DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
ARKANSAS GEOLOGICAL COMMISSION
and
ARKANSAS SOIL AND WATER CONSERVATION COMMISSION

WATER-RESOURCES INVESTIGATIONS REPORT 86-4084

INTRODUCTION

Aquifers in the Tertiary Sparta and Memphis Sands (location map) are a major source of water supply for much of eastern and south-central Arkansas. Major withdrawals occur from the aquifer for industrial and public supply, with generally lesser but locally significant amounts withdrawn for agricultural uses. Water-level data from wells tapping the artesian aquifer in the Sparta and Memphis Sands indicate steadily declining water levels in some areas where relatively large withdrawals occur. In addition, a simulation of water levels using projected withdrawals to the year 1990 (Reed, 1972) indicated increasing water-level declines in the aquifer. In parts of south-central Arkansas, simulated water levels actually declined to below the top of the aquifer; continued declines would cause a reduction in the saturated thickness and aquifer transmissivity. Declining water levels also increase the potential for saltwater contamination from saline water in water-bearing units below the aquifer.

Because of the potential quantity and quality problems, the continual monitoring of water levels in the aquifer in the Sparta and Memphis Sands is essential for proper aquifer management and the continuation of the use of the aquifer as a major source of water for much of eastern and south-central Arkansas.

The U.S. Geological Survey with the cooperation of the Arkansas Geological Commission has been monitoring water levels in the aquifer in the Sparta and Memphis Sands annually throughout the aquifer's extent within the State of Arkansas. This report, prepared in cooperation with the Arkansas Geological Commission and the Arkansas Soil and Water Conservation Commission interprets water-level data through hydrologic maps of the potentiometric surface and water-level changes. The potentiometric surface map is based on water levels collected in the spring of 1985. The water-level change map is based on a comparison of water levels collected in the spring of 1980 and 1985. This report includes the Sparta Sand and most of the Memphis Sand aquifer within the State of Arkansas. Little or no data are available in the northeastern part of the State where limited withdrawals from the aquifer occur.

AQUIFER DESCRIPTION

The aquifer as used in this report is situated within the Sparta and Memphis Sands. The Sparta Sand, located in the central and southern parts of the study area, is underlain by the Cane River Formation and overlain by the Cook Mountain Formation, both confining units. In the northern part of the study area, the Cane River Formation changes facies from clay to sand, forming a single sand unit from the bottom of the Carrizo Sand, which underlies the Cane River Formation, to the top of the Sparta Sand. This unit is as much as 900 feet thick and is classified as the Memphis Sand. Hosman and others (1968) show the facies change occurring near latitude 35° N. Water levels in wells finished in the Sparta Sand correlate with water levels in wells finished in the Memphis Sand. Therefore, the water-bearing formations are treated as one aquifer in this report. The aquifer in the Sparta and Memphis Sands in Arkansas extends from the State boundaries on the south, east, and north and to the outcrop and subcrop areas to the west.

Water in the aquifer in the Sparta and Memphis Sands is generally confined, except in the outcrop and subcrop areas. Recharge to the aquifers occurs chiefly through precipitation on the outcrops and through percolation of water from overlying alluvium where it covers the outcrops. Minor amounts of recharge probably also occur from leakage of water through confining beds above or below, where the heads are greater than the head in the aquifer in the Sparta and Memphis Sands. Discharge from the aquifer in the Sparta and Memphis Sands occurs by withdrawal from wells and by natural discharge to beds above or below these units where conditions of head permit. A more detailed description of the aquifer in the Sparta and Memphis Sands is given in Hosman and others (1968).

POTENTIOMETRIC SURFACE MAP

The potentiometric surface map indicates the altitude to which water would rise in tightly cased wells tapping the aquifers. The map is based on 202 water-level measurements made from March 22 to May 17, 1985 (Edds, 1985), prior to the beginning of the irrigation season. The potentiometric contours define the potentiometric surface and indicate the general direction of ground-water flow. Ground water flows perpendicular to the contours.

The map of the potentiometric surface indicates that ground water generally flows towards the south and east except where affected by pumpage. Three cones of depression centered in Columbia, Union and Jefferson Counties are a result of relatively large withdrawals in these areas (table 1). The effect of the relatively large withdrawals in Arkansas and Prairie Counties is reflected in a northeastward elongation of the cone of depression that is centered in Jefferson County. The actual magnitude of decline in the Sparta Sand in Arkansas and Prairie Counties at other times of the year may be greater than that indicated, because greater than 90 percent of this pumpage is withdrawn during the summer months for irrigation, and the time lapse between the end of the pumping season and the spring measurements is sufficient to allow for recovery of the potentiometric surface in these two counties.

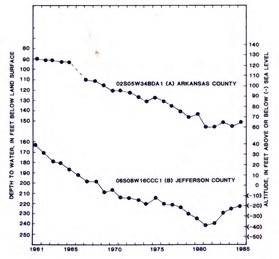
WATER USE

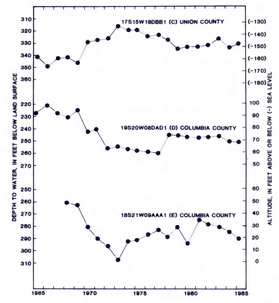
Water use from the aquifer in the Sparta and Memphis Sands varies widely throughout their extent. Largest withdrawals occur from the Sparta Sand aquifer in Arkansas, Columbia, Jefferson, Prairie and Union Counties. Pumpage data for these counties between 1965 and 1980 are summarized in Table 1. Except for Union County, withdrawals from these counties have generally been increasing since at least 1965. Withdrawals in Columbia, Jefferson and Union Counties are utilized predominantly for industrial and public supply. Withdrawals in Arkansas and Prairie County are seasonal for irrigation. Relatively minor amounts are withdrawn from the aquifer in counties elsewhere in Arkansas.

WATER-LEVEL CHANGE MAP

Changes in water levels from 1980 to 1985 are illustrated by the water-level change map. Changes are based on net difference in water levels from 185 wells measured during spring 1980 and spring 1985. As shown, water levels decreased over most of the study area. Increases in water levels occurred within Jefferson County and in parts of south-central Arkansas. These differences probably reflect changes in aquifer withdrawals.

Longer-term trends in water levels are illustrated by the hydrographs of five wells completed in the aquifer in the Sparta and Memphis Sands in Jefferson, Arkansas, and Columbia Counties. The generally steady decline since 1961 illustrated by the hydrograph from the well in Arkansas County is probably a reflection of increases in pumpage for agriculture. The hydrograph from the well in Jefferson County also shows a decrease since 1961; water-level fluctuations in this well probably result from changes in pumpage for industrial and public supply uses. Water-level fluctuations illustrated by hydrographs of the three wells in Union and Columbia Counties are more sporadic, probably responding to changes in industrial and public supply withdrawals.





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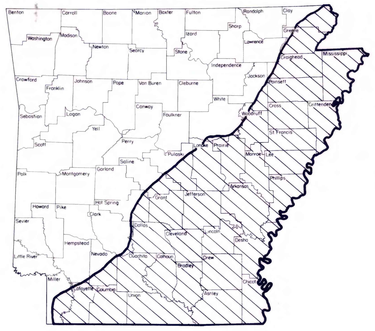

Table 1.--Withdrawals from the aquifer in the Sparta and Memphis Sands in selected counties in Arkansas

[Million gallons per day]

County	1965[1]	1970[2]	1975[3]	1980[4]
Jefferson	44.36	59.30	53.82	71.13
Arkansas	17.39	20.26	24.25	36.97
Prairie	6.75	7.72	15.8	20.92
Union	19.07	18.85	17.40	16.07
Columbia	3.03	5.84	6.02	7.22

1 Halberg and Stephens (1966)
2 Halberg (1972)
3 Halberg (1977)
4 Holland and Ludwig (1981)

CONVERSION FACTORS

For use of readers who prefer to use metric units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level. NGVD of 1929 is referred to as sea level in this report.

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MAPS SHOWING ALTITUDE OF THE POTENTIOMETRIC SURFACE AND CHANGES IN WATER LEVELS IN THE AQUIFER IN THE SPARTA AND MEMPHIS SANDS