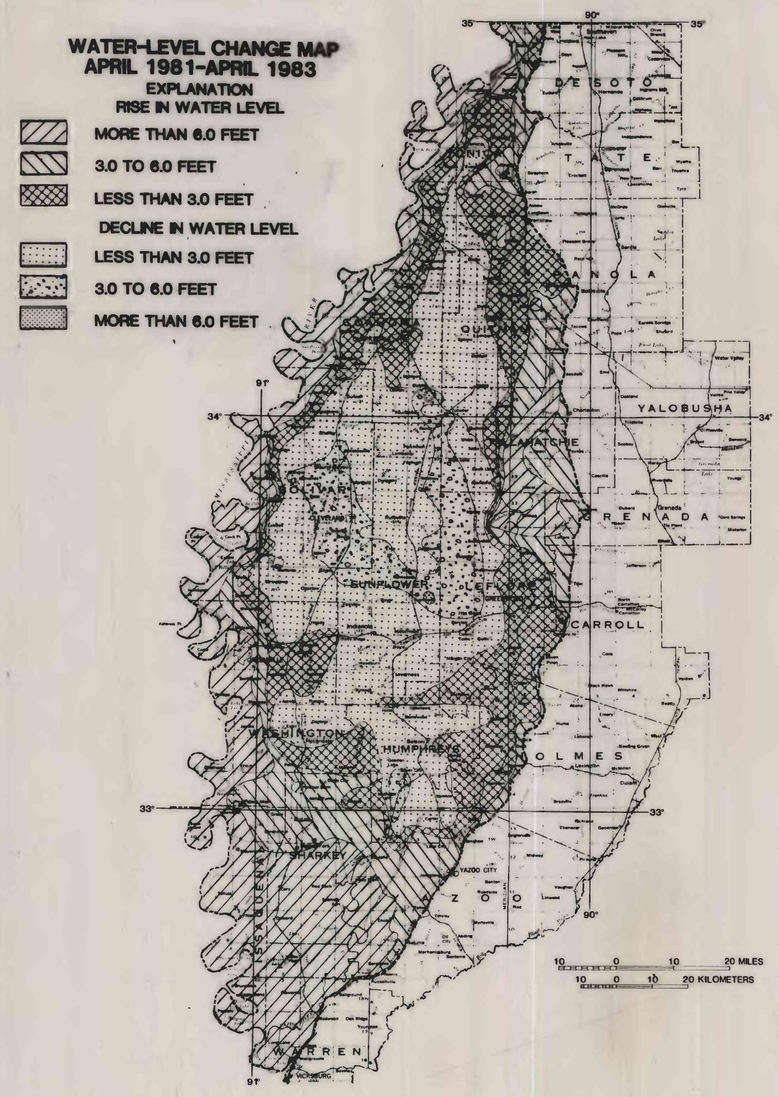
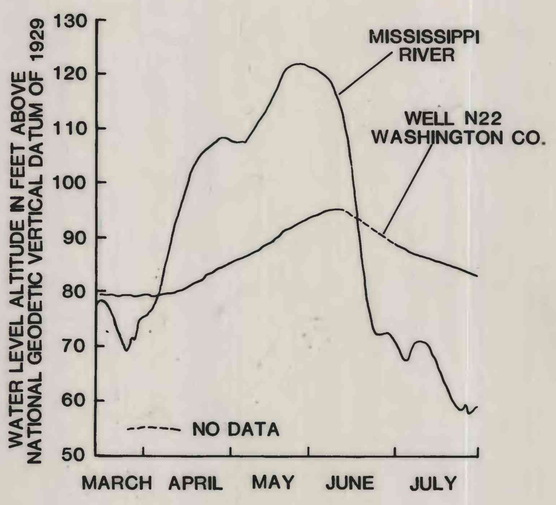
Department of the Interior
United States Geological Survey

Prepared in cooperation with the
Mississippi Department of Natural Resources
Bureau of Land and Water Resources

Water-Resources Investigations Report 83-4285



HYDROGRAPHS OF MISSISSIPPI RIVER AND NEARBY OBSERVATION WELL IN WASHINGTON COUNTY FOR PERIOD MARCH 14-JULY 31, 1983



ADDITIONAL INFORMATION

The map showing the results of the April 1983 water-level measurements is the sixth of a series of semi-annual maps showing seasonal ground-water levels in the alluvial aquifer of the Delta. Data describing the individual wells used in this study may be obtained from the following:

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Mississippi Department of Natural Resources
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Post Office Box 10631
Jackson, Mississippi 39209
(601) 961-5200

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SELECTED REFERENCES

Bettandorff, J. M., and Leake, S. A., 1976, Water for industrial and agricultural development in Attala, Holmes, Humphreys, Issaquena, Sharkey, and Yazoo Counties, Mississippi: Mississippi Research and Development Bulletin, 49 p.

Dalsin, G. J., 1978, Water for industrial and agricultural development in Bolivar, Carroll, Leflore, Sunflower, and Tallahatchie Counties, Mississippi: Mississippi Research and Development Bulletin, 41 p.

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____1982b, Water-level maps of the alluvial aquifer, northwestern Mississippi, April 1982: U.S. Geological Survey Water-Resources Investigations Report 82-4061.

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Base maps modified
from U.S. Geological
Survey Map of Mississippi,
Scale 1:500,000, 1972

INTRODUCTION

The Mississippi River valley alluvium extends over an area of about 7,000 square miles in northwestern Mississippi. This area, known locally as the "Delta", is extremely productive agriculturally due to the fertile soil, favorable climate, and plentiful water. Cotton, rice, soybeans, and catfish are all grown in abundance. The Delta possesses all the characteristic features of an active alluvial plain; low relief, oxbow lakes, abandoned stream channels, natural levees, backswamp areas and bayous. Land surface slopes gently southward. The study area extends from near Memphis, Tennessee, south to Vicksburg, Mississippi, and is bordered on the west by the Mississippi River and on the east by the Bluff Hills.

This report is one in a series of reports designed to describe the results of a study that measures and analyzes water-level changes occuring in the alluvial aquifer. Water-level measurements have been made twice each year since September 1980, preceeding and following the annual pumping season. Water-level altitudes in observation wells and altitudes of some stream stages were used to prepare the potentiometric map. The depth-to-water map was prepared using water-level measurements made in April 1983. The water-level change map was prepared using water-level measurements made in April 1981 and April 1983. The hydrologic maps in this report were prepared by the U.S. Geological Survey in cooperation with the Mississippi Bureau of Land and Water Resources, using water-level measurements made in about 500 wells in the alluvial aquifer in April 1981 and April 1983.

ALLUVIAL AQUIFER

The Mississippi River valley alluvium in northwestern Mississippi, of Quaternary age, was deposited by the ancestral Mississippi River and its tributaries on an erosional Tertiary surface. The alluvium generally follows the typical alluvial stratigraphic sequence, gradually becoming finer-grained upward from gravels at the base to sands to silts and clays in the upper part. The coarse lower clastics make up the alluvial aquifer, which averages 120 feet in thickness. The fine upper deposits, averaging 20 feet in thickness, are relatively impermeable, with local exceptions. The topography of the underlying, irregular Tertiary surface controls alluvial thickness because there is little surface relief in the Delta. The alluvium generally is thickest in the interior of the Delta (often greater than 150 feet thick) and thinnest along the Bluff Hills (usually less than 100 feet thick) at the eastern margin of the Delta.

High hydraulic conductivities are found in the alluvial aquifer because of the unconsolidated nature of these deposits. This fact combined with the substantial thickness of sand and gravel accounts for the large yields to wells (more than 3,000 gallons per minute in many wells) possible from this aquifer.

The alluvial aquifer is recharged from three sources:

1) Rivers and streams in the Delta, particularly the Mississippi River and Yazoo-Tallahatchie-Coldwater River system
2) Underlying aquifers in the Sparta Sand and Cockfield Formation
3) Precipitation on the more sandy areas of the Delta, particularly along the Bluff Hills

High river stages and heavy precipitation were prevalent during the winter and spring preceeding the April 1983 water-level measurements. These wet conditions brought water levels up significantly from April 1981 levels near the areas of major recharge at or near the boundaries of the Delta. In the interior of the Delta, away from the areas of recharge, water levels have continued to show a long-term decline, averaging about 1.5 ft per year for this two-year period.

WATER-LEVEL CHANGE MAP APRIL 1981-APRIL 1983

The water-level change map shows the net change in ground-water levels from April 1981 to April 1983. A two-year period was chosen for this water-level change map in order to illustrate long-term changes in water levels. Ground-water levels fell in the interior of the Delta and rose along the Mississippi River, along the Yazoo-Tallahatchie-Coldwater River system, near the Bluff Hills, and in the southern Delta. Significant declines occurred in Bolivar, Sunflower, Tallahatchie, Humphreys, Leflore, and Coahoma Counties, where water levels fell more than 6 ft in some areas. Most of the decline from April 1981 to April 1983 was due primarily to heavy pumpage during the 1981 growing season. The aquifer can be divided into two general areas based on this map and previous water-level change maps. In one area, water levels have declined gradually in recent years, with slight seasonal recoveries. In the other area, water level changes have been more pronounced and bidirectional than in the other area, fluctuating markedly with the seasons, much as before aquifer development. This phenomena stems from the fact that the central part of the Delta is removed from the major sources of recharge, whereas the periphery of the Delta is closer to these sources, and thus much more responsive to sudden changes in stream stages and precipitation amounts.

Due to the areal distribution of confined conditions in the alluvial aquifer during April 1983, the large water-level rises along the edges of the Delta represent increasing artesian pressure rather than a significant increase in aquifer storage. This pressure will diminish as stream stages fall. Conversely, water-level declines in the unconfined interior represent long-term losses in storage.

Irrigation pumpage during this two-year period was relatively heavy. Rice and catfish farming accounted for most of this pumpage. Rice acreage increased to a record 340,000 acres in 1981 and then fell to 260,000 acres in 1982. About 82 percent of the rice in the Delta is irrigated by ground water, the remainder with surface water. The annual water application to rice averages 4.3 acre-feet/acre. Catfish acreage increased to 53,000 acres in 1981 and to 60,000 acres in 1982. Ground water is the sole source of water for catfish farming in the Delta. The annual water application to catfish ponds averages 7.5 acre-feet/acre.

Computations based upon the water-level change map show that total amount of water in storage in the alluvial aquifer was reduced by approximately 680,000 acre-feet from April 1981 to April 1983. Total pumpage for this period was approximately 3,700,000 acre-feet. Thus, a water budget analysis gives a net recharge of approximately 3,000,000 acre-feet, which is about 80 percent of total pumpage for this period. Recharge rates are doubtlessly greater now than during predevelopment times due to pumpage-induced ground-water capture but have not increased enough to fully offset the present large aquifer drafts.

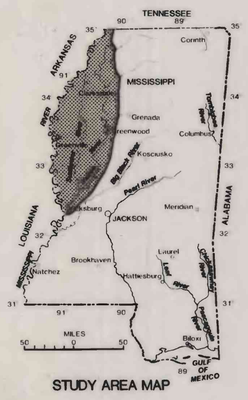
DEPTH-TO-WATER MAP

The depth-to-water map shows the approximate depth to water below land surface for April 1983. Water levels generally were nearest land surface along the edges of the Delta due to the heavy winter and spring recharge to the aquifer. Water levels were above land surface in several areas. Deeper water levels were found in the interior of the Delta, where recharge is not so immediate.

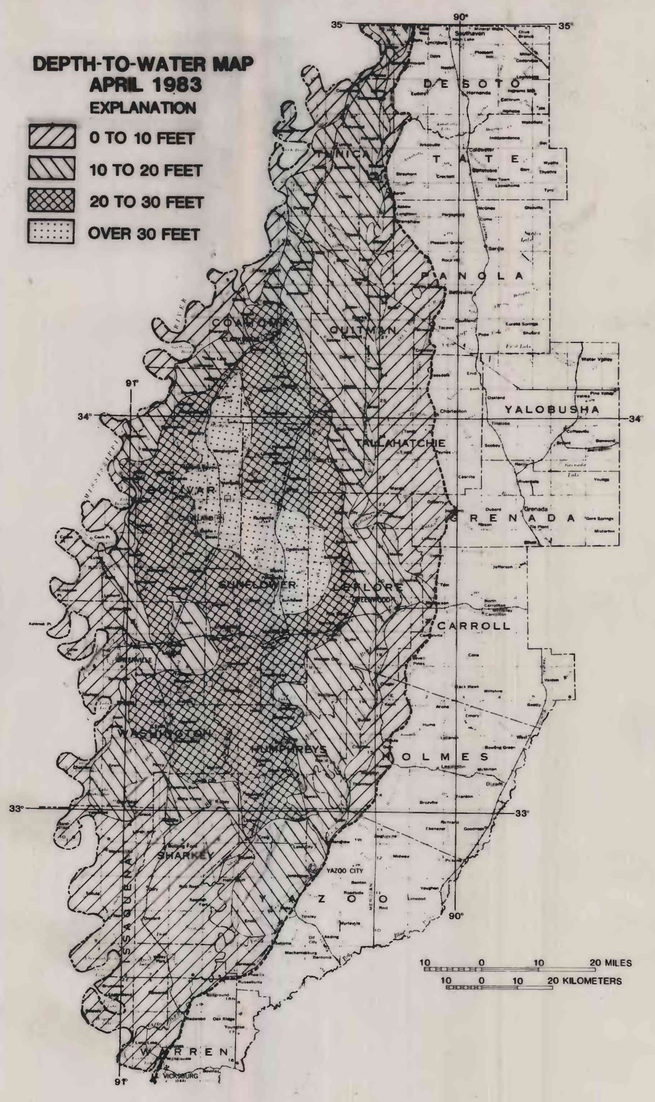
Both confined and unconfined conditions occur in the alluvial aquifer. Because the upper confining layer is approximately 20 feet thick, water levels deeper than about 20 feet identify unconfined areas. Thus, the depth-to-water map shows that the aquifer generally was unconfined in the interior of the Delta and generally was confined along the periphery during April 1983. A continuation of the present large drafts will cause water levels to decline further and the unconfined zone to increase areally. Continued water-level declines will cause reductions in possible well yields due to reductions in the available saturated aquifer thickness in addition to increasing lift costs and forcing well pumps to be lowered.

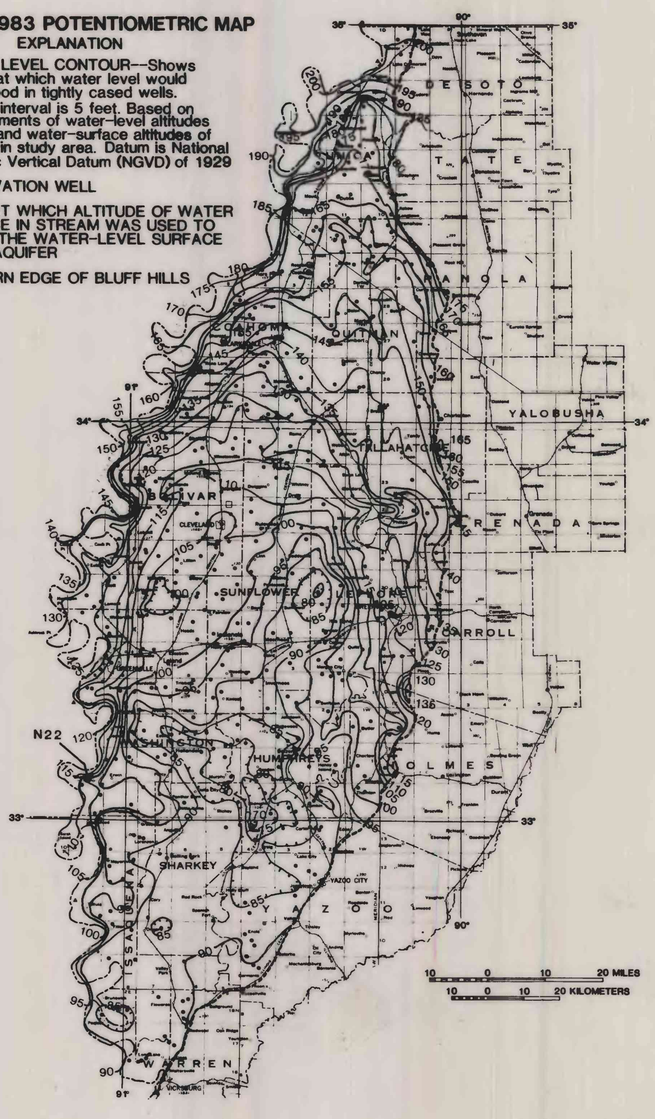
To convert English units to International units:

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
acre	.4047	hectare
acre-foot (acre-ft)	.0008107	cubic hectometer (hm^3)
gallon per minute (gal/min)	.06308	liter per second (L/s)



STUDY AREA MAP





POTENTIOMETRIC MAP APRIL 1983

The April 1983 potentiometric map shows the ground-water surface of the alluvial aquifer preceeding the 1983 growing season. The general flow pattern in the aquifer is made up of two components - a north to south axial flow and an east-west trans-axial flow from the boundaries of the Delta inward toward the Sunflower River. The latter component is particularly pronounced in the central Delta.

Potentiometric gradients along the Mississippi River and the Bluff Hills are steep in response to the favorable recharge conditions prevalent during the winter and spring. Observation well N22 in Washington county, 0.8 miles from the Mississippi River, was in an area of steep potentiometric gradients during April 1983 (see hydrographs). The hydrographs for N22 and for the Mississippi River near N22 show that the Mississippi River exerted a marked influence on the ground-water levels at N22, with about a 12-day river crest to ground-water peak delay time. A flood with a rise in stage of about 50 feet produced a corresponding increase in ground-water levels of about 16 feet. About 100 days were required for the flood to pass.

There are two principal cones of depression in the alluvial aquifer, one centered in Humphreys County and the other straddling the Sunflower-Leflore County line. Both cones are smaller than in September 1982 due to normal seasonal recharge and are smaller than in April 1982 due to a reduction in 1982 pumpage from 1981 levels (Darden, 1982b).

WATER-LEVEL MAPS OF THE ALLUVIAL AQUIFER, NORTHWESTERN MISSISSIPPI, APRIL 1983

DAVID M. SUMNER
1984

JACKSON, MISSISSIPPI