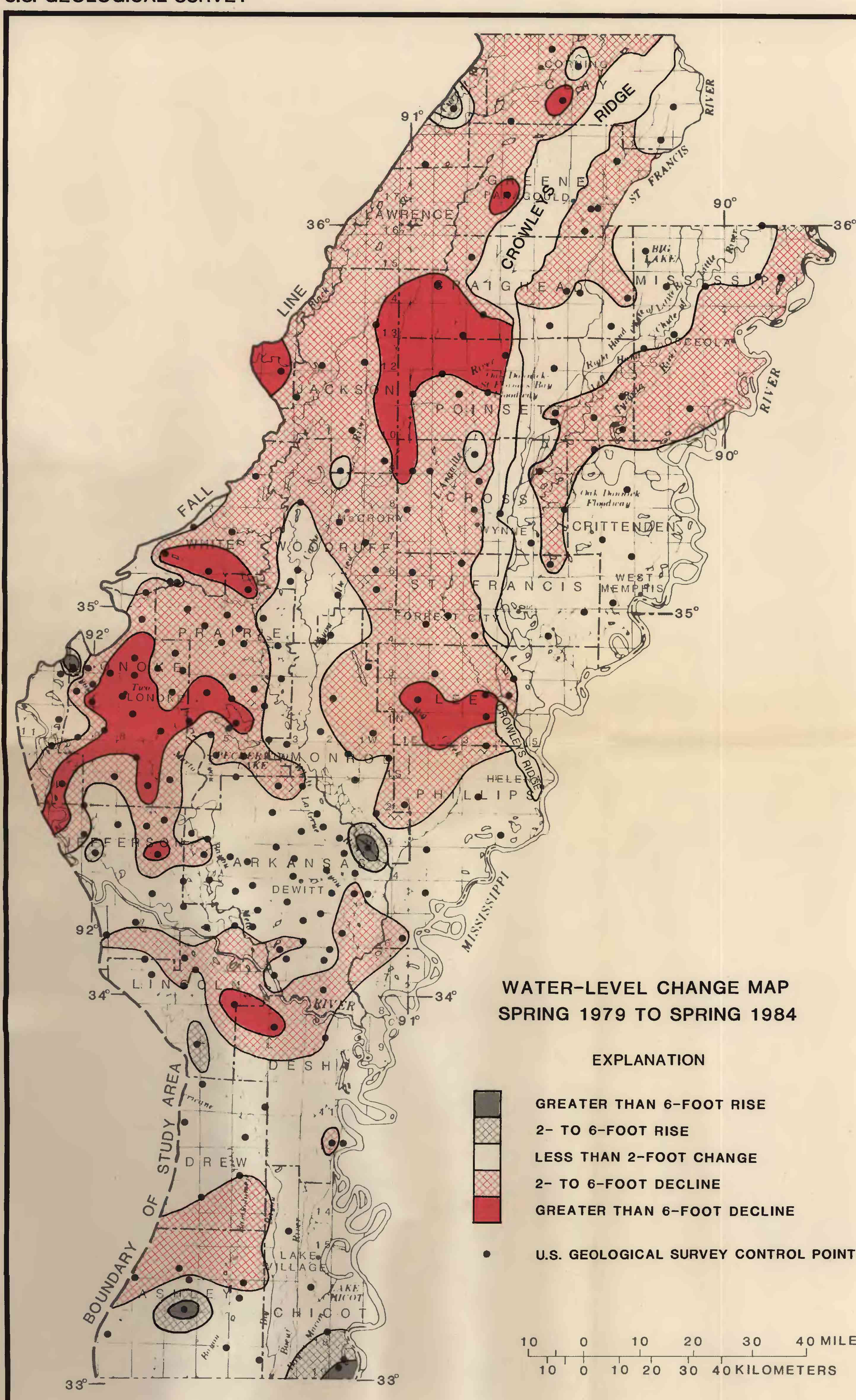
Prepared in cooperation with the
ARKANSAS GEOLOGICAL COMMISSION
ARKANSAS SOIL AND WATER CONSERVATION COMMISSION
LOCAL CONSERVATION DISTRICTS
and the
U.S. SOIL CONSERVATION SERVICE



INTRODUCTION

The Mississippi River Valley alluvial aquifer, herein referred to as the alluvial aquifer, is a major source of water for most of eastern Arkansas. Agriculture is largely dependent on the aquifer as approximately 3.3 Bgal/d are withdrawn for that purpose (Hall and Holland, 1984). Much smaller withdrawals also occur for industrial, public supply, and domestic use.

The purpose of this report is to illustrate, using the spring and fall potentiometric surface maps, the water levels in the alluvial aquifer under pre-pumping and post-pumping conditions, respectively, and to illustrate, using the depth-to-water and saturated thickness maps, the effect of heavy pumpage in the alluvial aquifer.

The U.S. Geological Survey, with the cooperation of the Arkansas Geological Commission, has been monitoring water levels annually in the alluvial aquifer within the State of Arkansas for several years. This report, prepared in cooperation with the Arkansas Geological Commission, Arkansas Soil and Water Conservation Commission, local Conservation Districts, and U.S. Soil Conservation Service, presents maps of the potentiometric surface in the spring and fall of 1984, water-level changes (1979-84), and saturated thickness of the aquifer. The potentiometric surface map for the spring of 1984 is based on water-level measurements collected by the U.S. Geological Survey (Edds, 1984) and the U.S. Soil Conservation Service (Plafcan, 1985). The fall of 1984 potentiometric surface map is based only on water-level measurements collected by the U.S. Soil Conservation Service (Plafcan, 1985). The water-level change map is based on a comparison of water-level measurements made by the U.S. Geological Survey in the spring of 1979 and spring of 1984. The depth-to-water and saturated thickness maps are based on water-level measurements collected by both the U.S. Geological Survey and the U.S. Soil Conservation Service. Saturated thickness of the aquifer is illustrated on the depth-to-water map in the areas of greatest long-term water-level decline.

AQUIFER DESCRIPTION

The alluvial aquifer is composed of both 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. Lithology of the terrace deposits is similar to those in the flood plain (Boswell and others, 1968). The thickness of the alluvial deposits generally ranges from 50 to 200 ft. Alluvial deposits are generally thinnest near the Fall Line (the physiographic boundary between the Coastal Plain and the Interior Highlands) and increases eastward. The upper clay layer varies in thickness from a few feet to more than 50 ft, and, where present, forms a confining layer over the coarser material below. Heavy pumpage in some areas has resulted in the decline of water levels below the bottom of the overlying clay layer. Yields of wells from the aquifer generally range from 1,500 to 3,000 gal/min, with the greater amounts occurring in the alluvial material. The aquifer is divided within the study area by Crowleys Ridge, an erosional remnant of Tertiary strata that is much less permeable than the alluvial sand and gravel (Boswell and others, 1968). Crowleys Ridge extends from north of the Missouri-Arkansas State line, to Helena, Arkansas.

In areas where the clay layer prevents infiltration of precipitation, horizontal flows from adjacent areas are generally the most important source of recharge. In areas without a substantial clay layer, infiltration of precipitation may be the most important source of recharge. Recharge also may occur from streams and lakes during periods of high water.

POTENTIOMETRIC SURFACE MAPS

The potentiometric surface maps indicate the altitude to which water levels would rise in tightly cased wells in the spring and fall, 1984. The spring map, which reflects pre-pumping conditions, is based on 712 water-level measurements collected by the U.S. Geological Survey and the U.S. Soil Conservation Service between February and June 1984. The fall map which reflects post-pumping conditions, is based on 333 measurements collected by the U.S. Soil Conservation Service between August and November 1984.

Both the spring and fall potentiometric surface maps reflect the general flow patterns within the aquifer, with movement being perpendicular to the contours and down the hydraulic gradient. The gradient of both potentiometric surfaces is toward the south and southwest, except where affected by heavy pumping. One area centered in Arkansas County and another in Poinsett and Cross Counties have large cones of depression resulting from withdrawals of large quantities of water for irrigation. In 1981, Arkansas County used 380 Mgal/d and Cross and Poinsett Counties together used 593 Mgal/d for irrigation.

A comparison of the potentiometric surface for the spring and fall indicates that water levels declined an average of about 2.5 ft, although some localized increases in the fall were evident. A decline in stage in the Mississippi River between the spring and fall also resulted in that river changing from a source of recharge to a drain for the aquifer.

DEPTH-TO-WATER AND SATURATED THICKNESS MAP

Water levels are shallowest near the Fall Line and near fully penetrating streams such as the Arkansas, White, and Mississippi Rivers. The deepest water levels are within areas greatly affected by pumping. In some parts of these areas the saturated thickness of the aquifer has been reduced to as little as 20 ft. The saturated thickness is a measure of the thickness of the aquifer containing water and is shown only for the heavy pumping areas. It is determined as the difference in feet between the altitude of the water table and the altitude of the bottom of the aquifer. Generally, the areas of thickest saturation are near the rivers, where water levels are high, and the aquifer is essentially full. The least amount of saturation is within the two principal developing cones of depression where a few localized areas have less than 20 ft of saturation.

WATER-LEVEL CHANGE MAP

Of the 245 wells monitored by the U.S. Geological Survey over the 5-year period, 35 showed a net increase while 210 showed a net decrease. The largest declines of water levels occurred in the areas of heaviest pumpage in Arkansas, Lonoke, Cross, and Poinsett Counties, where a combined total of 1.1 Bgal/d were being used for irrigation in 1980 (Holland and Ludwig, 1981). The wells showing increases in water levels were scattered and not common to any particular area.

Hydrographs for three wells completed in the alluvial aquifer in Arkansas, Poinsett, and Mississippi Counties illustrate long-term water-level changes. The wells located in Arkansas and Poinsett Counties are in areas of heavy pumpage, and their hydrographs show long-term declines of water levels for these areas. The 20-year hydrograph for the well in Mississippi County shows small seasonal fluctuations related to stage fluctuations in the Mississippi River and local changes in storage, but does not indicate a long-term decline in the water-table altitude.

SELECTED REFERENCES

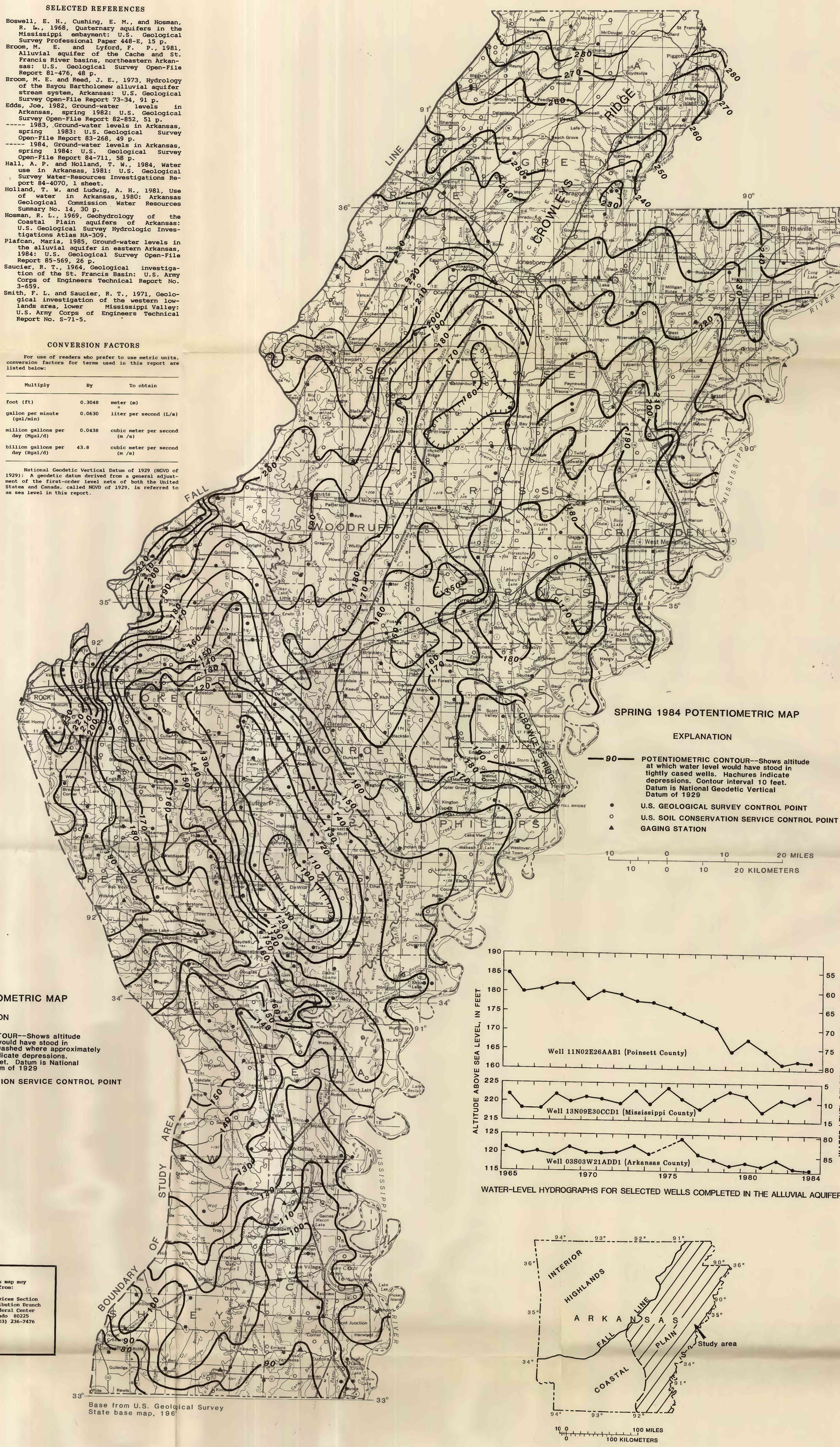
Boswell, E. H., Cushing, E. M., and Hosman, R. L., 1968, Quaternary aquifers in the Mississippi embayment: U.S. Geological Survey Professional Paper 448-E, 15 p.
Broom, M. E. and Lyford, F. P., 1981, Alluvial aquifer of the Cache and St. Francis River basins, northeastern Arkansas: U.S. Geological Survey Open-File Report 81-476, 48 p.
Broom, M. E. and Reed, J. E., 1973, Hydrology of the Bayou Bartholomew alluvial aquifer stream system, Arkansas: U.S. Geological Survey Open-File Report 73-34, 91 p.
Edds, Joe, 1982, Ground-water levels in Arkansas, spring 1982: U.S. Geological Survey Open-File Report 82-852, 51 p.
----- 1983, Ground-water levels in Arkansas, spring 1983: U.S. Geological Survey Open-File Report 83-268, 49 p.
----- 1984, Ground-water levels in Arkansas, spring 1984: U.S. Geological Survey Open-File Report 84-711, 58 p.
Hall, A. P. and Holland, T. W., 1984, Water use in Arkansas, 1981: U.S. Geological Survey Water-Resources Investigations Report 84-4070, 1 sheet.
Holland, T. W. and Ludwig, A. H., 1981, Use of water in Arkansas, 1980: Arkansas Geological Commission Water Resources Summary No. 14, 30 p.
Hosman, R. L., 1969, Geohydrology of the Coastal Plain aquifers of Arkansas: U.S. Geological Survey Hydrologic Investigations Atlas HA-309.
Plafcan, Maria, 1985, Ground-water levels in the alluvial aquifer in eastern Arkansas, 1984: U.S. Geological Survey Open-File Report 85-569, 26 p.
Saucier, R. T., 1964, Geological investigation of the St. Francis Basin: U.S. Army Corps of Engineers Technical Report No. 3-659.
Smith, F. L. and Saucier, R. T., 1971, Geological investigation of the western lowlands area, lower Mississippi Valley: U.S. Army Corps of Engineers Technical Report No. S-71-5.

CONVERSION FACTORS

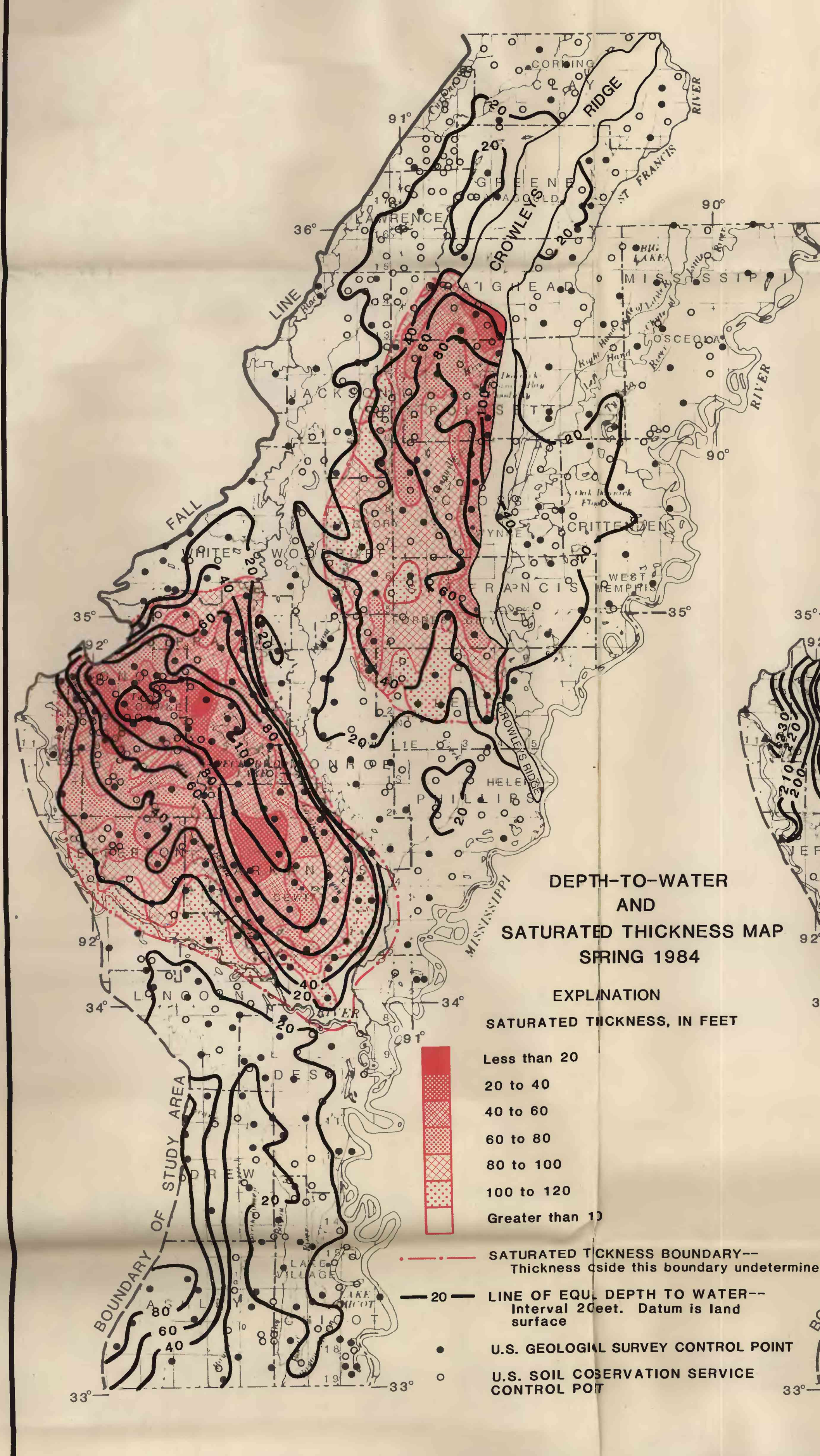
For use of readers who prefer to use metric units, conversion factors for terms used in this report are listed below:

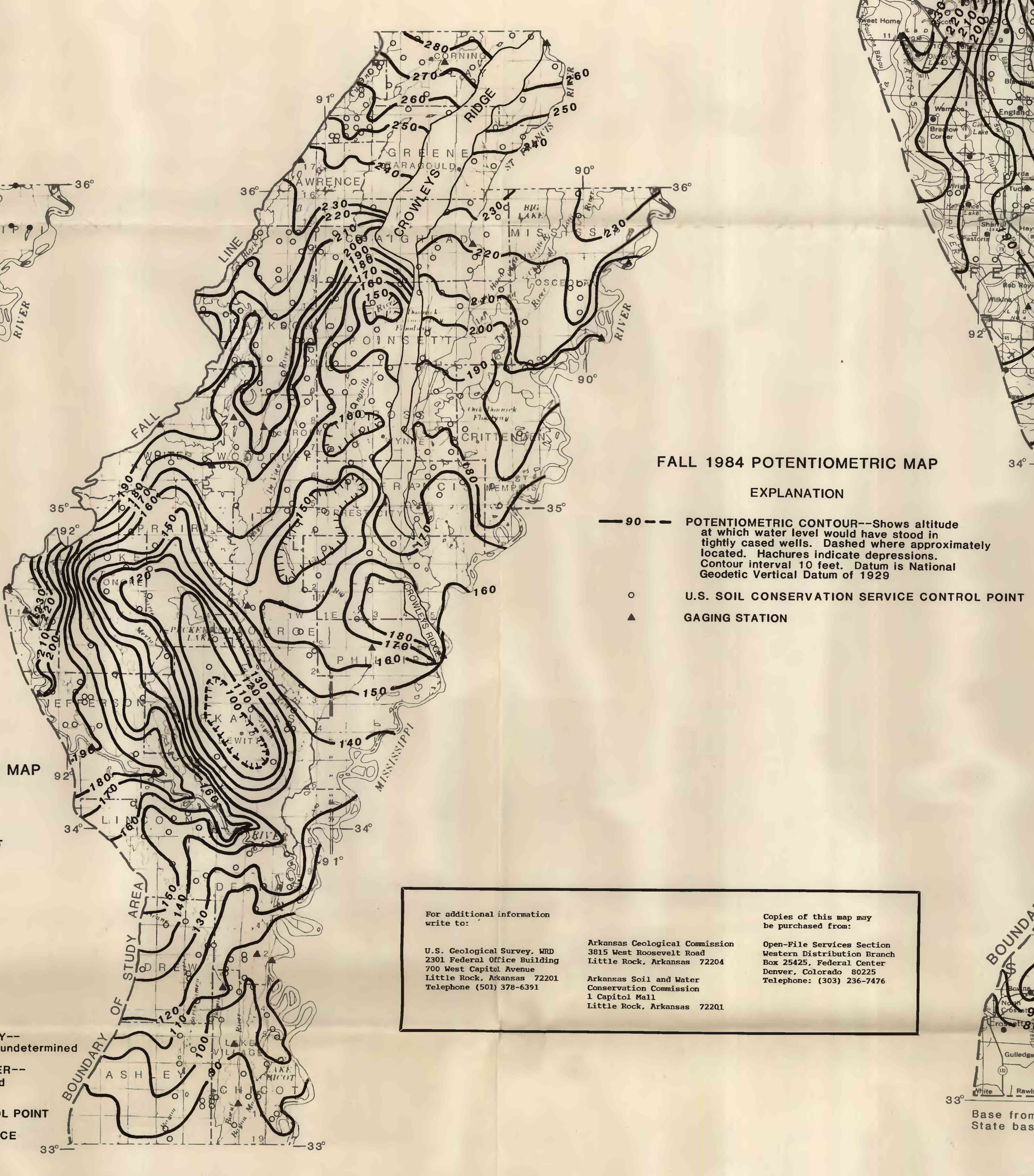
Multiply	By	To obtain
foot (ft)	0.3048	meter (m)
gallon per minute (gal/min)	0.0630	liter per second (L/s)
million gallons per day (Mgal/d)	0.0438	cubic meter per second (m /s)
billion gallons per day (Bgal/d)	43.8	cubic meter per second (m /s)

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 Statea and Canada, called NGVD of 1929, is referred to as sea level in this report.



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





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Copies of this map may be purchased from:

Open-File Services Section
Western Distribution Branch
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Denver, Colorado 80225
Telephone: (303) 236-7476

LOCATION MAP

WATER LEVEL AND SATURATED THICKNESS MAPS OF THE ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1984

By Maria Plafcan and Joe Edds

1986