AT LEFT, VIEW of the Beardsley recharge pit, showing the flood control dam in the background. Walkway leads to a water level recording device installed in the vertical standpipe.

Report on Artificial Recharge at Beardsley, Ariz.

To Save Precious Water--Bury It!

George E. Maddox and Sol Resnick

One of the most critical problems in Arizona at present is the diminishing ground water supply. The year-to-year decline in volume of water available — the average yearly overdraft on the ground water reserves is approximately four million acre-feet — is illustrative of the inability of precipitation to naturally recharge water to the aquifers at a rate commensurate with the withdrawal.

To maintain the present agricultural, domestic and industrial use, and to prevent further land subsidence in Arizona, a method must be found to slow or stop the depletion of the water supply. Artificial ground water recharge can be the method by which this is accomplished.

Most Flood Water Lost

Today, flood water from rains is allowed to flow down natural desert drainages and be lost by evapotranspiration along their courses. Very little, if any, beneficial use is made of the flood water on the ground surface. In Arizona probably only about one million acre-feet ever arrives at the ground water table for recharge. To capture and put the excess flood water underground by artificial means would, in many areas, reverse the downward trend of the water table, and in all areas slow the rate of depletion of ground water reservoirs.

In Maricopa County Water Conservation District Number One, near Beardsley, where ground water levels under agricultural land have dropped to 475 feet in some areas, flood water from Trilby Wash Detention Basin is available for artificial recharge. Hence, the district in cooperation with the Institute of Water Utilization initiated recharge tests.

The first tests were made using gravity injection into irrigation wells, as reported in a previous issue of *Progressive Agriculture*. However, because the cost of water treatment when using wells for recharge makes this method unfavorable for agriculture, other, more inexpensive methods, were investigated.

New Method Has Advantages

The recharge method now being tested, that may prove feasible yet economical, is a combination of recharge pit and wells. Geological information developed from logs of water wells showed a bed of coarse, clean sand and gravel lying within 20 feet of land surface and extending to a depth of 65 feet. Flood water can be

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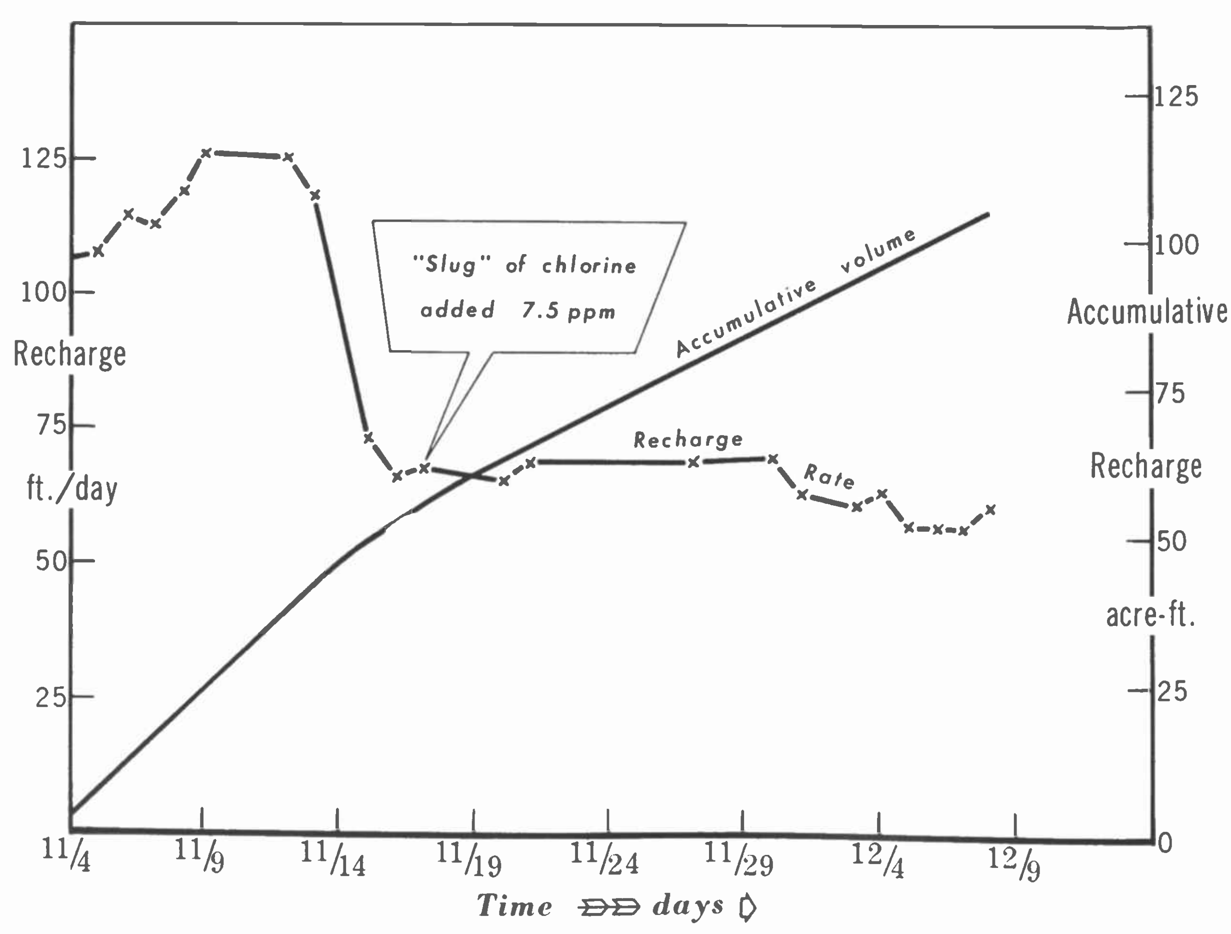
BELOW, chart shows how recharge infiltration slowed up about the tenth day, then accelerated sharply a few days later when chlorine was added to the recharge water.



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98—Controlling Mesquite with 2,4,5-T

(*Continued from Preceding Page*)

recharged into this sand and gravel bed with chlorination being the only treatment required. The recharge water then spreads over a large area where it can seep into existing irrigation wells and down into the present aquifers.

The recharge pit used was 21 feet deep and 55 by 12 feet on the bottom with side slopes of 2:1 from surface to —10 feet, then vertical from this point to the bottom. Six observation wells were placed up to 200 feet from the edge of the pit. A staff gage was placed in the pit to facilitate measurement of water levels, and recharge water was brought into the pit through a 12 inch pipe equipped with an inflow meter which gives rate of flow and total inflow.

Use Nearby Well for Test

Although flood water would be used if the recharge test is successful, water for the test came from a nearby well. The pumped water was free from sediment and contained 350 parts per million total dissolved salts. Water flowed into the pit at a rate of 350 gallons per minute (gpm) at the beginning of the test and later increased to a maximum of 1050 gpm. Throughout the test, copper sulfate was added to the recharge water to suppress the growth of algae.

Infiltration rates during a test from November 4, 1961 through December 8, 1961, varied from 126.0 to 56.0 feet per day, with the accumulated volume of water recharged amounting to 109 acre-feet. The most rapid change in infiltration rate came after 10 days of recharge, when the rate dropped from 125 to 65 feet per day in a period of four days. A rapid increase in infiltration rate after 16 days, with the addition of chlorine to the recharge water, suggests the possibility that plugging of the sand and gravel was lue to growth of microorganisms in the soil.

Only the observation well at the edge of the recharge pit registered any significant amount of water, 0.3 feet, over the length of the test. This probably indicates rapid lateral movement of water at the bottom of the sand and gravel bed away from the pit.

Future Tests Are Planned

Future recharge tests will involve the use of chlorine as well as copper sulfate to control both bacteria and algae. The side slope of the pit will be excavated to increase the area of exposure of the sand and gravel recharge unit by approximately 25 per cent. Walls of the pit will be lined with pea-size gravel, which will serve as a filter for removing some microorganisms and suspended sediment from flood water used for recharge. Costs for all phases of the test will be recorded, and an economic evaluation made for the recharge operation.

New Device for Taking Temperature of a Cow

Vearl R. Smith and
H. A. Baldwin

In the hot summer months of Southern Arizona, milking dairy cows have difficulty maintaining normal body temperature. Cattle increase moisture evaporation (sweating) from the skin and increase respiration rate (panting) in an attempt to keep the body temperature constant during hot weather. Cattle have sweat glands similar to other animals, but cattle do not sweat as profusely as horses. For this reason, sweating in cattle is not as effective a cooling mechanism as in some animals.

To make matters even worse, the roughage part of the ration of cattle produces large amounts of heat during the process of digestion. At temperatures of 85° F. and above, the milking cow has to expend extra effort to eliminate heat produced within the body. At high temperatures (100° F.), if the body temperature increases above normal, even though the cow is sweating and panting, the cow will eat less in an attempt to maintain body temperature within normal limits.

Eating Makes Profit!

Of course, we don't want our cattle to eat less whether they are dairy or beef, because this means a drop in milk production for dairy or less rapid gains for beef cattle. The body temperature increases as much as 2° F. above normal on hot Arizona summer days in spite of all the cow can do to control it. This not only affects the productive capacity of cattle, but also their fertility. Fertility of dairy cattle during the summer months is markedly lower than other times during the year.

Since the maintenance of body temperature is of such importance to cattle in Arizona, we need a good method of measurement. In the past a rectal thermometer has been used to measure body temperature. This requires that the animal be confined. Moving, confining and restraining the animal all tend to increase body temperature, so that a temperature reading under these circumstances will not be exact measurement of "at rest" temperature.

A technique was developed to obtain internal body temperatures by free observation. Free observation implies that the body temperature may be taken at any time without approaching or confining the animal. In fact, the cow may be lying in the shade chewing a cud, or walking about the corral at a distance up to 30 yards from the receiver.

Sensitive Transmitter

The instruments used in this technique are a small sensor-transmitter and an FM receiver. The sensor-transmitter is implanted in a cow and sends signals continuously. The tone of the signal varies with a change in temperature. The sensor-transmitter is sensitive to 0.1° C. change in temperature.

The receiver, a commercially available FM radio, receives the signals continuously detected, decoded, and recorded on a graph. Once the instrument is in operation, the temperature of the animal at any particular time of the day or night can be seen on the graph. The reaction of the animal to heat and different treatments can be precisely measured. For instance, walking a cow for 30 minutes when the atmospheric temperature is 60° F. causes a rise in temperature of 2° F.

Measure Environment Changes

This work is only in the early experimental stages, but with this technique much more accurate measurements can be made of the effect of such things as feed, spraying with water, shade, exercise, and many other experimental manipulations on body temperature.

Dr. Smith is head of the Department of Dairy Science. Mr. Baldwin was head of The University of Arizona's Applied Research Laboratory at the time this research was being done.