

Drainage by PUMPED WELLS

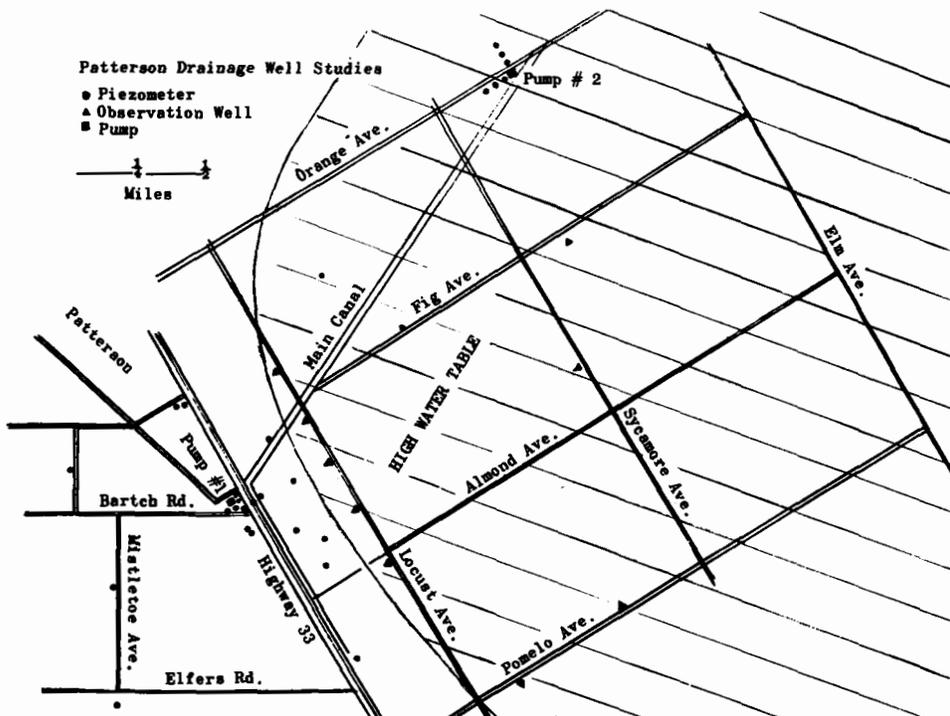
An Investigation on the West Side of the
San Joaquin Valley

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Investigations on the west side of the San Joaquin Valley indicate that wells carefully located at sites of good aquifer characteristics can be pumped effectively to control water tables over a limited area. Previous experience by local irrigation districts had led to the belief that drainage by pumped wells was unreliable in this area of fine-textured alluvial soils of sedimentary origin. However, this type of drainage can become physically feasible where there are no perched or confined water tables. Application of this method depends on economic considerations, such as the possibility of reusing the water.

THE DRAINAGE PROBLEM in the Patterson area of Stanislaus County is typical of conditions existing on the west side of the San Joaquin Valley extending from Brentwood in the north to Gustine in the south. Generally, the underground aquifers decrease in thickness and in width down to 100 feet in a direction going from west to east or from the Coast Range Mountains to the San Joaquin River. The soils came from sedimentary rock alluvium and are fine-textured. These physical circumstances tend to bring about a drainage problem when water delivery exceeds consumption. The high water table in the test area was attributed to accumulation from: (1) local irriga-

Fig. 1—Patterson pumped-well drainage study location map.



Drainage Pump No. 1 in the Patterson study, located in a Stanislaus County walnut orchard.



Pump outlets showing good flow of drainage water into ditch for reuse in irrigation as part of the Patterson drainage study.



tion water application losses, including seepage losses from canals and ditches, plus deep percolation losses from overirrigation, and (2) subsurface flow from higher elevated, permeable irrigated lands in the west to lower elevated, less permeable lands in the east toward the San Joaquin River.

The investigations included many test

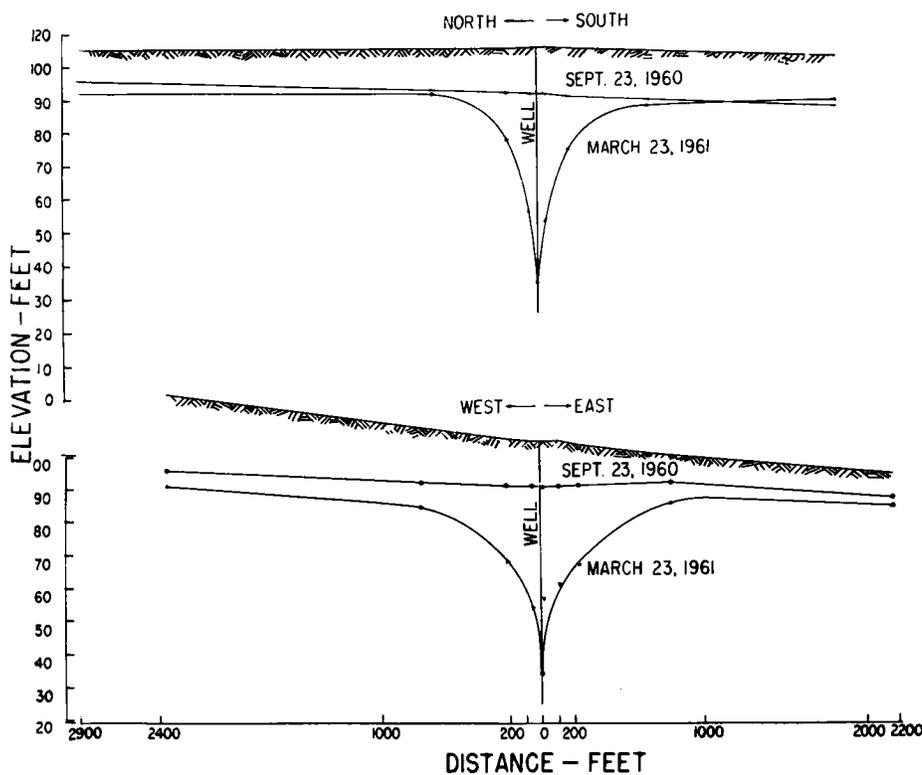


Fig. 2—Water table profile chart at Pump No. 1.

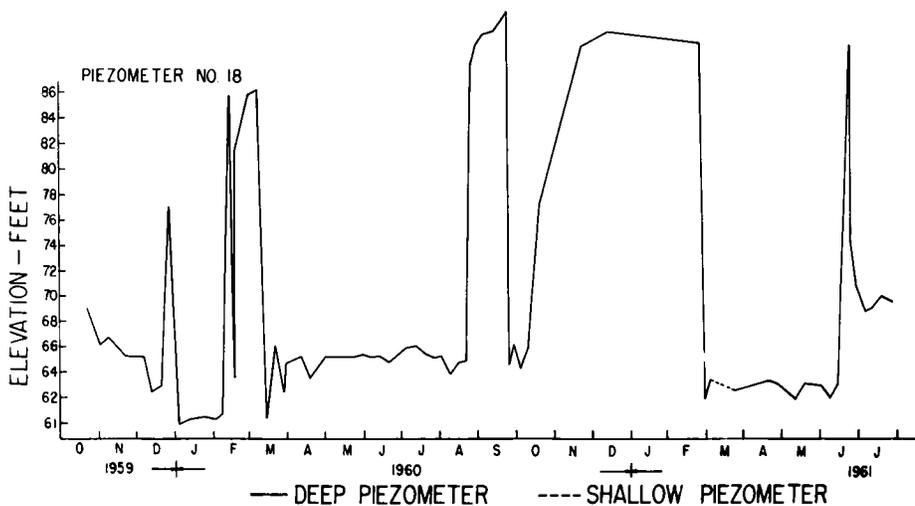


Fig. 3—Water table fluctuations in 80 foot piezometer located 50 feet east of Pump No. 1

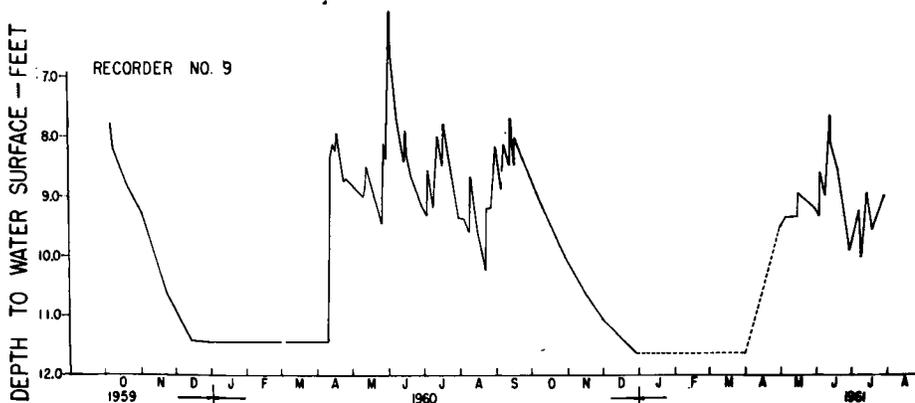


Fig. 4—Chart of hydrographic recorder No 9 located 1800 feet east of Pump No. 1.

drillings by the State Department of Water Resources, to determine aquifer characteristics. Core samples indicated several possible pump locations and wells were drilled at what were considered the two best sites. The first well was used to study interceptor characteristics of a pumped well. It was drilled by the Patterson Water District in 1959 adjacent to State Highway 33, one-fourth mile west and uphill from the high water table area.

The log of a 111-foot test hole at this site indicated the presence of about 30 feet of gravel occurring in layers at various depths. A 14-inch perforated casing was placed in a 36-inch gravel-packed hole. The pump bowls were set at 80 feet. The static water table was at 14 feet below the ground surface. A grid system of 27 deep and shallow piezometers were placed around the well. The deep piezometers were 80 to 100 feet and the shallow about 20 feet deep.

Piezometers

The piezometers were 3/4-inch iron pipes. They were placed into the test holes drilled by the State Department of Water Resources to measure lowering of the water levels from pumping and to determine vertical hydraulic gradients. In the area of high water table, ten shallow observation wells were equipped with continuous water stage recorders to determine the effects of pumping the interceptor well.

The second well, drilled in 1961, was located in the eight-square-mile area with the high water table. The gravel stratum in this area was closer to the ground surface and did not extend as deep as at the first well site. The well was drilled to about 60 feet, and the bowls were set at 30 feet.

At the beginning of the test, the water table was between five and seven feet below the ground surface. Results showed that the pump drawdown on the first well extended about 700 feet north and south and 1000 feet east and west of the well. The area affected was elliptical and estimated at about 50 acres (see Figure 2). The nearly same radius of influence uphill and downhill from the well indicated the subsurface rate of flow from high to lowlands is slow. Average discharge during the study was 300 gallons per minute (gpm).

Figure 3 shows the water table fluctuations in an 80-foot piezometer located 150 feet east of the well. Steep rises of the curve indicate when the pump was shut down; steep drops indicate when it was turned on again. Drawdown and recovery

at this distance were almost simultaneous with the operation of the pump.

Figure 4 charts the hydrograph of recorder No. 9 which was located 1800 feet east of the first pumped well. The rapid rise of the water table in April 1960 and April 1961, and the sharp drop in September 1960 coincide with the beginning and the end of the irrigation season. The fluctuations of the curve indicate the influence of irrigations in the immediate vicinity of the recorder. In comparing Fig. 4 to Fig. 3 it is obvious that the pumped well had no influence on the water table at the site of recorder No. 9.

The water levels in both deep and shallow piezometers were the same in all observations. This indicated there was no perched water table condition, no vertical hydraulic gradient, and that the aquifers were all interconnected.

Results of a pump test on the second well showed that the water table was lowered a distance of about 700 feet in a west and east direction and 400 feet in a north and south direction. This area also was elliptical in shape, about 20 acres in area and had no vertical hydraulic gradients. The average discharge during the study was 175 gpm which compared favorably with the discharge and area affected by the first well. The pumping lift from this second well was 25 feet. This water was reusable for irrigation, and such wells may be an economical means of drainage.

The study indicates that the bulk of the contributing water causing the drainage problem is from local irrigation losses due to deep percolation. Since the water level in both deep and shallow piezometers was the same around the first well, a confined water table condition seems to be nonexistent. Numerous test well drillings may be needed to find the shallow aquifers for successful drainage by pumped wells on the west side of the San Joaquin Valley. Local control of water application losses from irrigation may help minimize the number and extent of drainage pumps. Research is continuing on multi-well systems and cost of drilling and operating these systems.

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FARM ENTERPRISE

Accounting and Management

ARTHUR SHULTIS

Enterprise accounting is a system providing a separate profit statement and cost analysis for each crop and kind of livestock in the total farm business. These statements show the contribution of profit or loss each enterprise makes toward the total farm profit. But more important, the detailed information made available on production, income, inputs and costs allows the analysis and study of each enterprise with the possibility for discovering changes to make it more profitable. As part of this analysis, comparisons can be made with the sample schedules of inputs and costs on important crops that are available at local Agricultural Extension offices.

ENTERPRISE ACCOUNTING is supplemental to, and need not disturb, a satisfactory accounting system for the total farm business for a calendar year. The same income and expense segregations and income tax reporting can continue. Such total farm profit figures are valuable for comparison with previous years and in financial management. But they are of little value in making the many important decisions such as how much of what to grow—or what methods to use where there is more than one enterprise in the farm business. A record year for the total farm business may include the start of some enterprises and the closing of others.

An enterprise covers a production cycle of a single crop or type of livestock produced to earn a profit. With a crop, it starts with land preparation and ends after harvest and marketing. A barley crop starts one year and ends the next, or with a fallow year may cover two years. A continuous livestock enterprise, like a milking herd or beef cow herd, will usually be figured for the calendar or fiscal year. A nonbearing orchard can also be handled as an enterprise to learn its yearly development costs. Different variety, or age or treatment blocks of an orchard can be handled as separate enterprises to compare results.

Enterprise accounting involves the allocation of all farm incomes and expenses to the several enterprises. This can best

be done at different times. Incomes and single expenditures for a specific enterprise can be credited or charged to the enterprise sheets or accounts at the time the transaction is recorded in the total farm accounting system. Cost of labor, work by farm machinery, and irrigation water can best be figured and charged to enterprises at the end of each month. Thus, each enterprise account will show the major part of the costs to date after completing routine month-end accounting. Administration and overhead costs can be charged by suitable methods at the end of the year.

Information and help on farm enterprise accounting is available in a recent publication that treats the entire subject and discusses and illustrates the work sheet and accounting methods. Records and forms are illustrated. The transmitting of information to a city office is discussed. The possibilities and limitations of mechanical and electronic methods are also considered. Write for "FARM ENTERPRISE ACCOUNTING AND MANAGEMENT," by Arthur Shultis, Manual 31, Price \$1, Agricultural Publications, 207 University Hall, University of California, Berkeley 4, California.