

Soil Drainage Investigations

soil conditions and source of water to be drained must be known before the installation of successful drainage system

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The solution of a particularly difficult drainage problem in the Sacramento Valley—resulting from river seepage—involves the use of several investigation techniques.

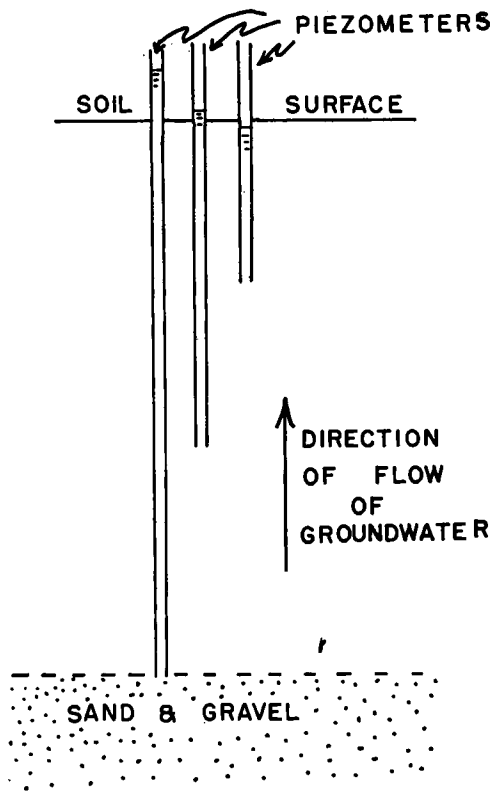
Part of a farm near the Sacramento River is flooded by seepage during periods of high water. Even when the river is low, the water table causes drowning of the crops and reduced yields. In the past drainage ditches and moles were put in the area but were not successful. Water stood on the soil surface only five feet away from an open ditch when it was running only partly full.

Surface drains are not successful in areas of artesian water—where the water is rising vertically in the soil because of pressure in lower strata.

After a preliminary study of the farm's surface soil with an auger which went to 20', piezometers—open-ended pipes that measure the water pressure at that point—were jetted into the ground to determine the water pressures in the various strata. By spacing several arrays of piezometers over a field the paths of flow of the ground water can be determined from the readings obtained.

A spray rig, including a 500-gallon tank and pump capable of delivering 8–10 g.p.m.—gallons per minute—of water

Upward movement of groundwater indicated by higher water levels in deeper piezometers.



at pressures of 200–400 pounds per square inch was used. The piezometers were $\frac{1}{2}$ " pipe cut into 7' lengths for ease in handling.

As the jetting progresses the operator works the pipe up and down piston-wise in the soil to enlarge the hole. The jetting water rises to the surface alongside of the pipe in what is called the boil. If the boil is lost—water ceases to rise alongside the pipe—the end of the piezometer is in a gravel stratum that takes the water as fast as it is delivered. It is possible to get a rough idea of the strata by the ease of jetting and to some extent by observing the material which rises to the surface alongside of the pipe.

After the piezometers were in place they were read periodically to analyze the drainage situation. At all of the locations the piezometers indicated an upward movement of water toward the soil surface because the water level in the deeper piezometers was higher than the water level in the shallow piezometers. Apparently water seeps downward from the river until it strikes the gravel and sand strata. It then moves laterally through the strata. Close to the river the surface soil strata have low permeability and prevent the water from rising to the

Concluded on page 14

Equipment used for jetting piezometer in soil drainage investigation.

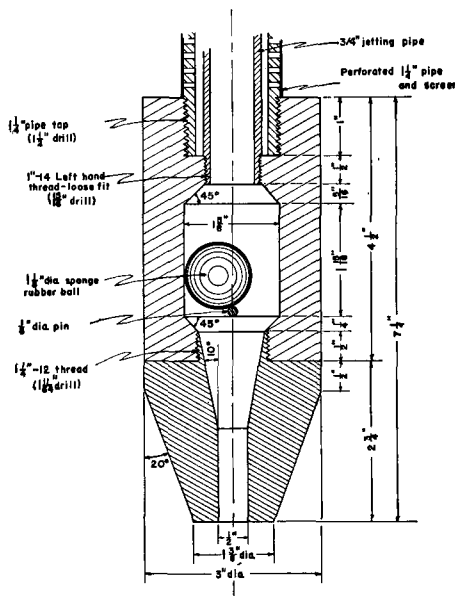


DRAINAGE

Continued from page 8

soil surface. About 600' from the river the permeability of the soil is such that little resistance is offered to the upward movement of the water and it rises into the peaty surface layers to create the drainage problem. This conclusion is based on the small vertical pressure gradient at this point. The small gradient indicates a high permeability of the soil. In addition, the lateral movement of the water seems to be impeded by a lens of clay located 1,000' from the river. The extent of the clay is not clearly defined and the effect of the clay lens is a matter of conjecture.

To extend the existing information well points were put in. A well point is a piece of perforated pipe about 1½" to 2" in diameter. The perforated section is 2' to 3' long and is wrapped with two layers of screen to keep the sand from entering the pipe. Some well points are equipped with a valve arrangement to allow them to be jetted into the soil. Two well points were jetted into the soil to a



Section view of jet-type well point.

depth of 55' to 60'. At this depth the well points were in gravel and could not be jetted any farther because the soil was lost.

The purpose of putting in the well points is to determine if the water table can be lowered effectively by pumping from the gravel layer. They can also be used to estimate the permeability of the soil. After the well points were in place, pumping tests were run to determine the amount of water pumped per foot of drawdown in the well. In addition, piezometers were jetted into the gravel layer. These piezometers were spaced 10', 20' and 100' from the well points. The well points were pumped at the rate of 45 gallons per minute. After 13 minutes the water level in the piezometer 10' away had dropped 11"; the water level in the piezometer 20' away had dropped 8" and the piezometer 100' away changed very little. These readings indicated the possible success of drainage by pumping from a well.

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HARVESTER

Continued from page 9

A trailing vine elevator—spring loaded sheet metal vine chute—lifted the trailing vines over the top of the cutter bar. An unguarded double sickle, driven by a hydraulic motor, Scotch yoke assembly cut the fruit from the vines.

A floating cutter bar was necessary to compensate for wire-to-ground elevation differences. A net upward force of about 20 pounds—accomplished with a counterbalance—was exerted against the underside of the trellis.

The cutter bar was supported by a low friction telescope accomplished by the use of a multi-ball bushing linear guide for round tubes.

A 6" retraction of the cutter bar permitted the bar to cut in line with the stakes and to automatically by-pass each obstacle.

The retraction unit was composed of a hydraulic sensing unit, holding relay circuit, time delay circuit, four way solenoid valve and an oil cylinder.

Cutter bar protection was provided by an oil cylinder connected to a closed accumulator that held the cutter bar perpendicular to the tractor yet permitted the bar to swivel when obstructions were met.

A sheet metal cane depressor—dragged along the top side of the trellis—assisted in holding the clusters at a minimum elevation while being cut.

A cross conveyor received the falling

fruit and moved it to the continuous paper tray along tractor centerline.

To permit easy access into a row, vertical separation of the cane depressor and cutter bar was required and accomplished by a hydraulic cylinder plus cable linkage.

In 1955 selected varieties of grapes were prepared for machine harvesting by the trellising-training system of growing. As a result, the peak labor requirement was reduced by shifting part of the conventional labor from the harvest pe-

riod to the more slack growing season. A labor shift was desirable because it would result in a more stabilized labor force. Further development of both the vines and the harvester are required before a finite analysis can be made.

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Side elevation—1955 grape harvester.

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|-------------------------|--------------------------|------------------------------------|---------------|
| (A) 32" Cutter bar | (E) Paper roll | (I) Retraction head cylinder | (M) Dust boot |
| (B) Cutter head support | (F) Cane depressor | (J) Cutter bar hydraulic motor | |
| (C) Cross conveyor | (G) Chute for raisin lay | (K) Cross conveyor hydraulic motor | |
| (D) Vine lifter | (H) Swivel head cylinder | (L) Cutter head balance cable | |

