Prepared in cooperation with the
ARKANSAS GEOLOGICAL COMMISSION
ARKANSAS SOIL AND WATER CONSERVATION COMMISSION
LOCAL CONSERVATION DISTRICTS,
and the
U.S. SOIL CONSERVATION SERVICE

INTRODUCTION

The study area, which coincides with the Mississippi Alluvial Plain section of the Coastal Plain physiographic province (Fenneman, 1938) is bounded to the north by the Missouri State line and to the south by the Louisiana State line. The Mississippi River bounds the study area to the east. The western boundary is formed by the Fall Line (the physiographic boundary between the Coastal Plain and the Interior Highlands) and by the approximate western extent of the alluvial aquifer.

Most of the land is used for agriculture. Rice and soybeans, which are the principal crops, are dependent on large quantities of freshwater for irrigation. Historically and presently (1987), the main source of freshwater has been the Mississippi River Valley alluvial aquifer, henceforth referred to as the alluvial aquifer (an aquifer is a water-bearing layer of rock or sediment that will yield a usable quantity of water to a well or spring). Approximately 3,400 Mgal/d of water were withdrawn from the alluvial aquifer in 1980, mostly for rice production (Holland and Ludwig, 1981).

The U.S. Geological Survey, in cooperation with the Arkansas Geological Commission (AGC), has been monitoring water levels for several years in a network of wells completed in the alluvial aquifer to determine the effects of large withdrawals for irrigation on water levels (Edds, 1984; Edds and Fitzpatrick, 1984; Edds and Spencer, 1985; Edds and Remsing, 1986; Plafcan and Edds, 1986; Plafcan and Fugitt, 1987). In 1984, this network was enlarged by additional monitor wells that are measured by local District personnel of the U.S. Soil Conservation Service (SCS) (Plafcan, 1985). This report was prepared in cooperation with the AGC, the Arkansas Soil and Water Conservation Commission (ASWCC), local Conservation Districts, and the SCS, and is intended to illustrate the effects of withdrawals on water levels in the alluvial aquifer.

Maps shown in this report were prepared from data collected by both the U.S. Geological Survey (Edds and Remsing, 1986) and the SCS (Plafcan, 1987). The maps show the potentiometric surface of the alluvial aquifer before and after the 1986 pumping season, the depth to water in spring 1986, and the change in water levels between spring 1981 and 1986. Hydrographs showing long-term water-level changes in wells at selected locations are also included.

AQUIFER DESCRIPTION

The Mississippi River alluvium is composed of flood-plain and terrace deposits of Quaternary age. The flood-plain deposits generally grade from gravel and coarse sand in the lower part to silt and clay in the upper part. The saturated alluvium beneath the upper silt and clay constitutes the alluvium aquifer and is comprised of gravels and coarse to fine sand. Lithology of the terrace deposits is similar to those in the flood plain (Boswell and others, 1968).

The thickness of the alluvial deposits ranges from near zero along the Fall Line and thickens eastward to a maximum of about 250 feet. The alluvial deposits generally are 100 to 150 feet thick. The upper silt and clay layer varies in thickness from a few feet to more than 75 feet, and, where present, forms a confining layer for the aquifer in the underlying coarser material. Intensive ground-water withdrawals in some areas has resulted in the long-term decline of water levels below the bottom of the clay layer. Yields of wells generally range from 1,000 to 3,000 gal/min (Petersen and others, 1985). The aquifer is interrupted by Crowleys Ridge, an erosional remnant of Tertiary strata that extends from north of the Missouri-Arkansas State line to Helena, Arkansas. Material in the ridge is much less permeable than the alluvial sand and gravel (Boswell and others, 1968) and thus the area is little used for irrigation.

Recharge to the aquifer is principally by infiltration of precipitation where the silt and clay layer is thin or absent, by leakage from the silt and clay layer, and by infiltration. In areas where a thick silt and clay layer prevents direct infiltration of precipitation, horizontal flows from adjacent areas are the principal source of recharge.

POTENTIOMETRIC SURFACE MAPS

The potentiometric-surface maps indicate the altitude to which water levels would rise in tightly cased wells that penetrate the alluvial aquifer. The spring 1986 potentiometric-surface map reflects conditions prior to seasonal irrigation withdrawals and are based on water-level measurements collected by the U.S. Geological Survey and district Soil Conservation Service personnel in 747 wells between February and June 1986. The fall 1986 potentiometric-surface map reflects post irrigation season conditions when water levels begin to rise form their lowest elevations of the irrigation season. Water levels begin to rise in late August and early September and continue to rise through December. Recoveries during this time may be more than 8 feet but average recoveries are about 3 feet. Data for this map are based on water-level measurements collected by district Soil Conservation Service personnel in 433 wells between August and November 1986.

Both the spring and fall potentiometric surface maps reflect the general flow patterns within the aquifer; water moves perpendicular to the contours in the direction of the hydraulic gradient. The regional direction of ground-water flow is south and southeast, except where affected by intensive withdrawals and near reaches of the Mississippi and other rivers that are hydraulically connected with the alluvial aquifer.

An area centered in Arkansas County and another in western Poinsett and Cross Counties are marked by cones of depression that resulted from large ground-water withdrawals for irrigation. In 1981, users in Arkansas County withdrew 380 Mgal/d and those in Cross and Poinsett Counties together withdrew 593 Mgal/d for irrigation (Hall and Holland, 1984), most of which came from alluvial deposits. Smaller cones of depression are present in Greene, Monroe, and St. Francis Counties.

Water levels are highest in the spring, when the aquifer has recovered from the previous irrigation season. Water levels after the irrigation season average about 3 feet lower than those before the irrigation season (Plafcan, 1987).

FIVE-YEAR WATER-LEVEL CHANGE MAP

Half of the 241 wells monitored by the U.S. Geological Survey in 1981 and 1986 showed a rise in water-level altitude, whereas the other half showed a decline. Areas of declines greater than 6 feet occurred in two locations--central Lonoke County and in western parts of Craighead and Poinsett Counties. Both areas are affected by intensive withdrawals for irrigation. Approximately 640 Mgal/d were withdrawn, mostly from the alluvial aquifer, for irrigation and fish farming in Lonoke and Prairie Counties in 1981 (Hall and Holland, 1984), and approximately 356 Mgal/d were withdrawn for irrigation in Poinsett County. Most areas with a water-level rise greater than 6 feet were near major streams and probably reflect infiltration from the streams.

Hydrographs for two wells completed in the alluvial aquifer in areas of intensive withdrawal in Poinsett and Lonoke Counties illustrate long-term, nearly continuous, water-level declines. The hydrograph for the well in Mississippi County shows small seasonal fluctuations related to stages in the Mississippi River and local changes in storage, but does not indicate a long-term water-level decline over the last 20 years.

DEPTH-TO-WATER MAP

Water levels in the alluvial aquifer are shallowest near the Fall Line and near streams that penetrate the aquifer, such as the Arkansas, White, and Mississippi Rivers. Water levels in the aquifer in these areas are shallow for two reasons: decreased use of ground water due to availability of surface water and recharge to the aquifer from the river, especially in areas where navigation pools hold the water level in the river above the water level in the aquifer, thus allowing the river to constantly recharge the aquifer. Thinner alluvial deposits along the Fall Line also contribute to shallow water levels in this area. The deepest water levels, those greater than 100 feet below the land surface, correspond to the areas of large ground-water withdrawals in Arkansas, Lonoke, Prairie, and Poinsett Counties.

LOCATION MAP

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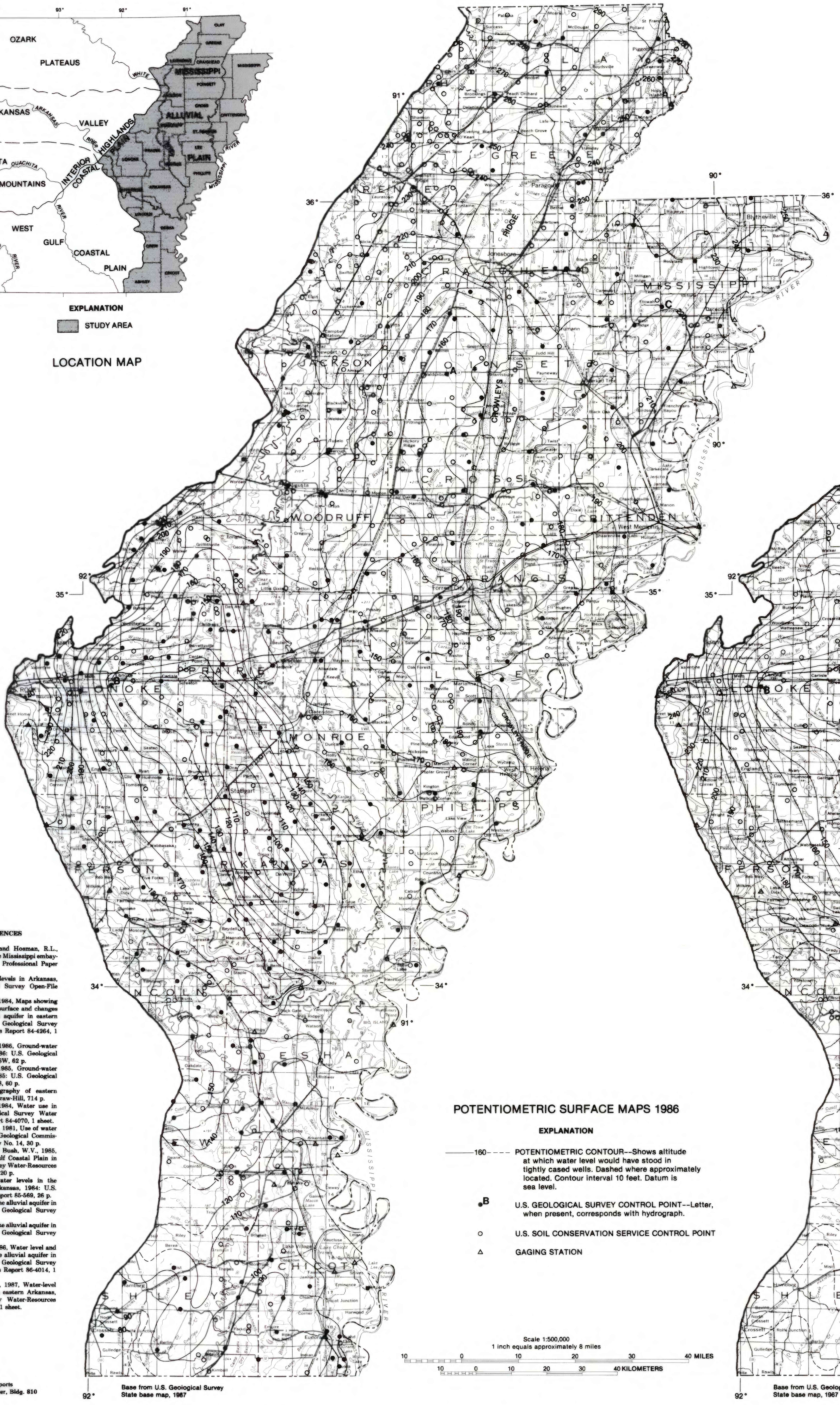
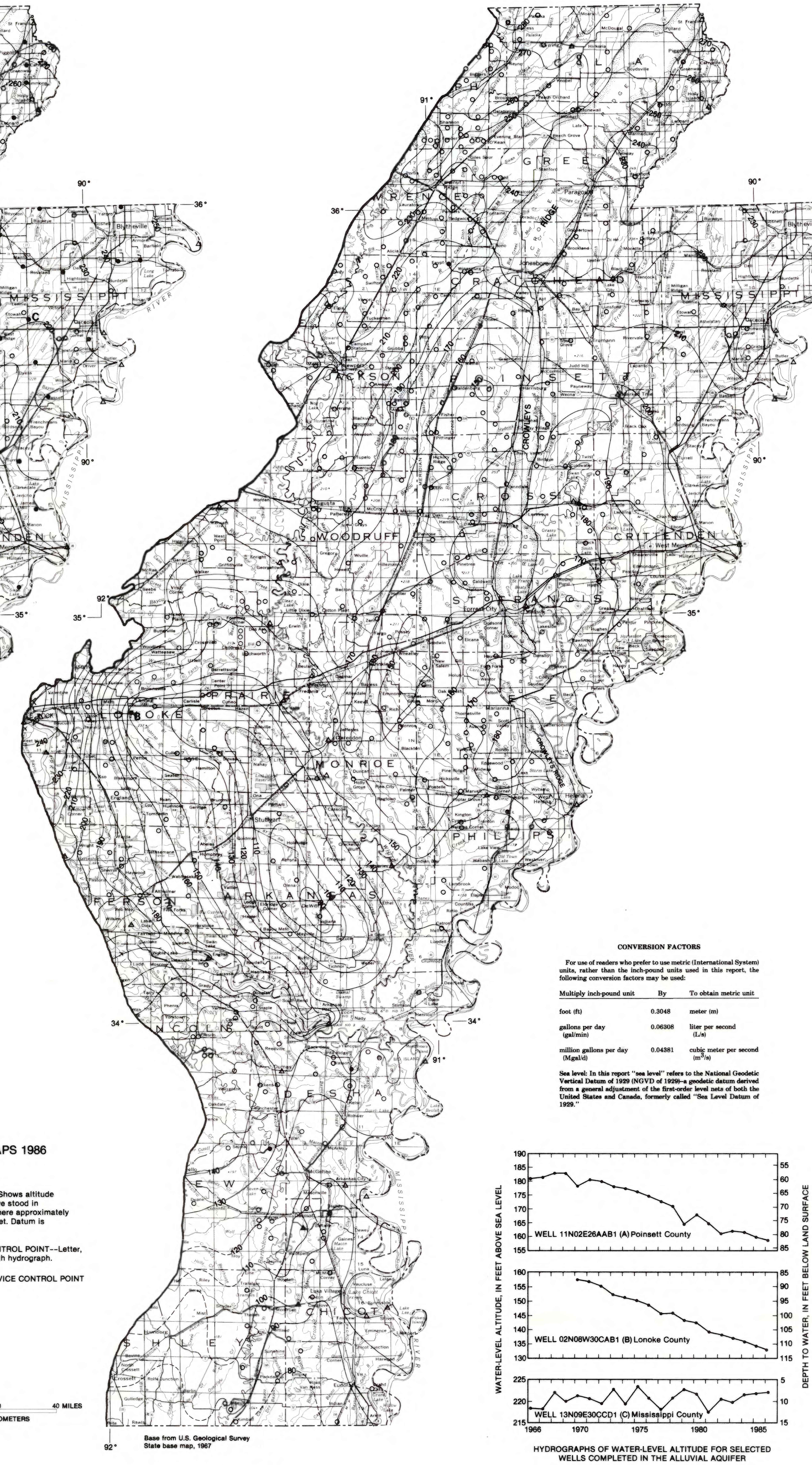


SPRING



FALL

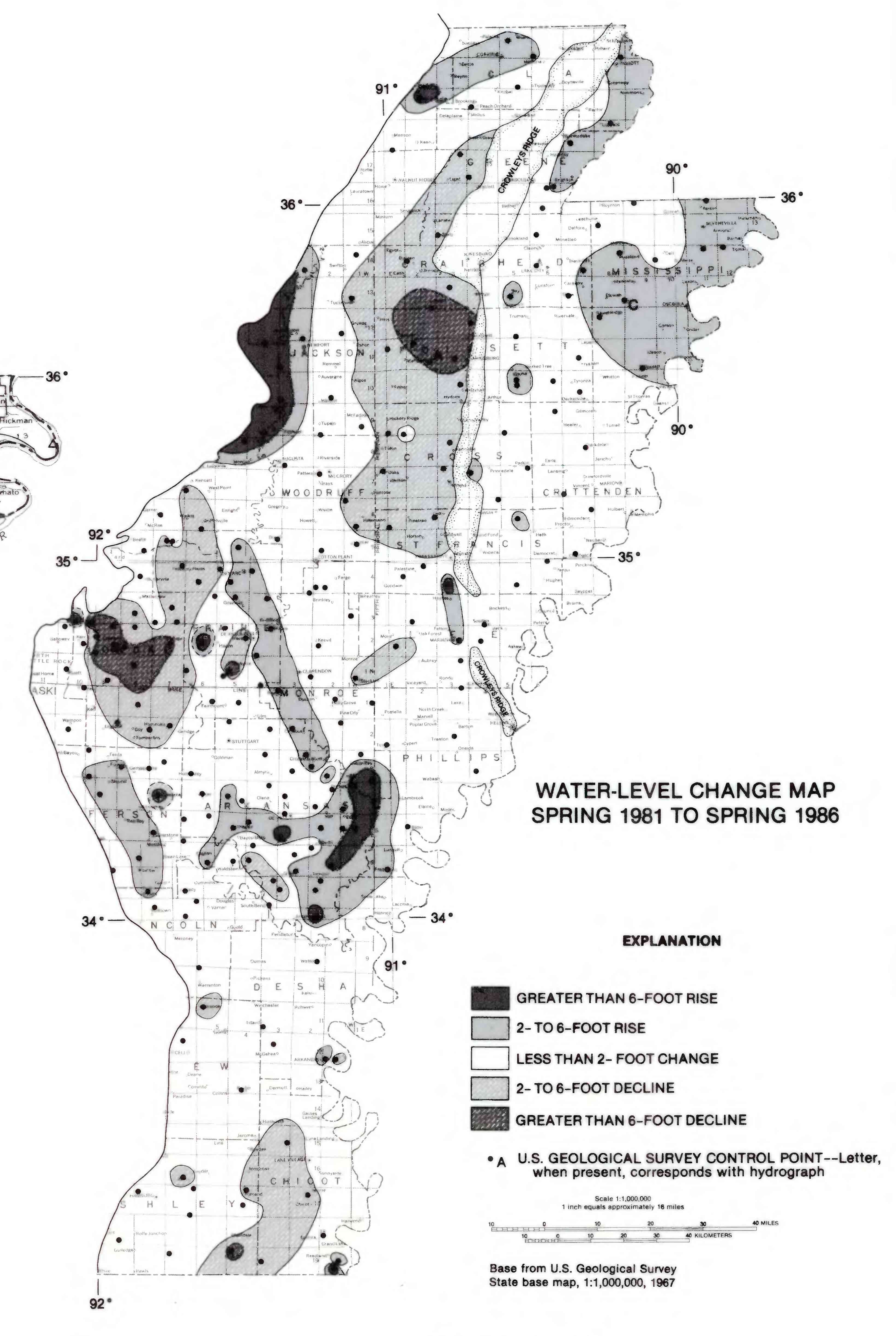
CONVERSION FACTORS

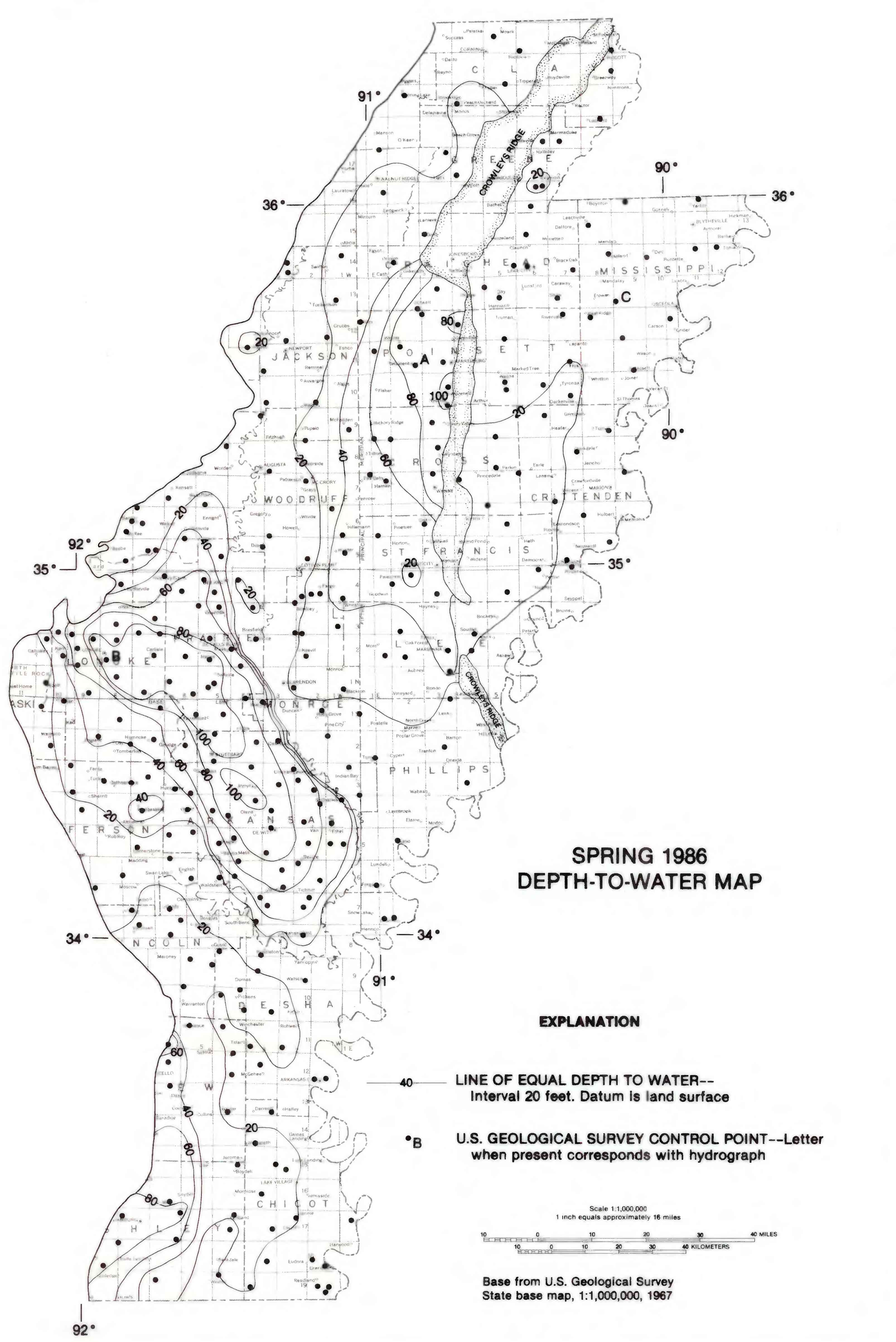
For use of readers who prefer to use metric (International System) units, rather than the inch-pound units used in this report, the following conversion factors may be used:

Multiply inch-pound unit	By	To obtain metric unit
foot (ft)	0.3048	meter (m)
gallons per day (gal/min)	0.06308	liter per second (L/s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Sea level: In this report "sea level" refers to the 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 "Sea Level Datum of 1929."

HYDROGRAPHS OF WATER-LEVEL ALTITUDE FOR SELECTED WELLS COMPLETED IN THE ALLUVIAL AQUIFER





WATER-LEVEL MAPS OF THE MISSISSIPPI RIVER VALLEY ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1986

By Maria Plafcan and L.M. Remsing

1989