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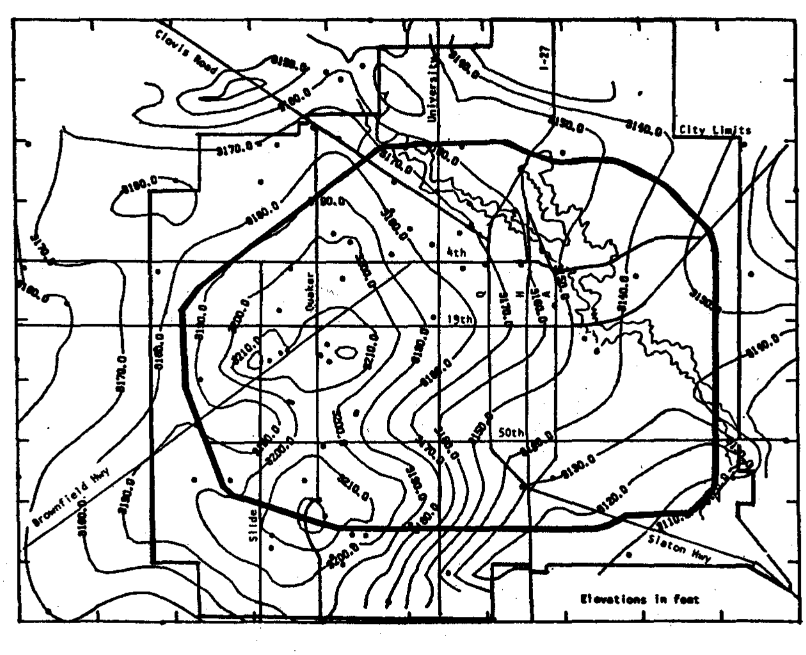
WRC STUDIES RISING GROUNDWATER BENEATH LUBBOCK

The Water Resources Center at Texas Tech University has completed a study of the amount of groundwater stored below the city of Lubbock and the potential for developing that water for beneficial use, including a portion of the local drinking water supply. The study was led by professors Ken Rainwater and R. Heyward Ramsey of the Department of Civil Engineering and Marvin Dvoracek of the Department of Agricultural Engineering, and carried out by graduate student Yu-Chi Chen and technician Brad Thornhill. The study area included approximately 60 square miles, bounded by the Lubbock city limits and by the Yellowhouse Canyon in the north and east. A total of 80 wells were measured for depth to the water table, and water samples were collected from 30 wells for chemical analyses. The information obtained has been used as the basis for a feasibility study of the cost of development of this water resource for potable supply.

While the water table in the Ogallala aquifer, which underlies most of the High Plains of Texas, has been declining over the years, the water table under the city of Lubbock has been rising recently. This is due to a combination of factors. Many wells were installed earlier in this century by the city and private users within what is now the city limits, and heavy pumping lowered the water table beneath the city. In 1957, the city started to supplement its water supply by importing water from the Bailey County well field near Muleshoe. In 1968, Lake Meredith, managed by the Canadian River Municipal Water District, became the principal water supply for the city. These new sources led to the abandonment of most of the wells within the city, thus ending the downward movement of the water table. As Lubbock became more urbanized, the volumes of rainfall runoff entering the playa lakes in the city increased. Water collected in the playas has the opportunity to seep down into the ground or to evaporate into the atmosphere. The greater the volume of water regularly held in the playas, the greater the amount of infiltration. To enable them to hold more water, many of these lakes have been deepened. This operation often required the removal of several feet of clay, which had served as a natural sealant to limit seepage to the Ogallala, from the bottom of the



Contour Map of Water Table Elevation in January, 1987 playas. Thus, modified playas, and some of the natural ones, are serving as recharge sites for the aquifer.

The results of the study were summarized by mapping the information as contours of water depth, water table elevation, and saturated thickness of the aquifer. The elevation of the water table in January 1987, as shown in the figure, indicates the presence of a relative mound of water with peaks near the Maxey and Leroy Elmore Parks. The water table has risen most dramatically in the southwestern portion of the city, with rises of 20 to 40 feet having occurred since 1981 at some locations. The water table is only 15 feet below the ground surface near the peaks of the mound. Texas Tech University has installed dewatering wells near structures below grade, such as Jones Stadium and the deep basements of the Business Administration and Art-Architecture Buildings. The high water table is also responsible for the continued inundation of the Lubbock Lake Site, where it prohibits access to a very valuable archaeological formation. Future below-grade construction in areas where the water table is close to the surface, such as the proposed depressed Tech Freeway, must take into account the presence of the groundwater.

The results of the Water Resources Center's study show that the water table has been rising at an average rate of two feet per year within the study area. This corresponds to a change in storage within that area of 9.3 million gallons per day, or 3.4 billion gallons per year. For comparison, the average daily water demand for the city is currently about 34 million gallons per day. The total groundwater storage below the study area was approximately 146 billion gallons in January, 1987. If no other water sources were available, this groundwater could supply the city at current use levels for over eleven years. Actually, this groundwater constitutes a third water source which could be considered economically with the current sources.

Groundwater quality analyses were performed at the Environmental Science Laboratory of the Department of Civil Engineering, the City of Lubbock Water Treatment Plant, and the Lubbock Christian University Institute for Water Research. The analyses included most of the chemicals considered in the primary drinking water standards set in the Safe Drinking Water Act of 1986. The results indicated that the quality of water varied throughout the study area, with the best quality water being found near the major recharging playas. As is typical in many parts of the Southern High Plains, the water, classified as "very hard", contains fluoride at roughly twice the primary drinking water limit. A small number of wells in the northwestern portion of the study area also contained water with concentrations of some trace metals above the allowable limits. Since the water quality analyses have shown that raw groundwater quality is not sufficient for drinking water, the costs of improving the water quality have been investigated.

The treatment study demonstrated that it would be economical to convert the groundwater into drinking water. Several modern treatment methods for improving the quality of the water have been analyzed. These include various combinations of reverse osmosis, ion exchange, activated carbon adsorption, and pressure filtration. A feasibility study has shown that the local groundwater could be collected and treated for injection into the existing distribution system at costs which are very competitive with the current cost of purchase and treatment of Lake Meredith water. Updated unit cost estimates for the Justiceburg water development project were not available for comparison.

In summary, the research has shown that the water stored beneath the city is increasing. The water has become a threat to underground structures and a detriment to drainage of storm runoff. It is possible, here in this semi-arid city, that this water could be put to good use for the citizens of Lubbock. Modern treatment technologies could be applied economically to derive maximum benefit from this water. Other uses which do not require drinking water quality should also be explored.

WRC REPORTS ON STATUS OF AQUIFER RECHARGE RESEARCH

Having completed two years of field data collection in an expanded study of the artificial recharge of playa lake water to the Ogallala Aquifer, Dr. Lloyd V. Urban, Dr. B.J. Claborn, and Dr. R.H. Ramsey report that the concept continues to "look extremely promising."

Phase IV extended the concept illustrated in the

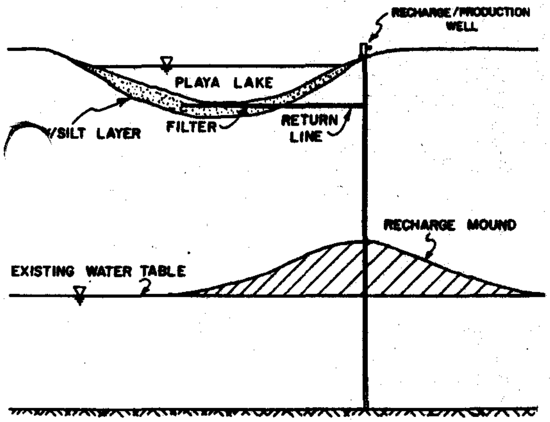


Figure 1. Recharge System Concept

accompanying Figure 1 in which a series of pipes, covered by filter materials, are buried in a playa lake at a time when the lake is dry. Gravity flow conducts the filtered water, by means of a well, to the water table whenever water is standing in the lake. When desired, a pump in the same well retrieves the water for delivery to the crops.

In phase IV three filter fields were located near the lowest part of the lake (Figure 2). Each of the three blocks included approximately 2400 feet of a filter material arranged in a grid pattern over an area of approximately 3/4 acres.

The filter material used in block 1 consists of a three-inch-diameter flexible perforated plastic pipe with a fabric sleeve. The filter was laid in a sand bed in each trench, with 6 inches of sand covering the filter and 6 inches of natural playa material completing the backfill.

Block 2 included 2,375 feet of 12-inch-wide filters placed in V-shaped trenches.

For Block 3 a 12-inch layer of soil was excavated from the bottom of the playa basin, creating a pan. Forty trenches, 16 inches wide by 8 inches deep, were then dug in the pan. A layer of gravel was placed in the bottom of each trench, then three-inch perforated flexible plastic pipe was installed and covered with gravel. A two-foot-wide strip of fabric filter material was then installed directly above each trench and the pan was backfilled with six inches of sand and six inches of the natural material that had been removed from the base of the playa.

Work to date has established that

1. The concept is technically viable; commercially-available filter materials, when properly installed in a playa basin, can successfully recharge significant quantities of water that would otherwise be lost to evaporation.

2. While the quality of the recharged water is generally good, biological growth in the well will require periodic neutralization, and additional water quality studies are indicated.

3. Weed control over the filter beds and periodic chlorination to rejuvenate the recharge well are necessary to sustain high recharge rates.

4. Widespread application of the technology could have a significant impact on the long-term water supplies of the region.

Additional research is needed in design, construction, and operation of recharge wells. It is also proposed that a full-scale demonstration project be constructed and operated to serve as a model for potential users to emulate. Such a model would be expected to demonstrate conclusively that the concept has potential for enhancing habitat for wildlife, migrating waterfowl

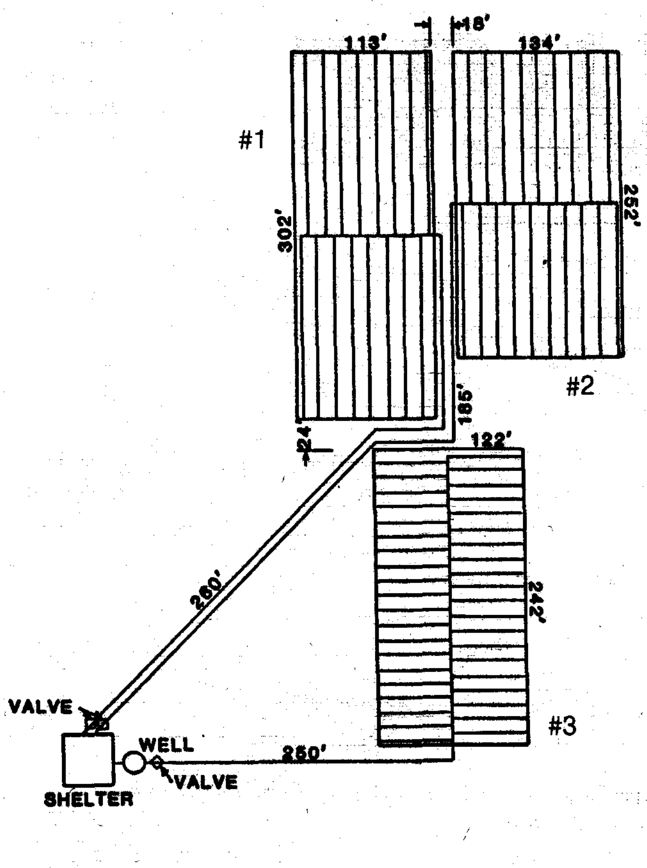


Figure 2. Filter and Return Line Orientation

and threatened species.

The research has been supported by the Texas Water Development Board, the Texas Advanced Technology Research Program, the High Plains Underground Water Conservation District No. 1, and the Texas Tech University Water Resources Center.

Continuing analysis of water quality during the study has been accomplished by Dr. Ramsey; Y. Chen; and Dr. Richard E. Zartman, Associate Professor of Plant and Soil Science. Additional information on the study can be obtained by contacting the Water Resources Center.

CLABORN TO OFFER 5-DAY SHORTCOURSE IN DALLAS-FORT WORTH AREA IN MAY AND AUGUST

Dr. Bill Claborn, Associate Professor of Civil Engineering at Tech; Roy D. Dodson, M.S., P.E., president of the engineering consulting firm Dodson and Associates, Inc.; and Duane Barrett, B.S., P.E., hydrologist for Dodson and Associates, Inc. will present hands-on intensive microcomputing shortcourses using improved versions of the Corps of Engineers HEC-2 and HEC-1 programs at the Flagship Inn, Arlington, Texas.

The HEC-2 program, to be presented May 16-20, is to be based on the Dodson Professional HEC-2 version of the Corps of Engineers backwater program for the computer analysis of channel and flood plain studies. The ProHEC2 system includes not only the HEC-2 program itself but also a spreadsheet type data entry program and over 250 help screens which explain the input data required for HEC-2. The ProHEC2 system also has the capability of generating stream profile or cross section plots in an AutoCAD compatible file format.

This intensive hands-on shortcourse covers hydraulic engineering techniques for flood plains studies. During the four and one-half day shortcourse participants will gain hands-on experience in using the program on the IBM-PC.

The HEC-1 programs, to be presented at the same place August 22-26, has similar capabilities in the computation of runoff and the design of detention basins.

Further information on the courses can be obtained by calling Dr. Claborn at (806) 742-3485.

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