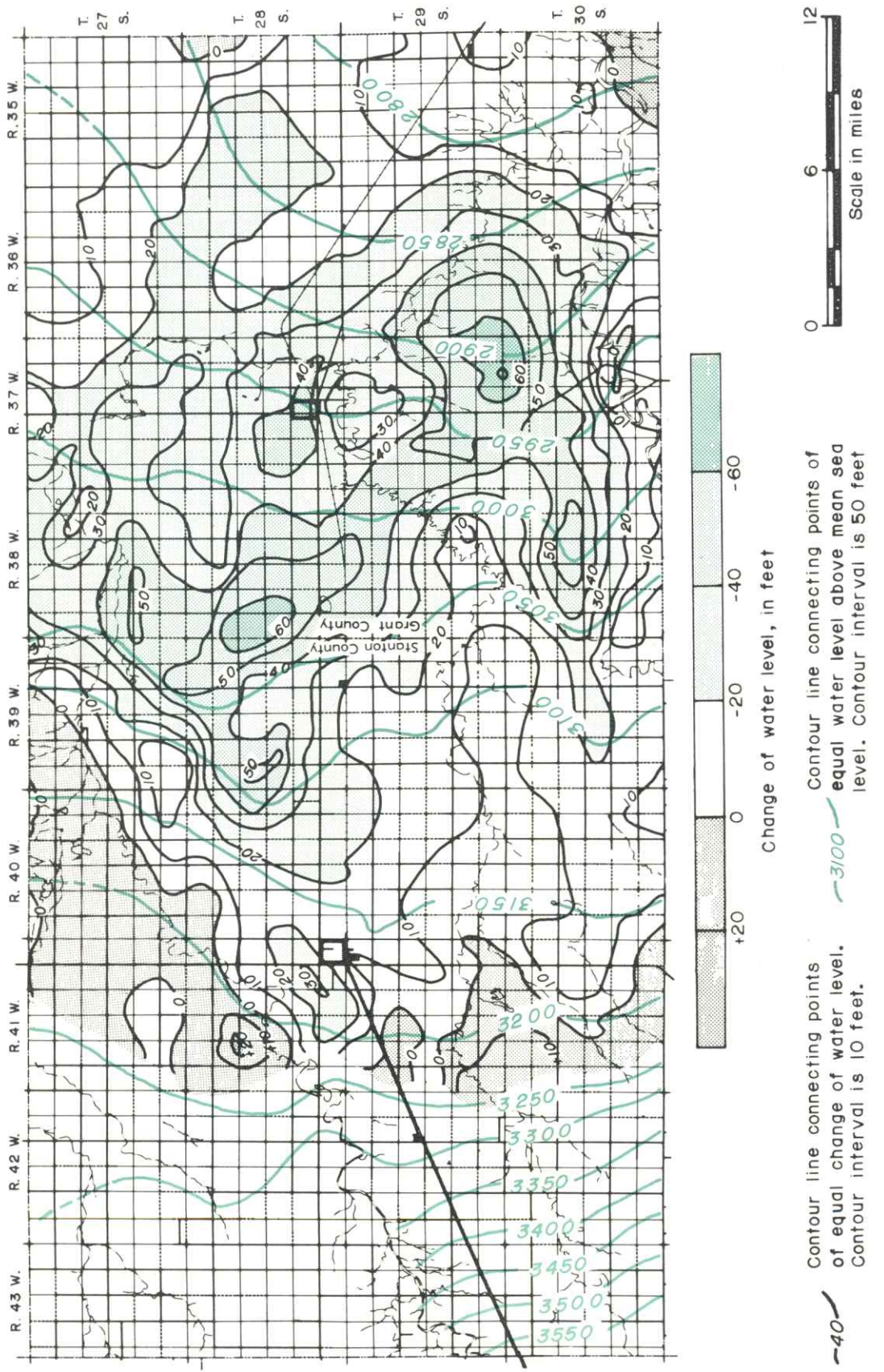


Figure 5.--Map showing lines of equal change in water level between 1939-42 and January 1963, and water-level contours as of January 1963. (Modified after Fader and others, 1964.)

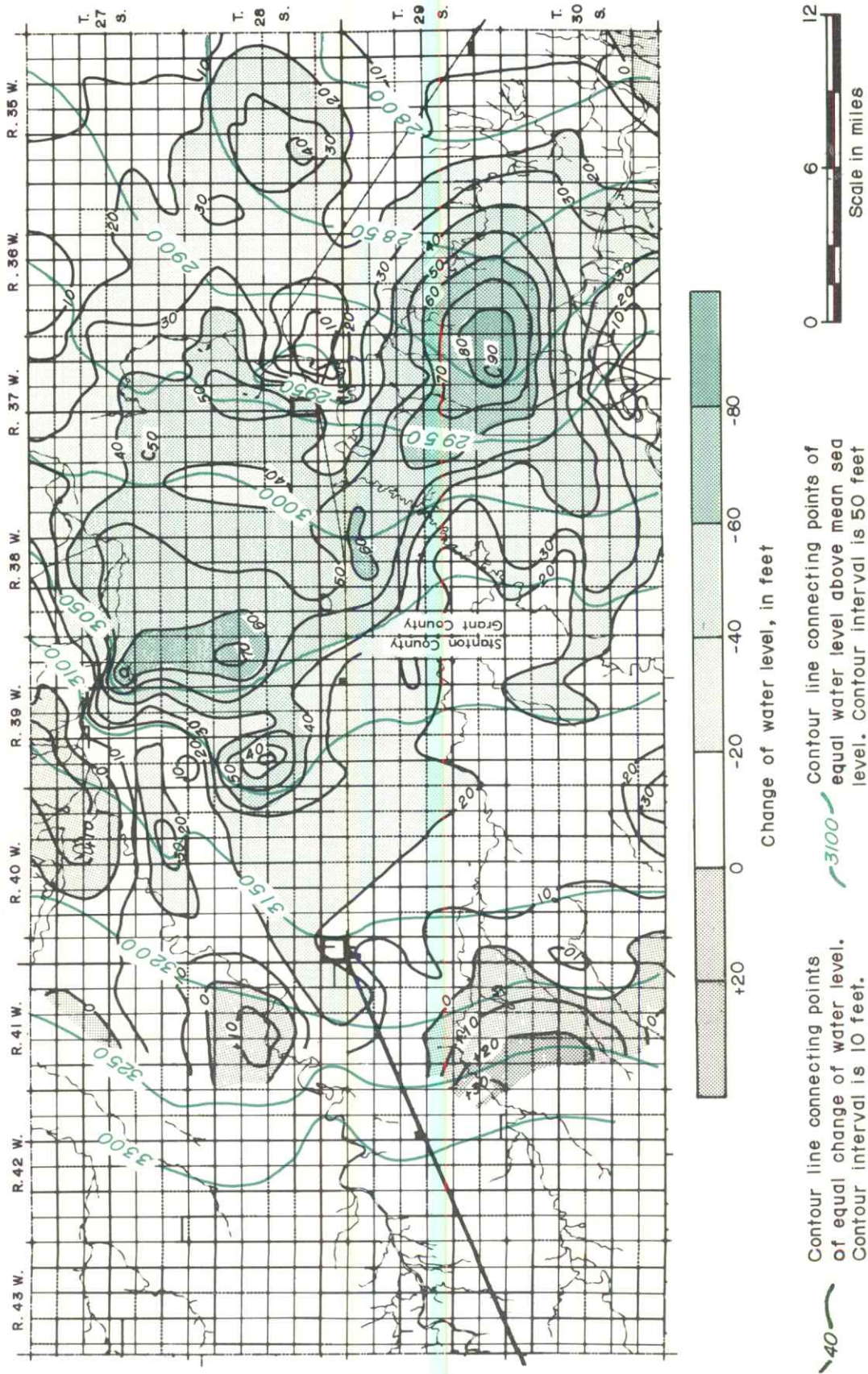


Figure 6.--Map showing lines of equal change in water level between 1939-42 and January 1964, and water-level contours as of January 1964.

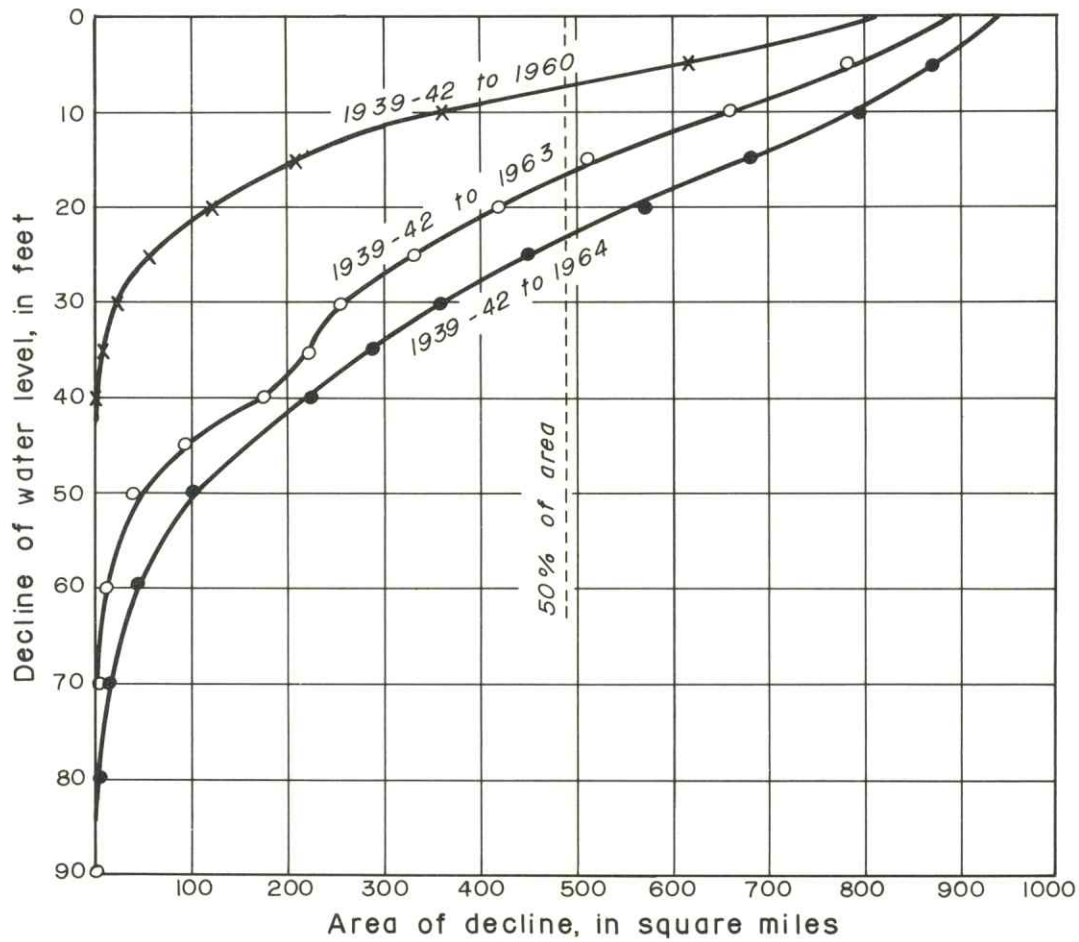


Figure 7.--Areal decline of water levels. (Modified after Fader and others, 1964.)

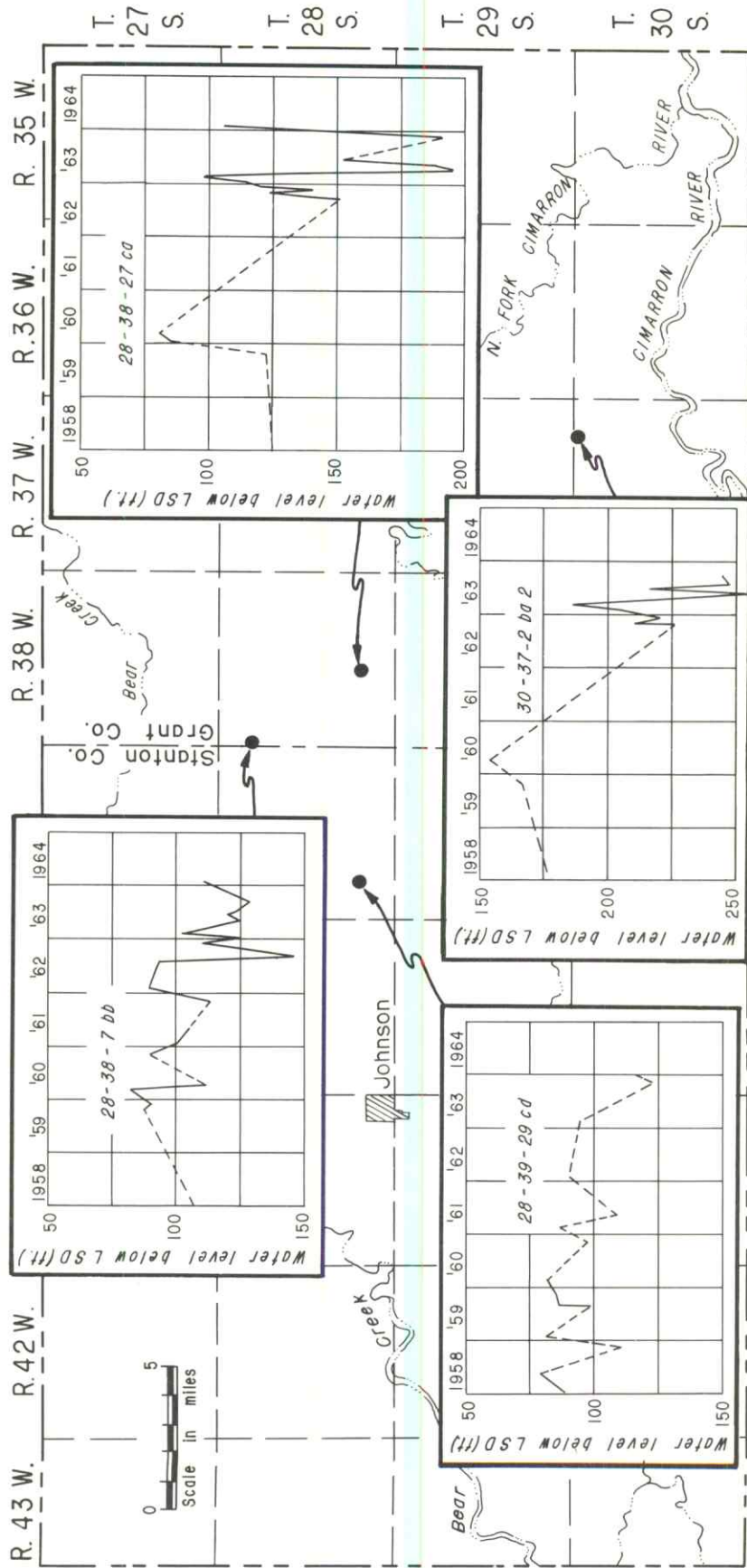


Figure 8.--Hydrographs of water levels below land surface datum (LSD) in selected wells. (Modified after Broecker and others, 1962, and 1963, in preparation.)

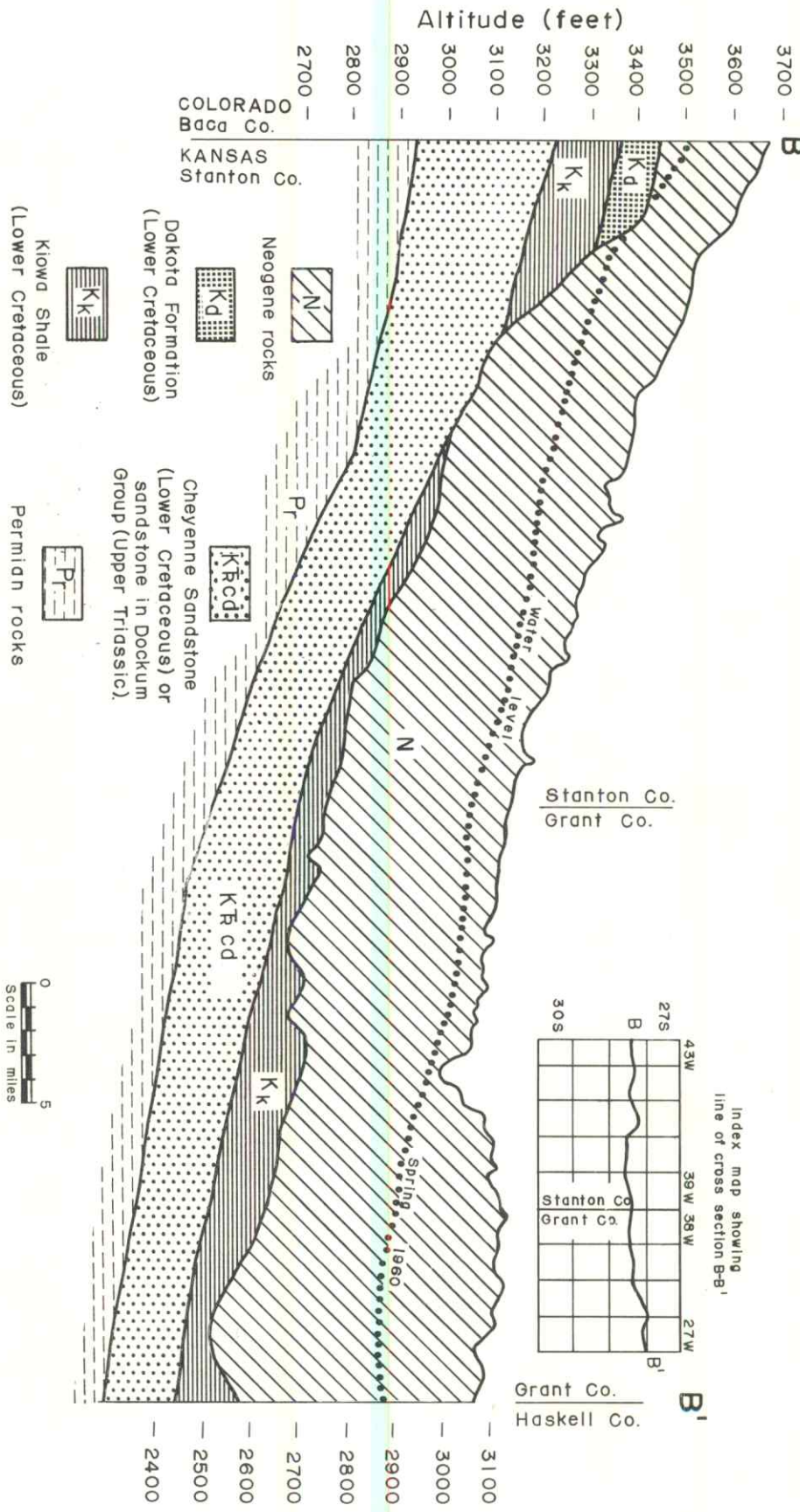
SUMMARY

The graphs and illustrations indicate that as the use of ground water in Grant and Stanton counties has increased, water levels have declined, and the amount of water remaining in storage has been significantly reduced. The further expansion of irrigation, currently in progress, will result in progressively greater use of ground water. As water levels decline, yields of wells will decline, and cost of pumping will increase. Thus, the present economic advantages of the availability of water for irrigation will diminish.

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EAST-WEST CROSS SECTION B-B' GRANT-STANTON AREA, KANSAS



Geologic cross section B-B', Grant and Stanton counties, Kansas. (Modified after Fader and others, 1964.)