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DEPARTMENT OF THE INTERIOR
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Water Resources Division

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PROGRESS REPORT: GROUND-WATER APPRAISAL OF CUYAMA VALLEY, CALIFORNIA

Prepared in cooperation with the
Santa Barbara County Water Agency

OPEN-FILE REPORT

Menlo Park, California
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Ground-water withdrawals in Cuyama Valley (fig. 1) have increased about 500 percent since the early forties, and since about 1947 annual withdrawal has exceeded the estimated perennial yield of the basin. This has caused a general decline of water levels in the valley, and a well-defined cone of depression about 2 by 6 miles in area, reflecting a maximum water-level decline of about 140 feet, has developed near Cuyama. Continued overdraft will increase pumping lifts until pumping costs are no longer economical.

The U.S. Geological Survey, in cooperation with the Santa Barbara County Water Agency, has been engaged in a water-resources investigation of the area during the past year. Preliminary findings are summarized in this progress report, which has been prepared at the request of the Santa Barbara County Water Agency.

Ground water in Cuyama Valley is replenished mostly by rain on a watershed of about 700 square miles (fig. 2). Most of that area, at altitudes from 2,000 to 5,000 feet above sea level, receives less than 14 inches of precipitation a year. Somewhat greater precipitation, about 24 to 30 inches, occurs in the headwater region of the Cuyama River and on the crest of the Sierra Madre Mountains, where altitudes exceed 7,000 feet. However, only a small part of the drainage from these highland areas reaches the Cuyama ground-water basin. In the valley itself the average annual rainfall is less than 10 inches. The average annual rainfall for the 21-year period (1945-65) at Cuyama is 5.79 inches (fig. 3). Most of the rain falls in winter and spring.

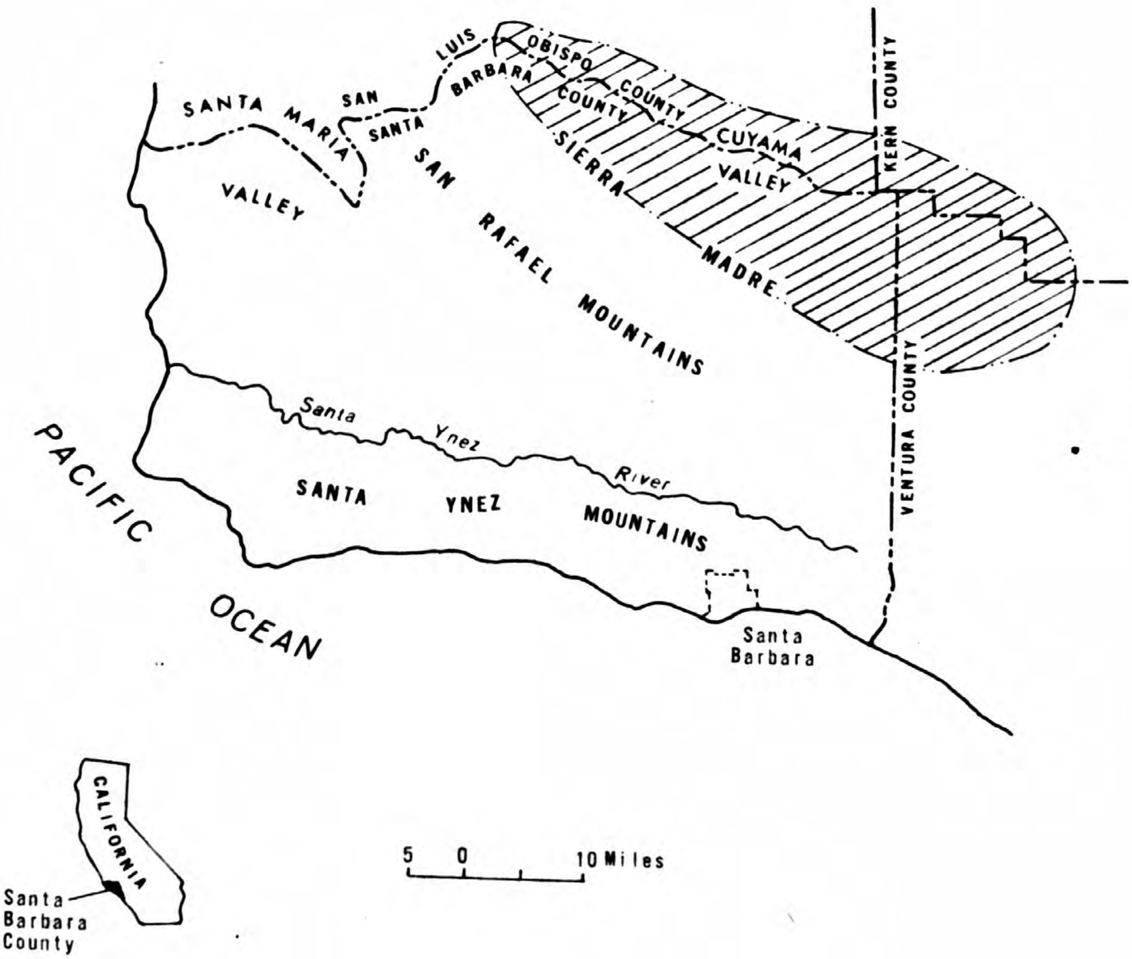


FIGURE 1.-INDEX MAP

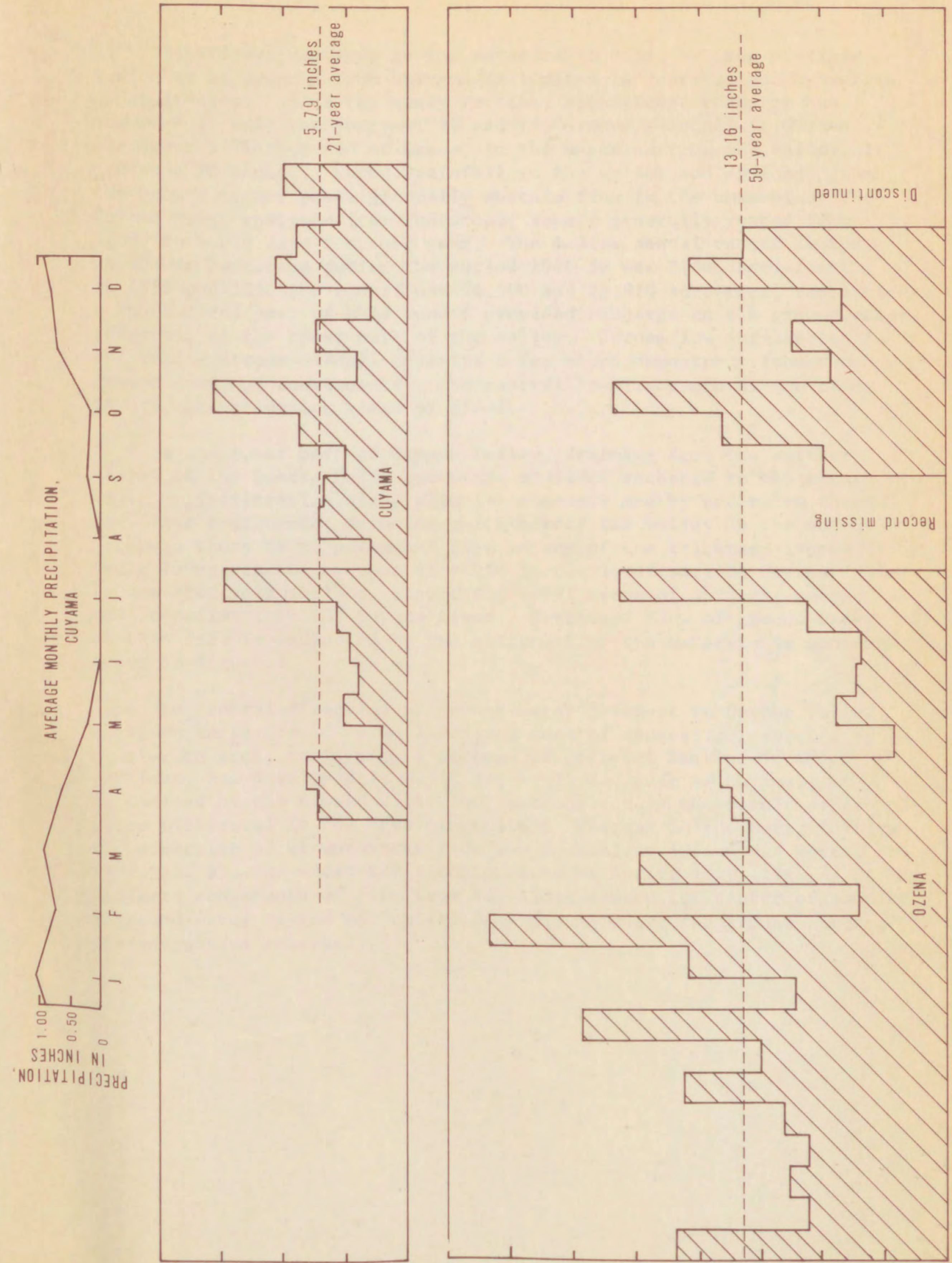


FIGURE 3.-AVERAGE ANNUAL PRECIPITATION AT OZENA AND CUYAMA

Significant recharge to the water table directly from precipitation or by seepage from streams is limited to years of above-average precipitation. Since the early forties, significant recharge has occurred in only two years--1952 and 1958--when rainfall at Cuyama was about 12 inches and at Ozena, in the upper part of the valley, it exceeded 20 inches. Normal rainfall in the valley and drainage from the area's higher peaks generally sustain flow in the channel of the Cuyama River upstream from Ventucopa; runoff generally ranges from 1,000 to 4,000 acre-feet per year. The median annual runoff at the gage near Ventucopa during the period 1946-58 was 2,800 acre-feet. In 1952 and 1958 the runoff was 14,500 and 26,510 acre-feet, respectively; a substantial part of this runoff provided recharge to the ground-water reservoir in the upper part of the valley. Streamflow infiltrates into the coarse stream-channel deposits a few miles downstream from the gaging station; consequently, the central 25-mile reach of the river is dry, except during times of flood.

In the lower part of Cuyama Valley, drainage from the northern slopes of the Sierra Madre Mountains provides recharge to the water table by infiltration along alluvial channels and by underflow through the older continental deposits which border the valley on the south. Although there is no perennial flow in any of the tributary creeks in their lower reaches, the water table in the lower part of Cuyama Valley is comparatively shallow, supporting local areas of springs, seeps, and underflow into the Cuyama River. Northward flow of ground water in this area is indicated by the alinement of the water-table contours shown in figure 2.

The general direction of ground-water movement in Cuyama Valley is shown in figure 2. A well-defined cone of depression, about 2 by 6 miles in area, reflecting a maximum water-level decline of about 140 feet, has developed in T. 10 N., R. 25 W., east of Cuyama. It is defined by the closed 2,140-foot contour and is the result of ground-water withdrawal in the area since 1947. Whereas in the early forties the direction of ground-water flow was downvalley (Upson and Worts, 1951, pl. 5), the water-table contours as of spring 1966 (fig. 2) indicate components of flow from all sides toward the center of pumping. A ground-water divide now exists near Cuyama where the ground-water gradients have reversed.

The area of declining water levels in Cuyama Valley, comprising about 55,000 acres, is shown in figure 4. In the upper and lower parts of the valley, local concentrations of sustained pumping have caused a decline of water levels of 40 to 50 feet. In the principal area of ground-water pumping, south of State Highway 166 and west of State Highway 33, the decline is 120 to 150 feet. Although irrigated acreage in the valley has increased rapidly since 1939, ground-water withdrawals until 1946, averaging about 11,000 acre-feet per year, apparently did not exceed the perennial yield of the basin. However, after 1947 water levels declined uniformly at rates of 4 to 8 feet per year, as the result of greatly increased withdrawals in the area. For the period 1947-54, gross pumpage averaged about 38,500 acre-feet per year; it increased to about 58,000 acre-feet per year for the period 1955-65. Pumpage estimates for the 11 years, 1955-65, are given below:

Estimated agricultural pumpage, Cuyama Valley, 1955-65

Year	Acre-feet	Year	Acre-feet
1955	61,600	1960	58,000
1956	58,000	1961	59,000
1957	49,300	1962	67,100
1958	49,700	1963	61,700
1959	58,000	1964	60,700
		1965	56,000

Average gross pumpage, 1955-65: 58,100 acre-feet per year

The increase in agricultural pumpage in Cuyama Valley is due not only to the expansion of the irrigated acreage but also to a change in crop patterns. Whereas potatoes and grains were the principal crops in the early forties, alfalfa has been the chief crop in recent years. The water requirements of alfalfa, which is being grown on more than half the irrigated acreage in the valley, are 2 to 3 times that of most other crops.

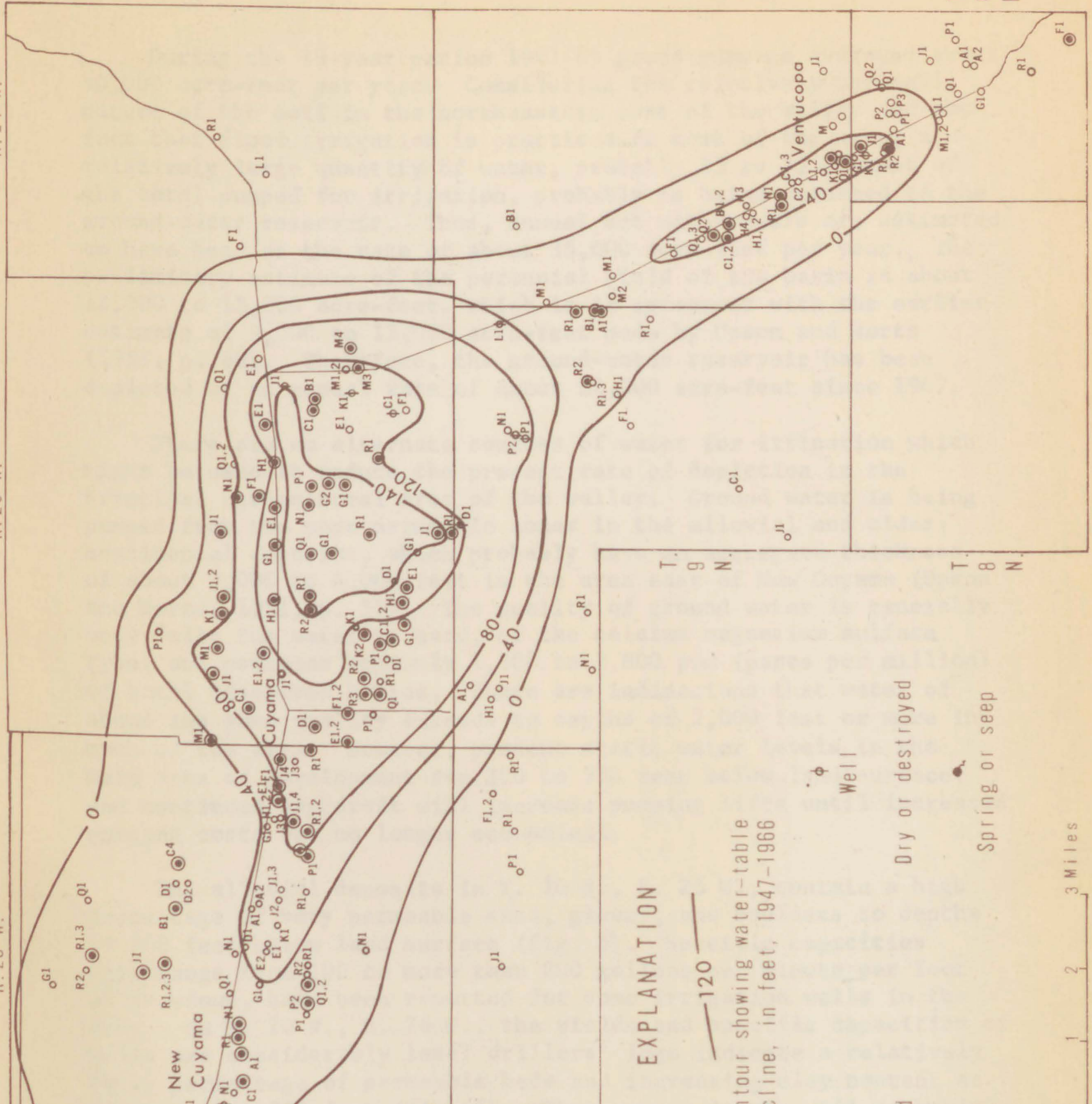
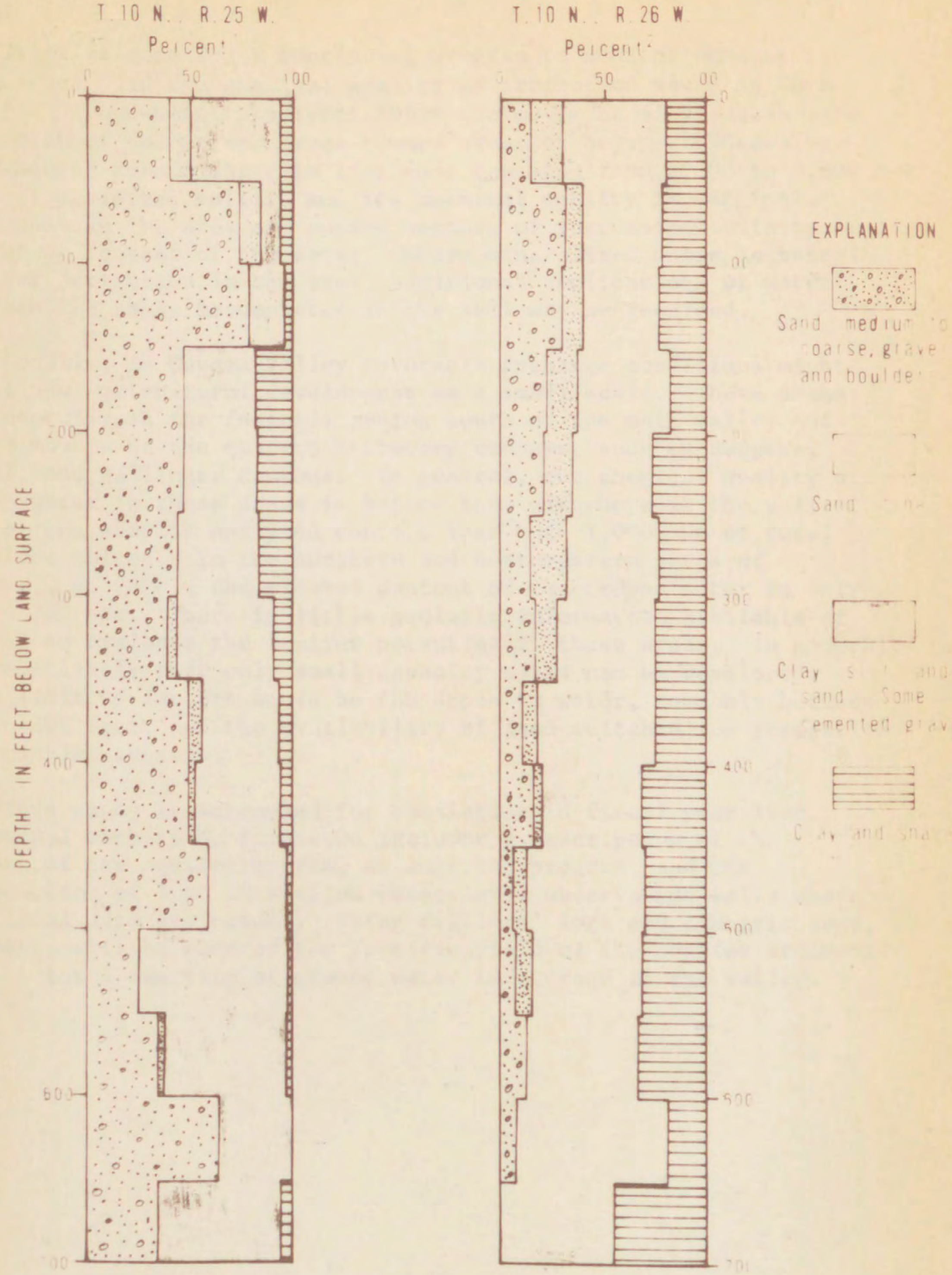


FIGURE 4.-MAP SHOWING WATER TABLE DECLINE, 1947 TO 1966

During the 19-year period 1947-65 gross pumpage averaged about 50,000 acre-feet per year. Considering the relatively permeable nature of the soil in the northeastern part of the valley and the fact that flood irrigation is practiced in most of the area, a relatively large quantity of water, probably 25 to 35 percent of the total pumped for irrigation, probably is being returned to the ground-water reservoir. Thus, annual net withdrawals are estimated to have been at the rate of about 35,000 acre-feet per year. The preliminary estimate of the perennial yield of the basin is about 12,000 to 13,000 acre-feet, which is in agreement with the earlier estimate of 9,000 to 13,000 acre-feet made by Upson and Worts (1951, p. 60). Therefore, the ground-water reservoir has been depleted at an annual rate of about 22,000 acre-feet since 1947.

There are no alternate sources of water for irrigation which might be used to reduce the present rate of depletion in the principal agricultural area of the valley. Ground water is being pumped from the more permeable zones in the alluvial and older continental deposits, which probably have an aggregate thickness of about 3,000 to 4,000 feet in the area east of New Cuyama (Upson and Worts, 1951, p. 35). The quality of ground water is generally only fair; the water is hard, of the calcium magnesium sulfate type, and contains commonly 1,500 to 1,800 ppm (parts per million) of total dissolved solids. There are indications that water of about the same quality extends to depths of 2,000 feet or more in much of the area. However, present static water levels in the main area of development are 200 to 350 feet below land surface, and continued overdraft will increase pumping lifts until increased pumping costs are no longer economical.

The alluvial deposits in T. 10 N., R. 25 W., contain a high percentage of very permeable sand, gravel, and boulders to depths of 700 feet below land surface (fig. 5). Specific capacities that range from 100 to more than 200 gallons per minute per foot of drawdown, have been reported for some irrigation wells in the area. In T. 10 N., R. 26 W., the yields and specific capacities of wells are considerably less; drillers' logs indicate a relatively small percentage of permeable beds and increasing clay content at depths below 250 feet (fig. 5). Thus, water levels will probably decline at an accelerated rate as the cone of depression, shown in figures 2 and 4, expands into adjacent areas of lower permeability.



1 Average composition of 50-foot depth intervals based on drillers' reports for 37 wells
2 Average composition of 50-foot depth intervals based on drillers' reports for 32 wells

FIGURE 5.-DIAGRAM SHOWING CHARACTER OF SEDIMENTARY DEPOSITS IN T. 10 N., R. 25 W. AND T. 10 N., R. 26 W., CUYAMA VALLEY

There is need for a continuing program to monitor changes in water levels and the chemical quality of irrigation water in Cuyama Valley. Ground-water gradients favor the movement of brackish water from north of the Cuyama River toward areas of heavy withdrawals. The brackish ground water in that zone contains from 2,000 to 5,000 ppm of total dissolved solids, and its chemical quality is marginal. Some wells in the area are unused because of increasing salinity or high boron content of the water. Where mineralized water is being used for irrigation in the area, additional applications of water to leach the salts accumulated in the soil may be required.

Locally, in Cuyama Valley favorable recharge conditions might permit new agricultural development on a small scale. These areas are generally in the foothill region south of the main valley and at the mouths of the eastern tributary canyons, such as Burgess, Quatal, and Ballinger Canyons. In general, the chemical quality of ground water in these areas is better than elsewhere in the valley; most of the samples analyzed contain less than 1,000 ppm of total dissolved solids. In the northern and northeastern parts of T. 10 N., R. 28 W., the mineral content of the ground water is only 400 to 700 ppm. There is little geologic information available at present to evaluate the aquifer potential in these areas. In general, it seems likely that only small-capacity wells can be developed. Other limiting factors would be the depth to water, commonly between 150 to 300 feet, and the availability of land suitable for irrigation by sprinkler systems.

This study is scheduled for completion in fiscal year 1968. Additional work to be completed includes a description of the geology of the aquifer system, an augering program, and the construction of 5 to 10 shallow water-level observation wells where additional data are needed. Using drillers' logs and electric logs, estimates will be made of the specific yield of the aquifer sediments and the total quantity of ground water in storage in the valley.

REFERENCE

Upson, J. E., and Worts, G. F., Jr., 1951, Ground water in the Cuyama Valley, California: U.S. Geol. Survey Water-Supply Paper 1110-B, p. 21-81.