

MEMORANDUM ON AVAILABILITY OF GROUND WATER FOR  
IRRIGATION IN CERTAIN AREAS OF EASTERN ARKANSAS

By

P. E. Dennis and others

U.S. Geological Survey

OPEN-FILE REPORT

57-32

Chief, Ground Water Branch, Washington, D. C.

December 18, 1957

P. Eldon Dennis, Little Rock, Ark. (GW)

Approval for open-file release of "Memorandum on Availability of Ground Water for Irrigation in Certain Areas of Eastern Arkansas."

In reply to my request for permission to release the subject report to the open files I received the following letter from the Soil Conservation Service.

"Reference is made to your letter of November 15, 1957, transmitting your report entitled 'Memorandum On Availability of Ground Water for Irrigation in Certain Areas of Eastern Arkansas', and requesting permission to make this an open file report.

"We wish to point out that anyone attempting to use the data in the report should be advised that these data were developed as estimates of probable irrigation development under specific sets of conditions of drainage and flood control and of projected prices and costs of production as used in the Mississippi River and Tributaries project studies, and do not necessarily reflect the total irrigable potential, acreage-wise, of the areas involved.

"With this reservation, permission is herewith granted to make this an open file report.

"We appreciate your interest and assistance in helping to develop this information."

We are attaching a copy of this letter to each copy of the report, so that anyone reading the report may know of the assumptions on which the Soil Conservation Service developed its estimates.

P. Eldon Dennis  
District Geologist



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
WASHINGTON 25, D. C.

MEMORANDUM ON AVAILABILITY OF GROUND WATER FOR IRRIGATION  
IN CERTAIN AREAS OF EASTERN ARKANSAS

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This memorandum was prepared in response to a request from the Soil Conservation Service, Little Rock, Ark., for information on the future prospects of irrigation of rice with water from wells in certain areas in the basins of the Cache, St. Francis, and L'Anguille Rivers, Big and Dials Creeks, and Bayou Neto and the Bouef-Tensas-Macon basin. It was prepared as a part of the Statewide ground-water investigation in cooperation with the Arkansas Geological and Conservation Commission and the University of Arkansas. The specific areas and water requirements specified by the Soil Conservation Service are listed in the appendix.

This memorandum is based on all available information on the number and yield of wells, the thickness and character of aquifers, and fluctuations of water levels in the areas named. Much of it is based on analogy with other areas, as detailed studies have not been made in the areas named. It outlines the evidence leading to the conclusions as to the availability from wells of the specific quantities of water indicated by the Soil Conservation Service, and points out factors that might have an adverse effect on development.

It is assumed that all additional development will be from wells, and no consideration is given to supplies from streams and surface reservoirs.

Open-File Report

November 1957

Reach 3 of the Cache project area has approximately equal areas in Jackson and Woodruff Counties. The area in Jackson County is used as an example. In 1955 there were about 75 irrigation wells in the area, and records including measurements of water level were obtained on more than 60 of them. Depths to water in the wells ranged from 13 to 32 feet below land surface but generally was about 20 to 25 feet. Depths of the wells ranged from 80 to 125 feet, but most of the wells were from 90 to 113 feet deep. Total estimated pumpage was about 8,400 acre-feet for rice and about 1,900 acre-feet for supplemental irrigation of row crops. If the same amount of water was pumped in the part of Reach 3 in Woodruff County, the total is 20,600 acre-feet of ground water used in Reach 3. This is in reasonable agreement with the Soil Conservation Service estimate of 25,768 acre-feet, which includes all irrigation from ground-water and surface-water sources.

The water levels in observation wells in this reach declined, on the average of 2.8 feet in 1954 and 1.6 feet in 1955. In 1956 the net decline was 0.4 foot, but there were as many wells showing a rise as there were showing a decline. In 1957 the levels rose 5.8 feet, so for the 4-year period there was a cumulative net rise of 1.0 foot. A part of this reach lies in an area in which a rise in water levels was noted between 1938 and 1953. (Counts and Engler, 1954)

Irrigation-well development began in the area about 1930, but 70 percent of the wells in operation in 1955 were drilled later than 1949 and 40 percent of them were drilled between 1953 and 1955.

Water-table maps by Counts and Engler<sup>1/</sup> show a pronounced nose along the Cache River, suggesting possible recharge in that area.

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<sup>1/</sup> Counts, H. B., and Engler, Kyle, 1954, Changes in water levels in deposits of Quaternary age in Eastern Arkansas from 1938 to 1953: Ark. Univ. Agr. Expt. Sta., Rept. ser. 42.

Water in the Quaternary deposits in the extreme southwestern part of this reach may be salty. This possibility is suggested by the salt-water area in White County southeast of Bald Knob and across the White River from the southwestern part of this reach.

#### Cache R-1 and R-2

Reaches 1 and 2 lie in Prairie and Monroe Counties. At present the ground-water resources are relatively undeveloped. The part in Prairie County is just east of a cone of depression developed by intensive pumping for irrigation of rice. Water levels, and therefore pumping lifts, will be affected by this cone. The one observation well in these reaches shows a cumulative rise in level of 1.8 feet from 1953 to 1957.

#### Cache R-4

Reach 4 includes parts of Independence, Craighead, Lawrence, and Greene Counties. It lies generally north of the Grand Prairie cone of depression and includes the water-table nose along the Cache River that suggests possible recharge (Counts and Engler, 1954, figs. 1 and 2). The levels in observation wells declined 1.8 feet, on the average, in 1954, 1.4 feet in 1955, 1.1 feet in 1956, and 0.1 foot in 1957. Part of the area has had a rapid development of irrigation wells during these 4 years.

#### Cache R-5

Reach 5 includes parts of Greene, Lawrence, and Clay Counties. It lies in an area in which little change in water levels occurred from 1938 to 1953. Probably more irrigation wells were completed between 1953 and 1957 than had <sup>average</sup> been completed prior to 1953. Nevertheless, the/annual changes in water levels in observation wells has been slight. The levels declined 2.1 feet in 1954, 0.4 foot in 1955 and 1956, and rose 0.3 foot in 1957.

No specific ground-water information on these areas is available.

### Bayou De View R-1, R-2, and R-3

These reaches lie immediately east of the Cache River and extend through parts of Monroe, Woodruff, Jackson, Cross, Poinsett, and Craighead Counties. Average annual changes of water levels, in feet, in observation wells are given in the following table

	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>
R-1	-2.4	-0.7	-0.1	+0.6
R-2	-1.9	-1.8	-1.0	-1.1
R-3	-1.2	-0.8	-0.6	-1.6

These reaches lie between the water-table (recharge?) nose along Cache River and the water-table trough created by heavy pumping for irrigation along the L'Anguille River west of Crowley's Ridge. This suggests that they may support less intensive ground-water development than the Cache areas and more than the L'Anguille areas. In reach 1 it is known that water in all Tertiary aquifers near Brinkley is salty and irrigation from deep wells, as practiced to a limited extent in the Grand Prairie, would not be possible in parts of this reach.

### Dials Creek

This project area, in Monroe County and east of the White River, is partly within the Grand Prairie cone of depression but generally south of the rain trough that extends northward west of Crowley's Ridge. Slight rises in water levels in observation wells in some years suggest that the southern part of this project area may be in or near a recharge area, but the data are not sufficient to confirm this or to compute average rises or declines in water levels.

## Big Creek R-1, R-2, R-3, R-4, R-5, and Big Cypress

Reaches 1, 2, and 3, chiefly in Phillips County, are in an area where the surficial deposits consist of Recent alluvium and where, by analogy, considerable local recharge might be expected. Records of water levels are scanty in the area and no general trends are discernible.

Reaches 4 and 5 and Big Cypress, in Lee, Monroe, St. Francis, and Woodruff Counties, include a part of the main trough that extends from the Grand Prairie cone of depression northward west of Crowleys Ridge. This trough was developed as early as 1938 but since 1953 has deepened only slightly. In 1954, water levels in observation wells in these reaches rose 1.08 feet on the average, but, in 1955, 1956 and 1957 the levels declined 2.48 feet, 1.13 feet, and 0.75 foot, respectively.

It is known that water in the Tertiary aquifers is salty near Marianna, and irrigation from deep wells, as practiced to a limited extent in the Grand Prairie, would not be possible in these reaches.

## Flat Fork

This reach is like Big Creek R-5 in most respects, but records of water-level fluctuations in observation wells suggest that the levels have become more or less stabilized with respect to present withdrawals. The annual average changes are as follows: 1954, +0.2 foot; 1955, -2.2 feet; 1956, +0.2 foot; 1957, -0.4 foot.

## Lick Creek, Prairie Cypress, Little Cypress, and Crooked Creek

Little specific information on ground water in these project areas is available other than that already given for adjacent reaches. Moderate average annual declines in water levels in observation wells occurred in Prairie Cypress as follows: 1955, 0.48 foot; 1956, 0.74 foot; and 1957, 0.46.

## L'Anguille River R-1, R-2, R-3, R-4, R-5, Brushy Creek, and First Creek

Reach 1 is an area in which the main aquifer of the Quaternary deposits may be partly or entirely absent and Tertiary deposits are likely to contain salty water.

Reaches 2, 3, 4, 5, Brushy Creek, and First Creek lie along the ground-water trough west of Crowleys Ridge that developed as early as 1938, was deeper and more pronounced in 1953, and has deepened slightly since that time. In these reaches the Quaternary aquifer probably is overlain by a thick clay cap as it is in the Grand Prairie region. Before large additional amounts of ground-water are developed in this area, detailed ground-water studies should be made to determine the quantities available. Under the State cooperative program, the Geological Survey expects to start such studies in St. Francis and Cross Counties this fiscal year. The annual average changes in water levels in feet, in observation wells in three of the reaches are given in the following table:

	<u>1954</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>
L'Anguille R-3	-1.2	-1.9	-0.9	-1.0
L'Anguille R-5	+0.1	0.0	-1.9	+1.7
First Creek	+1.0	-1.5	-2.0	-0.9



## Bayou Meto

B-1 Reach is an area of considerable ground-water development, and a major trough in the water table has developed in this direction from the Grand Prairie cone of depression. In at least some parts of its course the Bayou Meto has not cut through the clay cap that characteristically overlies the aquifer in the Grand Prairie. The northwestern part of this reach is outside the limits of the Quaternary aquifer, and quantities of ground water sufficient for irrigation cannot be obtained.

B-2 Reach is also an area of considerable ground-water development. It also lies generally along the ground-water trough or within the Grand Prairie cone of depression. Unlike B-1 the entire area is probably underlain by the Quaternary aquifer. A thick clay cap overlies the aquifer in some places, but whether it is generally present over the area has not been determined.

B-3 Reach includes a large part of the Grand Prairie cone of depression--an area of present overdevelopment of ground water. Many wells in the area now yield less than half their original capacities and some wells are reported to have been abandoned because they would no longer yield as much as 300 gallons per minute. Water levels in the area have steadily declined since the beginning of record (1928), as shown by the attached hydrograph of one of the observation wells. Wells in the central part of the cone have declined more than 60 feet below their original levels. Unless the aquifer is recharged artificially, the amount of ground water pumped for irrigation probably will continue to decrease until an equilibrium is established with the ground-water flow into the area. The character of the last part of the hydrograph and a rise in water levels in the Grand Prairie in 1957 suggest that this equilibrium may be established within the next decade or two if the development of new irrigation wells around the margins of the cone does not cut off too much of the present recharge.

Little Bayou Neto 1, 2, and 3, Wabbaseka 1, 2, and 3, and Bradley Slough

The eastern parts of these reaches lie within the Grand Prairie cone of depression, but most of the area is west of the cone. Declines in water levels in observation wells in this area during the past several years may have been caused largely by the rapid increase in the number of irrigation wells. Logs of some wells show little or no clay overlying the aquifer; and some, and perhaps much, of the recharge to the Quaternary aquifer occurs in these reaches. Detailed work to delineate the recharge areas is planned for this area. Until such work is done the amount of present and possible future recharge cannot be determined. A large amount of additional ground-water development in this area possibly might decrease the amount of recharge to the Grand Prairie region. In general, the westernmost areas of these reaches are most likely to support large additional withdrawals of ground water and such withdrawals are less likely to reduce recharge to the Grand Prairie region than withdrawals in other parts of these reaches.

#### Boeuf-Tensas-Macon Basin

The areas of these reaches indicated on the map total more than 700,000 acres and cover a large part of the irrigated areas in Ashley, Chicot, Dasha, and Lincoln Counties. However, the Soil Conservation Service studied only overflow zones and an area of 118,000 acres. Detailed studies of much of the area have been made but no basis of comparing the data on present pumpage with the Soil Conservation Service figures for smaller areas can be found. Declines in water levels in observation wells seem to be related to additional amounts of water pumped each year, and in many areas recoveries are rapid after cessation of pumping or during long periods of rainfall. To date there has been no evidence of serious overdraft in these counties. On the contrary, there is considerable evidence that much more ground water might

be used without overdraft if the wells are properly spaced and distributed throughout the area. In the southwestern part of Chicot County, water from Quaternary deposits is too salty for most uses, but present development does not permit determination of the boundaries of the salt-water area.

#### St. Francis River Basin—All Reaches

A large part of this basin probably is subject to local recharge and will support a considerably expanded ground-water development. Mississippi County, where detailed studies have been made, is used as an example for the entire basin.

The total amount of ground water withdrawn by irrigation wells from the Quaternary deposits in Mississippi County is well within the "safe yield" of the aquifer. Water levels over the entire county primarily reflect recharge and natural discharge and pumpage has only local and temporary effects.

Tyroneza River Reach 3 is entirely within Mississippi County except for one small section in Poinsett County. About 325 acre-feet is pumped annually from 7 wells in this reach. This figure correlates well with the Soil Conservation Service estimate of 444 acre-feet from both ground and surface sources.

Ditch 40 area is entirely in Mississippi County and has 14 irrigation wells. Total annual pumpage from these wells is about 2,100 acre-feet, which correlates with the Soil Conservation Service estimate that 2,594 acre-feet is withdrawn annually from ground and surface sources.

Ditch 1, Reach 2 is entirely in Mississippi County and has 4 irrigation wells. Total annual pumpage is about 250 acre-feet.

Buffalo Ditch, Reach 2 area is entirely in Mississippi County except for a small section in southeastern Missouri. About 900 acre-feet is pumped annually from 15 irrigation wells in the area, whereas the Soil Conservation Service estimates that only 400 acre-feet is pumped.

#### Summary

estimates

In the two general areas where the Soil Conservation Service/estimates of present pumpage were compared with those of the Geological Survey, the estimates check each other as closely as could be expected from the methods used. The Soil Conservation Service estimates under the heading "Future Without Project" (see appendix) indicate an average increase of about 33 percent over present use. The Geological Survey estimates that from 1945 to 1955 the amount of water pumped from wells for irrigation in Arkansas probably increased about 100 percent. If the projected increase indicated by the Soil Conservation Service is for a 10-year period or longer it would appear to be conservative. The Soil Conservation Service estimates under the heading "Future With Project" indicate an increase in total use to a little more than 2-1/2 times the present use. For those parts of the area that have been studied in detail such an increase in the use of ground water is entirely feasible without serious overdraft if the wells are properly spaced and development spread over the entire area underlain by the aquifer. Proper spacing of wells would mean widest spacing possible in those areas not subject to local recharge because of an overlying relatively impermeable clay cap above the aquifer. The areas underlain by this relatively impermeable clay are in greatest danger of overdevelopment because they generally are considered to be best suited for rice culture. Of all the crops irrigated in Arkansas rice requires the largest amount of water by far.