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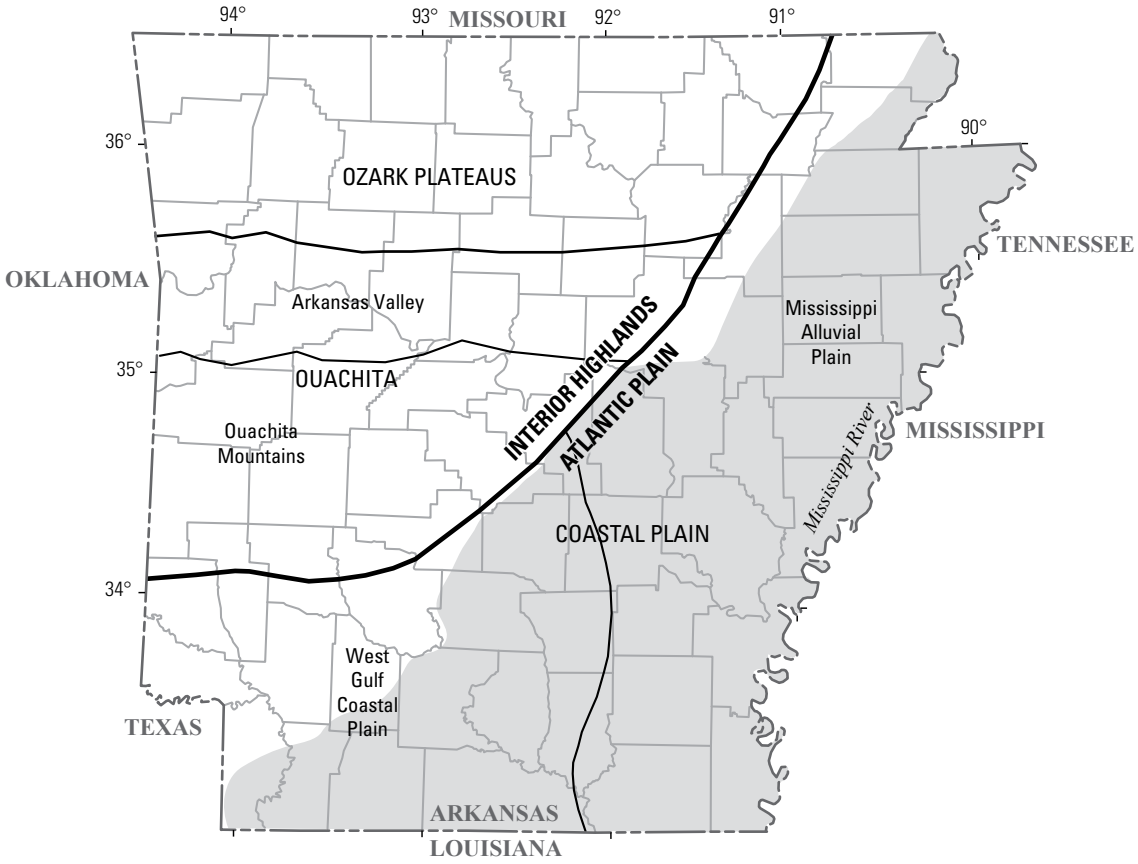
Water Levels and Water Quality in the Sparta-Memphis Aquifer (Middle Claiborne Aquifer) in Arkansas, Spring–Summer 2009



Scientific Investigations Report 2013–5100

U.S. Department of the Interior
U.S. Geological Survey

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SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

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Contents

Plates

[In pocket]

Figures

Tables

Conversion Factors

Inch/Pound to SI

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

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F=(1.8×°C)+32

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C=(°F–32)/1.8

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Water Levels and Water Quality in the Sparta-Memphis Aquifer (Middle Claiborne Aquifer) in Arkansas, Spring–Summer 2009

By T.P. Schrader

Abstract

The U.S. Geological Survey in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey has monitored water levels in the Sparta Sand of Claiborne Group and Memphis Sand of Claiborne Group (herein referred to as the Sparta Sand and the Memphis Sand, respectively) since the 1920s. Groundwater withdrawals have increased while water levels have declined since monitoring was initiated. Herein, aquifers in the Sparta Sand and Memphis Sand will be referred to as the Sparta-Memphis aquifer throughout Arkansas. During the spring of 2009, 324 water levels were measured in wells completed in the Sparta-Memphis aquifer and used to produce a regional potentiometric-surface map. During the summer of 2009, 64 water-quality samples were collected and measured for specific conductance, temperature, and pH from wells completed in the Sparta-Memphis aquifer.

The regional direction of groundwater flow in the Sparta-Memphis aquifer is generally to the south-southeast in the northern half of Arkansas and to the east and south in the southern half of Arkansas, away from the outcrop area except where affected by large groundwater withdrawals. The highest and lowest water-level altitudes measured in the Sparta-Memphis aquifer were 325 feet above and 157 feet below National Geodetic Vertical Datum of 1929, respectively.

Eight depressions (generally represented by closed contours) are located in the following counties: Bradley; Ashley; Calhoun; Cleveland; Columbia; Arkansas, Jefferson, Lincoln, and Prairie; Cross and Poinsett; and Union. Two large depressions shown on the 2009 potentiometric-surface map, centered in Jefferson and Union Counties, are the result of large withdrawals for industrial, irrigation, or public supply. The depression centered in Jefferson County deepened and expanded in recent years into Arkansas and Prairie Counties. The area enclosed within the 40-foot contour on the 2009 potentiometric-surface map has expanded south to the Drew County line and moved west from the intersection of Arkansas, Jefferson, and Lincoln Counties when compared with the 2007 potentiometric-surface map. To the north, east, and west, the 40-foot contour is comparable to the 2007 potentiometric-surface map. The lowest water-level altitude measurement during 2009 in the center of the depression in Union County represents a rise of 42 feet since 2003. The area enclosed by the lowest altitude contour, 140 feet below National Geodetic Vertical Datum of 1929, on the 2009 potentiometric-surface map is about half the area on the 2007 potentiometric-surface map. In the depression in western Poinsett and Cross Counties, the 140-foot contour extended north to the Poinsett-Craighead County line and south across Cross County about two-thirds of the distance to the St. Francis County line.

A water-level difference map was constructed using water-level measurements made during 2005 and 2009 from 309 wells. The difference in water level between 2005 and 2009 ranged from -74.6 to 60.2 feet. Areas with a general rise in water levels occur in central Columbia County, southern Jefferson County, and most of Union County. In the area around west-central Union County, water levels rose as much as 60.2 feet with water levels in 18 wells rising 20 feet or more, representing an average annual rise of 5 feet or more. Water levels generally declined throughout most of the rest of Arkansas.

Hydrographs were constructed using a minimum of 25 years of water-level measurements at each of 206 wells. During the period 1985–2009, mean annual water levels rose in Calhoun, Columbia, Lafayette, and Union Counties, about 1.3 feet per year (ft/yr), 0.2 ft/yr, 0.1 ft/yr, and 0.6 ft/yr, respectively. Mean annual water-level declines between 0.0 and 2.3 ft/yr occurred in all other counties. In western Arkansas County, water-level altitudes in a continuously monitored well declined 60 feet during the irrigation season (April to September).

Specific conductance ranged from 43 microsiemens per centimeter at 25 degrees Celsius (µS/cm) in Ouachita County to 1,230 µS/cm in Phillips County. The mean specific conductance was 392 µS/cm. Although there is a regional increase in specific conductance to the east and south, specific conductance values greater than 700 µS/cm occurred in samples from wells in Arkansas, Ashley, Monroe, Phillips, and Union Counties.

Introduction

The U.S. Geological Survey (USGS) in cooperation with the Arkansas Natural Resources Commission (ANRC) and the Arkansas Geological Survey has monitored water levels in the Sparta Sand of Claiborne Group and Memphis Sand of Claiborne Group (herein referred to as the Sparta Sand and the Memphis Sand, respectively) since the 1920s. Groundwater withdrawals generally have increased while water levels generally have declined since monitoring was initiated. Since 1980, the USGS has produced reports, at various intervals, that describe groundwater conditions in the Sparta Sand and Memphis Sand aquifers in Arkansas. These reports are the products of a continuing project that includes the groundwater networks and basic data collection for Arkansas to provide information for the management of this valuable resource.

The study area (fig. 1) in Arkansas is bounded on the north by the Missouri State line, on the east by the Tennessee and Mississippi State lines, and on the south by the Louisiana State line. The western boundary is defined as the western extent of the outcrop and subcrop (Hosman, 1982) of the Sparta Sand and the Memphis Sand. Water levels in the aquifer in the Sparta Sand generally correlate with those in the aquifer in the Memphis Sand; therefore, the water-bearing formations are considered to be one hydrologic unit (Stanton, 1997).

Purpose and Scope

This report presents water-level and water-quality conditions in the aquifers in the Sparta Sand and the Memphis Sand in Arkansas. Herein, aquifers in the Sparta Sand and Memphis Sand will be referred to as the Sparta-Memphis aquifer. During the spring of 2009, water levels were measured in 324 wells completed in the Sparta-Memphis aquifer. These measurements were used to describe the potentiometric surface of the Sparta-Memphis aquifer. During the summer of 2009, 64 water-quality samples were collected and measured for specific conductance, temperature, and pH. This report presents a potentiometric-surface map, a water-level difference map comparing water levels from 2005 to 2009, selected water-level hydrographs, and a graph showing the distribution of specific conductance in samples.

Water Use

Water use in the Sparta-Memphis aquifer in Arkansas generally has increased from 1965 to 2000 (fig. 2). In 1965, water use in the Sparta-Memphis aquifer was about 112 million gallons per day (Mgal/d), increasing to 142 Mgal/d in 1970, 144 Mgal/d in 1975, and 185 Mgal/d in 1980 (Halberg, and Stephens, 1966; Halberg, 1972; Halberg, 1977; Holland and Ludwig, 1981). In 1985, water use declined to

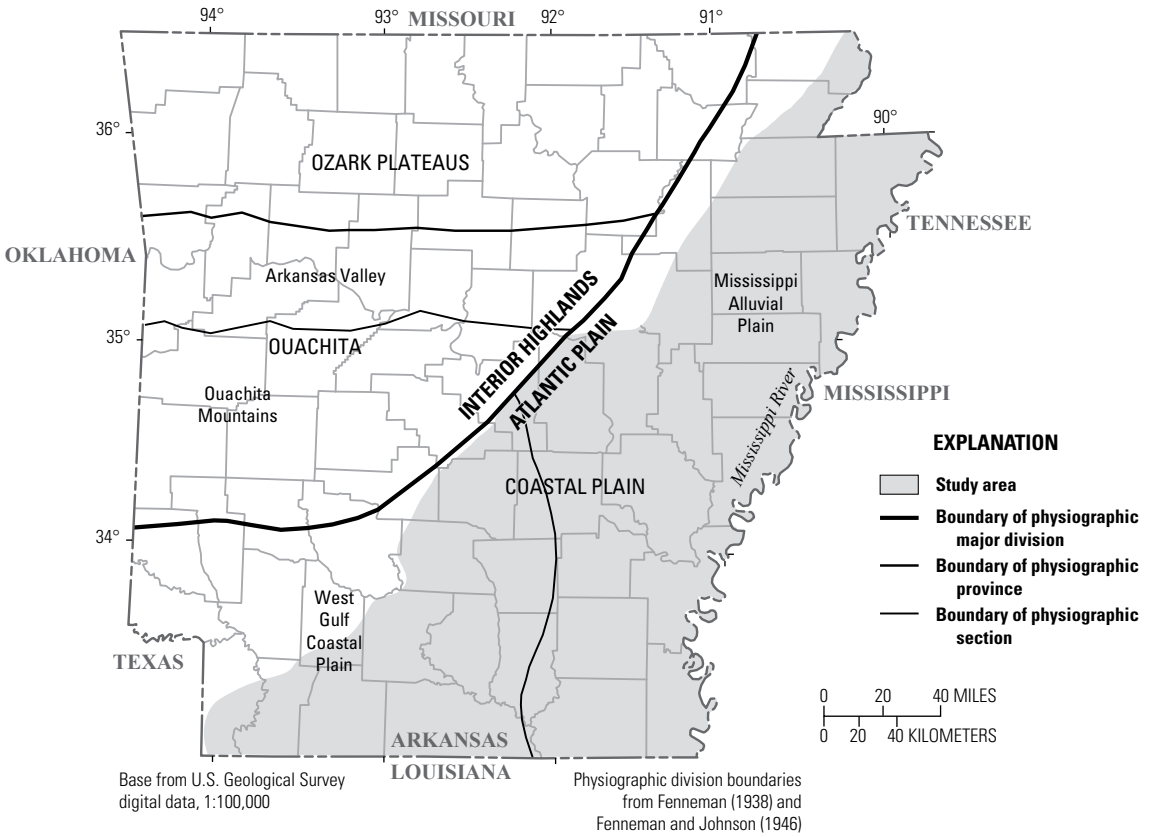

Figure 1. Location of study area.

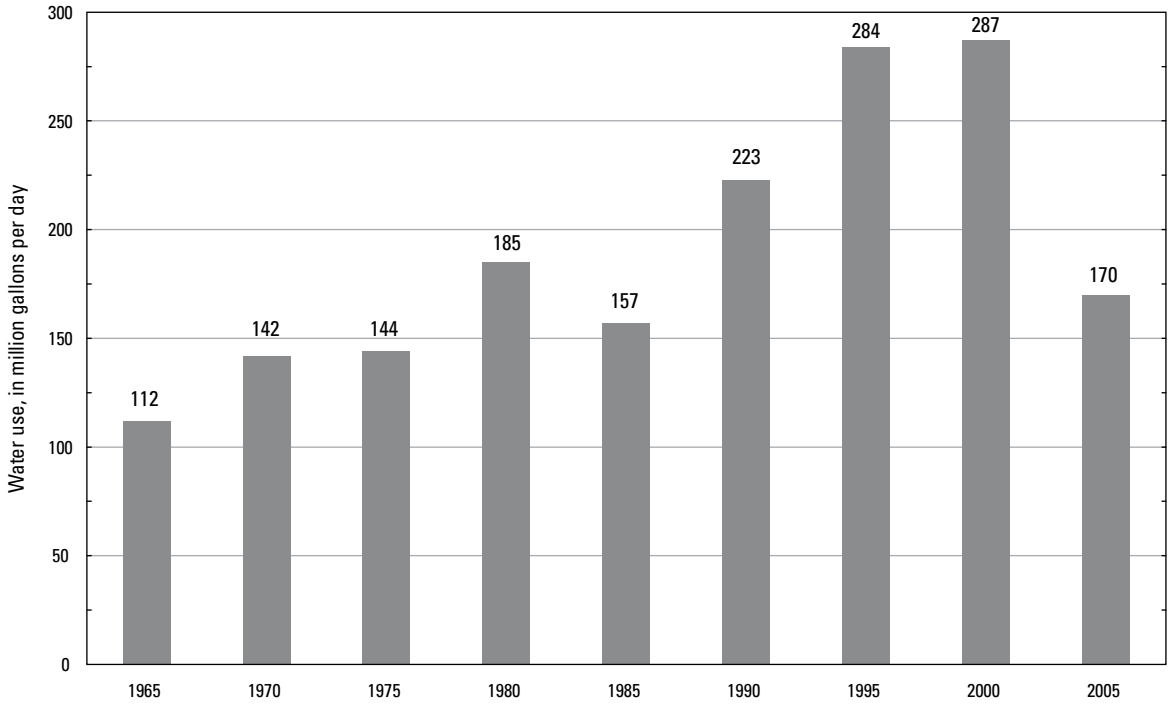

Figure 2. Water use in the Sparta-Memphis aquifer in Arkansas, 1965–2005.

about 157 Mgal/d (Holland, 1987). Water use in the Sparta-Memphis aquifer was about 223 Mgal/d in 1990 and 284 Mgal/d in 1995 (Holland, 1993, 1999). In 2000, water use in the Sparta-Memphis aquifer was about 287 Mgal/d (Holland, 2004), an increase of about 156 percent from 1965. In 2005, water use in the Sparta-Memphis aquifer declined to about 170 Mgal/d (Holland, 2007).

Water use from the Sparta-Memphis aquifer in 2005 was divided into three primary categories— irrigation, public supply, and industrial. Irrigation used about 61.0 Mgal/d (35.9 percent), public supply used about 58.9 Mgal/d (34.6 percent), and industrial used about 48.0 Mgal/d (28.2 percent). Agriculture and power generation each accounted for less than 1 percent of the water use in the Sparta-Memphis aquifer in Arkansas in 2005. Major pumping centers that use the Sparta-Memphis aquifer for public supply and industry occur in Columbia, Jefferson, and Union Counties. Arkansas, Craighead, Cross, Desha, Lonoke, Monroe, Phillips, and Prairie Counties accounted for the majority of the water withdrawn for irrigation from the Sparta-Memphis aquifer in 2005 (Holland, 2007).

Well-Numbering System

The well-numbering system used in this report is based upon the Federal land survey used in Arkansas. The component parts of a well number are the township designation; the range designation; the section number; three-letter designation that indicates, respectively, the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section in which the well is located; and the sequence number of the well in the quarter-quarter-quarter section. The letters are assigned counterclockwise, beginning with "A" in the northeast quarter or quarter-quarter or quarter-quarter-quarter section in which the well is located. For example, well 01S03W04BBD16 (fig. 3) is located in Township 1 South, Range 3 West, in the southeast quarter of the northwest quarter of the northwest quarter of section 4. This well is the 16th well in this quarter-quarter-quarter section of section 4 from which data were collected.

Methods

USGS and ANRC personnel measured water levels from March to May 2009 from wells completed in the Sparta-Memphis aquifer. Measurements were made using steel or electric tapes graduated in hundredths of a foot. The steel and electric tapes were calibrated prior to collecting water-level measurements. Calibration was performed by comparing the steel or electric tapes to a standardized steel tape used only for calibration.

Well locations were verified using Global Positioning System (GPS) receivers to acquire the horizontal-coordinate information, latitude and longitude, based on the North American Datum of 1983. The latitude and longitude of the wells in Arkansas were recorded from a GPS receiver

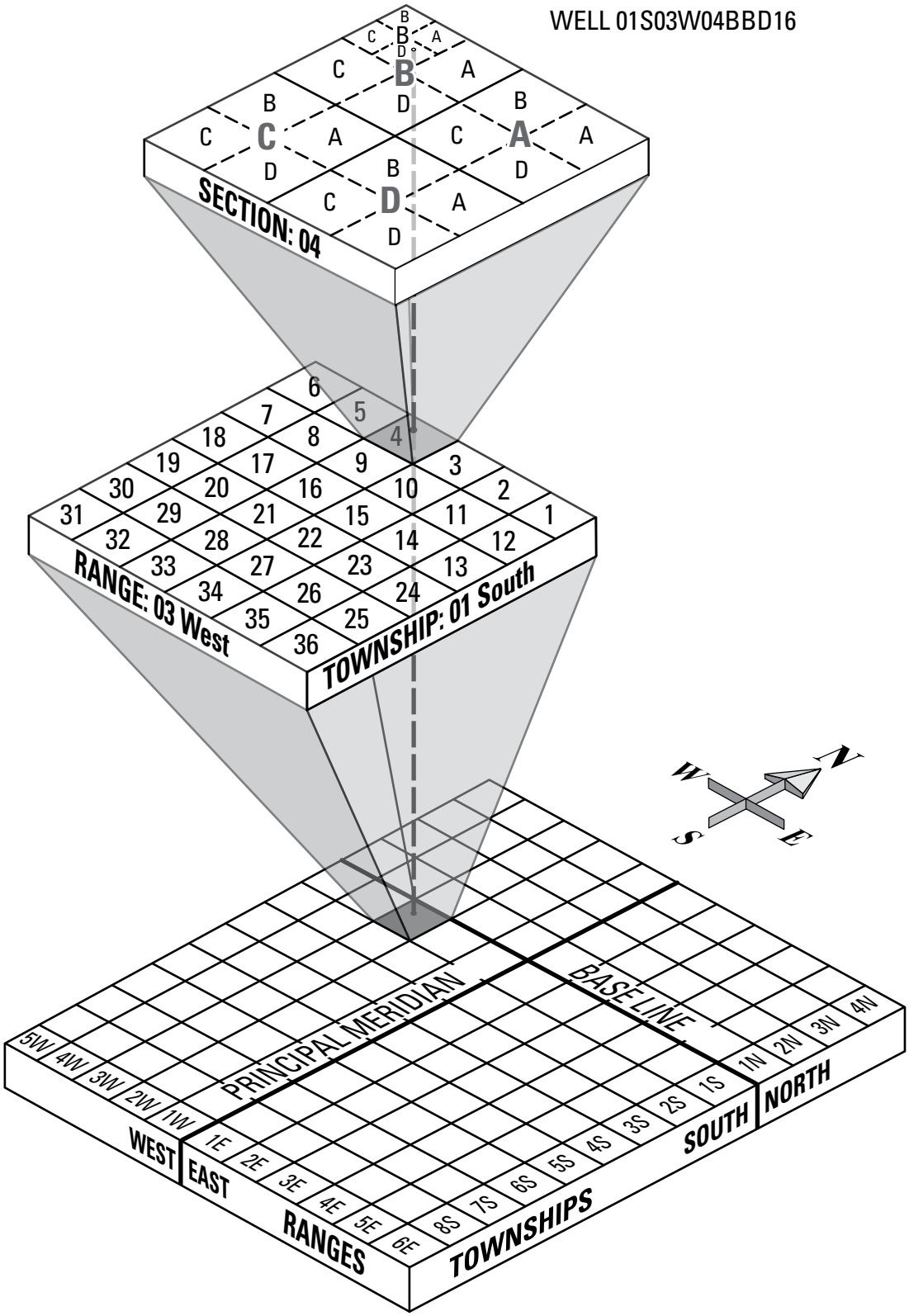

Figure 3. Well-numbering system.

accurate to one-tenth of a second of latitude and longitude (approximately 10–20 feet (ft)). The latitude and longitude of each well were transferred to topographic maps and the altitude of each well (National Geodetic Vertical Datum of 1929 [NGVD 29]) was determined from the topographic contours at the location on the map. Altitude is accurate to about 2.5 to 5 ft, or half the contour interval on the map.

Two methods for calculating the annual rise or decline of water levels are used. One method is to take the difference between the final and initial water levels and divide by the period of time. This method uses two measurements and calculated values are dependent solely on the final and initial water levels. A second method uses the linear regression of water levels and time of measurement to calculate the annual rise or decline in water level. Linear regression is more robust because it includes all the measurements to determine the trend line, resulting in a value that is dependent on all water levels during the period of record. The slope, β, of the line is the annual rise or decline in water level. The intercept, β_0, would be the water level in the year 1900, the origin for the graph. The predevelopment water level will not be discussed as this condition cannot be demonstrated. The R^2 term is the coefficient of determination, the correlation coefficient, or the fraction of variance explained by the regression. The R^2 value gives the proportions of the total variability that can be accounted by the independent variable (Helsel and Hirsch, 1992). Values of R^2 can range from 0.00 to 1.00. A large value of R^2 can indicate a linear change in water level. A low value of R^2 can indicate a sporadic change in water level. The equation of the regression line or line of best fit, Y = aX+b, may be written as:

$$h = \beta t + \beta_0$$

where

h is water level altitude, in feet;
β is the slope of the line, in feet per year;
t is time, in years; and
β_0 is the y-intercept or water-level altitude at time equal to 1,900, in feet.

Five assumptions are associated with linear regression: (1) Y is linearly related to X, (2) data used to fit the linear regression are representative of data of interest, (3) variance of the residuals is constant and does not depend on X or on anything else, (4) the residuals are independent, and (5) the residuals are normally distributed. The assumption of a normal distribution is involved only when testing hypotheses, requiring the residuals from the regression equation to be normally distributed (Helsel and Hirsch, 1992).

Water-quality samples were collected for specific conductance, temperature, and pH using the procedures described in the National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated). Wells were purged a minimum of three-casing volumes, and specific conductance, temperature, and pH were monitored until measurements stabilized (Fishman and Friedman, 1989). Casing volumes for the wells were calculated from the well casing diameter, depth to water, and well depth. The cross-sectional area of the casing is calculated from the casing diameter, and the height of the water column is determined by subtracting the depth to water from the well depth. The area and the height of the water column are multiplied for a casing volume in cubic feet, then converted to gallons. The calculated purge volume at each well was then divided by the pumping rate to determine the minimum pumping time for purging. Pumping rates ranged from 100 to 550 gallons per minute.

Specific conductance and pH were measured from selected wells using a specific-conductance and pH meter with temperature compensation. The specific-conductance and pH meter was calibrated twice daily by comparing the measurement of two specific conductance calibration standards. Specific conductance is a measure of the electrical conductance of a solution. As the dissolved-solids concentration in groundwater increases, specific conductance increases. Most of the wells sampled were public supply and industrial wells.

Sparta-Memphis Aquifer

The Sparta Sand and Memphis Sand (table 1) of Eocene age mainly consist of fine to medium sand in Arkansas with some silt, clay, and lignite in the upper parts. Sands in the Sparta Sand were deposited by shifting streams on a deltaic-fluvial flood plain (Payne, 1968). These sands mostly are interconnected, but separately identifiable sands can be traced for short distances (Snider and others, 1972). The Cook Mountain Formation of Claiborne Group overlies the Sparta Sand and Memphis Sand and serves as an upper confining unit (table 1). The permeable units of the Sparta Sand and the Memphis Sand compose the Sparta and Memphis aquifers.

The Sparta Sand is composed of a sequence of alternating sand and clay beds between the massive clays of the overlying Cook Mountain Formation and the underlying Cane River Formation of Claiborne Group confining units (Hosman and others, 1968) shown in table 1. The Sparta Sand is in the southern part of the study area (south of about 35 degrees latitude, pl. 1) where the Cane River Formation is composed predominantly of clay. The Memphis Sand is in the northern part of the study area (north of about 35 degrees latitude) where the Cane River Formation or equivalent facies is composed predominantly of sand. Moving south to north in the area, the Cane River Formation undergoes a facies change northward at about 35 degrees latitude, and the marine clays become sand. The transitional zone of interfingering sands and clays is narrow. The northern sand facies of the Cane River Formation is the middle part of the Memphis Sand (Hosman and others, 1968). In the southern area, the Claiborne Group is subdivided into the Carrizo Sand, Cane River Formation, Sparta Sand, Cook Mountain Formation, and the Cockfield

Table 1. Stratigraphic correlation in the northern and southern parts of Arkansas.

[Table constructed from Petersen, Broom, and Bush, 1985; Scheiderer and others, 2008]

Series	Group	Formations in the south part of Arkansas	Formations in the north part of Arkansas	Hydrogeological units	
Eocene	Jackson	Undifferentiated	Undifferentiated	Vicksburg-Jackson confining unit	
	Claiborne	Cockfield Formation	Cockfield Formation	Upper Claiborne aquifer	
		Cook Mountain Formation	Cook Mountain Formation	Middle Claiborne confining unit	
		Sparta Sand	Memphis Sand	Middle Claiborne aquifer (Sparta-Memphis)	
		Cane River Formation		Lower Claiborne confining unit	
		Carrizo Sand		Lower Claiborne aquifer	
Paleocene	Wilcox	Wilcox Group	Wilcox Group	Lower Wilcox aquifer	
	Midway	Undifferentiated	Undifferentiated	Midway confining unit	

Formation (table 1). The equivalent section in the northern area is subdivided into the Memphis Sand, the Cook Mountain Formation, and the Cockfield Formation. The Memphis Sand in the northern area is equivalent to the Carrizo Sand, the Cane River Formation, and the Sparta Sand in the southern area. The Memphis Sand is underlain by a thick layer of clay in the upper part of the Wilcox Group (Hosman and others, 1968).

The Sparta Sand and Memphis Sand generally thicken and groundwater increases in salinity as depth increases to the southeast. The Sparta Sand is 50 to 200 ft thick within the outcrop area (along the western limit) and thickens easterly to nearly 900 ft. The Sparta Sand contains freshwater throughout most of its extent in Arkansas. However, saltwater is present in the extreme southeastern part of the State in parts of Ashley, Chicot, and Union Counties (Payne, 1968).

Water Levels

Water-level measurements in wells screened in the Sparta-Memphis aquifer (appendix 1) were used to produce a regional potentiometric-surface map (pl. 1), water-level difference map (pl. 2), and hydrographs (fig. 4). Water levels measured during the spring of 2009 were subtracted from water levels measured during the spring of 2005 at selected Sparta-Memphis aquifer wells and used to create the water-level difference map (pl. 2). Hydrographs were generated for 206 wells (that have water-level measurements with a minimum 25-year period of record, with one exception at well 04S05W05ACC1 in Arkansas County that is a continuous well with 3 years of data) and compiled by county; hydrographs for 29 of the wells are shown in figure 4. The water levels shown in the hydrographs indicate long-term changes in hydrologic conditions. Long term water-level declines shown in the hydrographs reflect the response of the groundwater flow system to stresses caused by groundwater pumping.

Potentiometric-Surface Map

A potentiometric-surface map was constructed using 324 water-level measurements (appendix 1) from wells completed in the Sparta-Memphis aquifer during spring 2009. Hydrologic principles, water-use data, and historical information were used in conjunction with the water-level data to delineate the potentiometric-surface contours. The number and location of wells used to construct potentiometric-surface maps differ from year to year.

The potentiometric-surface map of the Sparta-Memphis aquifer shows the altitude at which water would have stood in tightly cased wells completed in the aquifer (pl. 1). The surface is mapped by determining the altitude of the water levels measured in the wells and is represented on the map by contours that connect points of equal water-level altitude. The general direction of groundwater flow in the Sparta-Memphis aquifer is perpendicular to the contours in the direction of decreasing hydraulic gradient.

The regional direction of groundwater flow in the Sparta-Memphis aquifer is generally to the south-southeast in the northern half of Arkansas and to the east and south in the southern half of Arkansas, away from the outcrop area except where affected by large depressions. The direction of groundwater flow in 2009 is towards each of three large depressions. The first depression is located in western Cross and Poinsett Counties in the northern half of the study area, the second is in Arkansas, Jefferson, and Lincoln Counties in the center of the study area, and the third is in Union County in the southern part of the study area. Parts of the study area not affected by these three depressions exhibit a regional direction of groundwater flow to the east and south, away from the outcrop area. The highest water-level altitude measured in Sparta-Memphis aquifer was 325 ft above NGVD 29, located in Grant County in the outcrop at the western boundary of the study area; the lowest water-level

altitude was 157 ft below NGVD 29 in Union County near the southern boundary of the study area. The water-level altitude in this well in Union County was 28 ft higher than in 2005 (Schrader, 2006).

Eight depressions (represented by closed contours) are located in the following counties: Bradley; Ashley; Calhoun; Cleveland; Columbia; Arkansas, Jefferson, Lincoln, and Prairie; Cross and Poinsett; and Union. Depressions usually are caused by withdrawal rates that exceed recharge rates within the aquifer over an extended period of time. When a well is pumped, the water level in and around the well declines, creating a depression in the potentiometric surface. Groundwater flows toward the depression at a rate that is proportional to the slope of the depression and the transmissivity of the aquifer. If withdrawal rates exceed recharge rates to the aquifer, the area of the declining water level expands to form a depression.

Two large depressions, centered in Jefferson and Union Counties, are the result of large withdrawals for industrial, irrigation, or public supply. The depression centered in Jefferson County has deepened and expanded in recent years into Arkansas and Prairie Counties as a result of large withdrawals for irrigation and public supply. The lowest water-level altitude measured in this depression is approximately 3 ft higher in 2009 than in 2007 (Schrader, 2009). The area enclosed within the 40-ft contour on the 2009 potentiometric-surface map has expanded south to the Drew County line and moved west from the intersection of Arkansas, Jefferson, and Lincoln Counties when compared with the 2007 potentiometric-surface map (Schrader, 2009). To the north, east, and west, the location of the 40-ft contour is comparable to the 2007 potentiometric-surface map (Schrader, 2009). The area of 40-ft contour is about the same on the 2009 and 2007 potentiometric-surface maps (Schrader, 2009).

The depression in Union County is roughly circular within the -60-ft contour. The lowest water-level altitude measurement was 161 ft below NGVD 29 in 2007 (Schrader, 2009), with a 4-ft rise to 157 ft below NGVD 29 in 2009. In 2003, this depression was elongated east and west and beginning to coalesce with the depression in Columbia County (Schrader, 2006). Decreasing withdrawals in Columbia and Union Counties have resulted in a separation of these two depressions. The depression in Union County has diminished and encloses a smaller area than in recent years. The lowest water-level altitude measurement during 2009 in the center of the depression in Union County, represents a rise of 42 ft since 2003 (Schrader, 2006). The location of the lowest water-level altitude can vary through time. Changes in pumping rates and well efficiency can affect the location of the lowest water-level altitude. The lowest water-level altitude measurement in 2009 is from a different well than the lowest water-level altitude measurement in 2003 (Schrader, 2006). The area enclosed by the lowest altitude contour, 140 ft below NGVD 29, on the 2009 potentiometric-surface map is about half the area enclosed by that same contour on the 2007 potentiometric-surface map (Schrader, 2009). On the 2007 potentiometric-surface map (Schrader, 2009), the lowest altitude contour, 160 ft below NGVD 29, is not present on the 2009 potentiometric-surface map. Since 2001, the depression in Union County has receded from Union Parish, Louisiana. The -100-ft contour had extended into Union Parish on the 2001 potentiometric-surface map (Schrader, 2004). The -60-ft contour on the 2009 potentiometric-surface map is near the Arkansas-Louisiana State border. A broad depression in western Poinsett and Cross Counties was first shown in the 1995 potentiometric-surface map (Stanton, 1997) and has both increased and decreased in size since 1995. The depression expanded in area in 1997 and 1999 and then decreased in area in 2003 and 2005. In 1997, the depression covered most of the western half of Poinsett County (Joseph, 1998). In 1999, the 150-ft contour of the depression extended from Poinsett County through Cross County into St. Francis County (Joseph, 2000; Schrader, 2004). In 2003, the depression covered most of the western half of Poinsett County (Schrader, 2006). In 2005, the depression covered part of western Poinsett County and extended into northwestern Cross County. In 2007, the 140-ft contour expanded north to the Poinsett-Craighead County line, further east, and the farthest extent south into Cross County (Schrader and Jones, 2007). In 2009, the 140-ft contour has extended south across Cross County about two-thirds of the distance to the St. Francis County line. The lowest water-level altitude measurement in this depression, 131 ft above NGVD 29, is 3 ft lower than in 2007.

Unlike other depressions in the Sparta-Memphis aquifer, the depression in Poinsett and Cross Counties primarily is caused by withdrawals for irrigation, instead of withdrawals for public supply and industrial uses. The Mississippi Embayment Regional Aquifer Study project has identified an area in Poinsett and Cross Counties where the Sparta-Memphis aquifer and the Mississippi River Valley alluvial aquifer (herein referred to as the alluvial aquifer) are hydrologically connected. Borehole geophysical logs show that the Jackson Group, the unit that underlies the alluvial aquifer; the Cockfield Formation of Claiborne Group; and the Cook Mountain Formation of Claiborne Group, the unit that confines the Sparta-Memphis aquifer, are absent in this area (Hart and others, 2008). Irrigation withdrawals from the alluvial aquifer have resulted in water-level declines in the Sparta-Memphis aquifer (Schrader, 2008).

Five other depressions are shown on the 2009 potentiometric surface. The depression in Columbia County was first shown on the 1996–97 potentiometric-surface map (Joseph, 1998). In 2009, the area has decreased, with water levels rising about 3 ft since 2005 in the well with the lowest water-level altitude measurement. The depression in Calhoun County was first shown on the 1999 potentiometric-surface map (Joseph, 2000). The area and depth remained reasonably consistent from 2001 to 2005 (Schrader, 2004, 2006; Schrader and Jones, 2007), but the depression expanded and deepened in 2007 (Schrader, 2009). In 2009, the area and depth are about the same as in 2007. The depressions in Bradley and Ashley Counties were first shown in 2007 (Schrader, 2009). In 2009, this depression has separated into two small depressions in Bradley and Ashley Counties. The depression in Cleveland County was first shown in 2003 (Schrader, 2006). This depression has deepened from 24 to 17 ft above NGVD 29 from 2003 to 2009.

Water-Level Difference from 2005 to 2009

A water-level difference map (pl. 2) was constructed using the difference between water-level measurements made during 2005 and 2009 at 309 wells (appendix 2). The difference in water levels was calculated by subtracting the 2009 depth-to-water level from the 2005 depth-to-water level. Negative values shown on plate 2 indicate a decline and positive values indicate a rise in water level. Rises in water level are indicated on plate 2 with blue triangles pointing upward; declines in water level are indicated with red triangles pointing downward. Triangles are scaled to the relative value of the rise or decline. Water-level differences do not necessarily indicate a long-term water-level trend, but are intended to show where water levels have increased or decreased from 2005 to 2009.

The differences in water level between 2005 and 2009 ranged from -74.6 to 60.2 ft, with a mean of -1.1 ft. The largest measured rise (60.2 ft) in water level was in Union County. The largest measured decline (-74.6 ft) in water level was in Columbia County. Areas with a general rise in water levels include central Columbia County, southern Jefferson County, and most of Union County (pl. 2). The inset map on plate 2 shows a more detailed view of part of Union County. In the area around west-central Union County (pl. 2), water levels in 18 wells rose 20 ft or more, with an average annual rise of 5 ft or more. The rising water levels in west-central Union County coincide with water conservation measures initiated in 1999 and the conversion of large industrial water users from groundwater to surface water from the Ouachita River beginning in December 2004 (Freiwald and Johnson, 2008). Water levels generally declined throughout most of the Sparta-Memphis aquifer.

Long-Term Hydrographs

Hydrographs from 206 wells with a minimum of 25 years of water-level measurements were constructed. Selected hydrographs are shown in figure 4 with locations indicated on plate 1. The well 04S05W05ACC1 in Arkansas County has only 3 years of continuous data and has been included for additional discussion. The data for well 04S05W05ACC1 has not been included in the statistical summary for Arkansas County. The minimum 25-year period of record is used to evaluate long-term trends not dominated by variations in climate and localized pumping rates on water levels in a single well. A trend line using linear regression was calculated for the period from 1985 to 2009 to determine the slope in feet per year (ft/yr) for water levels in each well. The slope of the trend line represents the typical annual decline or rise in water level during the 25-year period. A statistical summary of the number of wells, the range, mean, and median of the annual rise or decline in water level, and the range of the R^2 values for each county is listed in table 2. Negative values denote a decline in water level.

During the period 1985–2009, county mean annual water levels generally declined. The county mean annual water level rose in Calhoun, Columbia, Lafayette, and Union Counties (table 2) about 1.3 ft/yr, 0.2 ft/yr, 0.1 ft/yr, and 0.6 ft/yr, respectively. In Union County, 2009 is the first year that the county mean has shown a rise since the county hydrograph analysis of water-level rise or decline was first used in 1996–97 (Joseph, 1998). Mean annual declines were between 0.5 ft/yr and 0.0 ft/yr in Ashley, Cleveland, Crittenden, Dallas, Grant, Monroe, Nevada, Ouachita, Phillips, St. Francis, and Woodruff Counties. Mean annual declines were between 1.0 ft/yr and 0.5 ft/yr in Craighead, Desha, Drew, Lonoke, Mississippi, and Pulaski Counties. Mean annual declines were between 1.5 ft/yr and 1.0 ft/yr in Arkansas, Bradley, Cross, Jefferson, Lee, Poinsett, and Prairie Counties. The mean annual decline for Lincoln County was 2.3 ft/yr. The data set for Lincoln County wells was skewed by a single well having an annual decline of 4.6 ft/yr. The median annual decline for Lincoln County was about 1.6 ft/yr.

Water levels in the Sparta-Memphis aquifer may change substantially throughout the year. In western Arkansas County, hydrograph B (pl. 1, fig. 4) shows 3 years of daily water levels. In September 2006, a transducer was installed at this site to collect hourly water levels. These data are transmitted four times a day for display on the USGS water data Web site (http://waterdata.usgs.gov). The hydrograph shows about a 60-ft seasonal change in water level for both years shown. The period of the 60-ft decline in water level coincides with the spring-summer irrigation season.

Water-Quality Conditions

Water samples were collected in the summer of 2009 from 64 wells completed in the Sparta-Memphis aquifer and measured onsite for specific conductance, temperature, and pH (appendix 3). Although there is a regional increase in specific conductance to the east and south, anomalous increases occur in some parts of the study area. Specific conductance ranged from 43 microsiemens per centimeter at 25 degrees Celsius (µS/cm) in Ouachita County to 1,230 µS/cm in Phillips County. Relatively large specific conductance values (greater than 700 µS/cm) occur in samples from wells in Arkansas, Ashley, Monroe, Phillips, and Union Counties. Morris and Bush (1986) and Broom and others (1984) cited upward leakage of saltwater from the Nacatoch Formation of Cretaceous age into the Sparta aquifer through a fault or abandoned oil and gas wells as possible explanations for these anomalies. Large specific conductance values occur near the water-level depression (pl. 1) in Union County and increase eastward toward Ashley County. This increase in specific conductance may be because of leakage of water with greater conductance from an underlying aquifer. Several specific-conductance values greater than 2,000 µS/cm for groundwater from the Sparta aquifer in Union County have been documented (Broom and others, 1984).

Specific conductance values from samples collected in 2009 and 2005 generally were less than 400 µS/cm. The histograms of specific conductance data for 2009 (64 samples), and 2005 (60 samples) are shown in figure 5 (Schrader, 2007). The mean specific conductance was 392 µS/cm in 2009 and 362 µS/cm in 2005. Both histograms have a right skew. The largest category for both years is the 201–400 µS/cm range. The 201–400 µS/cm range included 53 percent of the samples in 2009 and 38 percent of the samples in 2005. The lowest range, 1–200 µS/cm, decreased from 33 percent of the samples in 2005 to 14 percent of the samples in 2009. The small change in the mean specific conductance and the distribution of data from 2005 to 2009 may indicate a change in water quality or be the result of the distribution of sampling locations.

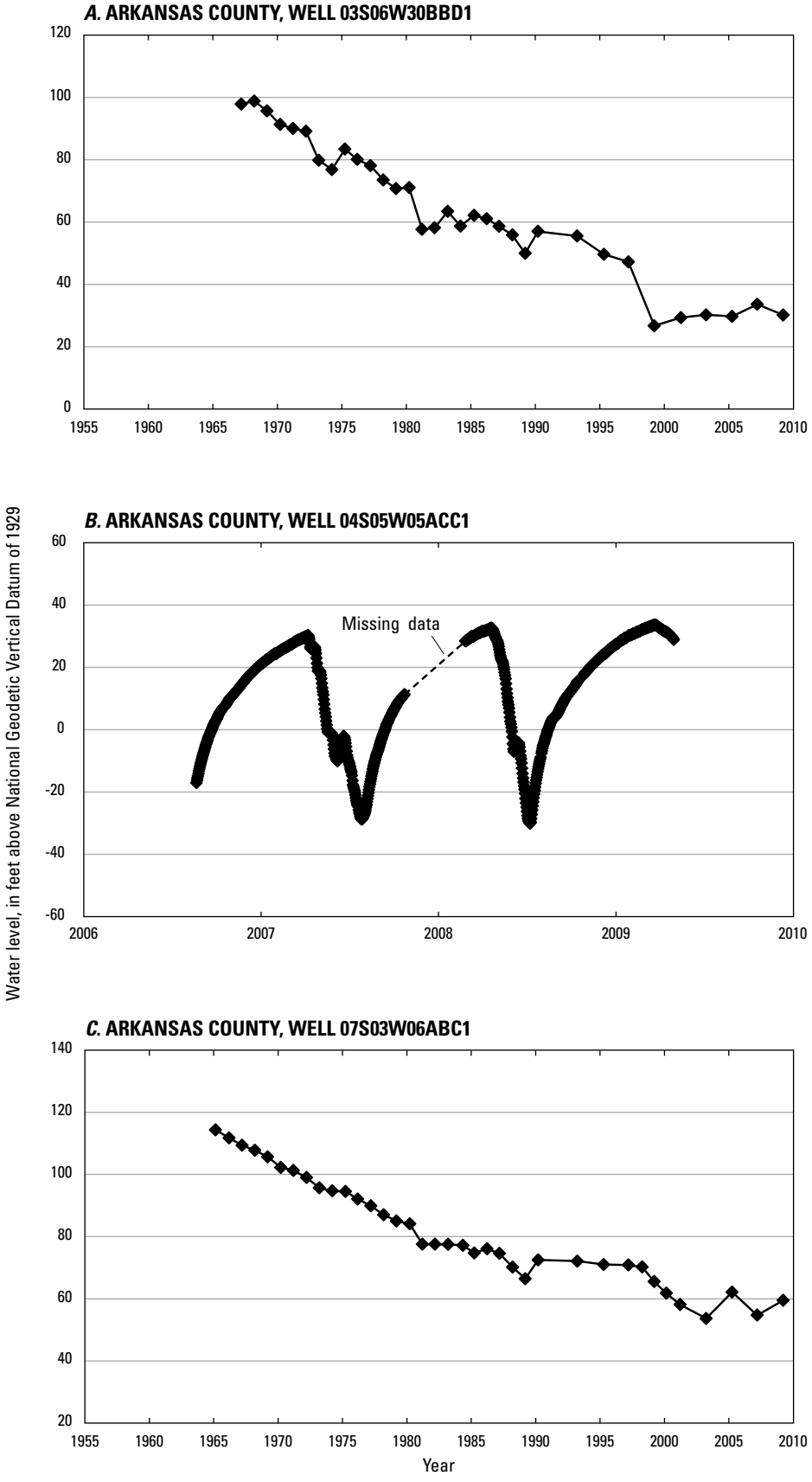

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.

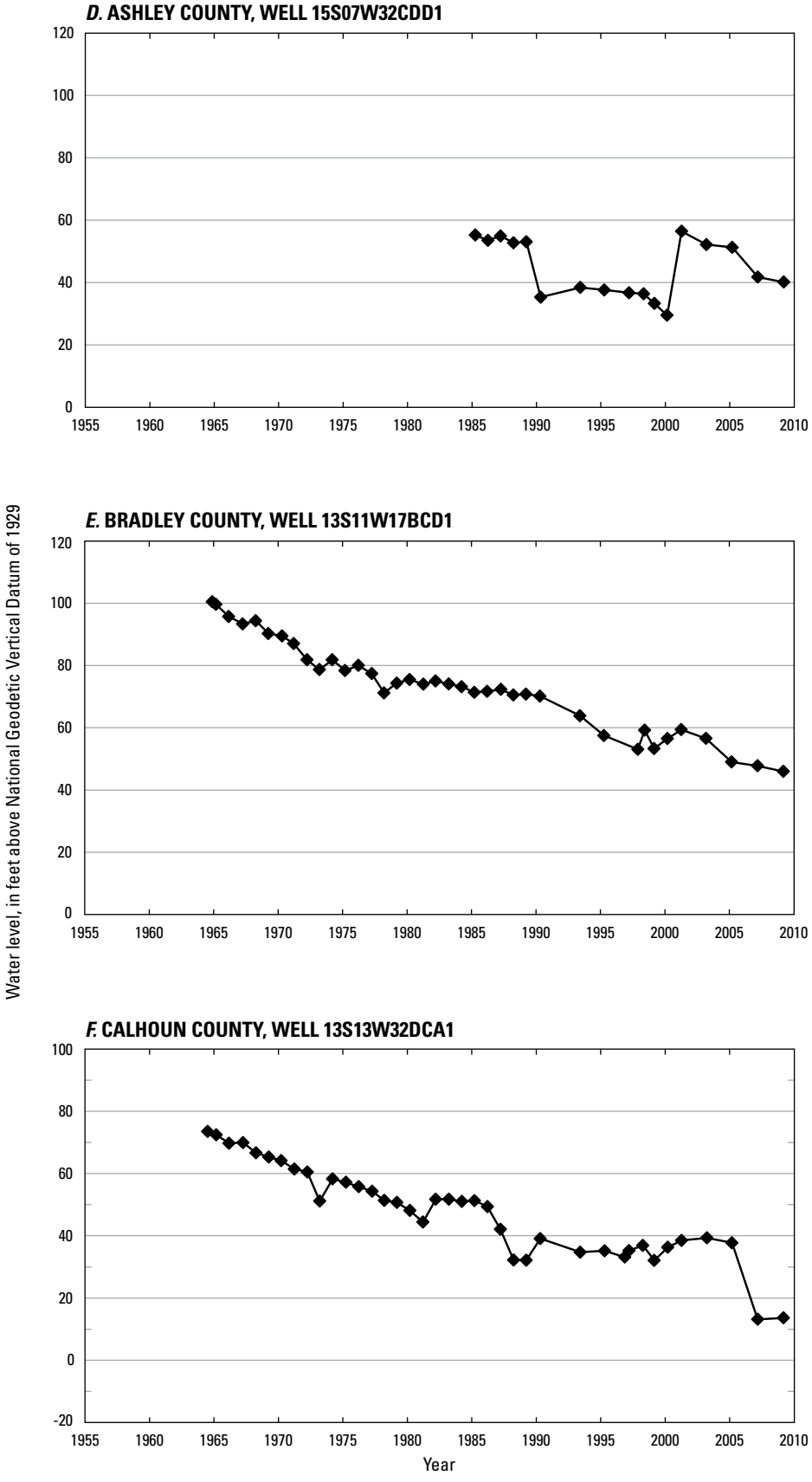

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

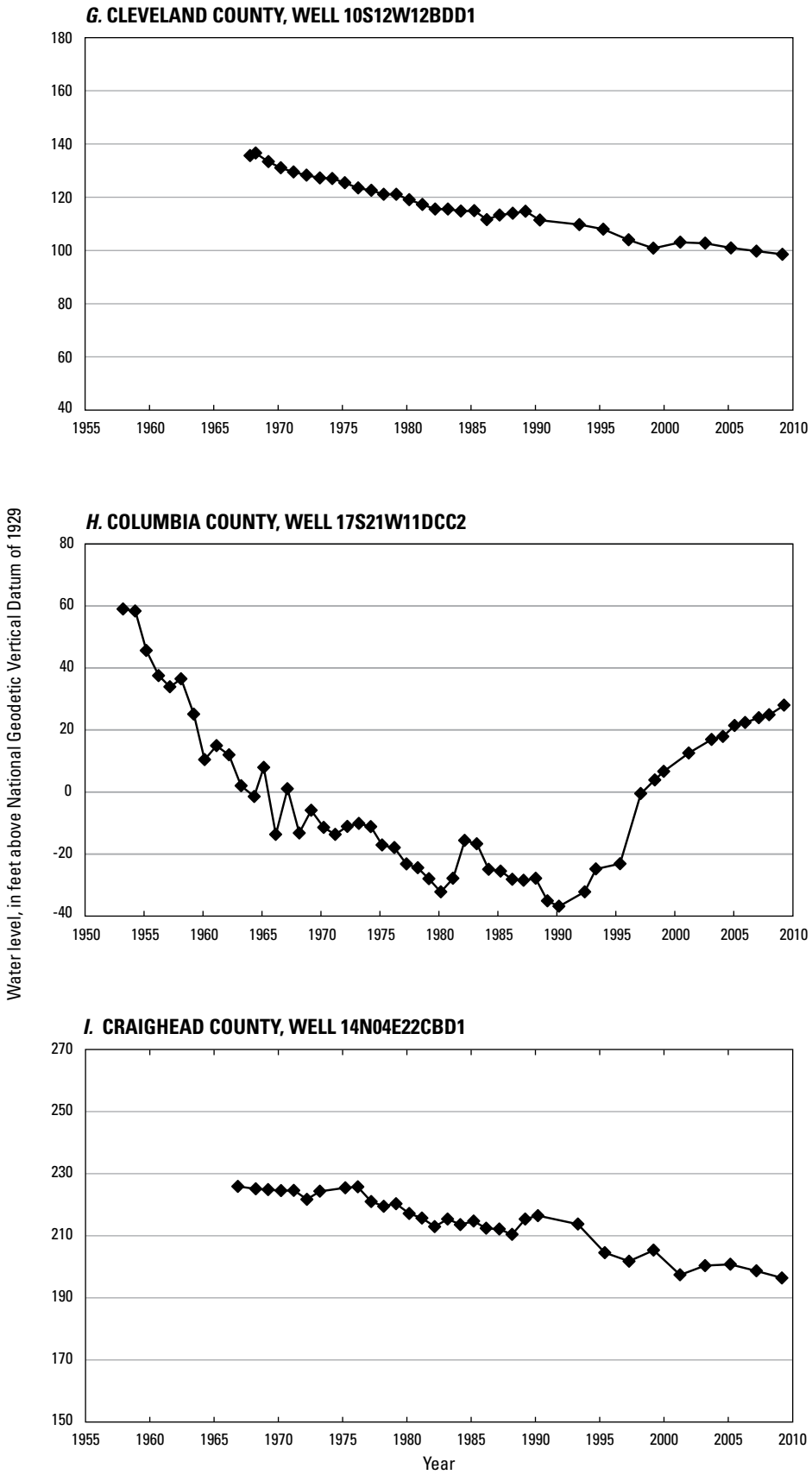

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

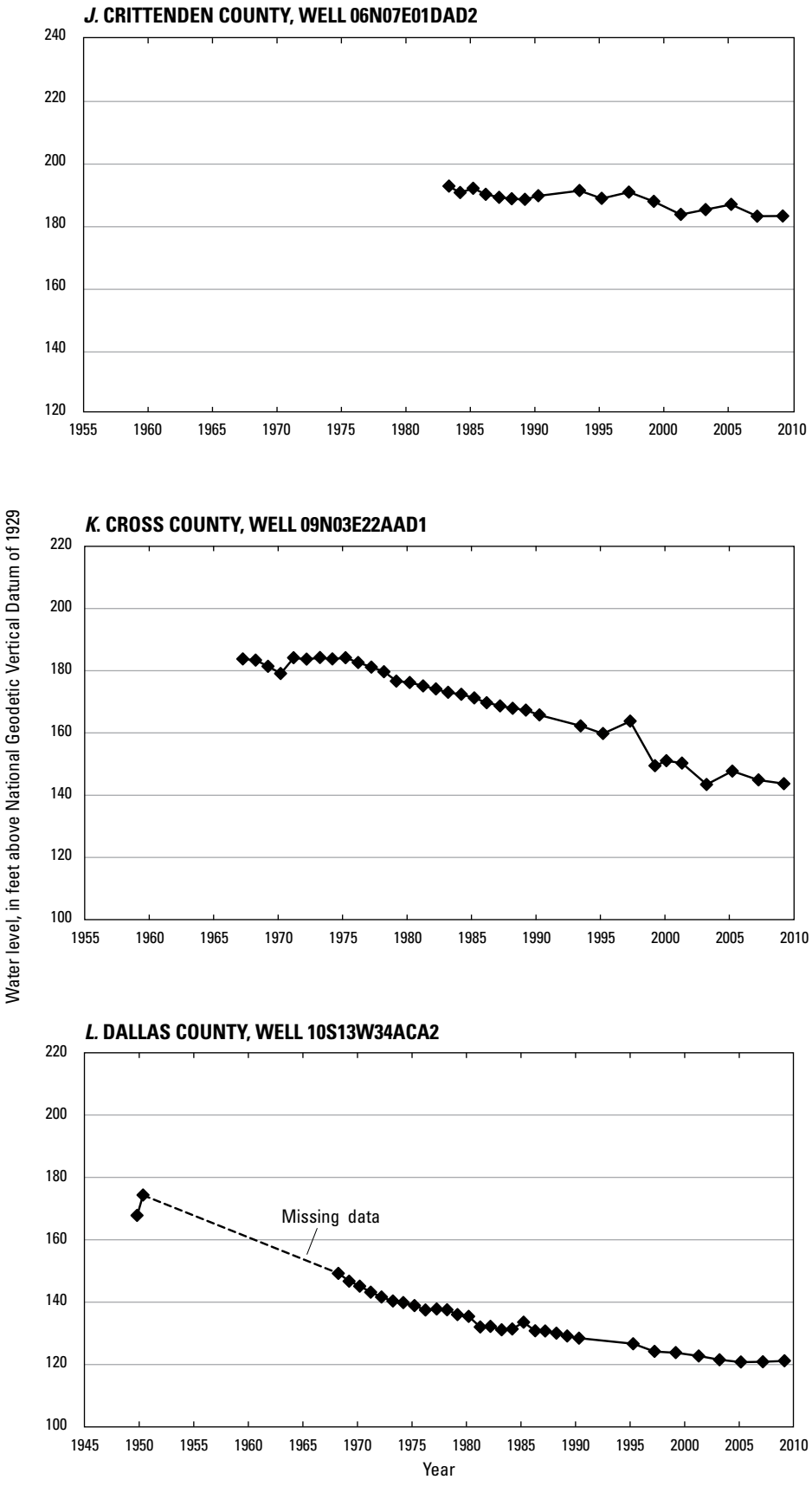

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

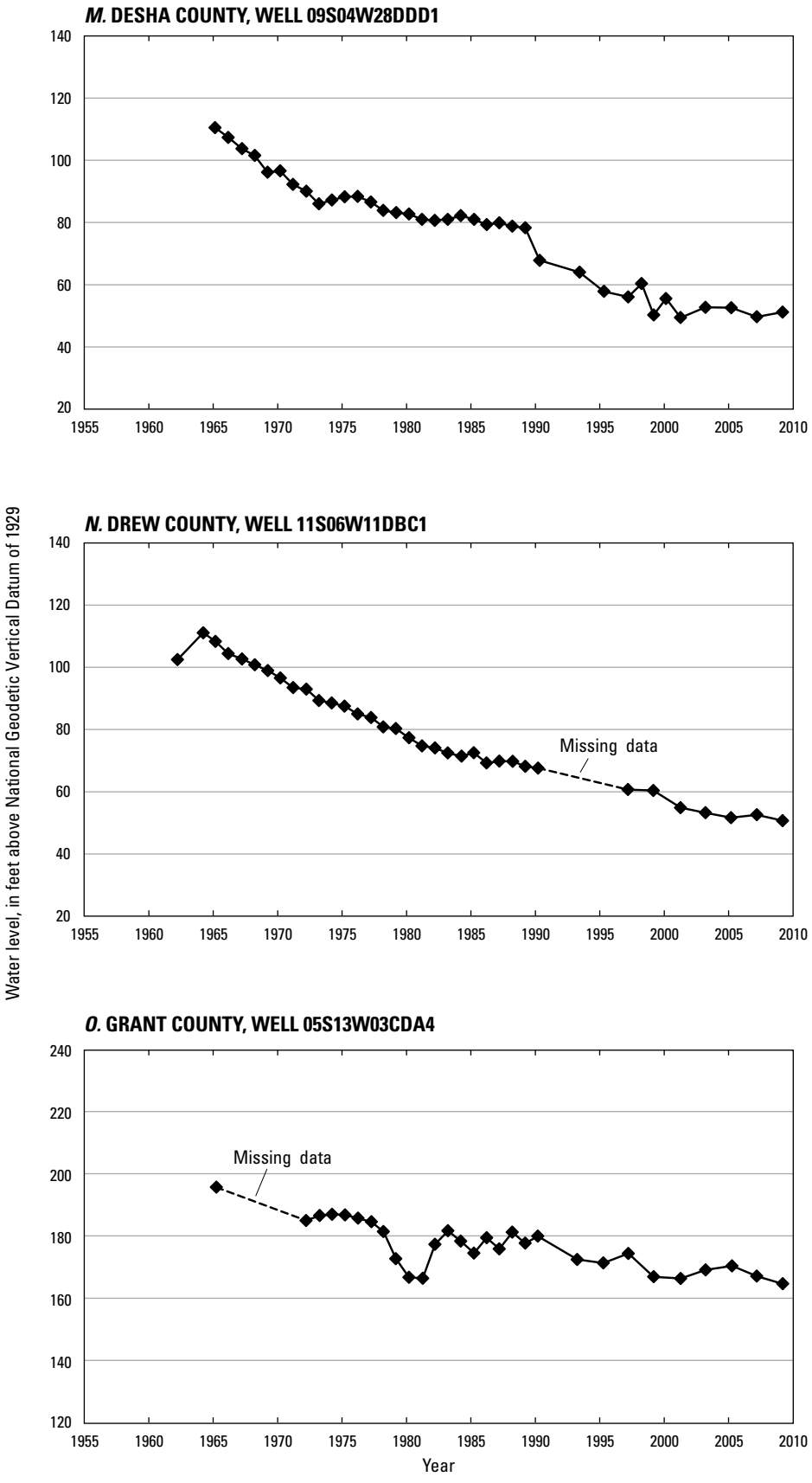

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

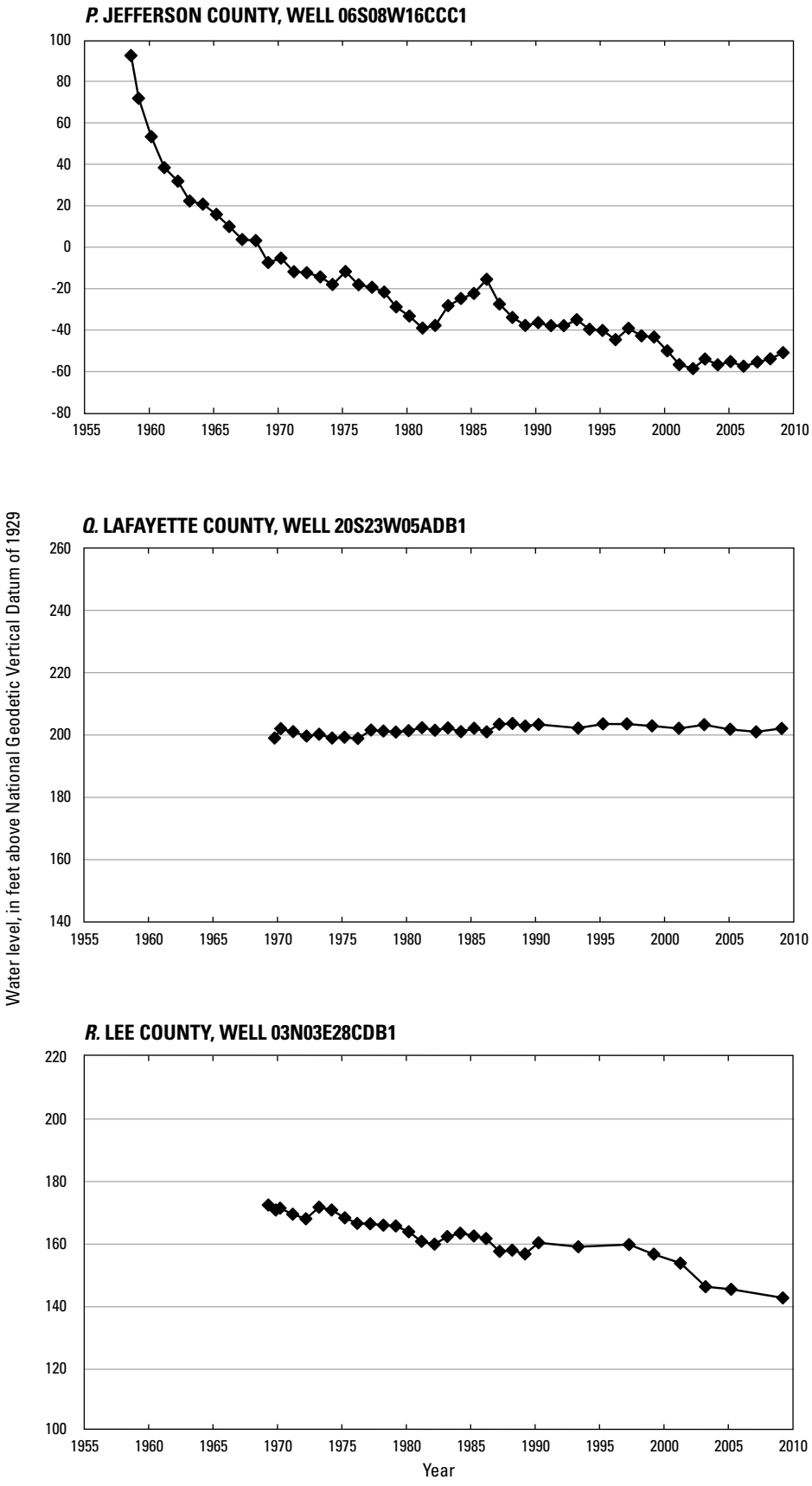

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

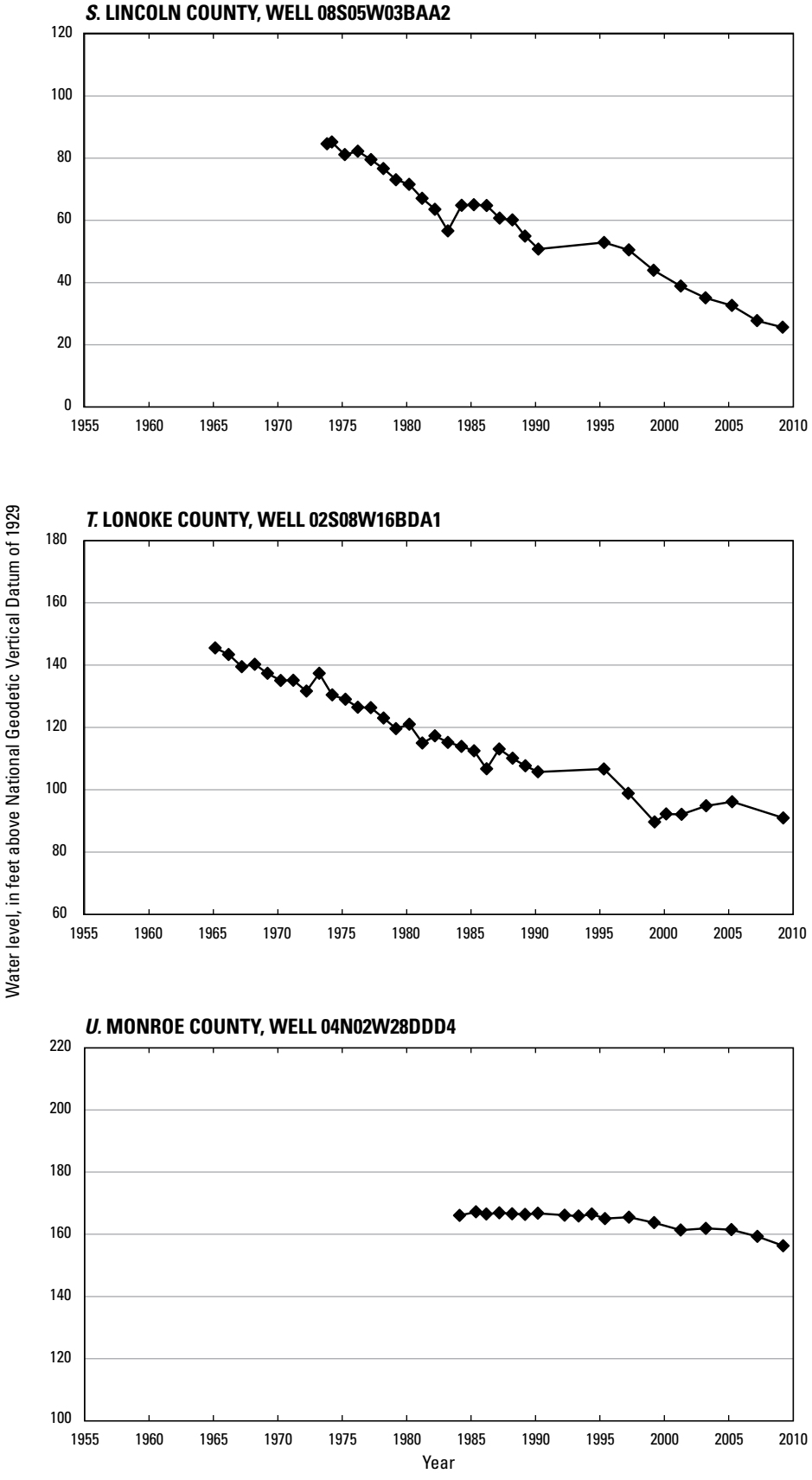

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

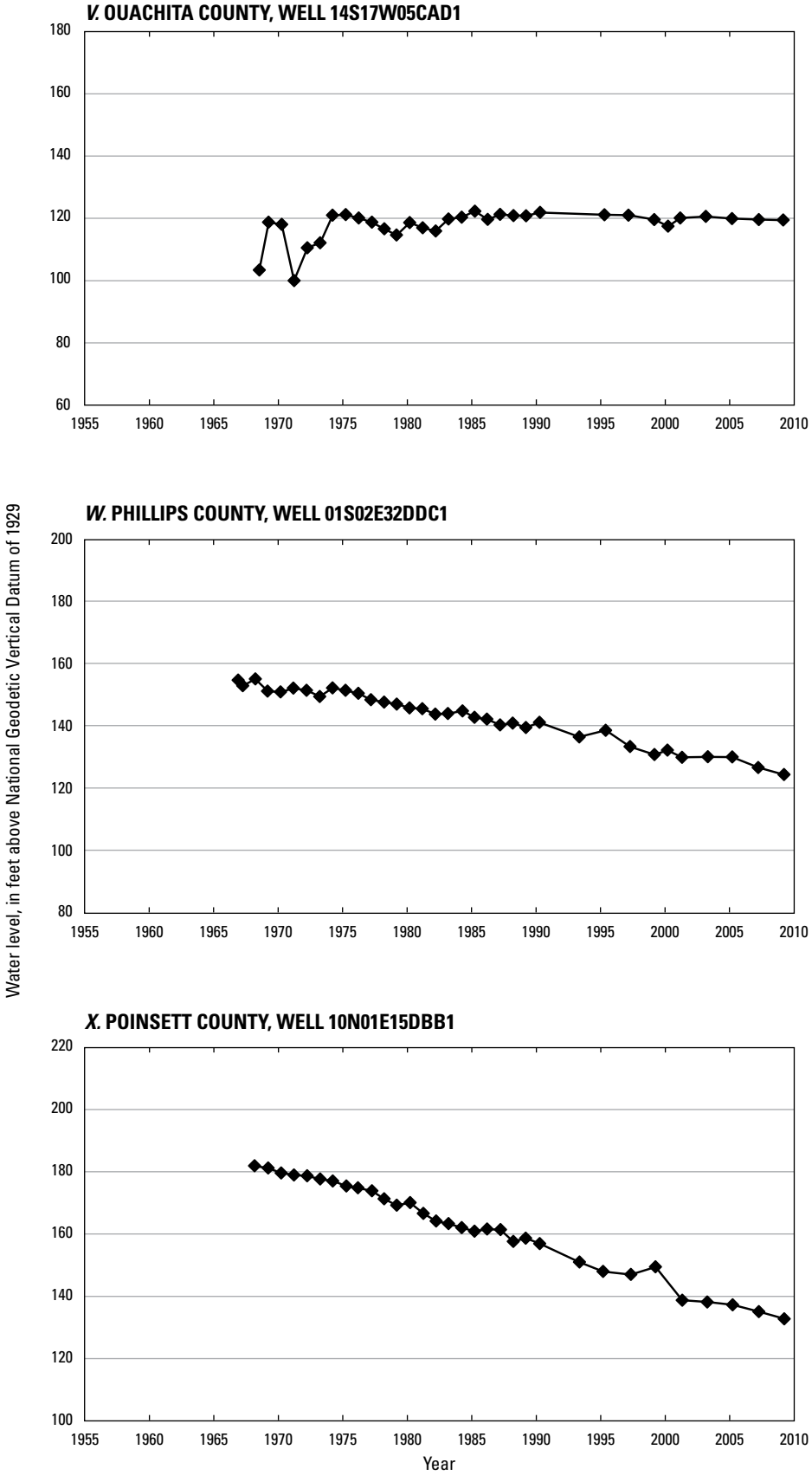

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

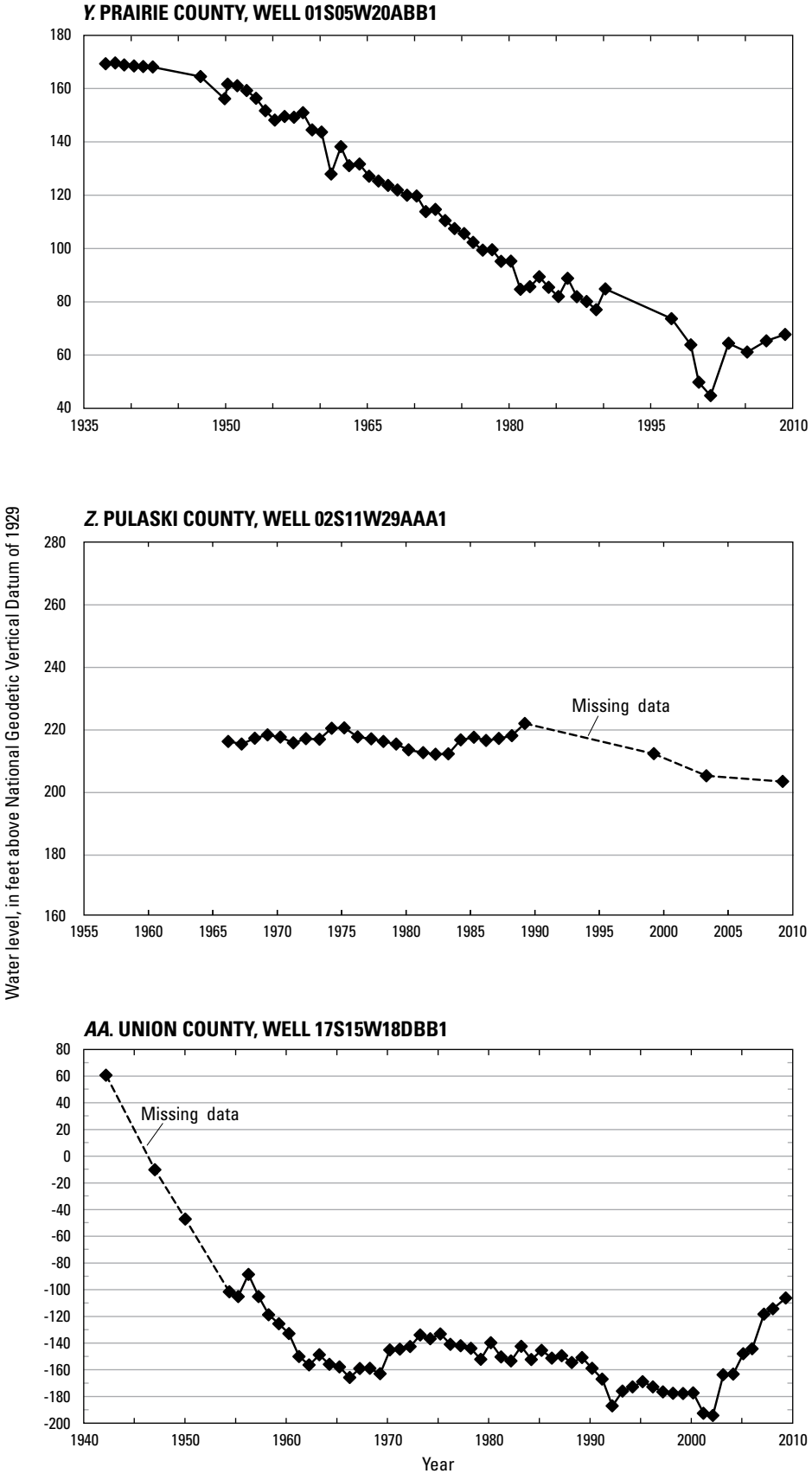

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

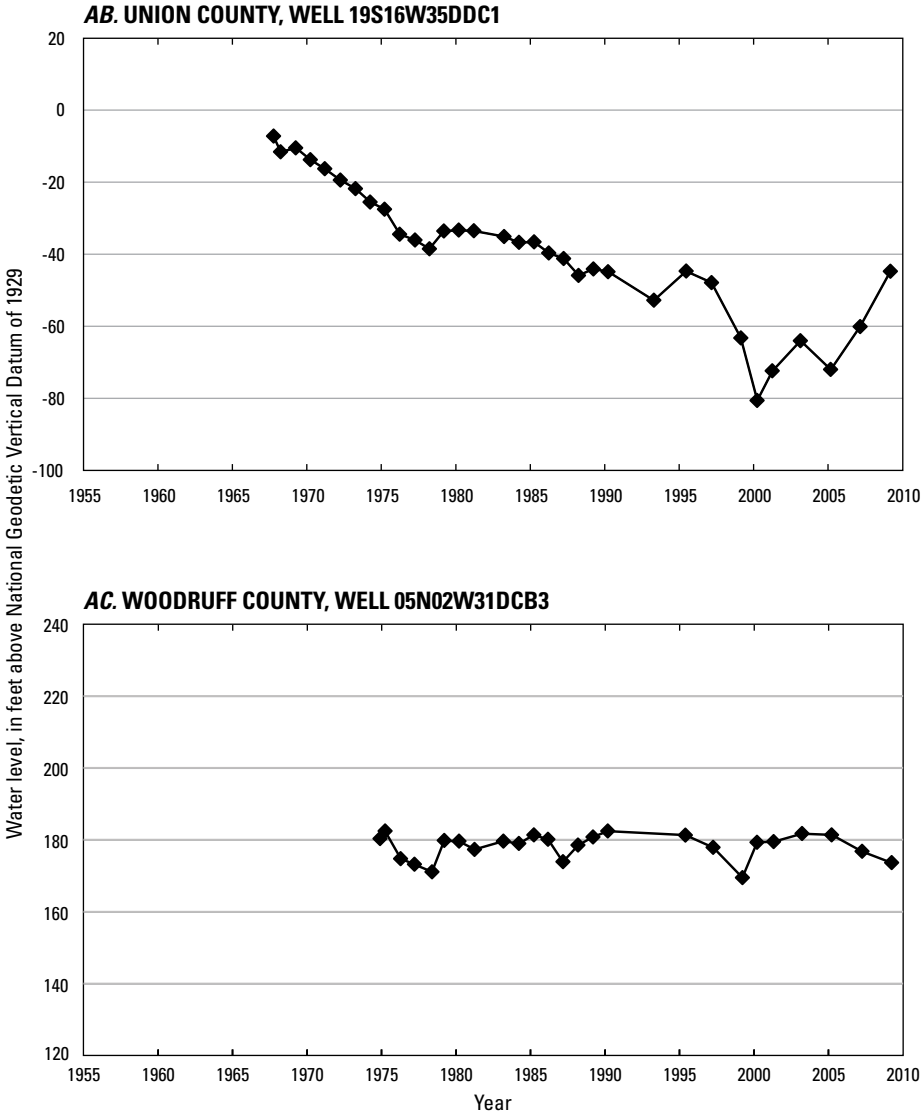

Figure 4. Water-level hydrographs for selected wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

Table 2. Number of wells, range, mean, median, and correlation coefficient, R^2, of annual rise-decline in water level by county for wells in the Sparta-Memphis aquifer, 1985–2009.

[Annual rise or decline in water level for each well is calculated using linear regression; negative value indicates decline; positive value indicates rise]

County	Number of wells	Range of annual rise-decline in water level (feet/year)	Mean annual rise-decline in water level (feet/year)	Median annual rise-decline in water level (feet/year)	Range of R^2 values for trend line
Arkansas	27	-1.97 to 0.47	-1.07	-1.28	0.01 to 0.84
Ashley	1	-0.40 to -0.40	-0.40	-0.40	0.11 to 0.11
Bradley	3	-1.46 to -0.77	-1.11	-1.13	0.67 to 0.97
Calhoun	3	-0.88 to 5.48	1.25	-0.84	0.46 to 0.78
Cleveland	6	-1.50 to 1.06	-0.45	-0.60	0.24 to 0.92
Columbia	14	-0.77 to 2.89	0.24	-0.04	0.04 to 0.94
Craighead	3	-0.80 to -0.40	-0.67	-0.80	0.13 to 0.82
Crittenden	4	-0.29 to 0.11	-0.09	-0.10	0.00 to 0.67
Cross	4	-1.24 to -0.84	-1.01	-0.99	0.77 to 0.93
Dallas	10	-0.58 to -0.02	-0.24	-0.16	0.01 to 0.96
Desha	6	-1.50 to -0.69	-0.96	-0.75	0.37 to 0.92
Drew	5	-0.95 to -0.15	-0.59	-0.51	0.02 to 0.99
Grant	8	-1.53 to -0.07	-0.48	-0.37	0.18 to 0.95
Jefferson	18	-2.67 to 0.00	-1.30	-1.26	0.00 to 0.94
Lafayette	3	-0.03 to 0.15	0.05	0.02	0.00 to 0.40
Lee	2	-1.53 to -0.69	-1.11	-1.11	0.75 to 0.98
Lincoln	6	-4.60 to -1.28	-2.30	-1.63	0.58 to 0.98
Lonoke	3	-1.21 to -0.77	-0.99	-0.99	0.71 to 0.99
Mississippi	1	-0.55 to -0.55	-0.55	-0.55	0.28 to 0.28
Monroe	4	-1.02 to 0.07	-0.37	-0.27	0.00 to 0.94
Nevada	1	-0.18 to -0.18	-0.18	-0.18	0.10 to 0.10
Ouachita	15	-1.42 to 0.95	-0.12	-0.07	0.00 to 0.93
Phillips	6	-0.73 to 0.37	-0.26	-0.24	0.00 to 0.95
Poinsett	2	-1.28 to -0.77	-1.02	-1.02	0.48 to 0.97
Prairie	10	-1.50 to 0.22	-1.12	-1.22	0.03 to 0.96
Pulaski	1	-0.66 to -0.66	-0.66	-0.66	0.85 to 0.85
St. Francis	1	-0.15 to -0.15	-0.15	-0.15	0.09 to 0.09
Union	38	-1.21 to 9.20	0.64	-0.35	0.01 to 0.99
Woodruff	1	-0.11 to -0.11	-0.11	-0.11	0.06 to 0.06

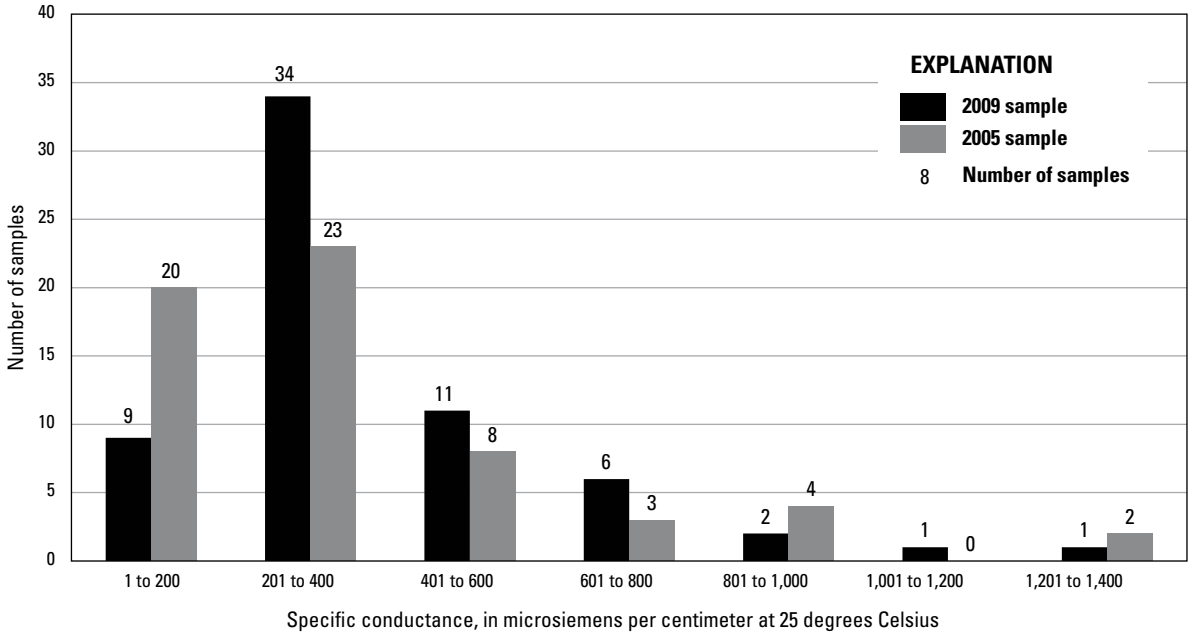

Figure 5. Distribution of specific conductance in samples from the Sparta-Memphis aquifer in 2005 and 2009 in Arkansas.

Summary

The U.S. Geological Survey in cooperation with the Arkansas Natural Resources Commission and the Arkansas Geological Survey has monitored water levels since the 1920's. Groundwater withdrawals generally have increased while water levels generally have declined since monitoring was initiated. During the spring of 2009, 324 water levels were measured in wells completed in the Sparta-Memphis aquifer. During the summer of 2009, 64 water-quality samples were collected and measured for specific conductance, temperature, and pH from wells completed in the Sparta-Memphis aquifer.

Water use in the Sparta-Memphis aquifer in Arkansas generally increased from 1965 to 2000. In 2000, water use in the Sparta-Memphis aquifer was about 287 Mgal/d, an increase of about 156 percent from 1965. In 2005, water use in the Sparta-Memphis aquifer declined to about 170 Mgal/d.

The Sparta Sand is composed of a sequence of alternating sand and clay beds between the massive clays of the overlying Cook Mountain Formation of Claiborne Group and the underlying Cane River Formation of Claiborne Group confining units. The Sparta Sand is in the southern part of the study area (south of about 35 degrees latitude). The Memphis Sand is in the northern part of the study area (north of about 35 degrees latitude). The Memphis Sand is underlain by a thick layer of clay in the upper part of the Wilcox Group.

The regional direction of groundwater flow in the Sparta-Memphis aquifer is generally to the south-southeast in the northern half of Arkansas and to the east and south in the southern half of Arkansas, away from the outcrop area except where affected by large depressions. The highest water-level altitude measured in the Sparta-Memphis aquifer was 325 ft above the National Geodetic Vertical Datum of 1929 [NGVD 29] in the outcrop at the western boundary of the study area in Grant County; the lowest water-level altitude was 157 ft below NGVD 29 in Union County.

Eight depressions are located in the study area. Two large depressions, centered in Jefferson and Union Counties, are the result of large withdrawals for industrial, irrigation, or public supply. The depression centered in Jefferson County has deepened and expanded in recent years into Arkansas and Prairie Counties as a result of large withdrawals for irrigation and public supply. The area enclosed within the 40-foot contour on the 2009 potentiometric-surface map has expanded south to the Drew County line and moved west from the intersection of Arkansas, Jefferson, and Lincoln Counties since 2007. The lowest water-level altitude measurement during 2009 in the center of the depression in Union County has risen 42 feet since 2003. The area enclosed by the lowest altitude contour, 140 feet below NGVD 29, on the 2009 potentiometric-surface map is about half the area on the 2007 potentiometric-surface map. A broad depression in western Poinsett and Cross Counties was first shown in the 1995 potentiometric-surface map and is caused by withdrawals for irrigation. In the 2009 potentiometric-surface map, the 140-ft contour extended north to the Poinsett-Craighead County line and south across Cross County about two-thirds of the distance to the St. Francis County line.

A water-level difference map was constructed using the difference between water-level measurements made during 2005 and 2009 from 309 wells. The difference in water level

between 2005 and 2009 ranged from -74.6 to 60.2 feet. Areas with a general rise in water levels include central Columbia County, southern Jefferson County, and most of Union County. In the area around west-central Union County, water levels rose as much as 60.2 feet with water levels in 18 wells rising 20 feet or more, which is an average annual rise of 5 feet or more. Water levels generally declined throughout most of the Sparta-Memphis aquifer.

Hydrographs from 206 wells were constructed with a minimum of 25 years of water-level measurements. During the period 1985–2009, the county mean annual water level rose in Calhoun, Columbia, Lafayette, and Union Counties, about 1.3 feet per year (ft/yr), 0.2 ft/yr, 0.1 ft/yr, and 0.6 ft/yr, respectively. In Union County, 2009 is the first year that the county mean has shown a rise since the county hydrograph analysis of water-level rise or decline was first used in 1996–97. Mean annual declines were between 0.5 ft/yr and Monroe, Nevada, Ouachita, Phillips, St. Francis, and Woodruff Counties. Mean annual declines were between 1.0 ft/yr and 0.5 ft/yr in Craighead, Desha, Drew, Lonoke, Mississippi, and Pulaski Counties. Mean annual declines were between 1.5 ft/yr and 1.0 ft/yr in Arkansas, Bradley, Cross, Jefferson, Lee, Poinsett, and Prairie Counties. The mean annual decline for Lincoln County was 2.3 ft/yr. In western Arkansas County, water-level altitudes in a continuously monitored well changed 60 feet during the irrigation season (April to September).

Specific conductance ranged from 43 microsiemens per centimeter at 25 degrees Celsius (µS/cm) in Ouachita County to 1,230 µS/cm in Phillips County. The mean specific conductance was 392 µS/cm. Although there is a regional increase in specific conductance to the east and south, anomalous increases occur in some parts of the study area. Large specific conductance values (greater than 700 µS/cm) occur in samples from wells in Arkansas, Ashley, Monroe, Phillips, and Union Counties. The histograms of specific conductance data for 2009 and 2005 both have a right skew. The mean specific conductance was 362 µS/cm in 2005 and 392 µS/cm in 2009. The 201–400 µS/cm range included 38 percent of the samples in 2005 and 53 percent of the samples in 2009. The lowest range, 1–200 µS/cm, decreased from 33 percent of the samples in 2005 to 14 percent of the samples in 2009. The small change in the mean specific conductance and the distribution of data from 2005 to 2009 may indicate a change in water quality or may be the result of the distribution of sampling locations.

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Appendix 1—Water-Level Data Collected during Spring 2009 from Wells Completed in the Sparta-Memphis Aquifer in Arkansas

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Arkansas County							
02S04W06CDB1	343312	912849	51	160.98	212	4/1/2009	USGS
02S04W23DAA1	343044	912355	67	141.41	208	4/1/2009	USGS
02S04W33BBB1	342922	912703	38	166.79	205	4/1/2009	USGS
02S05W16CBB1	343144	913319	40	172.68	213	4/2/2009	USGS
02S05W27BBB1	343028	913230	35	180.87	216	4/1/2009	USGS
02S05W34BDA1	342925	913148	34	181.77	216	4/1/2009	USGS
02S05W35AAB1	342930	913035	39	176.73	216	4/1/2009	USGS
03S04W02CCB1	342748	912458	52	149.71	202	4/1/2009	USGS
03S04W26CDA1	342421	912438	59	144.10	203	4/1/2009	USGS
03S05W02AAB1	342842	913034	35	174.79	210	4/1/2009	USGS
03S05W13BDC1	342631	913005	35	174.57	210	4/1/2009	USGS
03S05W15CBB1	342633	913229	29	176.86	206	4/1/2009	USGS
03S05W18CAB1	342629	913525	34	161.94	196	4/1/2009	USGS
03S05W28DAB1	342447	913240	30	173.68	204	4/1/2009	USGS
03S06W30BBD1	342516	914216	30	160.82	191	4/1/2009	USGS
04S01W04CBD1	342225	910808	86	110.47	196	3/31/2009	USGS
04S01W28BAA1	341927	910748	86	104.43	190	3/31/2009	USGS
04S04W11BCC1	342157	912502	42	155.82	198	4/2/2009	USGS
04S04W19CBB1	342004	912929	37	157.76	195	4/1/2009	USGS
04S04W22DAA1	342007	912515	36	158.64	195	4/2/2009	USGS
04S05W01BAA1	342322	912956	28	168.16	196	4/1/2009	USGS
04S05W05ACC1	342303	913413	34	152.33	186	4/23/2009	USGS
04S05W15AAA1	342132	913133	31	169.79	201	4/1/2009	USGS
04S05W36DCC1	341752	913004	38	158.02	196	4/1/2009	USGS
05S01W17BAA1	341551	910745	83	92.51	176	3/31/2009	USGS
05S03W04ADB1	341734	912007	46	142.39	188	3/31/2009	USGS
05S04W26ACA1	341358	912434	55	133.14	188	3/31/2009	USGS
05S05W36DAA1	341245	912947	33	146.88	180	3/31/2009	USGS
06S02W06ABB1	341228	911620	68	113.25	181	3/31/2009	USGS
06S02W17ADA1	341023	911453	75	112.68	188	3/31/2009	USGS
06S02W22CDB1	340904	911331	75	110.83	186	3/31/2009	USGS
06S03W27BAA1	340859	912009	63	117.84	181	3/31/2009	USGS
07S02W28ABA1	340340	911411	77	103.53	181	3/31/2009	USGS
07S03W06ABC1	340702	912248	59	125.52	185	3/31/2009	USGS
08S02W09BCC1	340031	911448	75	99.32	174	3/31/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
			Ashley County				
15S07W32CDD1	332118	915101	40	149.86	190	3/23/2009	USGS
17S09W15ACC1	331334	920116	80	19.93	100	3/23/2009	USGS
			Bradley County				
12S09W31CCB1	333711	920444	34	196.99	231	3/20/2009	USGS
13S09W06ACB2	333647	920417	26	182.02	208	3/20/2009	USGS
13S11W17BCD1	333454	921607	46	204.04	250	3/20/2009	USGS
16S12W21CAA1	331839	922052	19	81.12	100	3/20/2009	USGS
			Calhoun County				
13S13W32CDA1	333227	922742	14	194.38	208	3/17/2009	USGS
13S15W36CBD1	333227	923532	75	82.93	158	3/17/2009	USGS
14S13W03CAB1	333145	922551	37	165.46	202	3/17/2009	USGS
14S13W05BBD1	333207	922802	30	158.81	189	3/17/2009	USGS
14S13W12CCB1	333040	922404	28	177.48	205	3/17/2009	USGS
15S13W20BDC1	332411	922807	85	24.44	109	3/17/2009	USGS
			Chicot County				
13S03W22DAD1	333312	912308	66	69.26	135	3/23/2009	USGS
			Cleveland County				
08S12W13CAA2	340131	921639	114	146.87	261	3/25/2009	USGS
09S09W04BBD1	335820	920237	84	224.37	308	3/26/2009	USGS
09S11W01DCA1	335729	921134	17	207.52	225	3/25/2009	USGS
09S11W01DDA2	335729	921120	56	208.94	265	3/25/2009	USGS
09S11W11CDB1	335623	921251	71	162.19	233	3/25/2009	USGS
10S09W23CDC1	334918	920021	57	163.04	220	3/26/2009	USGS
10S09W35ACD1	334758	915957	60	158.71	219	3/26/2009	USGS
10S12W12BDD1	335133	921743	99	121.44	220	3/25/2009	USGS
11S11W16AAB1	334543	921423	98	204.79	303	3/25/2009	USGS
			Columbia County				
15S20W20CCB1	332453	931215	154	217.85	372	3/11/2009	USGS
16S20W08DCC1	332114	931141	81	320.99	402	3/11/2009	USGS
16S20W18ACD1	332053	931237	71	265.72	337	3/11/2009	USGS
16S21W14CBB1	332049	931517	81	199.86	281	3/11/2009	USGS
16S21W20DAD1	331955	931736	98	252.24	350	3/11/2009	ANRC
16S22W22CCD1	331948	932225	202	138.34	340	3/11/2009	USGS
17S19W15AAB1	331546	930318	51	267.38	318	3/11/2009	USGS
17S19W17ACA1	331538	930536	43	260.11	303	3/11/2009	USGS
17S19W18CBD1	331517	930656	45	260.31	305	3/11/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Columbia County—Continued							
17S19W19BCA1	331433	930705	34	267.17	301	3/11/2009	USGS
17S19W30ABB1	331406	930650	30	217.72	248	3/11/2009	USGS
17S20W13BCD1	331532	930807	32	308.29	340	3/11/2009	USGS
17S20W17CDA1	331520	931201	27	298.40	325.1	3/11/2009	USGS
17S20W36ABC1	331307	930755	42	292.97	335	3/12/2009	USGS
17S21W01BBC1	331743	931424	50	255.40	305	3/11/2009	USGS
17S21W08DCA1	331613	931758	93	206.53	300	3/11/2009	USGS
17S21W11DCC2	331609	931449	28	272.06	300	5/5/2009	USGS
17S21W11DCC3	331609	931449	23	274.99	298	3/11/2009	USGS
17S21W17BAB1	331608	931820	88	198.81	287	3/11/2009	USGS
17S22W21ABD1	331517	932304	213	82.23	295	3/12/2009	USGS
17S22W22ABB1	331522	932210	186	135.13	321	3/12/2009	USGS
17S22W23BBB1	331521	932137	210	129.61	340	3/12/2009	USGS
18S20W06DDC1	331143	931249	4	295.65	300	3/11/2009	USGS
18S20W08CBC1	331115	931227	-7	270.36	263	3/11/2009	USGS
18S20W10CAA1	331054	931016	14	276.42	290	3/11/2009	USGS
18S21W01ACC1	331223	931339	-1	295.84	295	3/11/2009	USGS
18S21W17ACD1	331034	931759	85	230.16	315	3/10/2009	USGS
18S22W27DDD1	330835	932159	177	135.31	312	3/10/2009	USGS
19S20W09CBD1	330555	931129	68	264.02	332	3/10/2009	USGS
19S20W34BDD1	330239	931031	88	201.72	290	3/10/2009	USGS
19S21W16DBB1	330517	931724	110	174.38	284	3/10/2009	USGS
19S23W10ABD1	330644	932833	197	45.09	242	3/10/2009	USGS
19S23W11CDA2	330609	932744	195	52.54	248	3/10/2009	USGS
19S23W11DDB1	330605	932722	192	53.76	246	3/10/2009	USGS
19S23W14BAB2	330555	932752	192	52.11	244	3/10/2009	USGS
20S22W03DCC1	330138	932236	162	52.40	214	3/10/2009	USGS
20S22W11ACD1	330109	932133	164	107.49	271	3/10/2009	USGS
Craighead County							
13N03E23CDD1	354404	904433	157	91.25	248	4/14/2009	USGS
14N04E22CBD1	354929	903921	196	59.67	256	4/14/2009	USGS
14N04E28DBD1	354837	903953	189	64.89	254	4/14/2009	USGS
14N05E36CBC1	354751	903100	207	13.16	220	4/14/2009	USGS
15N04E20ADB1	355506	904043	319	119.08	438	4/14/2009	USGS
15N05E29DBB1	355360	903433	233	25.24	258	4/14/2009	USGS
15N06E18ACA1	355544	902858	211	18.66	230	4/14/2009	ANRC

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Crittenden County							
05N08E11CCA2	350345	901300	185	25.88	211	4/8/2009	USGS
06N07E01DAD2	350958	901738	183	26.22	209	4/8/2009	USGS
07N09E14BAC1	351348	900628	187	30.49	217	4/8/2009	USGS
09N07E21BBB1	352341	902131	190	26.17	216	4/8/2009	USGS
Cross County							
06N04E06ACA1	351004	904238	152	205.58	358	4/9/2009	USGS
07N05E04ADD1	351538	903330	173	35.80	209	4/9/2009	USGS
08N02E18BDB1	351908	905538	136	92.30	228	4/9/2009	ANRC
09N01E16CAC1	352405	905951	141	92.54	234	4/9/2009	USGS
09N01E25AAD1	352244	905554	135	91.54	227	4/9/2009	ANRC
09N03E22AAB2	352404	904518	148	129.23	277	4/9/2009	USGS
09N03E22AAD1	352403	904512	144	134.24	278	4/9/2009	USGS
09N04E30DCA1	352232	904218	158	271.39	429.32	4/9/2009	USGS
Dallas County							
07S14W30DCC1	340431	923360	215	120.40	335	3/9/2009	USGS
07S14W31AAA1	340425	923334	218	112.36	330	3/9/2009	USGS
07S16W20CAB1	340555	924545	295	26.95	322	3/9/2009	USGS
08S15W34BDC1	335859	923730	214	26.32	240	3/9/2009	USGS
08S16W18ACC1	340152	924639	236	15.55	252	3/9/2009	USGS
08S16W27DDD1	335937	924307	242	33.29	275	3/9/2009	USGS
09S13W35CCD1	335309	922413	129	71.47	200	3/9/2009	USGS
09S14W01BDC1	335754	922919	182	82.60	265	3/9/2009	USGS
09S16W19CAA1	335605	924701	253	7.25	260	3/9/2009	USGS
10S13W34ACA2	334829	922458	121	151.08	272	3/9/2009	USGS
10S14W27CDB1	334908	923138	238	32.36	270	3/9/2009	USGS
10S15W18BCC1	335120	924120	252	76.44	328	3/9/2009	USGS
Desha County							
09S02W26AAC1	335346	911521	79	73.83	153	3/24/2009	USGS
09S04W28DDD1	335310	913007	51	113.98	165	3/24/2009	USGS
10S02W26CCC2	334750	911624	71	77.24	148	3/24/2009	USGS
10S04W11CBC1	335034	912905	54	107.07	161	3/24/2009	USGS
11S02W03CCA1	334616	911711	67	71.64	139	3/24/2009	USGS
12S03W26CBB1	333749	912259	41	102.01	143	3/24/2009	USGS
12S03W34DAD1	333643	912305	62	84.63	147	3/24/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
			Drew County				
11S04W02ACA2	334632	912827	55	97.92	153	3/23/2009	USGS
11S04W25CB2	334249	912707	58	89.89	148	3/23/2009	USGS
11S06W11DBC1	334607	914122	51	152.49	203	3/23/2009	USGS
12S06W30BBD1	333807	914543	43	227.93	271	3/23/2009	USGS
12S06W32DAD1	333649	914402	54	161.09	215	3/23/2009	USGS
13S05W36ACB1	333151	913408	77	92.09	169	3/23/2009	USGS
15S04W12DDA1	332429	912724	62	63.48	125	3/23/2009	USGS
			Grant County				
03S13W12AAA1	342846	922106	227	134.47	361	3/25/2009	USGS
03S15W26DAA1	342601	923447	325	11.98	337	3/25/2009	USGS
05S13W03CAA1	341844	922400	170	90.07	260	3/25/2009	USGS
05S13W03CDA4	341838	922402	165	116.39	281	3/25/2009	USGS
05S13W07ADB1	341810	922650	190	79.53	270	3/25/2009	USGS
05S13W30AAA1	341550	922650	200	129.76	330	3/25/2009	USGS
05S14W06DCC1	341843	923327	203	89.57	293	3/25/2009	USGS
05S15W05ABD1	341924	923827	220	16.41	236	3/25/2009	USGS
06S11W05ACD1	341341	921413	51	217.63	269	3/25/2009	USGS
06S15W26ACA1	341022	923538	205	75.47	280	3/25/2009	USGS
07S12W21BDB1	340558	921953	221	2.37	223	3/25/2009	USGS
			Hot Spring County				
05S16W35ACA1	341460	924151	307	35.47	342	3/9/2009	USGS
			Jefferson County				
03S08W19BAD1	342624	915444	41	176.38	217	3/27/2009	USGS
03S08W19BBD1	342628	915505	32	183.26	215	3/27/2009	USGS
03S08W19BDB1	342619	915455	36	179.38	215	3/31/2009	USGS
03S09W23BBD1	342627	915713	35	188.64	224	3/31/2009	USGS
03S10W14CAD1	342659	920330	100	121.01	221	3/31/2009	USGS
03S10W27AAD1	342502	920434	83	139.14	222	3/31/2009	USGS
03S11W22ABC1	342651	921058	132	178.17	310	3/30/2009	USGS
04S07W17BCC1	342140	914742	15	185.22	200	3/30/2009	USGS
04S08W35BBD1	341909	915056	-18	218.37	200	3/27/2009	USGS
04S10W17BDA1	342212	920646	59	206.43	265	3/26/2009	USGS
04S10W29ADB1	342025	920625	55	212.06	267.55	3/26/2009	USGS
04S11W14BAD1	342220	921000	84	316.03	400	3/30/2009	USGS
05S08W30ADB1	341452	915440	-75	296.14	221	4/29/2009	USGS
05S09W19BAA3	341609	920131	-47	272.91	226	3/30/2009	ANRC

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Jefferson County—Continued							
05S09W31DDC1	341337	920109	-48	275.32	227	3/26/2009	USGS
05S10W11ACA1	341741	920322	16	219.37	235	3/26/2009	ANRC
05S10W16BAD1	341700	920549	29	247.89	277	3/30/2009	USGS
05S10W16DBB1	341635	920543	2	313.03	315	3/30/2009	USGS
05S10W16DBD1	341635	920534	-11	312.89	302	3/30/2009	USGS
06S08W16CCC1	341143	915517	-51	253.38	202.42	3/26/2009	USGS
06S08W25ADC1	341025	915116	-20	223.88	203.48	3/26/2009	USGS
06S09W17CAD1	341159	920207	-26	259.15	233	3/26/2009	USGS
06S09W17CCA1	341152	920221	-29	263.82	234.34	3/26/2009	USGS
06S10W23ACA2	341123	920504	7	227.88	235	3/30/2009	USGS
06S10W23ACD1	341116	920508	6	232.57	239	3/30/2009	USGS
06S10W23DBA1	341105	920506	2	249.98	252	3/30/2009	USGS
07S07W24BAB1	340633	914523	15	172.56	188	3/26/2009	USGS
07S10W24CAC1	340549	920421	45	266.27	311	3/30/2009	USGS
Lafayette County							
16S23W12CAD1	332143	932609	243	78.77	322	3/10/2009	USGS
16S24W26AAC1	331950	933303	209	58.26	267	3/10/2009	USGS
17S23W19ACC1	331520	933128	237	54.00	291	3/10/2009	USGS
18S23W29ACC1	330911	933039	243	11.52	255	3/10/2009	USGS
19S23W29BDB1	330352	933103	208	42.29	250	3/10/2009	USGS
19S25W13CAB1	330555	933922	218	37.06	255	3/10/2009	USGS
20S23W05ADA1	330223	933026	207	34.71	242	3/10/2009	USGS
20S23W05ADB1	330223	933036	202	39.87	242	3/10/2009	USGS
Lee County							
01N04E09CDD1	344210	904119	142	66.48	208	4/8/2009	USGS
02N01E10CAD1	344743	905925	143	58.14	201	4/8/2009	USGS
03N03E28CDB1	345006	904749	142	64.71	207	4/8/2009	USGS
Lincoln County							
07S07W30CDC1	340444	915043	18	189.56	208	3/24/2009	USGS
08S04W22AAA1	340105	912753	50	116.68	167	3/24/2009	USGS
08S05W03BAA2	340310	913454	25	154.59	180	3/24/2009	USGS
08S05W35ACC1	335907	913337	13	153.44	166	3/24/2009	USGS
08S08W35DBB1	335858	915222	28	221.80	250	3/24/2009	USGS
08S08W35DCB1	335851	915217	19	251.48	270	3/24/2009	USGS
09S07W07DAD1	335634	915128	13	283.36	296	3/24/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Lonoke County							
01N07W03BCC1	344425	914503	91	131.94	223	4/6/2009	USGS
01S08W02DBD1	343855	914960	103	107.17	210	4/6/2009	ANRC
02N07W06ACD1	344939	914737	112	128.74	241	4/6/2009	USGS
02N07W09AAA1	344906	914500	131	100.58	232	4/6/2009	USGS
02N07W22DBA1	344651	914426	93	134.45	227	4/6/2009	USGS
02N07W24DAC1	344650	914209	78	152.69	231	4/6/2009	USGS
02N07W32DDD1	344453	914619	84	142.30	226	4/6/2009	USGS
02S07W08DCC1	343235	914700	57	145.17	202	4/7/2009	USGS
02S08W16BDA1	343228	915232	91	124.98	216	4/7/2009	USGS
02S09W15BBB2	343247	915825	145	80.81	226	4/7/2009	USGS
03N07W03CAA1	345445	914426	154	80.55	235	4/6/2009	USGS
03N07W23CCC1	345144	914350	137	91.26	228	4/6/2009	ANRC
03N08W11ACD1	345403	914935	153	95.42	248	5/1/2009	USGS
03N08W22DAD1	345205	915024	136	96.77	233	4/30/2009	ANRC
03N08W22DAD2	345205	915024	134	99.48	233	4/30/2009	USGS
03N08W22DDD2	345152	915025	134	100.59	235	4/30/2009	ANRC
Mississippi County							
11N09E26AAD3	353302	900523	213	26.60	240	4/13/2009	USGS
11N09E26ABA2	353304	900539	209	27.11	236	4/13/2009	USGS
Monroe County							
01N03W14CCB1	344144	911801	95	77.28	172	4/7/2009	USGS
03N02W26DAB1	345042	911026	141	50.58	192	4/7/2009	USGS
04N02W28DDD4	345535	911221	156	35.64	192	4/7/2009	USGS
04N02W30BAC1	345617	911504	167	14.78	182	4/7/2009	USGS
04N02W30BAD1	345617	911515	157	18.74	176	4/7/2009	USGS
Ouachita County							
11S15W27ABD1	334441	923726	129	70.76	200	3/16/2009	USGS
11S17W14CAC1	334631	924927	124	21.58	146	3/12/2009	USGS
11S17W36CCA1	334341	924834	122	10.64	133	3/12/2009	USGS
12S15W09BBA1	334223	923922	154	58.57	213	3/16/2009	USGS
12S16W25BDC1	333929	924211	106	34.48	140	3/13/2009	USGS
12S16W26ABD1	333946	924304	101	35.57	137	3/13/2009	USGS
12S18W19CDC1	334014	925951	212	23.42	235	3/12/2009	USGS
12S18W25CAB1	333937	925442	107	80.41	187	3/17/2009	USGS
12S19W09BAB1	334251	930352	279	10.88	290	3/12/2009	USGS
12S19W14AAA1	334143	930105	228	8.53	237	3/12/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Ouachita County—Continued							
12S19W35BDD1	333901	930146	192	157.61	350	3/12/2009	USGS
13S16W28ADD1	333416	924451	72	34.19	106	3/16/2009	USGS
13S18W31BDD1	333343	925956	170	72.04	242	3/12/2009	USGS
13S19W28BCD1	333434	930418	191	39.32	230	3/12/2009	USGS
14S17W02ABB1	333253	924927	113	17.80	131	3/12/2009	USGS
14S17W05CAD1	333238	925255	120	37.40	157	3/12/2009	USGS
14S17W32CAD1	332803	925251	141	79.50	220	3/17/2009	USGS
14S19W29ABB1	332941	930513	191	89.04	280	3/12/2009	USGS
15S15W32DBB2	332234	924027	-51	170.03	119	3/17/2009	USGS
15S16W23DAC1	332417	924314	43	127.23	170	3/13/2009	USGS
15S18W36ADD1	332311	925436	65	95.24	160	3/17/2009	USGS
15S19W10DCC1	332618	930318	139	70.92	210	3/12/2009	USGS
15S19W21CDD2	332438	930432	72	199.76	272	3/12/2009	USGS
Phillips County							
01S02E32DDC1	343324	905455	125	86.43	211	4/7/2009	USGS
02S02E01ADC1	343323	905056	140	36.47	176	4/7/2009	USGS
02S04E02DBA1	343243	903907	124	125.68	250	4/7/2009	USGS
02S05E16BCB1	343108	903526	152	37.59	190	4/7/2009	USGS
02S05E29CCC1	342851	903635	147	32.29	179	4/7/2009	USGS
03S03E30DAA1	342403	904915	135	37.23	172	4/7/2009	USGS
04S02E25CCC1	341824	905121	125	40.59	166	4/7/2009	USGS
Poinsett County							
10N01E12BDC1	353026	905630	131	102.92	234	4/9/2009	USGS
10N01E15DBB1	352931	905825	133	99.23	232	4/9/2009	USGS
10N01E33ABA1	352725	905924	141	80.38	221	4/9/2009	USGS
10N03E02BCD1	353139	904447	138	112.85	251	4/9/2009	USGS
10N03E23CAC1	352850	904432	143	114.59	258	4/9/2009	USGS
11N02E16CCC1	353448	905321	132	111.48	243	4/9/2009	USGS
11N03E25BDD1	353325	904323	146	122.55	269	4/9/2009	USGS
12N03E12BBB1	354137	904340	132	114.38	246	4/9/2009	USGS
12N03E35BCC1	353745	904456	141	102.65	244	4/9/2009	USGS
12N03E35DDA1	353727	904353	142	104.84	247	4/9/2009	USGS
Prairie County							
01N05W19CDC1	344113	913505	71	141.08	212	4/2/2009	USGS
01N06W02ABB1	344442	913701	104	117.17	221	4/2/2009	USGS
01N06W34CBB1	343943	913846	66	159.78	226	4/2/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Prairie County—Continued							
01S05W06BCB1	343904	913532	65	154.53	220	4/2/2009	USGS
01S05W20ABB1	343640	913352	68	152.27	220	4/2/2009	USGS
01S06W01BDD2	343859	913613	65	160.68	226	4/2/2009	USGS
01S06W11DBD1	343749	913654	65	161.40	226	4/2/2009	USGS
02N04W19ACB1	344649	912802	152	58.54	211	4/3/2009	USGS
02N06W04DBB1	344928	913852	133	101.96	235	4/3/2009	USGS
02N06W19AAB1	344718	914050	91	145.46	236	4/3/2009	USGS
02N06W20BCB1	344707	914033	94	141.86	236	4/3/2009	USGS
02N06W21DAD1	344644	913829	111	121.35	232	4/3/2009	USGS
02N06W22BDD1	344654	913801	104	128.97	233	4/2/2009	USGS
03N05W03ADA2	345452	913043	146	58.99	205	4/2/2009	USGS
03N05W20CCC1	345145	913356	139	73.59	213	4/2/2009	USGS
03N06W20CDD1	345140	914004	138	86.99	225	4/2/2009	USGS
Pulaski County							
02S11W29AAA1	343115	921225	203	42.04	245	4/6/2009	USGS
St. Francis County							
03N01W33CDD1	345446	910635	135	74.82	210	4/7/2009	USGS
04N04E18BAB1	345743	904319	152	67.91	220	4/8/2009	USGS
Union County							
16S14W15CAB1	331944	923218	-59	152.73	94	3/17/2009	USGS
16S15W20DAA1	331860	923958	-63	252.98	190	3/19/2009	USGS
16S15W31ACC1	331717	924129	-92	259.78	168	3/18/2009	USGS
16S16W02ABC1	332206	924329	-40	155.93	116	3/18/2009	USGS
16S18W34ABC2	331806	925709	40	211.24	251	3/17/2009	USGS
17S12W31DDD1	331206	922226	-12	231.99	220	3/18/2009	USGS
17S12W32BBC1	331202	922219	-15	246.34	231	3/17/2009	USGS
17S13W31BAC1	331200	922916	-92	308.27	216	3/17/2009	USGS
17S14W22BAB1	331354	923224	-84	285.17	201	5/5/2009	USGS
17S15W08CDD1	331505	924027	-104	279.20	174.92	3/18/2009	USGS
17S15W18DBB1	331439	924129	-106	289.26	182.93	5/5/2009	USGS
17S15W28DCC1	331233	923924	-141	426.09	285	3/19/2009	USGS
17S15W29CDC1	331229	924039	-130	349.58	220	3/19/2009	USGS
17S15W31DCA1	331145	924117	-109	380.73	272	3/18/2009	USGS
17S15W31DCA3	331144	924116	-136	391.11	255	3/18/2009	USGS
17S15W31DDA1	331144	924105	-106	367.33	261	5/5/2009	USGS
17S16W02CCC1	331559	924403	-132	314.27	182	3/19/2009	USGS

Appendix 1. Water level data collected during spring 2009 from wells completed in the Sparta-Memphis aquifer in Arkansas.—Continued

[USGS, U.S. Geological Survey; ANRC, Arkansas Natural Resources Commission; NGVD 29, National Geodetic Vertical Datum of 1929; Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Water-level altitude (feet above NGVD 29)	Depth to water (feet below land surface)	Land-surface datum (feet above NGVD 29)	Date of measurement	Source of data
Union County—Continued							
17S16W02DCD1	331602	924326	-151	373.13	222	3/19/2009	USGS
17S16W12CDD1	331506	924232	-157	378.42	221.58	3/19/2009	USGS
17S16W24BDB1	331357	924248	-129	333.81	205	3/19/2009	USGS
17S17W25DBA2	331256	924838	-74	323.95	250	5/5/2009	USGS
17S17W30DCD1	331257	925356	-45	325.07	280	3/17/2009	USGS
18S12W33BBB1	330651	922120	-24	136.20	112	3/19/2009	USGS
18S14W06CCD1	331039	923531	-107	339.28	232	3/18/2009	USGS
18S15W03DAB1	331104	923802	-91	330.63	240	5/6/2009	USGS
18S15W07BAC2	331035	924139	-94	346.79	253	3/19/2009	USGS
18S15W33ADA1	330659	923858	-95	347.84	253	3/18/2009	USGS
18S15W35DAC1	330636	923707	-75	275.84	201	3/18/2009	USGS
18S16W10CDD1	331000	924445	-127	308.87	182	3/18/2009	USGS
18S16W11DAC1	331011	924316	-130	401.94	272	3/18/2009	USGS
18S17W22BDD1	330856	925056	-43	327.80	285	5/5/2009	USGS
18S18W11ACD2	331051	925615	-23	261.67	239	3/19/2009	USGS
19S10W16CBC1	330329	920904	-8	89.87	82	3/19/2009	USGS
19S11W23ACA1	330255	921229	-11	152.67	142	3/19/2009	USGS
19S11W25AAA1	330218	921113	-17	151.75	135	3/19/2009	USGS
19S16W35DDC1	330109	924326	-45	219.84	175	3/18/2009	USGS
19S18W14ADA1	330452	925608	51	192.15	243	3/18/2009	USGS
Woodruff County							
05N01W11ABA1	350426	910407	150	60.83	211	4/13/2009	USGS
05N01W17DBB1	350311	910727	163	47.46	210	4/13/2009	USGS
05N02W31DCB3	350027	911456	174	19.38	193	4/13/2009	USGS
06N01W13ABA1	350852	910254	142	69.97	212	4/13/2009	ANRC
06N01W13ADC1	350827	910247	145	67.21	212	4/13/2009	ANRC
07N01W12BCB1	351442	910326	153	69.36	222	4/13/2009	USGS
08N01W12CDA1	351934	910311	149	76.47	225	4/13/2009	USGS
08N02W26ADC1	351726	911004	176	35.67	212	4/13/2009	USGS

Appendix 2—Difference in Water Level from 2005 to 2009 in the Sparta-Memphis Aquifer in Arkansas

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
Arkansas County					
02S04W06CDB1	343312	912849	154.52	160.98	-6.5
02S04W23DAA1	343044	912355	143.61	141.41	2.2
02S04W33BBB1	342922	912703	149.96	166.79	-16.8
02S05W16CBB1	343144	913319	168.1	172.68	-4.6
02S05W27BBB1	343028	913230	164.26	180.87	-16.6
02S05W34BDA1	342925	913148	174.64	181.77	-7.1
02S05W35AAB1	342930	913035	171.05	176.73	-5.7
03S04W02CCB1	342748	912458	144.05	149.71	-5.7
03S04W26CDA1	342421	912438	137.79	144.1	-6.3
03S05W02AAB1	342842	913034	165.61	174.79	-9.2
03S05W13BDC1	342631	913005	171.74	174.57	-2.8
03S05W15CBB1	342633	913229	163.54	176.86	-13.3
03S05W18CAB1	342629	913525	156.28	161.94	-5.7
03S05W28DAB1	342447	913240	167.89	173.68	-5.8
03S06W30BBD1	342516	914216	161.27	160.82	0.5
04S01W04CBD1	342225	910808	107.52	110.47	-3.0
04S04W11BCC1	342157	912502	151.06	155.82	-4.8
04S04W19CBB1	342004	912929	151.75	157.76	-6.0
04S04W22DAA1	342007	912515	155.51	158.64	-3.1
04S05W01BAA1	342322	912956	188.56	168.16	20.4
04S05W05ACC1	342303	913413	151.05	152.33	-1.3
04S05W15AAA1	342132	913133	159.17	169.79	-10.6
04S05W36DCC1	341752	913004	153.85	158.02	-4.2
05S01W17BAA1	341551	910745	89.08	92.51	-3.4
05S03W04ADB1	341734	912007	156.52	142.39	14.1
05S04W26ACA1	341358	912434	119.78	133.14	-13.4
05S05W36DAA1	341245	912947	133.87	146.88	-13.0
06S02W06ABB1	341228	911620	102.32	113.25	-10.9
06S02W17ADA1	341023	911453	104.83	112.68	-7.9
06S02W22CDB1	340904	911331	98.12	110.83	-12.7
06S03W27BAA1	340859	912009	112.51	117.84	-5.3
07S02W28ABA1	340340	911411	98.23	103.53	-5.3
07S03W06ABC1	340702	912248	122.84	125.52	-2.7
08S02W09BCC1	340031	911448	95.88	99.32	-3.4
Ashley County					
15S07W32CDD1	332118	915101	138.72	149.86	-11.1
17S09W15ACC1	331334	920116	17.97	19.93	-2.0

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
Bradley County					
12S09W31CCB1	333711	920444	186.36	196.99	-10.6
13S09W06ACB2	333647	920417	166.75	182.02	-15.3
13S11W17BCD1	333454	921607	201.02	204.04	-3.0
16S12W21CAA1	331839	922052	74.26	81.12	-6.9
Calhoun County					
13S13W32CDA1	333227	922742	170.27	194.38	-24.1
13S15W36CBD1	333227	923532	77.12	82.93	-5.8
14S13W05BBD1	333207	922802	156.36	158.81	-2.4
14S13W12CCB1	333040	922404	170.89	177.48	-6.6
15S13W20BDC1	332411	922807	24.75	24.44	0.3
Chicot County					
13S03W22DAD1	333312	912308	68.28	69.26	-1.0
Cleveland County					
09S11W01DCA1	335729	921134	207.21	207.52	-0.3
09S11W01DDA2	335729	921120	208.35	208.94	-0.6
09S11W11CDB1	335623	921251	161.94	162.19	-0.3
10S09W23CDC1	334918	920021	162.56	163.04	-0.5
10S09W35ACD1	334758	915957	154.84	158.71	-3.9
10S12W12BDD1	335133	921743	119.04	121.44	-2.4
11S11W16AAB1	334543	921423	203.83	204.79	-1.0
Columbia County					
15S20W20CCB1	332453	931215	216.13	217.85	-1.7
16S20W08DCC1	332114	931141	317.23	320.99	-3.8
16S20W18ACD1	332053	931237	262.5	265.72	-3.2
16S21W14CBB1	332049	931517	198.31	199.86	-1.6
16S21W20DAD1	331955	931736	248.24	252.24	-4.0
16S22W22CCD1	331948	932225	146.87	138.34	8.5
17S19W17ACA1	331538	930536	247.2	260.11	-12.9
17S19W18CBD1	331517	930656	269.07	260.31	8.8
17S19W19BCA1	331433	930705	273.69	267.17	6.5
17S19W30ABB1	331406	930650	221.74	217.72	4.0
17S20W17CDA1	331520	931201	317.24	298.4	18.8
17S20W36ABC1	331307	930755	296.42	292.97	3.4
17S21W01BBC1	331743	931424	269.75	255.4	14.4
17S21W08DCA1	331613	931758	210.87	206.53	4.3
17S21W11DCC2	331609	931449	278.57	272.06	6.5
17S21W11DCC3	331609	931449	280.37	274.99	5.4
17S21W17BAB1	331608	931820	203.27	198.81	4.5
17S22W21ABD1	331517	932304	81.62	82.23	-0.6

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
Columbia County—Continued					
17S22W22ABB1	331522	932210	137	135.13	1.9
17S22W23BBB1	331521	932137	136.11	129.61	6.5
18S20W08CBC1	331115	931227	273.44	270.36	3.1
18S20W10CAA1	331054	931016	277.51	276.42	1.1
18S21W01ACC1	331223	931339	299.63	295.84	3.8
18S21W17ACD1	331034	931759	228.8	230.16	-1.4
18S22W27DDD1	330835	932159	133.64	135.31	-1.7
19S20W09CBD1	330555	931129	265.92	264.02	1.9
19S20W34BDD1	330239	931031	127.13	201.72	-74.6
19S21W16DBB1	330517	931724	173.24	174.38	-1.1
19S23W10ABD1	330644	932833	43.52	45.09	-1.6
19S23W11CDA2	330609	932744	52.45	52.54	-0.1
19S23W11DDB1	330605	932722	54.03	53.76	0.3
19S23W14BAB2	330555	932752	50.46	52.11	-1.6
20S22W03DCC1	330138	932236	52.07	52.4	-0.3
20S22W11ACD1	330109	932133	107.13	107.49	-0.4
Craighead County					
13N03E23CDD1	354404	904433	87.15	91.25	-4.1
14N04E22CBD1	354929	903921	55.27	59.67	-4.4
14N04E28DBD1	354837	903953	60.31	64.89	-4.6
14N05E36CBC1	354751	903100	10.76	13.16	-2.4
15N04E20ADB1	355506	904043	118.18	119.08	-0.9
15N05E29DBB1	355360	903433	21.08	25.24	-4.2
15N06E18ACA1	355544	902858	15.31	18.66	-3.4
Crittenden County					
05N08E11CCA2	350345	901300	22.94	25.88	-2.9
06N07E01DAD2	350958	901738	22.53	26.22	-3.7
07N09E14BAC1	351348	900628	27.42	30.49	-3.1
Cross County					
06N04E06ACA1	351004	904238	201.92	205.58	-3.7
07N05E04ADD1	351538	903330	36.08	35.8	0.3
08N02E18BDB1	351908	905538	82.72	92.3	-9.6
09N01E16CAC1	352405	905951	81.37	92.54	-11.2
09N01E25AAD1	352244	905554	86.53	91.54	-5.0
09N03E22AAB2	352404	904518	126.92	129.23	-2.3
09N03E22AAD1	352403	904512	130.19	134.24	-4.1
09N04E30DCA1	352232	904218	265.67	271.39	-5.7

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
		Dallas County			
07S14W30DCC1	340431	923360	119.65	120.4	-0.8
07S14W31AAA1	340425	923334	109.53	112.36	-2.8
07S16W20CAB1	340555	924545	24.97	26.95	-2.0
08S15W34BDC1	335859	923730	25.63	26.32	-0.7
08S16W18ACC1	340152	924639	16.03	15.55	0.5
08S16W27DDD1	335937	924307	32.77	33.29	-0.5
09S13W35CCD1	335309	922413	71.36	71.47	-0.1
09S14W01BDC1	335754	922919	78.66	82.6	-3.9
09S16W19CAA1	335605	924701	6.03	7.25	-1.2
10S13W34ACA2	334829	922458	151.47	151.08	0.4
10S14W27CDB1	334908	923138	31.93	32.36	-0.4
10S15W18BCC1	335120	924120	75.78	76.44	-0.7
		Desha County			
09S02W26AAC1	335346	911521	68.91	73.83	-4.9
09S04W28DDD1	335310	913007	112.54	113.98	-1.4
10S02W26CCC2	334750	911624	71.24	77.24	-6.0
10S04W11CBC1	335034	912905	102.9	107.07	-4.2
11S02W03CCA1	334616	911711	69.02	71.64	-2.6
12S03W26CBB1	333749	912259	95.39	102.01	-6.6
12S03W34DAD1	333643	912305	77.5	84.63	-7.1
		Drew County			
11S04W02ACA2	334632	912827	93.47	97.92	-4.5
11S04W25CB2	334249	912707	85.87	89.89	-4.0
11S06W11DBC1	334607	914122	151.52	152.49	-1.0
12S06W30BBD1	333807	914543	223.83	227.93	-4.1
12S06W32DAD1	333649	914402	170.35	161.09	9.3
13S05W36ACB1	333151	913408	90.31	92.09	-1.8
15S04W12DDA1	332429	912724	62.32	63.48	-1.2
		Grant County			
03S13W12AAA1	342846	922106	131.01	134.47	-3.5
03S15W26DAA1	342601	923447	9.87	11.98	-2.1
05S13W03CAA1	341844	922400	82.09	90.07	-8.0
05S13W03CDA4	341838	922402	110.63	116.39	-5.8
05S13W07ADB1	341810	922650	59.43	79.53	-20.1
05S13W30AAA1	341550	922650	120.09	129.76	-9.7
05S14W06DCC1	341843	923327	86.47	89.57	-3.1
05S15W05ABD1	341924	923827	16.97	16.41	0.6
06S11W05ACD1	341341	921413	209.74	217.63	-7.9
06S15W26ACA1	341022	923538	65.53	75.47	-9.9
07S12W21BDB1	340558	921953	2.12	2.37	-0.3

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
		Jefferson County			
03S08W19BAD1	342624	915444	171.47	176.38	-4.9
03S08W19BBD1	342628	915505	166.74	183.26	-16.5
03S08W19BDB1	342619	915455	168.38	179.38	-11.0
03S09W23BBD1	342627	915713	165.45	188.64	-23.2
03S10W14CAD1	342659	920330	113.8	121.01	-7.2
03S10W27AAD1	342502	920434	126.25	139.14	-12.9
03S11W22ABC1	342651	921058	174.99	178.17	-3.2
04S07W17BCC1	342140	914742	168.4	185.22	-16.8
04S08W35BBD1	341909	915056	207.5	218.37	-10.9
04S10W17BDA1	342212	920646	191.72	206.43	-14.7
04S10W29ADB1	342025	920625	207.96	212.06	-4.1
04S11W14BAD1	342220	921000	309.76	316.03	-6.3
05S08W30ADB1	341452	915440	297.47	296.14	1.3
05S09W19BAA3	341609	920131	257.64	272.91	-15.3
05S09W31DDC1	341337	920109	276.94	275.32	1.6
05S10W11ACA1	341741	920322	171.02	219.37	-48.4
05S10W16BAD1	341700	920549	241.67	247.89	-6.2
05S10W16DBB1	341635	920543	294.23	313.03	-18.8
05S10W16DBD1	341635	920534	283.89	312.89	-29.0
06S08W16CCC1	341143	915517	255.74	253.38	2.4
06S08W25ADC1	341025	915116	225.65	223.88	1.8
06S09W17CAD1	341159	920207	258.15	259.15	-1.0
06S09W17CCA1	341152	920221	267.95	263.82	4.1
06S10W23ACA2	341123	920504	223.68	227.88	-4.2
06S10W23ACD1	341116	920508	223.97	232.57	-8.6
06S10W23DBA1	341105	920506	237.29	249.98	-12.7
07S07W24BAB1	340633	914523	164.84	172.56	-7.7
07S10W24CAC1	340549	920421	305.17	266.27	38.9
		Lafayette County			
16S23W12CAD1	332143	932609	74.85	78.77	-3.9
16S24W26AAC1	331950	933303	54.65	58.26	-3.6
17S23W19ACC1	331520	933128	51.57	54	-2.4
18S23W29ACC1	330911	933039	12.23	11.52	0.7
19S23W29BDB1	330352	933103	41.56	42.29	-0.7
19S25W13CAB1	330555	933922	38.5	37.06	1.4
20S23W05ADA1	330223	933026	34.86	34.71	0.1
20S23W05ADB1	330223	933036	40.15	39.87	0.3

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
Lee County					
01N04E09CDD1	344210	904119	59.65	66.48	-6.8
02N01E10CAD1	344743	905925	51.88	58.14	-6.3
03N03E28CDB1	345006	904749	61.97	64.71	-2.7
Lincoln County					
07S07W30CDC1	340444	915043	180.38	189.56	-9.2
08S04W22AAA1	340105	912753	119.87	116.68	3.2
08S05W03BAA2	340310	913454	147.58	154.59	-7.0
08S05W35ACC1	335907	913337	139.97	153.44	-13.5
08S08W35DBB1	335858	915222	201.98	221.8	-19.8
08S08W35DCB1	335851	915217	210.54	251.48	-40.9
09S07W07DAD1	335634	915128	268.54	283.36	-14.8
Lonoke County					
01N07W03BCC1	344425	914503	127.91	131.94	-4.0
01S08W02DBD1	343855	914960	97.32	107.17	-9.9
02N07W06ACD1	344939	914737	121.48	128.74	-7.3
02N07W09AAA1	344906	914500	98.77	100.58	-1.8
02N07W22DBA1	344651	914426	128.45	134.45	-6.0
02N07W24DAC1	344650	914209	146.54	152.69	-6.2
02N07W32DDD1	344453	914619	129.33	142.3	-13.0
02S07W08DCC1	343235	914700	140.15	145.17	-5.0
02S08W16BDA1	343228	915232	119.77	124.98	-5.2
02S09W15BBB2	343247	915825	71.35	80.81	-9.5
03N07W03CAA1	345445	914426	78.28	80.55	-2.3
03N07W23CCC1	345144	914350	85.33	91.26	-5.9
03N08W11ACD1	345403	914935	91.62	95.42	-3.8
03N08W22DAD1	345205	915024	92.69	96.77	-4.1
03N08W22DAD2	345205	915024	96.57	99.48	-2.9
03N08W22DDD2	345152	915025	96.24	100.59	-4.4
Mississippi County					
11N09E26AAD3	353302	900523	19.06	26.6	-7.5
11N09E26ABA2	353304	900539	15.34	27.11	-11.8
Monroe County					
01N03W14CCB1	344144	911801	72.73	77.28	-4.5
03N02W26DAB1	345042	911026	47.13	50.58	-3.4
04N02W28DDD4	345535	911221	30.49	35.64	-5.2
04N02W30BAC1	345617	911504	14.59	14.78	-0.2
04N02W30BAD1	345617	911515	9.86	18.74	-8.9

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
		Ouachita County			
11S15W27ABD1	334441	923726	71.72	70.76	1.0
11S17W14CAC1	334631	924927	18.7	21.58	-2.9
11S17W36CCA1	334341	924834	7.18	10.64	-3.5
12S15W09BBA1	334223	923922	70.57	58.57	12.0
12S16W25BDC1	333929	924211	33.82	34.48	-0.7
12S16W26ABD1	333946	924304	34.69	35.57	-0.9
12S18W19CDC1	334014	925951	8	23.42	-15.4
12S18W25CAB1	333937	925442	77.43	80.41	-3.0
12S19W09BAB1	334251	930352	10.01	10.88	-0.9
12S19W14AAA1	334143	930105	5.03	8.53	-3.5
12S19W35BDD1	333901	930146	156.23	157.61	-1.4
13S16W28ADD1	333416	924451	32.19	34.19	-2.0
13S18W31BDD1	333343	925956	70.02	72.04	-2.0
13S19W28BCD1	333434	930418	36.22	39.32	-3.1
14S17W05CAD1	333238	925255	36.93	37.4	-0.5
14S17W32CAD1	332803	925251	81.86	79.5	2.4
14S19W29ABB1	332941	930513	87.52	89.04	-1.5
15S18W36ADD1	332311	925436	95.43	95.24	0.2
15S19W10DCC1	332618	930318	73.25	70.92	2.3
15S19W21CDD2	332438	930432	198.38	199.76	-1.4
		Phillips County			
01S02E32DDC1	343324	905455	80.79	86.43	-5.6
02S02E01ADC1	343323	905056	36.62	36.47	0.1
02S04E02DBA1	343243	903907	112.84	125.68	-12.8
02S05E16BCB1	343108	903526	33.52	37.59	-4.1
02S05E29CCC1	342851	903635	34.96	32.29	2.7
03S03E30DAA1	342403	904915	43.88	37.23	6.7
04S02E25CCC1	341824	905121	35.99	40.59	-4.6
		Poinsett County			
10N01E12BDC1	353026	905630	95.1	102.92	-7.8
10N01E15DBB1	352931	905825	94.74	99.23	-4.5
10N01E33ABA1	352725	905924	75.44	80.38	-4.9
10N03E02BCD1	353139	904447	109.89	112.85	-3.0
10N03E23CAC1	352850	904432	111.69	114.59	-2.9
11N02E16CCC1	353448	905321	105.49	111.48	-6.0
11N03E25BDD1	353325	904323	120.71	122.55	-1.8
12N03E12BBB1	354137	904340	96.67	114.38	-17.7
12N03E35BCC1	353745	904456	102.24	102.65	-0.4
12N03E35DDA1	353727	904353	101.36	104.84	-3.5

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
		Prairie County			
01N05W19CDC1	344113	913505	139.47	141.08	-1.6
01N06W02ABB1	344442	913701	115.65	117.17	-1.5
01N06W34CBB1	343943	913846	155.79	159.78	-4.0
01S05W06BCB1	343904	913532	148.65	154.53	-5.9
01S05W20ABB1	343640	913352	158.85	152.27	6.6
01S06W01BDD2	343859	913613	163.98	160.68	3.3
01S06W11DBD1	343749	913654	164.72	161.4	3.3
02N04W19ACB1	344649	912802	91.13	58.54	32.6
02N06W19AAB1	344718	914050	138.21	145.46	-7.3
02N06W20BCB1	344707	914033	142	141.86	0.1
02N06W21DAD1	344644	913829	119.87	121.35	-1.5
02N06W22BDD1	344654	913801	118.96	128.97	-10.0
03N05W03ADA2	345452	913043	60.03	58.99	1.0
03N05W20CCC1	345145	913356	70.41	73.59	-3.2
03N06W20CDD1	345140	914004	83.79	86.99	-3.2
		St. Francis County			
03N01W33CDD1	345446	910635	68.01	74.82	-6.8
04N04E18BAB1	345743	904319	63.28	67.91	-4.6
		Union County			
16S14W15CAB1	331944	923218	160.88	152.73	8.2
16S15W20DAA1	331860	923958	288.32	252.98	35.3
16S15W31ACC1	331717	924129	294.15	259.78	34.4
16S16W02ABC1	332206	924329	168.36	155.93	12.4
16S18W34ABC2	331806	925709	205.26	211.24	-6.0
17S12W31DDD1	331206	922226	238.11	231.99	6.1
17S12W32BBC1	331202	922219	250.58	246.34	4.2
17S13W31BAC1	331200	922916	306.13	308.27	-2.1
17S14W22BAB1	331354	923224	317.24	285.17	32.1
17S15W08CDD1	331505	924027	325.58	279.2	46.4
17S15W18DBB1	331439	924129	331.1	289.26	41.8
17S15W28DCC1	331233	923924	437.19	426.09	11.1
17S15W29CDC1	331229	924039	373.46	349.58	23.9
17S15W31DCA1	331145	924117	425.27	380.73	44.5
17S15W31DDA1	331144	924105	414.99	367.33	47.7
17S16W02CCC1	331559	924403	336.32	314.27	22.1
17S16W02DCD1	331602	924326	387.68	373.13	14.6
17S16W12CDD1	331506	924232	406.31	378.42	27.9
17S16W24BDB1	331357	924248	394.04	333.81	60.2
17S17W25DBA2	331256	924838	359	323.95	35.1

Appendix 2. Difference in water level from 2005 to 2009 in the Sparta-Memphis aquifer in Arkansas.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); Negative values denote a decline; 2005 depth to water level from Schrader, 2007]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	2005 depth to water (feet below land-surface datum	2009 depth to water (feet below land-surface datum	Difference in water level from 2005 to 2009 (feet)
Union County—Continued					
17S17W30DCD1	331257	925356	321.93	325.07	-3.1
18S12W33BBB1	330651	922120	141.18	136.2	5.0
18S14W06CCD1	331039	923531	398.58	339.28	59.3
18S15W03DAB1	331104	923802	373.72	330.63	43.1
18S15W07BAC2	331035	924139	364.47	346.79	17.7
18S15W33ADA1	330659	923858	374.03	347.84	26.2
18S15W35DAC1	330636	923707	290.2	275.84	14.4
18S16W10CDD1	331000	924445	327.54	308.87	18.7
18S16W11DAC1	331011	924316	422.53	401.94	20.6
18S17W22BDD1	330856	925056	353.54	327.8	25.7
18S18W11ACD2	331051	925615	271.33	261.67	9.7
19S10W16CBC1	330329	920904	86.64	89.87	-3.2
19S11W23ACA1	330255	921229	151.98	152.67	-0.7
19S11W25AAA1	330218	921113	152.27	151.75	0.5
19S16W35DDC1	330109	924326	247.08	219.84	27.2
19S18W14ADA1	330452	925608	191.38	192.15	-0.8
Woodruff County					
05N01W11ABA1	350426	910407	55.76	60.83	-5.1
05N01W17DBB1	350311	910727	45.61	47.46	-1.9
05N02W31DCB3	350027	911456	11.64	19.38	-7.7
06N01W13ABA1	350852	910254	63.04	69.97	-6.9
06N01W13ADC1	350827	910247	66.03	67.21	-1.2
07N01W12BCB1	351442	910326	61.52	69.36	-7.8
08N01W12CDA1	351934	910311	72.04	76.47	-4.4
08N02W26ADC1	351726	911004	32.56	35.67	-3.1

Appendix 3—Specific Conductance, Temperature, and pH Data from Wells Completed in the Sparta-Memphis Aquifer in Arkansas, Summer 2009

Appendix 3. Specific conductance, temperature and pH data from wells completed in the Sparta-Memphis aquifer in eastern Arkansas, summer 2009.

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); µS/cm, microsiemens per centimeter at 25 degrees Celsius]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Specific conductance (µS/cm)	Temperature (degrees Celsius)	pH (standard units)
			Arkansas County			
02S04W06CDB1	343312	912849	8/3/2009	373	24.3	8.1
04S01W04CBD1	342225	910808	8/3/2009	794	26	7.7
07S03W06ABC1	340702	912248	8/3/2009	230	24.7	7.8
			Ashley County			
15S07W32CDD1	332118	915101	7/30/2009	884	27.2	8.7
			Bradley County			
13S09W06ACB2	333647	920417	7/30/2009	372	27.9	8.4
14S09W16AAC1	332931	920218	7/30/2009	410	25.2	8.1
			Calhoun County			
11S14W12CAC3	334630	922928	7/29/2009	178	23.8	6.6
14S13W03CAB1	333145	922551	7/30/2009	476	25.1	8.3
14S13W12CCB1	333040	922404	7/21/2009	455	23.2	8.7
14S15W16BAA1	333055	923912	7/30/2009	311	24.8	8.2
			Cleveland County			
09S09W04BBD1	335820	920237	7/30/2009	382	24.9	8.0
11S11W16AAB1	334543	921423	7/30/2009	300	26.3	8.0
			Columbia County			
15S20W20CCB1	332453	931215	7/29/2009	346	24.7	8.0
16S20W18ACD1	332053	931237	7/29/2009	367	25	8.4
17S20W17CDA1	331520	931201	7/21/2009	399	23.6	8.6
19S20W09CBD1	330555	931129	7/21/2009	230	23.9	8.6
			Craighead County			
14N04E28DBD1	354837	903953	8/5/2009	146	20.3	7.0
			Crittenden County			
05N07E34CAA1	350017	901909	8/4/2009	418	22.9	8.1
06N09E23AAB1	350745	900553	8/4/2009	247	23.8	7.9
			Cross County			
07N05E04ADD1	351538	903330	8/12/2009	227	21.3	7.4
09N01E16CAC1	352405	905951	8/4/2009	338	26.2	7.6
09N04E30DCA1	352232	904218	8/4/2009	491	24.2	7.8
			Dallas County			
07S14W31AAA1	340425	923334	7/29/2009	125	25.1	6.8
10S13W34ACA2	334829	922458	7/29/2009	277	24.9	7.3
			Desha County			
09S02W26AAC1	335346	911521	7/31/2009	284	24.3	8.1
12S03W34DAD1	333643	912305	7/31/2009	373	25	8.3

Appendix 3. Specific conductance, temperature and pH data from wells completed in the Sparta-Memphis aquifer in eastern Arkansas, summer 2009.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); µS/cm, microsiemens per centimeter at 25 degrees Celsius]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Specific conductance (µS/cm)	Temperature (degrees Celsius)	pH (standard units)
			Drew County			
11S05W21CDC1	334352	913724	7/30/2009	256	27.2	8.1
13S05W36ACB1	333151	913408	7/30/2009	361	25.8	8.8
			Grant County			
05S13W03CAA1	341844	922400	7/29/2009	89	22.3	6.4
06S15W26ACA1	341022	923538	7/29/2009	48	24.6	7.0
			Jefferson County			
04S07W17BCC1	342140	914742	8/3/2009	153	24.3	7.2
04S11W14BAD1	342220	921000	8/3/2009	101	23.4	8.2
06S09W17CD2	341148	920224	8/11/2009	148	27.3	6.6
06S10W23DBA1	341105	920506	8/3/2009	203	23.8	8.4
			Lafayette County			
20S23W05ADB1	330223	933036	7/29/2009	214	27.1	8.0
			Lincoln County			
07S06W33BAA1	340445	914140	7/31/2009	201	26	8.5
08S05W35ACC1	335907	913337	7/31/2009	244	25.4	8.8
09S07W07DAD1	335634	915128	7/31/2009	426	25.1	8.5
			Lonoke County			
02N07W09AAA1	344906	914500	8/3/2009	353	23	7.7
02S07W08DCC1	343235	914700	8/3/2009	368	23.6	7.6
			Monroe County			
01N03W14CCB1	344144	911801	8/3/2009	878	23.3	8.1
04N02W30BAC1	345617	911504	8/3/2009	741	19.9	7.8
			Nevada County			
14S21W04CCB1	333251	931708	7/29/2009	201	25.8	7.1
14S21W20AAB1	333050	931723	7/29/2009	210	26.2	7.1
			Ouachita County			
12S16W26BAA1	333948	924305	7/21/2009	228	20.6	7.1
12S19W14AAA1	334143	930105	7/29/2009	43	26.2	7.2
15S19W10DCC1	332618	930318	7/29/2009	203	25.8	6.9
			Phillips County			
01S02E32DDC1	343324	905455	8/4/2009	789	24.1	7.9
03S05E05BAB1	342755	903621	8/4/2009	793	20.7	8.0
04S02E25CCC1	341824	905121	8/4/2009	1,230	23.1	8.4
			Poinsett County			
10N01E15DBB1	352931	905825	8/5/2009	383	21.8	8.0
			Prairie County			
02N06W20BCB1	344707	914033	8/5/2009	380	21.9	7.3

Appendix 3. Specific conductance, temperature and pH data from wells completed in the Sparta-Memphis aquifer in eastern Arkansas, summer 2009.—Continued

[Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83); µS/cm, microsiemens per centimeter at 25 degrees Celsius]

Station name	Latitude (degrees, minutes, seconds)	Longitude (degrees, minutes, seconds)	Date	Specific conductance (µS/cm)	Temperature (degrees Celsius)	pH (standard units)
St. Francis County						
05N03E33ABA2	350020	904713	8/4/2009	517	19.7	7.5
Union County						
16S15W20DAA1	331860	923958	7/30/2009	556	25	8.8
16S16W01DDD1	332114	924211	7/22/2009	454	22.3	9.0
16S18W34ABC2	331806	925709	7/29/2009	335	25.1	8.4
17S13W31BAD1	331204	922907	7/22/2009	762	25	8.9
17S16W24BDB1	331357	924248	7/22/2009	437	22.7	8.7
17S17W30DCD1	331257	925356	7/21/2009	330	24.7	8.5
18S14W06CCD1	331039	923531	7/30/2009	733	24.5	8.6
19S11W25AAA1	330218	921113	7/22/2009	1,150	24.8	8.5
19S15W01CCA1	330535	923645	7/30/2009	325	23.2	8.2
19S16W35DDC1	330109	924326	7/22/2009	578	22.9	8.7
Woodruff County						
05N02W31DCB3	350027	911456	8/5/2009	201	20.3	7.9

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