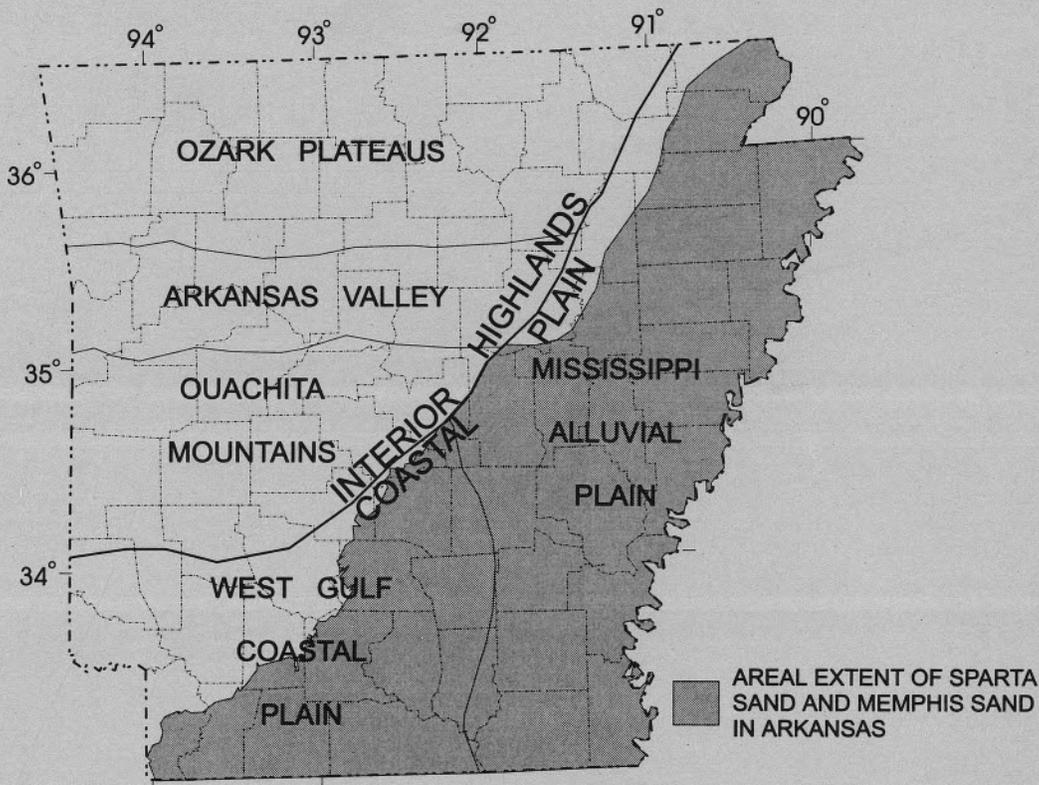


POTENTIOMETRIC SURFACE AND SPECIFIC CONDUCTANCE OF THE SPARTA AND MEMPHIS AQUIFERS IN EASTERN AND SOUTH-CENTRAL ARKANSAS, 1995

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 97-4119



Prepared in cooperation with the
ARKANSAS GEOLOGICAL COMMISSION and the
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CONDUCTANCE OF THE SPARTA AND MEMPHIS
AQUIFERS IN EASTERN ARKANSAS, 1995**

by Gregory P. Stanton

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**Little Rock, Arkansas
1997**



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Denver, Colorado 80225

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POTENTIOMETRIC SURFACE AND SPECIFIC CONDUCTANCE OF THE SPARTA AND MEMPHIS AQUIFERS IN EASTERN AND SOUTH-CENTRAL ARKANSAS, 1995

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ABSTRACT

The Sparta and Memphis aquifers in eastern and south-central Arkansas are a major source of water for industrial, public supply, and agricultural uses. An estimated 240 million gallons per day was withdrawn from the Sparta and Memphis aquifers in 1995, an increase of about 17 million gallons per day from 1990. During the spring and early summer of 1995, the water level in the Sparta and Memphis aquifers was measured in 145 wells, the specific conductance of 101 ground-water samples collected from those aquifers was measured. Maps of areal distribution of potentiometric surface and specific conductance generated from these data reveal spatial trends in these parameters across the eastern and south-central Arkansas study area. The altitude of the potentiometric surface ranged from about 206 feet below sea level in Union County to about 307 feet above sea level in Saline County.

The potentiometric surface of the Sparta and Memphis aquifers contains cones of depression descending below sea level in the central and southern portions of the study area, and a potentiometric high along the western study area boundary. Major recharge areas exhibit potentiometric highs greater than 200 feet above sea level and specific conductance values less than 200 microsiemens per centimeter, and generally are located in the outcrop/subcrop areas on the southern one-third of the western boundary and the northern portion of the study area. The regional direction of ground-water flow is from the north and west to the south and east, away from the outcrop and subcrop and northern regions, except near areas

affected by intense ground-water withdrawals; such areas are manifested by large cones of depression centered in Columbia, Jefferson, and Union Counties. The cones of depression in adjoining Columbia and Union Counties are coalescing at or near sea level. The lowest water level measured was about 206 feet below sea level in Union County. Increased specific conductance values were measured in the areas of the cones of depression in Columbia and Union Counties.

The cone of depression centered in Jefferson County coincides with an elongate area where ground water in the aquifer has low specific conductance. This area extends eastward from the outcrop/subcrop region of recharge. This extension of ground water with low specific conductance possibly indicates increased ground-water movement to the east-southeast from the outcrop/subcrop area induced by ground-water withdrawals in Jefferson County. Specific conductance increases markedly to the northeast and gradually to the south of this area.

Long-term hydrographs of eight wells in the study area, during the period 1970-1995, reveal water-level declines ranging from less than 0.5 foot per year in Phillips County to more than 2.0 feet per year in Union County. Water-level declines of greater than 1.5 feet per year generally are associated with the cones of depression centered in Columbia, Jefferson, and Union Counties.

INTRODUCTION

The Sparta and Memphis aquifers are a major source of water for much of eastern and south-central Arkansas. Major withdrawals occur from the aquifers

for industrial and public supply, with lesser but locally significant withdrawals for agricultural uses. During 1995, an estimated 240 million gallons per day (Mgal/d) of water was withdrawn from the Sparta and Memphis aquifers, up from about 222.50 Mgal/d in 1990. The two aquifers are the second most productive source of ground water in Arkansas (Holland, 1993).

The study area (fig. 1) includes most of the Coastal Plain physiographic province in Arkansas. The area is bounded on the north by the Missouri State line, on the south by the Louisiana State line, and on the east by the Tennessee and Mississippi State lines. The western boundary is defined as the western extent of the outcrop and subcrop (Hosman, 1982) of the Sparta Sand and the Memphis Sand.

The U.S. Geological Survey (USGS) in cooperation with the Arkansas Geological Commission and the Arkansas Soil and Water Conservation Commission has monitored water levels in the Sparta and Memphis aquifers since 1928. During March through July 1995, 145 water-level measurements and 101 specific conductance measurements were made in wells completed in these aquifers. The purpose of these measurements was to provide information describing the potentiometric surface and specific conductance of ground water in the Sparta and Memphis aquifers. This

report presents results as maps and as updated water-level hydrographs.

DESCRIPTION OF AQUIFERS

The Sparta Sand and Memphis Sand of Eocene age are part of the Claiborne Group and mainly consist of fine- to medium-grain sand. In the central and southern parts of the study area, the Sparta Sand is underlain by the marine clay of the Cane River Formation, which serves as a lower confining unit. In the northern part of the study area (north of about 35 degrees latitude), the Cane River Formation is predominantly composed of sand (Hosman and others, 1968), and the aquifer is thicker and more homogeneous. In this northern area, the Claiborne Group is not subdivided into the Sparta Sand, Cane River Formation, and Carrizo Sand, but the equivalent section is a single formation known as the "Memphis Sand." The Memphis Sand is underlain by a thick layer of clay that is part of the Wilcox Group. Some silt, clay, and lignite occur in the upper portion of the Sparta and Memphis Sands. Both the Sparta and Memphis Sand are overlain by the Cook Mountain Formation, which serves as an upper confining unit. The

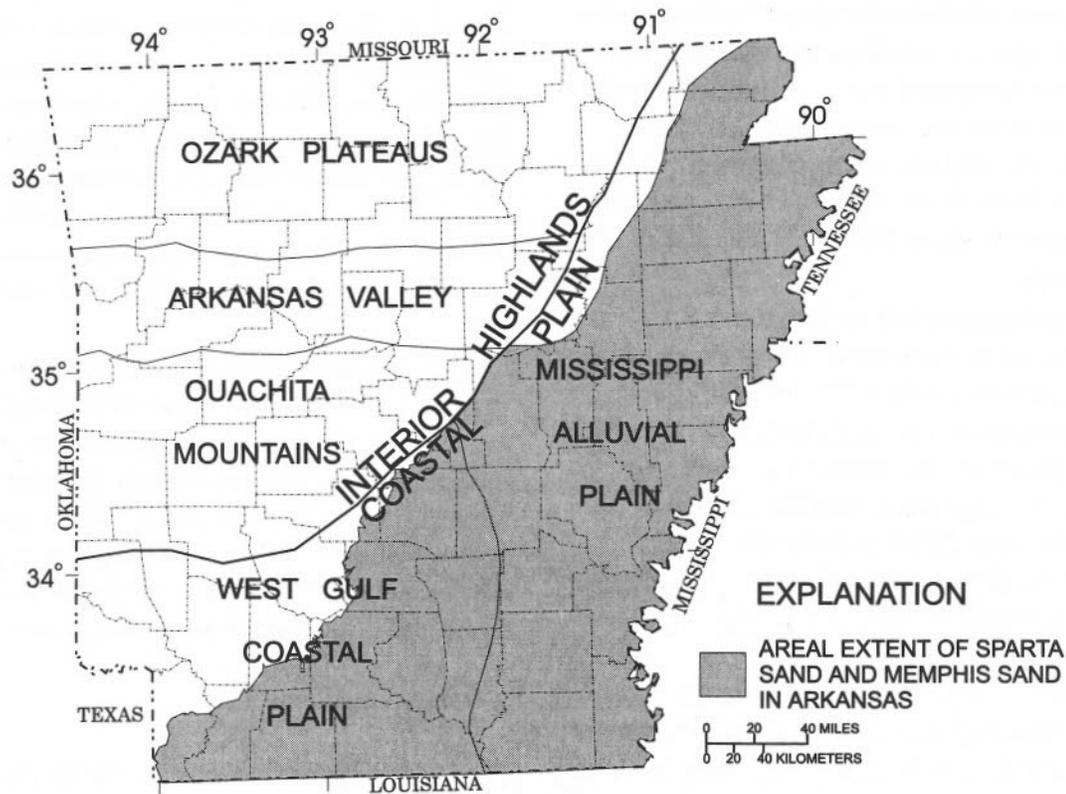


Figure 1. Location of study area.

permeable units of the Sparta Sand and the Memphis Sand comprise the respective aquifers. Water levels in the Sparta aquifer generally correlate with those in the Memphis aquifer; therefore, the water-bearing formations are considered to be one hydrologic unit.

Water in the Sparta and Memphis aquifers is generally confined except in the outcrop/subcrop areas (plate 1). Recharge to the aquifers chiefly occurs from infiltration of precipitation on the outcrop areas and from downward movement of water from the overlying alluvium in subcrop areas (Petersen and others, 1985). Minor amounts of recharge probably also occur from leakage of water through the upper and lower confining beds where a positive gradient exists between overlying or underlying aquifers and the Sparta or Memphis aquifer (Edds and Fitzpatrick, 1989). Lateral flow occurs from the Memphis Sand south to the Sparta Sand at the zone of lithofacies transition (plate 1) near 35° latitude (Petersen and others, 1985). Discharge from the Sparta and Memphis aquifers occurs by withdrawal from wells, discharge to confining beds above or below, and subsurface flow to the south. A more detailed description of the Sparta and Memphis aquifers is given in Hosman and others (1968) and Petersen and others (1985).

POTENTIOMETRIC-SURFACE MAP

The potentiometric-surface map shows the altitude to which water would have risen in tightly cased wells screened in the aquifers (plate 1). The map is based on 145 water-level measurements made during March through July 1995 (table 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 value. The general direction of ground-water flow in the Sparta and Memphis aquifers is perpendicular to the contours in the direction of downward hydraulic gradient.

The highest water-level altitude measured was about 307 feet (ft) above sea level, located in Saline County near the edge of the outcrop/subcrop region. The regional direction of ground-water flow is generally to the south to southwest in the northern half of the study area and to the east and south in the southern half, away from the outcrop and subcrop region except where affected by intense ground-water withdrawals. Three cones of depression centered in Columbia, Jefferson, and Union Counties are a result of large withdrawals of water for industrial and public supplies. The cone of depression centered in Jefferson County has an

elliptical shape because of withdrawals for irrigation in Arkansas and Prairie Counties. The cones of depression in Columbia and Union Counties are elongate to the southeast and northwest, respectively, and coalesce at or near sea level. The lowest point measured was about 206 ft below sea level in central Union County.

LONG-TERM HYDROGRAPHS

Twenty-five years of water-level data from each of eight selected wells completed in the Sparta and Memphis aquifers were plotted as hydrographs to illustrate the history of water-levels in Arkansas, Bradley, Columbia, Desha, Jefferson, Phillips, Poinsett, and Union Counties (fig. 2). Water levels have declined during the period of 1970 to 1995, generally more than 2 feet per year (ft/yr) in Union County; between 1.5 - 2.0 ft/yr in Arkansas, Columbia, Desha, and Jefferson Counties; between 1.0 and 1.5 ft/yr in Bradley and Poinsett Counties; and less than 0.5 ft/yr in Phillips County. Water-level declines of greater than 1.5 ft/yr generally are associated with the cones of depression centered in Columbia, Jefferson, and Union Counties. The hydrograph in Phillips County, indicating draw-down of less than 0.5 ft/yr, is from a well in an area unaffected by a cone of depression.

SPECIFIC CONDUCTANCE MAP

The specific conductance of water is proportional to the concentration of dissolved solids in solution. In ground-water samples collected from wells in Union County (Broom and others, 1984), total dissolved solids (in milligrams per liter) averaged about 60 percent of the specific conductance value in microsiemens per centimeter. The specific conductance map (plate 2) shows lines of equal specific electrical conductance of ground water in the Sparta and Memphis aquifers in microsiemens per centimeter at 25 degrees Celsius ($\mu\text{S}/\text{cm}$). The map is based on 101 specific conductance measurements made during the period April through July 1995 from wells that are open to only the Sparta or Memphis aquifers (table 2). Wells were pumped until temperature stabilized before a specific conductance sample was collected.

Table 1. Information pertaining to measured wells completed in the Sparta and Memphis aquifers

| Latitude | Longitude | Local well number | Water level altitude (feet above sea level) | Depth to water level (feet below land-surface datum) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|-------------------------|-----------|-------------------|--|---|---|---------------------|---------|
| Arkansas County | | | | | | | |
| 340116 | 911131 | 08S02W01CBA1 | 88 | 77.26 | 165 | 4/26/95 | Sparta |
| 340124 | 912039 | 08S03W12307 | 84 | 92.07 | 176 | 4/25/95 | Sparta |
| 340135 | 912152 | 08S03W12299 | 77 | 98.39 | 175 | 4/25/95 | Sparta |
| 340340 | 911410 | 07S02W28ABA1 | 92 | 89.22 | 181 | 4/26/95 | Sparta |
| 340711 | 912248 | 07S03W06ABC1 | 71 | 114.00 | 185 | 4/25/95 | Sparta |
| 341228 | 911622 | 06S02W06ABB1 | 77 | 103.93 | 181 | 4/25/95 | Sparta |
| 341247 | 912946 | 05S05W36DAA1 | 55 | 124.89 | 180 | 4/25/95 | Sparta |
| 341734 | 912006 | 05S03W04ADB1 | 65 | 122.34 | 187 | 4/25/95 | Sparta |
| 341752 | 913004 | 04S05W36DCC1 | 51 | 145.06 | 196 | 5/01/95 | Sparta |
| 341929 | 910739 | 04S01W28BAA1 | 93 | 96.66 | 190 | 4/27/95 | Sparta |
| 342004 | 912514 | 04S04W22DAA1 | 61 | 134.39 | 195 | 5/02/95 | Sparta |
| 342005 | 912926 | 04S04W19CBB1 | 53 | 141.73 | 195 | 5/01/95 | Sparta |
| 342155 | 912503 | 04S04W11BCC1 | 54 | 144.20 | 198 | 5/01/95 | Sparta |
| 342416 | 912437 | 03S04W26CDA1 | 62 | 141.44 | 203 | 5/01/95 | Sparta |
| 342416 | 912645 | 03S04W33BAA1 | 58 | 142.85 | 201 | 5/01/95 | Sparta |
| 342515 | 914210 | 03S06W30BBD1 | 50 | 141.34 | 191 | 5/02/95 | Sparta |
| 342554 | 913925 | 03S06W21ACC1 | 55 | 139.95 | 195 | 5/02/95 | Sparta |
| 342632 | 913005 | 03S05W13BDC1 | 45 | 165.50 | 210 | 4/28/95 | Sparta |
| 342633 | 913523 | 03S05W18CAB1 | 52 | 143.82 | 196 | 5/02/95 | Sparta |
| 342747 | 912457 | 03S04W02CCB1 | 67 | 134.90 | 202 | 4/28/95 | Sparta |
| 342839 | 913032 | 03S05W02AAB1 | 54 | 155.71 | 210 | 4/28/95 | Sparta |
| 342924 | 912700 | 02S04W33BBB1 | 64 | 141.22 | 205 | 4/29/95 | Sparta |
| 343044 | 912349 | 02S04W23DAA1 | 90 | 117.81 | 208 | 4/28/95 | Sparta |
| 343312 | 912849 | 02S04W06CDB1 | 69 | 142.96 | 212 | 4/28/95 | Sparta |
| Ashley County | | | | | | | |
| 332117 | 915103 | 15S07W32CDD1 | 38 | 152.37 | 190 | 4/18/95 | Sparta |
| Bradley County | | | | | | | |
| 331836 | 922052 | 16S12W21CAA1 | 29 | 70.57 | 100 | 4/19/95 | Sparta |
| 333453 | 921607 | 13S11W17BCD1 | 57 | 192.51 | 250 | 4/19/95 | Sparta |
| Calhoun County | | | | | | | |
| 333040 | 922403 | 14S13W12CCB1 | 38 | 166.79 | 205 | 4/26/95 | Sparta |
| 333226 | 922741 | 13S13W32CDA1 | 35 | 172.82 | 208 | 4/26/95 | Sparta |
| Cleveland County | | | | | | | |
| 334543 | 921422 | 11S11W16AAB1 | 94 | 208.53 | 303 | 4/20/95 | Sparta |
| 334917 | 920019 | 10S09W23CDC1 | 58 | 162.19 | 220 | 6/16/95 | Sparta |
| 335133 | 921749 | 10S12W12BDD1 | 108 | 112.00 | 220 | 4/20/95 | Sparta |
| 335728 | 921133 | 09S11W01DCA1 | 45 | 184.81 | 230 | 4/20/95 | Sparta |
| 335729 | 921120 | 09S11W01DDA2 | 61 | 204.79 | 266 | 4/20/95 | Sparta |
| Columbia County | | | | | | | |
| 330517 | 931725 | 19S21W16DBB1 | 110 | 174.42 | 284 | 5/24/95 | Sparta |
| 330555 | 931128 | 19S20W09CAC1 | 74 | 257.97 | 332 | 5/25/95 | Sparta |
| 330557 | 931146 | 19S20W08DAD1 | 71 | 248.77 | 320 | 5/24/95 | Sparta |

Table 1. Information pertaining to measured wells completed in the Sparta and Memphis aquifers (Continued)

| Latitude | Longitude | Local well number | Water level altitude (feet above sea level) | Depth to water level (feet below land-surface datum) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|--------------------------|-----------|-------------------|---|--|--|---------------------|---------|
| 330609 | 932743 | 19S23W11CDA2 | 193 | 55.11 | 248 | 5/24/95 | Sparta |
| 331142 | 931248 | 18S20W06DDC1 | -17 | 317.38 | 300 | 5/24/95 | Sparta |
| 331406 | 930650 | 17S19W30ABB1 | 31 | 217.50 | 248 | 5/31/95 | Sparta |
| 331519 | 931159 | 17S20W17CDA1 | 9 | 316.12 | 325 | 5/30/95 | Sparta |
| 331537 | 930328 | 17S19W15ABD1 | 50 | 274.98 | 325 | 5/31/95 | Sparta |
| 331609 | 931449 | 17S21W11DCC2 | -20 | 323.09 | 303 | 6/02/95 | Sparta |
| 331753 | 931513 | 16S21W35CCD1 | -23 | 297.66 | 275 | 6/02/95 | Sparta |
| 331948 | 932222 | 16S22W22CCD1 | 205 | 134.78 | 340 | 5/25/95 | Sparta |
| 332049 | 931516 | 16S21W14CBB1 | 64 | 217.01 | 281 | 5/25/95 | Sparta |
| 332052 | 931237 | 16S20W18ACD1 | 55 | 282.16 | 337 | 5/25/95 | Sparta |
| 332453 | 931215 | 15S20W20CCB1 | 155 | 216.84 | 372 | 6/02/95 | Sparta |
| Craighead County | | | | | | | |
| 354641 | 904114 | 13N04E05DCC1 | 205 | 135.35 | 340 | 3/22/95 | Memphis |
| 354836 | 903953 | 14N04E28DBD1 | 197 | 56.62 | 254 | 6/22/95 | Memphis |
| 354929 | 903922 | 14N04E22CBD1 | 204 | 51.53 | 256 | 6/22/95 | Memphis |
| Crittenden County | | | | | | | |
| 350344 | 901300 | 05N08E11CCA2 | 188 | 22.96 | 211 | 3/22/95 | Memphis |
| 350958 | 901738 | 06N07E01DAD2 | 188 | 20.60 | 209 | 3/22/95 | Memphis |
| Cross County | | | | | | | |
| 351018 | 904231 | 06N04E06ACA1 | 162 | 196.26 | 358 | 3/22/95 | Memphis |
| 351537 | 903329 | 07N05E04ADD1 | 177 | 32.27 | 209 | 3/21/95 | Memphis |
| 352231 | 904215 | 09N04E30DCA1 | 174 | 254.85 | 429 | 3/21/95 | Memphis |
| 352359 | 904514 | 09N03E22AAD1 | 160 | 118.14 | 278 | 3/23/95 | Memphis |
| 352403 | 905949 | 09N01E16CAC1 | 158 | 76.40 | 234 | 3/23/95 | Memphis |
| Dallas County | | | | | | | |
| 334832 | 922455 | 10S13W34ACA2 | 126 | 145.59 | 272 | 4/24/95 | Sparta |
| 335304 | 922413 | 09S13W35CCD1 | 133 | 66.67 | 200 | 4/24/95 | Sparta |
| 335935 | 924307 | 08S16W27DDD1 | 240 | 31.64 | 272 | 4/24/95 | Sparta |
| Desha County | | | | | | | |
| 333636 | 912304 | 12S03W34DAD1 | 69 | 78.19 | 147 | 5/03/95 | Sparta |
| 334223 | 911421 | 11S01W31BBB1 | 50 | 90.93 | 141 | 5/03/95 | Sparta |
| 334605 | 911705 | 11S02W03CCA1 | 82 | 56.72 | 139 | 5/03/95 | Sparta |
| 334748 | 911618 | 10S02W26CCC2 | 84 | 64.35 | 148 | 5/09/95 | Sparta |
| 335304 | 913005 | 09S04W28DDD1SP | 58 | 107.31 | 165 | 5/09/95 | Sparta |
| 335341 | 911522 | 09S02W26AAC1 | 87 | 66.42 | 153 | 5/09/95 | Sparta |
| Drew County | | | | | | | |
| 332418 | 912726 | 15S04W12DDA1 | 69 | 56.15 | 125 | 4/19/95 | Sparta |
| 333154 | 913404 | 13S05W36ACB1 | 81 | 88.13 | 169 | 4/19/95 | Sparta |
| 333649 | 914400 | 12S06W32DAD1 | 53 | 158.77 | 212 | 4/19/95 | Sparta |
| 334248 | 912708 | 11S04W25DAA1 | 69 | 78.69 | 148 | 4/19/95 | Sparta |
| Grant County | | | | | | | |
| 341024 | 923545 | 06S15W26ACA1 | 213 | 66.53 | 280 | 4/24/95 | Sparta |
| 341341 | 921414 | 06S11W05ACA1 | 83 | 196.79 | 280 | 4/21/95 | Sparta |
| 341841 | 923320 | 05S14W06DCC1 | 205 | 87.93 | 293 | 4/24/95 | Sparta |
| 341845 | 922359 | 05S13W03DBC1 | 161 | 98.61 | 260 | 4/21/95 | Sparta |

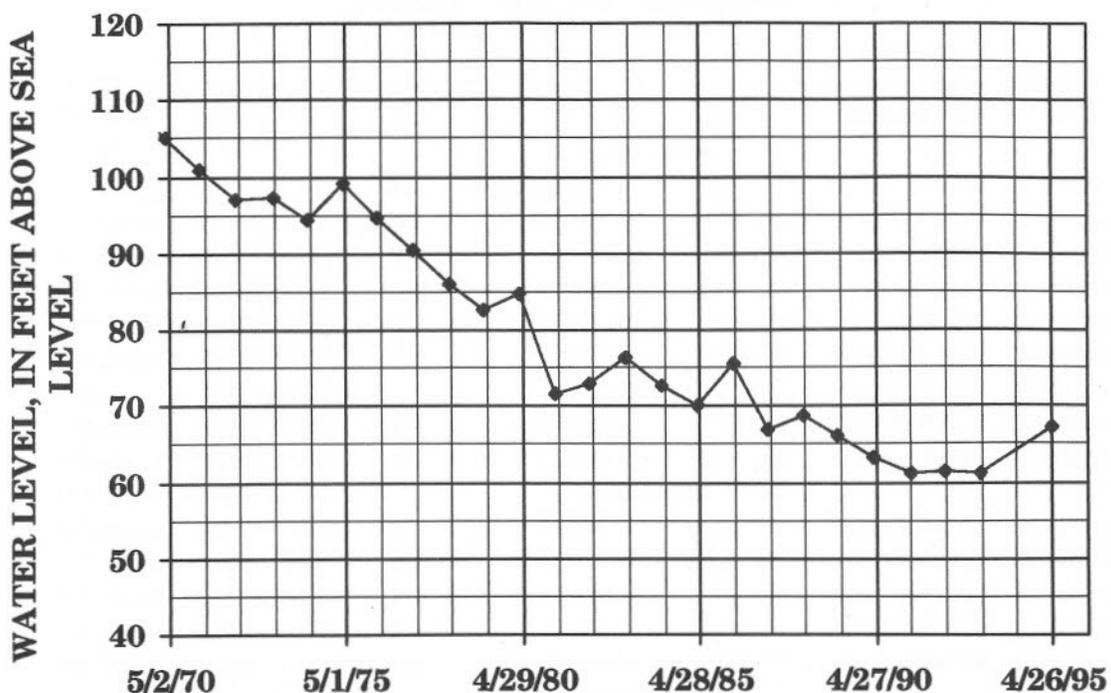
Table 1. Information pertaining to measured wells completed in the Sparta and Memphis aquifers (Continued)

| Latitude | Longitude | Local well number | Water level altitude (feet above sea level) | Depth to water level (feet below land-surface datum) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|-------------------------|-----------|-------------------|---|--|--|---------------------|---------|
| 342445 | 922845 | 03S14W35DCA1 | 251 | 68.81 | 320 | 4/21/95 | Sparta |
| 342846 | 922106 | 03S13W12AAA1 | 234 | 126.51 | 361 | 4/24/95 | Sparta |
| Jefferson County | | | | | | | |
| 340401 | 915917 | 07S09W35CCB1 | 35 | 234.76 | 270 | 5/17/95 | Sparta |
| 340547 | 920420 | 07S10W24CAC1 | 35 | 276.38 | 311 | 5/17/95 | Sparta |
| 340631 | 914520 | 07S07W24BAB1 | 36 | 152.27 | 188 | 5/18/95 | Sparta |
| 340947 | 914040 | 06S06W20CAA1 | 42 | 151.48 | 193 | 5/18/95 | Sparta |
| 341026 | 915116 | 06S08W25ADC1 | -4 | 207.52 | 203 | 5/16/95 | Sparta |
| 341117 | 920504 | 06S10W23ACD1 | 3 | 228.82 | 232 | 5/17/95 | Sparta |
| 341138 | 915516 | 06S08W16CCC1 | -38 | 240.07 | 202 | 5/16/95 | Sparta |
| 341249 | 915355 | 06S08W10CAC1 | -42 | 244.45 | 203 | 5/16/95 | Sparta |
| 341427 | 915652 | 05S09W35AAB1 | -68 | 272.62 | 205 | 5/23/95 | Sparta |
| 341446 | 915526 | 05S08W30CBA1 | -71 | 278.17 | 207 | 5/16/95 | Sparta |
| 342107 | 920440 | 04S10W22BDD1 | 57 | 187.18 | 244 | 5/23/95 | Sparta |
| 342140 | 914741 | 04S07W17BCC1 | 40 | 160.48 | 200 | 5/18/95 | Sparta |
| 342627 | 915502 | 03S08W19BBD1 | 61 | 153.84 | 215 | 5/18/95 | Sparta |
| 342644 | 921055 | 03S11W22ABC1 | 144 | 166.42 | 310 | 5/16/95 | Sparta |
| Lafayette County | | | | | | | |
| 330223 | 933033 | 20S23W05ADB1 | 204 | 38.42 | 242 | 4/25/95 | Sparta |
| 330546 | 933916 | 19S25W13CAB1 | 221 | 33.54 | 255 | 4/25/95 | Sparta |
| 330911 | 933038 | 18S23W29ACC1 | 242 | 13.38 | 255 | 4/25/95 | Sparta |
| 332026 | 933728 | 16S24W19DBC1 | 216 | 48.78 | 265 | 4/25/95 | Sparta |
| Lincoln County | | | | | | | |
| 335229 | 913758 | 10S05W05ADB1 | 60 | 110.86 | 171 | 5/03/95 | Sparta |
| 335907 | 913333 | 08S05W35ACC1 | 59 | 105.63 | 165 | 5/09/95 | Sparta |
| 340345 | 913446 | 08S05W03BAA2 | 53 | 127.30 | 180 | 5/09/95 | Sparta |
| 340444 | 915042 | 07S07W30CDC1 | 42 | 165.87 | 208 | 5/02/95 | Sparta |
| Lonoke County | | | | | | | |
| 343227 | 915227 | 02S08W16BDA1 | 107 | 109.21 | 216 | 5/02/95 | Sparta |
| 344425 | 914503 | 01N07W03BCC1 | 108 | 115.30 | 223 | 4/27/95 | Sparta |
| 344536 | 915703 | 02N09W35BBC1 | 156 | 78.34 | 234 | 5/02/95 | Sparta |
| 344652 | 914419 | 02N07W22DBA1 | 111 | 115.71 | 227 | 4/27/95 | Sparta |
| Monroe County | | | | | | | |
| 344145 | 911756 | 01N03W14CCB1 | 114 | 57.58 | 172 | 6/07/95 | Sparta |
| 345313 | 911014 | 03N02W12CBC1 | 158 | 28.00 | 186 | 6/09/95 | Sparta |
| 345535 | 911221 | 04N02W28DDD4 | 165 | 26.93 | 192 | 6/09/95 | Sparta |
| Nevada County | | | | | | | |
| 332818 | 931740 | 14S21W32DCD1 | 258 | 111.81 | 370 | 4/25/95 | Sparta |
| 333324 | 930708 | 13S20W36DCC1 | 244 | 105.98 | 350 | 4/25/95 | Sparta |
| Ouachita County | | | | | | | |
| 332618 | 930318 | 15S19W10DCC1 | 140 | 69.93 | 210 | 4/27/95 | Sparta |
| 332942 | 930513 | 14S19W29ABB1 | 195 | 84.89 | 280 | 4/27/95 | Sparta |
| 333234 | 925252 | 14S17W05CAD1 | 121 | 35.69 | 157 | 4/27/95 | Sparta |
| 334018 | 925948 | 12S18W19CDC1 | 203 | 32.28 | 235 | 4/27/95 | Sparta |

Table 1. Information pertaining to measured wells completed in the Sparta and Memphis aquifers (Continued)

| Latitude | Longitude | Local well number | Water level altitude (feet above sea level) | Depth to water level (feet below land-surface datum) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|------------------------|-----------|-------------------|---|--|--|---------------------|---------|
| 334342 | 924835 | 11S17W36CCA1 | 128 | 5.29 | 133 | 4/26/95 | Sparta |
| Phillips County | | | | | | | |
| 341822 | 905124 | 04S02E25CCC1 | 129 | 36.57 | 166 | 6/08/95 | Sparta |
| 342403 | 904914 | 03S03E30DAA1 | 138 | 33.76 | 172 | 6/08/95 | Sparta |
| 342856 | 903636 | 02S05E29CCC1 | 157 | 21.80 | 179 | 6/08/95 | Sparta |
| 343110 | 903525 | 02S05E16BCB1 | 156 | 33.70 | 190 | 6/08/95 | Sparta |
| 343242 | 903902 | 02S04E02DBA1 | 132 | 118.04 | 250 | 6/08/95 | Sparta |
| 343324 | 905446 | 01S02E32DDC1 | 139 | 72.21 | 211 | 6/09/95 | Sparta |
| Poinsett County | | | | | | | |
| 352930 | 905825 | 10N01E15DBB1 | 148 | 84.02 | 232 | 3/21/95 | Memphis |
| 353225 | 904316 | 11N03E25ACC1 | 162 | 111.37 | 273 | 6/20/95 | Memphis |
| Prairie County | | | | | | | |
| 343748 | 913654 | 01S06W11DBD1 | 83 | 142.97 | 226 | 4/27/95 | Sparta |
| 344113 | 913504 | 01N05W19CDC1 | 92 | 119.74 | 212 | 4/27/95 | Sparta |
| 344644 | 913828 | 02N06W21DAD1 | 123 | 109.18 | 232 | 4/27/95 | Sparta |
| 344649 | 912801 | 02N04W19ACB1 | 127 | 83.91 | 211 | 4/27/95 | Sparta |
| 344653 | 913800 | 02N06W22BDD1 | 120 | 112.98 | 233 | 4/27/95 | Sparta |
| Saline County | | | | | | | |
| 342904 | 923222 | 03S14W05CCC1 | 307 | 8.45 | 315 | 4/21/95 | Sparta |
| Union County | | | | | | | |
| 330110 | 924321 | 19S16W35DDC1 | -45 | 219.77 | 175 | 6/29/95 | Sparta |
| 330631 | 923708 | 18S15W35DAC1 | -106 | 306.73 | 201 | 7/06/95 | Sparta |
| 330652 | 922119 | 18S12W33BBB1 | -11 | 122.58 | 112 | 4/20/95 | Sparta |
| 330657 | 923859 | 18S15W33ADA1 | -108 | 361.02 | 253 | 7/06/95 | Sparta |
| 330807 | 924613 | 18S16W28BBB1 | -125 | 350.44 | 225 | 6/29/95 | Sparta |
| 331006 | 921443 | 18S11W09ABC1 | 47 | 88.35 | 135 | 4/20/95 | Sparta |
| 331011 | 924317 | 18S16W11DAB1 | -157 | 426.59 | 270 | 6/30/95 | Sparta |
| 331024 | 924229 | 18S16W12ACB1 | -182 | 485.23 | 303 | 6/29/95 | Sparta |
| 331042 | 924021 | 18S15W08ABB1 | -174 | 379.34 | 205 | 7/06/95 | Sparta |
| 331142 | 924118 | 17S15W31DCA1 | -201 | 472.58 | 272 | 6/29/95 | Sparta |
| 331203 | 922218 | 17S12W32BBC1 | -5 | 235.26 | 230 | 4/20/95 | Sparta |
| 331205 | 922916 | 17S13W31BAC1 | -66 | 281.59 | 216 | 7/07/95 | Sparta |
| 331228 | 924038 | 17S15W29CDC1 | -206 | 425.57 | 220 | 7/06/95 | Sparta |
| 331300 | 925356 | 17S17W30DCD1 | -24 | 304.38 | 280 | 7/05/95 | Sparta |
| 331900 | 923956 | 16S15W20DAA1 | -77 | 266.79 | 190 | 6/28/95 | Sparta |
| 331944 | 923217 | 16S14W15CAB1 | -56 | 149.66 | 94 | 6/27/95 | Sparta |
| 332205 | 924330 | 16S16W02ABC1 | -56 | 172.35 | 116 | 6/28/95 | Sparta |
| Woodruff County | | | | | | | |
| 350026 | 911454 | 05N02W31DCB3 | 181 | 11.70 | 193 | 6/07/95 | Memphis |

A. ARKANSAS COUNTY 03S04W02CCB1



B. BRADLEY COUNTY 16S20W18CAA1

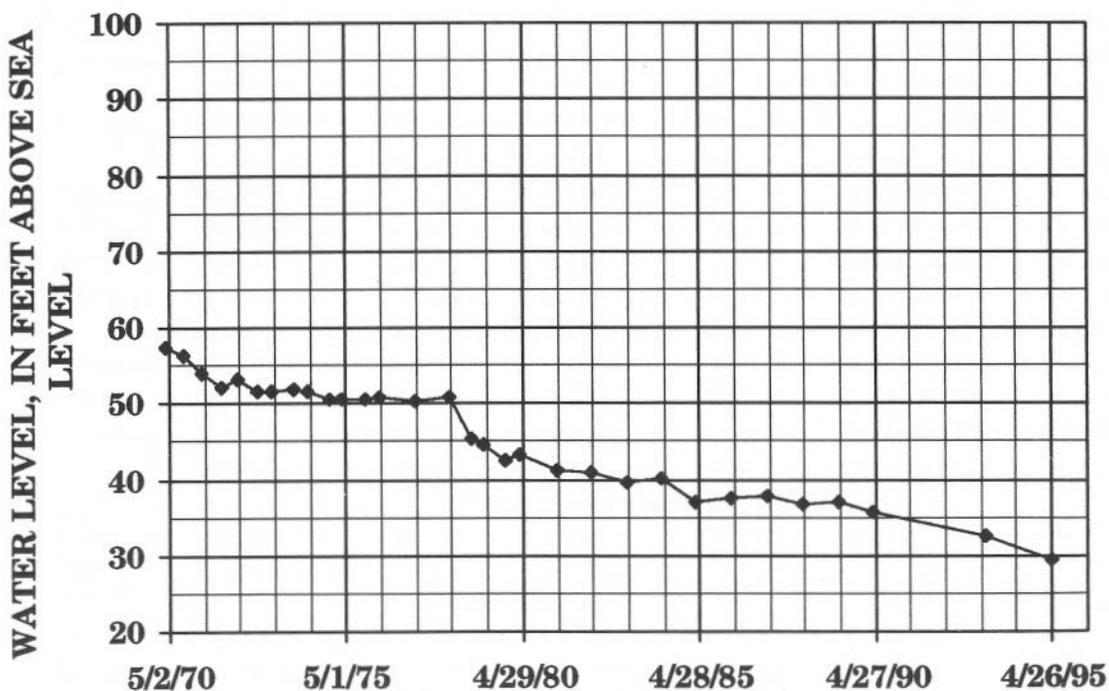
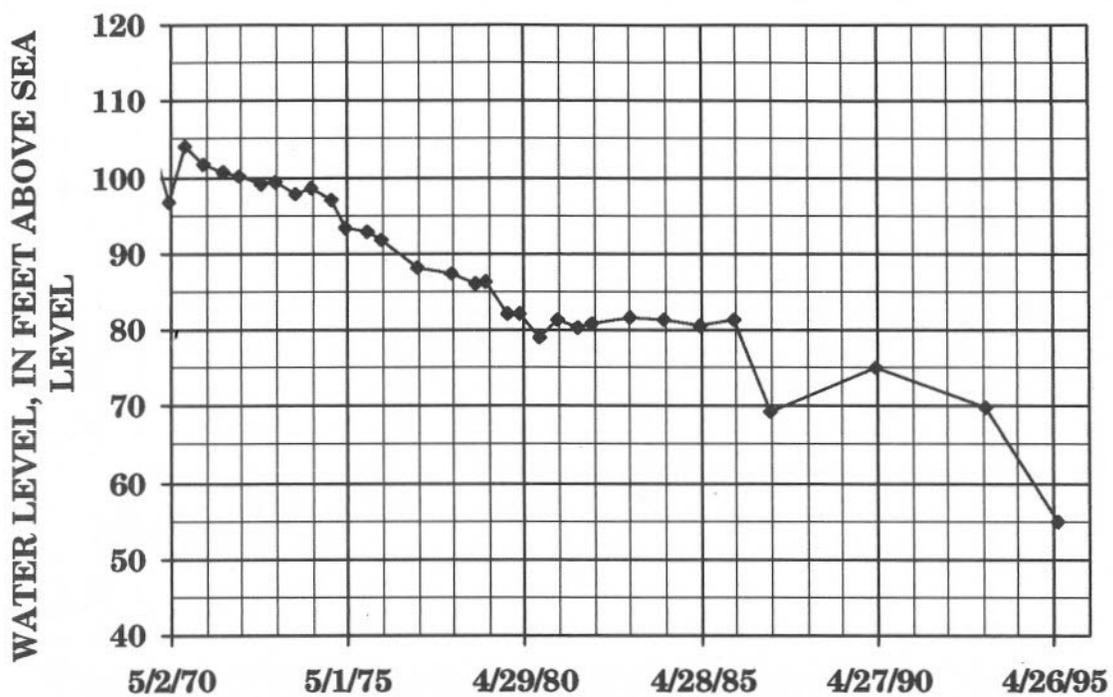


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 1 of 4).

C. COLUMBIA COUNTY 16S20W18ACD1



D. DESHA COUNTY 09S04W28DDD1SP

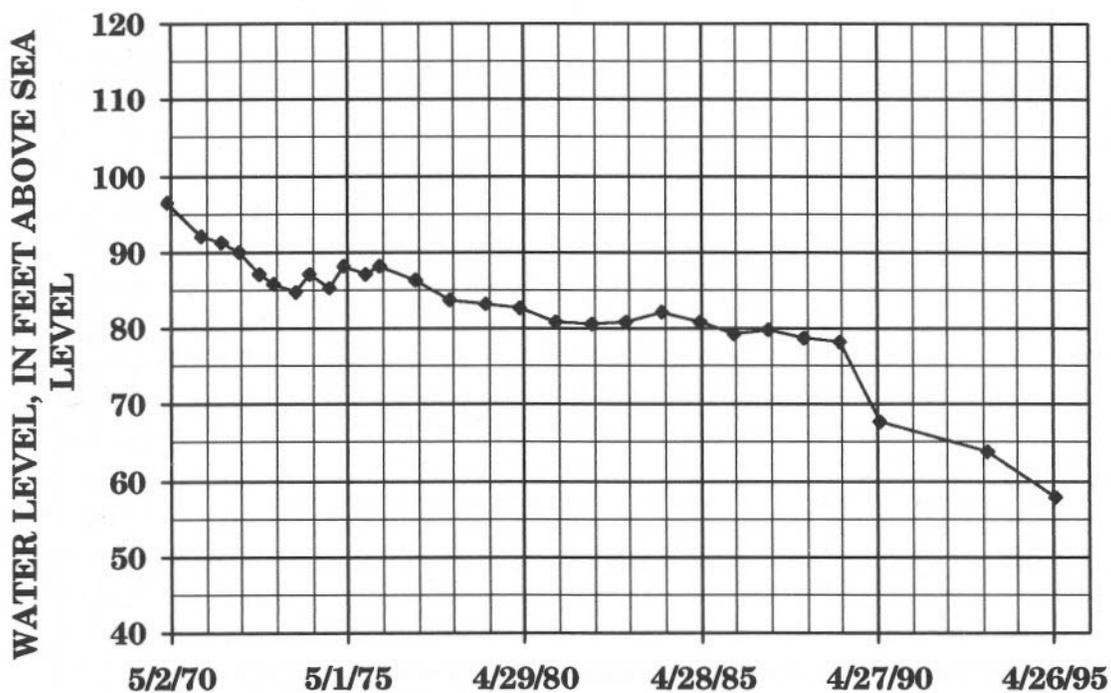
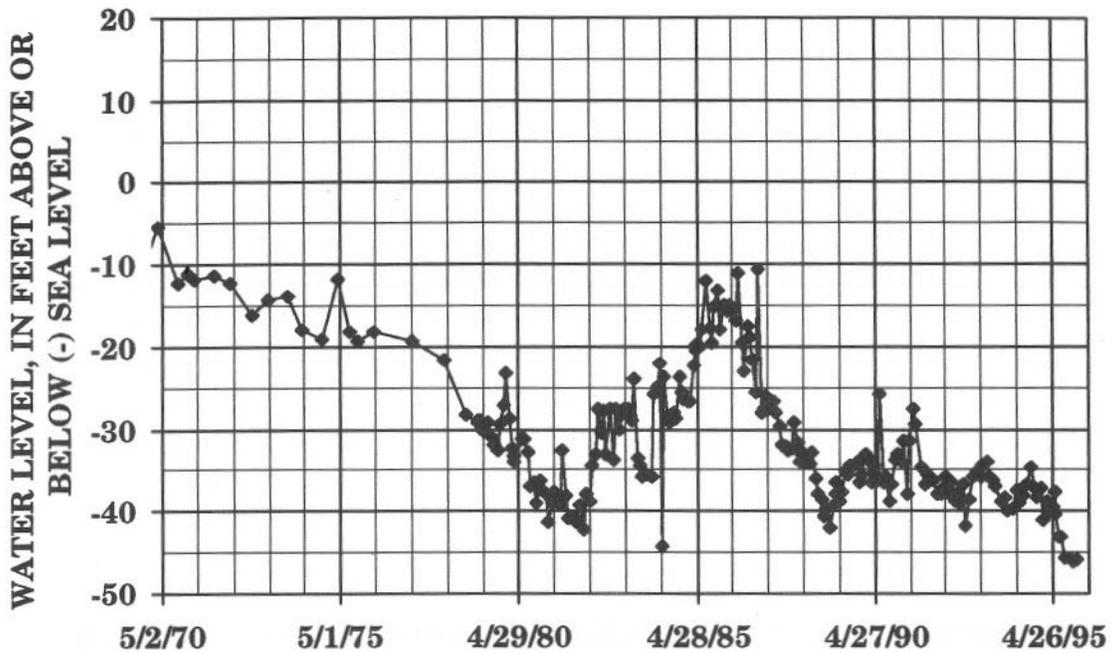


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 2 of 4).

E. JEFFERSON COUNTY 06S08W16CCC1



F. PHILLIPS COUNTY 01S02E32DDC1

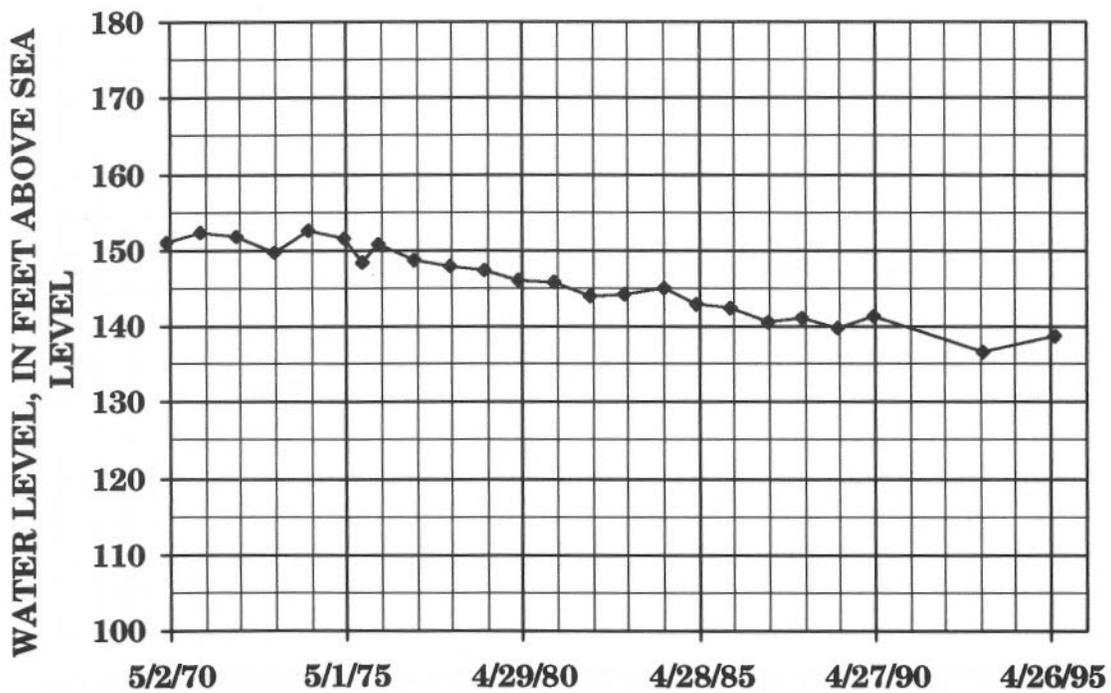
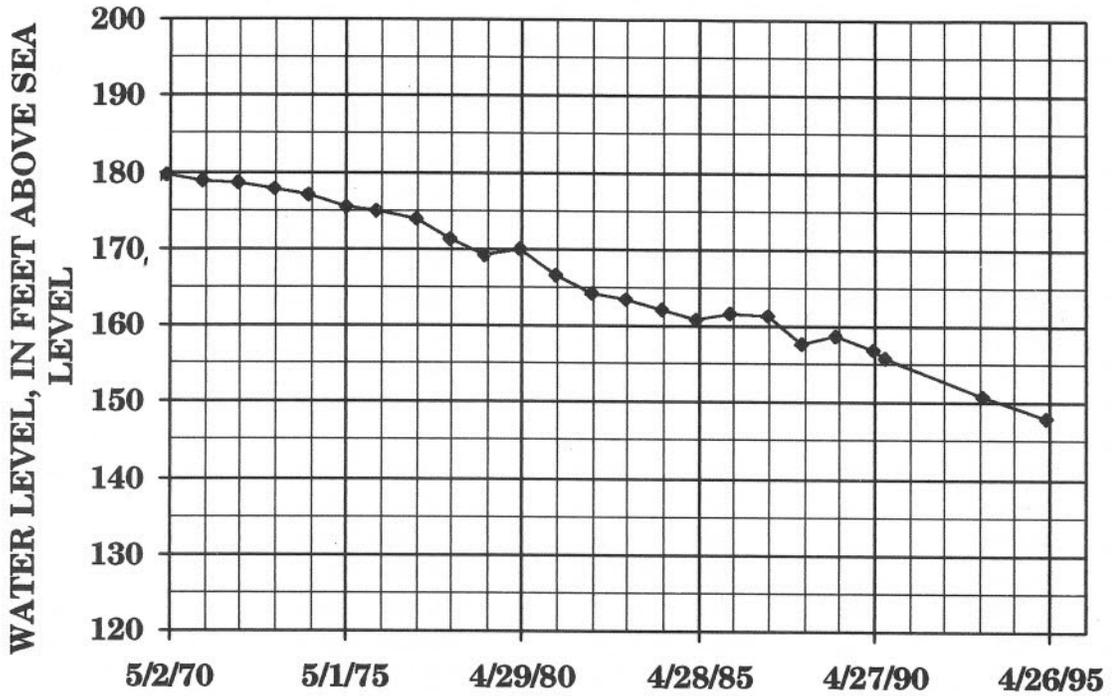


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 3 of 4).

G. POINSETT COUNTY 10N01E15DBB1



H. UNION COUNTY 17S15W31DCA1

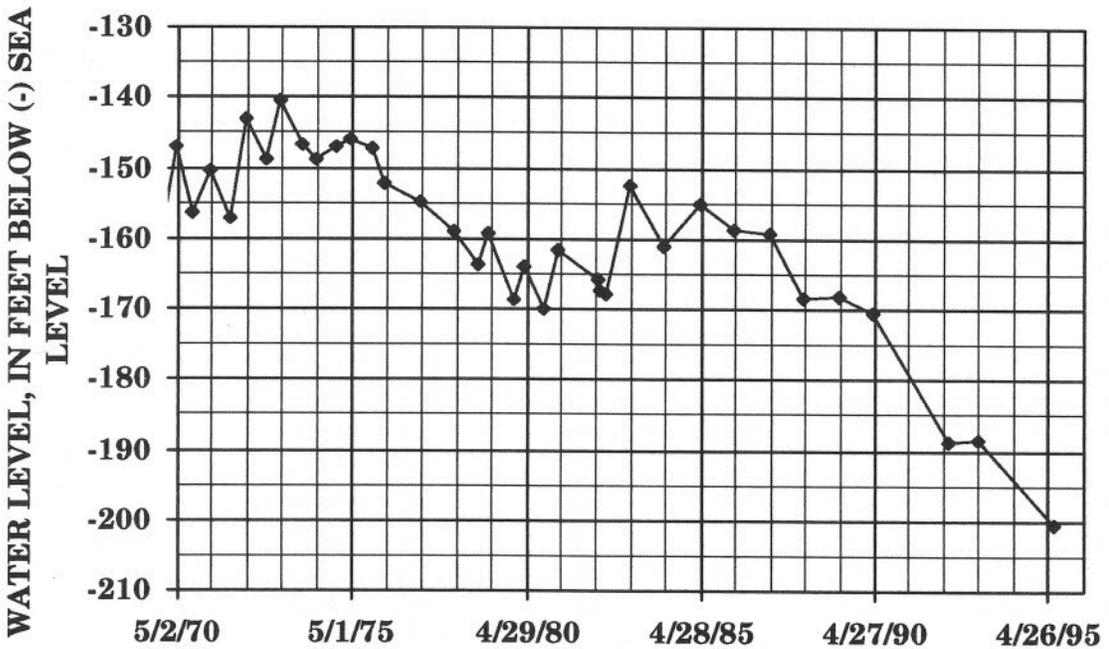


Figure 2. Water-level hydrographs for selected wells in the Sparta and Memphis aquifers (sheet 4 of 4).

Table 2. Specific conductance measurements in wells completed in the Sparta and Memphis aquifers[--, no data; $\mu\text{S/cm}$, microsiemens per centimeter at 25 degrees Celsius]

| Latitude | Longitude | Specific conductance ($\mu\text{S/cm}$) | Well depth (feet) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|-------------------------|-----------|---|-------------------|--|---------------------|---------|
| Arkansas County | | | | | | |
| 340135 | 912152 | 236 | 654 | 175 | 4/26/95 | Sparta |
| 340340 | 911410 | 294 | 690 | 181 | 6/22/95 | Sparta |
| 340711 | 912248 | 195 | 720 | 185 | 4/25/95 | Sparta |
| 341734 | 912006 | 395 | 802 | 187 | 4/25/95 | Sparta |
| 341752 | 913004 | 207 | 880 | 196 | 6/21/95 | Sparta |
| 342004 | 912514 | 352 | 800 | 195 | 6/21/95 | Sparta |
| 342005 | 912926 | 307 | 1,048 | 195 | 6/21/95 | Sparta |
| 342155 | 912503 | 409 | 836 | 198 | 6/21/95 | Sparta |
| 342321 | 912955 | 328 | 929 | 196 | 6/21/95 | Sparta |
| 342416 | 912437 | 440 | 666 | 203 | 5/01/95 | Sparta |
| 342515 | 914210 | 347 | 870 | 191 | 5/02/95 | Sparta |
| 342632 | 913005 | 353 | 910 | 210 | 6/21/95 | Sparta |
| 342633 | 913523 | 358 | 819 | 196 | 6/20/95 | Sparta |
| 342740 | 913050 | 398 | -- | -- | 6/29/95 | Sparta |
| 342829 | 912632 | 434 | 746 | 202 | 6/22/95 | Sparta |
| 342839 | 913032 | 439 | 801 | 210 | 6/21/95 | Sparta |
| 343018 | 912350 | 486 | 795 | 205 | 6/21/95 | Sparta |
| 343028 | 913230 | 503 | 818 | 210 | 6/29/95 | Sparta |
| 343041 | 912354 | 1,080 | 840 | -- | 6/20/95 | Sparta |
| 343312 | 912849 | 452 | 840 | 212 | 6/20/95 | Sparta |
| Ashley County | | | | | | |
| 332117 | 915103 | 879 | 1,000 | 190 | 4/19/95 | Sparta |
| Bradley County | | | | | | |
| 331836 | 922052 | 651 | 457 | 100 | 4/19/95 | Sparta |
| Calhoun County | | | | | | |
| 334633 | 922928 | 219 | 650 | 310 | 4/26/95 | Sparta |
| Cleveland County | | | | | | |
| 334543 | 921422 | 374 | 815 | 303 | 4/20/95 | Sparta |
| 335728 | 921133 | 279 | 558 | 230 | 4/20/95 | Sparta |
| 335729 | 921120 | 282 | 550 | 266 | 4/20/95 | Sparta |
| Columbia County | | | | | | |
| 330555 | 931128 | 234 | 623 | 332 | 5/24/95 | Sparta |
| 330609 | 932743 | 343 | 385 | 248 | 5/24/95 | Sparta |
| 331142 | 931248 | 313 | 502 | 300 | 5/24/95 | Sparta |
| 331518 | 930657 | 448 | -- | 315 | 7/28/95 | Sparta |
| 331519 | 931159 | 395 | 495 | 325 | 6/01/95 | Sparta |
| 331533 | 930803 | 419 | -- | 340 | 7/28/95 | Sparta |
| 331537 | 930328 | 447 | 516 | 325 | 5/31/95 | Sparta |
| 331537 | 930538 | 459 | -- | 305 | 7/28/95 | Sparta |
| Craighead County | | | | | | |
| 354929 | 903922 | 144 | 240 | 256 | 6/22/95 | Memphis |

Table 2. Specific conductance measurements in wells completed in the Sparta and Memphis aquifers (Continued)[--, no data; $\mu\text{S}/\text{cm}$, microsiemens per centimeter at 25 degrees Celsius]

| Latitude | Longitude | Specific conductance ($\mu\text{S}/\text{cm}$) | Well depth (feet) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|-------------------------|-----------|--|-------------------|--|---------------------|---------|
| Cross County | | | | | | |
| 352231 | 904215 | 530 | 1,148 | 429 | 6/21/95 | Memphis |
| 352359 | 904514 | 370 | 367 | 278 | 6/21/95 | Memphis |
| 352403 | 905949 | 529 | 400 | 234 | 6/20/95 | Memphis |
| Desha County | | | | | | |
| 333624 | 911242 | 325 | 520 | 136 | 5/03/95 | Sparta |
| 333636 | 912304 | 335 | 796 | 147 | 5/03/95 | Sparta |
| 334223 | 911421 | 263 | 753 | 141 | 5/03/95 | Sparta |
| 335341 | 911522 | 260 | 626 | 153 | 5/09/95 | Sparta |
| Drew County | | | | | | |
| 332539 | 913044 | 722 | 980 | 125 | 4/19/95 | Sparta |
| 333154 | 913404 | 324 | 692 | 169 | 4/19/95 | Sparta |
| 333534 | 914852 | 302 | 830 | 265 | 4/20/95 | Sparta |
| 334248 | 912708 | 318 | 622 | 148 | 4/19/95 | Sparta |
| Grant County | | | | | | |
| 341024 | 923545 | 47 | 172 | 280 | 4/24/95 | Sparta |
| 341341 | 921414 | 126 | 1,081 | 280 | 4/21/95 | Sparta |
| 341839 | 922402 | 69 | 539 | 281 | 4/21/95 | Sparta |
| 341841 | 923320 | 92 | 370 | 293 | 4/24/95 | Sparta |
| Jefferson County | | | | | | |
| 341117 | 920504 | 168 | -- | 232 | 5/17/95 | Sparta |
| 341447 | 915606 | 158 | -- | -- | 5/02/95 | Sparta |
| 341453 | 915441 | 165 | 753 | 221 | 5/18/95 | Sparta |
| 342140 | 914741 | 147 | 756 | 200 | 5/19/95 | Sparta |
| 342218 | 920957 | 85 | 854 | 400 | 5/16/95 | Sparta |
| 342432 | 920617 | 155 | 520 | 226 | 5/23/95 | Sparta |
| 342627 | 915502 | 262 | 789 | 215 | 5/19/95 | Sparta |
| 342649 | 921056 | 101 | -- | -- | 5/16/95 | Sparta |
| Lafayette County | | | | | | |
| 330223 | 933033 | 280 | 231 | 242 | 4/25/95 | Sparta |
| Lincoln County | | | | | | |
| 335229 | 913758 | 274 | 693 | 171 | 5/03/95 | Sparta |
| 335631 | 915121 | 207 | 1,052 | 300 | 5/02/95 | Sparta |
| 340444 | 915042 | 210 | 1,350 | 208 | 5/02/95 | Sparta |
| Lonoke County | | | | | | |
| 343227 | 915227 | 594 | 542 | 216 | 5/02/95 | Sparta |
| 344606 | 915442 | 403 | 255 | 243 | 6/19/95 | Sparta |
| 345624 | 915837 | 42 | -- | -- | 5/02/95 | Sparta |
| Ouachita County | | | | | | |
| 332618 | 930318 | 194 | 375 | 210 | 4/27/95 | Sparta |
| 333252 | 924926 | 640 | 278 | 120 | 4/27/95 | Sparta |
| Phillips County | | | | | | |
| 341822 | 905124 | 1,230 | 930 | 166 | 6/08/95 | Sparta |
| 343324 | 905446 | 857 | 689 | 211 | 6/09/95 | Sparta |

Table 2. Specific conductance measurements in wells completed in the Sparta and Memphis aquifers (Continued)[--, no data; $\mu\text{S}/\text{cm}$, microsiemens per centimeter at 25 degrees Celsius]

| Latitude | Longitude | Specific conductance ($\mu\text{S}/\text{cm}$) | Well depth (feet) | Land-surface datum altitude (feet above sea level) | Date of measurement | Aquifer |
|------------------------|-----------|--|-------------------|--|---------------------|---------|
| Poinsett County | | | | | | |
| 352930 | 905825 | 533 | 302 | 232 | 6/20/95 | Memphis |
| 353225 | 904316 | 528 | 250 | 273 | 6/20/95 | Memphis |
| Prairie County | | | | | | |
| 343705 | 913317 | 689 | 606 | 215 | 6/22/95 | Sparta |
| 343748 | 913654 | 675 | 618 | 226 | 6/20/95 | Sparta |
| 343902 | 913531 | 707 | 616 | 220 | 6/20/95 | Sparta |
| 344113 | 913504 | 586 | 522 | 212 | 6/20/95 | Sparta |
| 344644 | 913828 | 505 | 314 | 232 | 6/20/95 | Sparta |
| 344653 | 913800 | 572 | 451 | 233 | 6/20/95 | Sparta |
| 344708 | 914033 | 371 | -- | -- | 6/20/95 | Sparta |
| 345554 | 913347 | 303 | 300 | 208 | 6/23/95 | Sparta |
| Union County | | | | | | |
| 330057 | 924327 | 406 | 529 | 185 | 6/29/95 | Sparta |
| 330059 | 924306 | 406 | -- | -- | 6/29/95 | Sparta |
| 330219 | 921112 | 1,150 | 529 | 135 | 7/06/95 | Sparta |
| 330531 | 923642 | 325 | 318 | 182 | 7/07/95 | Sparta |
| 330607 | 922121 | 514 | 290 | 135 | 7/07/95 | Sparta |
| 330631 | 923708 | 729 | 685 | 201 | 7/06/95 | Sparta |
| 330657 | 923859 | 654 | 752 | 253 | 7/06/95 | Sparta |
| 330807 | 924613 | 547 | 636 | 225 | 6/29/95 | Sparta |
| 330809 | 924611 | 547 | -- | -- | 6/29/95 | Sparta |
| 330918 | 924207 | 572 | -- | 310 | 6/29/95 | Sparta |
| 331011 | 924317 | 533 | 767 | 270 | 6/30/95 | Sparta |
| 331024 | 924229 | 571 | 797 | 303 | 6/29/95 | Sparta |
| 331203 | 922218 | 808 | 822 | 230 | 4/20/95 | Sparta |
| 331205 | 922219 | 812 | -- | -- | 4/20/95 | Sparta |
| 331205 | 922916 | 686 | 772 | 216 | 7/07/95 | Sparta |
| 331237 | 923921 | 455 | 754 | 285 | 7/06/95 | Sparta |
| 331300 | 925356 | 331 | 690 | 280 | 7/05/95 | Sparta |
| 331351 | 925727 | 331 | -- | -- | 7/05/95 | Sparta |
| 331805 | 925709 | 340 | 465 | 248 | 7/05/95 | Sparta |
| 331900 | 923956 | 505 | 603 | 190 | 6/28/95 | Sparta |
| 331944 | 923217 | 591 | 466 | 94 | 6/27/95 | Sparta |
| 332206 | 924324 | 418 | -- | -- | 6/28/95 | Sparta |

Specific conductance data indicate regionally diverse zones of mineralization within the aquifers across the study area. Specific conductance ranged from 47 $\mu\text{S}/\text{cm}$ in Grant County to 1,230 $\mu\text{S}/\text{cm}$ in Phillips County. Along the western border of the southern two-thirds of the study area (near the outcrop/subcrop region) ground water in the Sparta aquifer has low specific conductance indicating low dissolved solids. This is indicative of a recharge area. These data are consistent with interpretation of the potentiometric map, which indicates water-level highs and recharge areas near the western edge of the study area. An area where the ground water has low specific conductance extends from the central portion of the western edge of the study area across Jefferson County. This feature may result from the large ground-water withdrawals and resulting cone of depression centered in Jefferson County, producing movement of less mineralized water from the recharge area toward the east-southeast. Specific conductance increases markedly to the northeast and gradually to the south of Jefferson County. This gradual increase of specific conductance to the south continues to the Louisiana State line with a greater increase apparently corresponding to the cones of depression in Union and Columbia Counties. A possible explanation for this increase in specific conductance is leakage of water with greater conductance from an underlying aquifer. A previous study (Broom and others, 1984) documented specific conductance values greater than 2,000 $\mu\text{S}/\text{cm}$ for ground water from the Sparta aquifer in Union County in 1984.

Elevated levels of specific conductance also occur in Phillips and Arkansas Counties where values increase to greater than 1,000 $\mu\text{S}/\text{cm}$. "Historic" data recorded anomalous highs in specific conductance ranging from 1,500 to 4,000 $\mu\text{S}/\text{cm}$ near Brinkley, Arkansas, in Monroe County (Morris and Bush, 1986). Morris and Bush (1986) cited leakage of saltwater from the Nacatoch aquifer into the Sparta aquifer via a fault or abandoned oil and gas wells as possible explanations for these anomalies.

SUMMARY

During the period of March through July 1995, 145 water-level measurements and 101 specific-conductance measurements were made by the U.S. Geological Survey in cooperation with the Arkansas Geological Commission and the Arkansas Soil and Water Conservation Commission in wells completed in the Sparta and Memphis aquifers in Arkansas. Potenti-

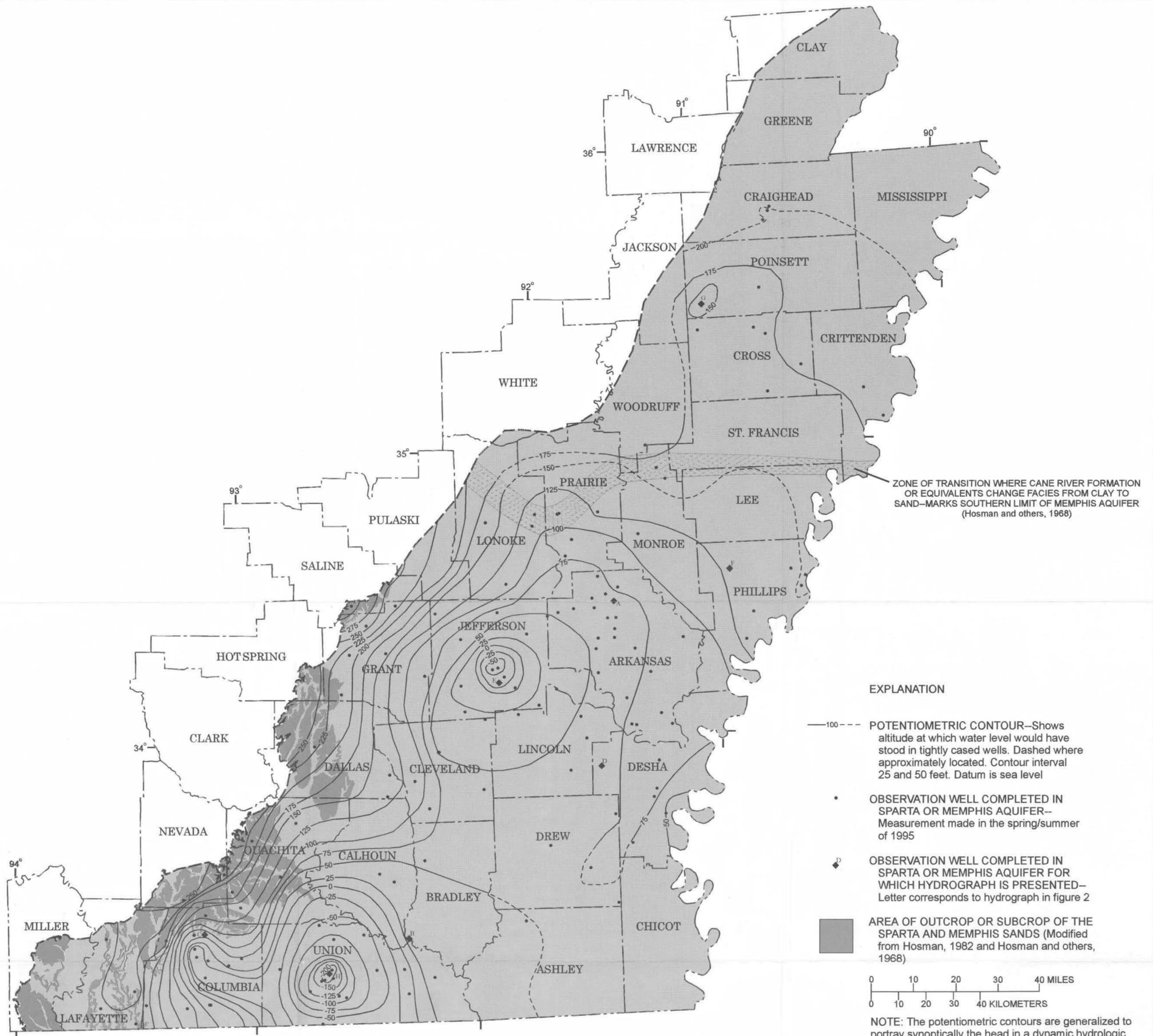
ometric-surface and specific-conductance maps generated from these data reveal spatial trends of these parameters across the study area. An estimated 240 Mgal/d was withdrawn from the Sparta and Memphis aquifers in 1995, an increase of about 17 Mgal/d from 1990.

Spatial trends in the potentiometric surface reflect the distribution of recharge and pumpage in the aquifer. A linearly trending potentiometric high along the western study area boundary coincides with a major recharge area. These areas exhibit potentiometric highs greater than 200 ft above sea level and specific conductance values less than 200 $\mu\text{S}/\text{cm}$, and generally are located in the outcrop/subcrop areas on the southern one-third of the western boundary and the northern portion of the study area. The regional direction of ground-water flow is from the north and west towards the south and east, away from the outcrop and subcrop and northern regions except where affected by intense ground-water withdrawals in the central and southern portions of the study area; such areas are manifested by large cones of depression centered in Columbia, Jefferson, and Union Counties descending below sea level. The lowest water level measured was about 206 ft below sea level in Union County. Increased specific conductance values in Columbia and Union Counties coincide with cones of depressions.

Long-term hydrographs of eight wells indicate trends of water-level decline over a 25-year history. During the period 1970-1995, water-level declines ranged from less than 0.5 ft/yr in Phillips County more than 2.0 ft/yr in Union County. Water-level declines of greater than 1.5 ft/yr generally are associated with the cones of depression centered in Columbia, Jefferson and Union Counties.

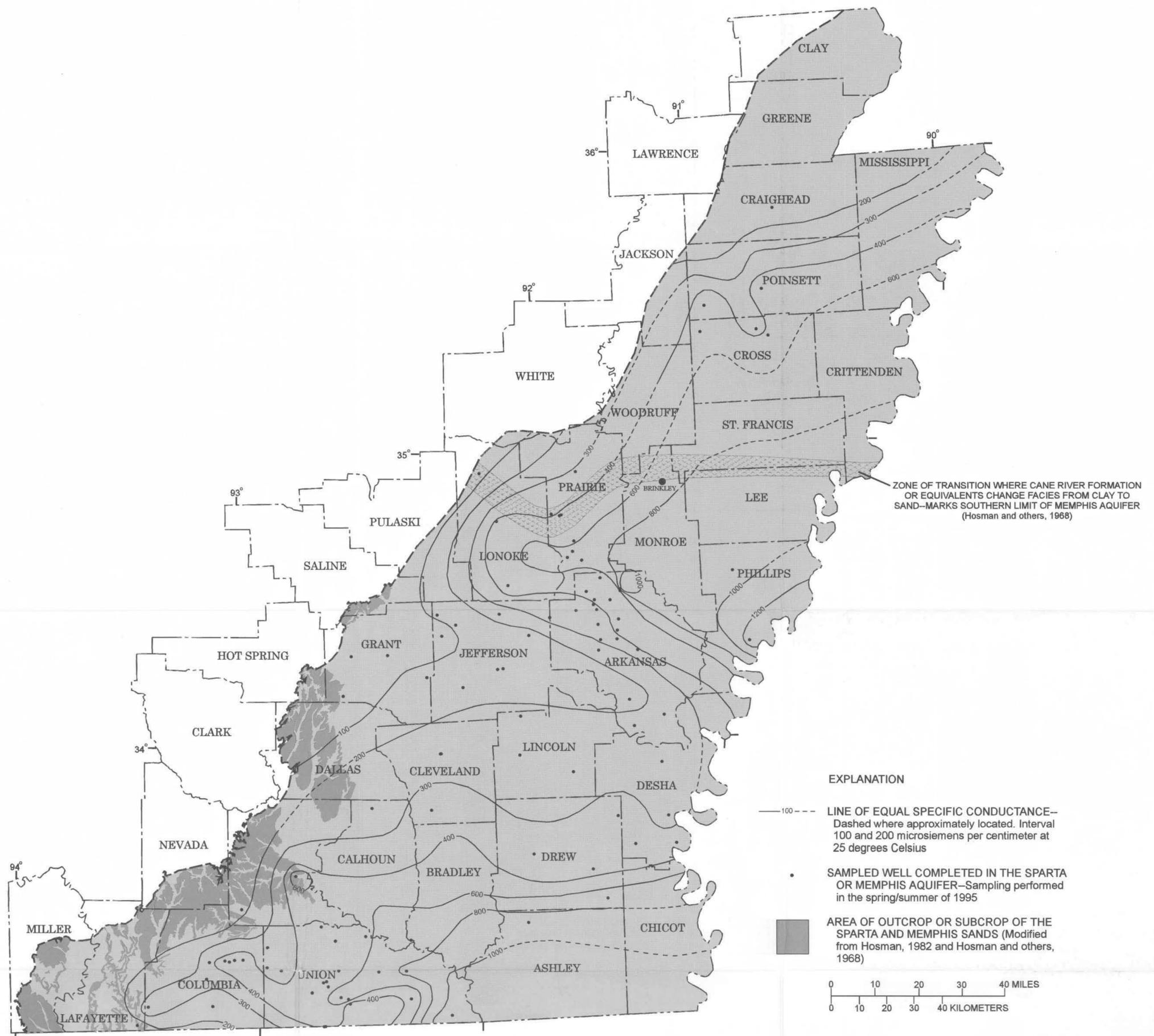
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POTENTIOMETRIC SURFACE
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GREGORY P. STANTON
1997



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