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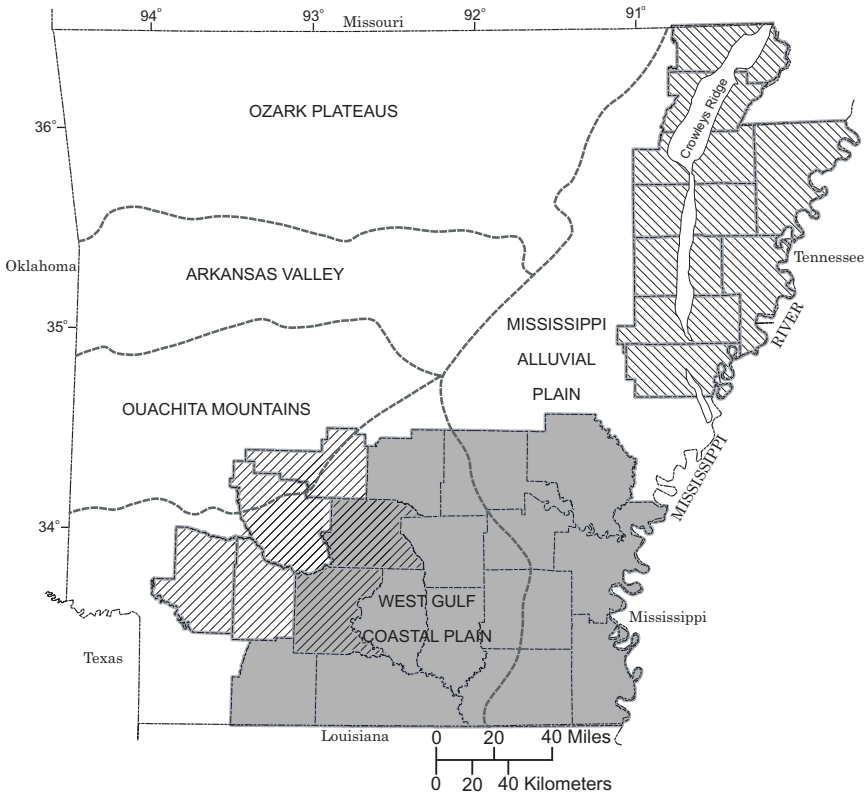
Potentiometric Surfaces in the Cockfield and Wilcox Aquifers of Southern and Northeastern Arkansas, 2003



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

Scientific Investigations Report 2004-5169

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

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By Daniel S. Yeatts

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Contents

Figures

Tables

Potentiometric Surfaces in the Cockfield and Wilcox Aquifers of Southern and Northeastern Arkansas, 2003

By Daniel S. Yeatts

Abstract

This report presents the results of water-level measurements made at wells in the Cockfield Formation and Wilcox Group of southern and northeastern Arkansas during 2003, and the water levels are displayed in potentiometric-surface maps and hydrographs. During March and April 2003, the water level was measured at 55 wells completed in the Cockfield aquifer, 13 wells completed in the Wilcox aquifer of southern Arkansas, and 43 wells completed in the Wilcox aquifer of northeastern Arkansas.

The Cockfield Formation generally consists of discontinuous sand units interbedded with silt, clay, and lignite in southeastern Arkansas. Sand beds near the base of the Cockfield Formation constitute most of the Cockfield aquifer. Withdrawals from the Cockfield aquifer in the study area during 2000 totaled about 9 million gallons per day. The potentiometric surface of the Cockfield aquifer constructed from the 2003 water levels shows that regional direction of ground-water flow generally is towards the east and southeast, away from the outcrop, except in areas of intense ground-water withdrawals. Some local ground-water flow in the outcrop area is toward rivers that have eroded into the Cockfield Formation and deposited alluvium in south Bradley and Calhoun Counties (Ouachita River), and in north Dallas County (Saline River). An evaluation of 20 wells with water-level data from 1983 to 2003 shows that water levels in 15 wells have declined at a rate of -0.04 to -0.97 feet per year, and water levels in 5 wells have risen at a rate of 0.07 to 0.32 feet per year. An evaluation of the same 20 wells from 2000 to 2003 shows that water levels have declined in only 8 wells, and water levels have risen in 12 wells.

The Wilcox Group is distributed throughout most of southern and eastern Arkansas. There are two study areas in southern and northeastern Arkansas.

The Wilcox Group of the southern study area consists of interbedded clay, sandy clay, sand, and lignite. Thin discontinuous sand units constitute the Wilcox aquifer in the southern study area. Withdrawals from the aquifer in the southern study area were about 1 million gallons per day during 2000. The potentiometric surface of the Wilcox aquifer in the southern study area shows that regional ground-water flow generally is south and east, except in Clark County where flow is towards the Ouachita River.

The Wilcox Group in the northeastern study area consists of thin interbedded lignitic sand and clays. A sand bed of about 200 feet thick in the middle to lower part of the Wilcox Group constitutes the major producing unit of the Wilcox aquifer in the northeastern study area. Withdrawals from the aquifer in the northeastern study area were about 23 million gallons per day during 2000. The potentiometric surface of the Wilcox aquifer in the northeastern study area shows that ground-water flow generally is south and east, except where ground-water withdrawals may have altered the natural direction of flow near the centers of pumping at Paragould and West Memphis. An evaluation of 27 wells with water-level data from 1983 to 2003 in the northeastern study area shows that water levels in all 27 wells have been declining at a rate of -0.17 to -1.73 feet per year. An evaluation of the same 27 wells from 2000 to 2003 shows that water levels in 18 wells have risen and in 9 wells have declined.

Introduction

The Cockfield Formation of Claiborne Group (hereafter referred to as Cockfield Formation) and the Wilcox Group contain aquifers that provide sources of ground water in southern and northeastern Arkansas. During the year 2000, about 36 million gallons per day (Mgal/d) of water was withdrawn from these aquifers in Arkansas, about 3Mgal/d of which is from outside the study areas (T.W. Holland, U.S. Geological Survey, written commun., 2003). Major withdrawals from the aquifers were for industrial and public water supplies, with lesser but locally important withdrawals for domestic and livestock uses.

A study was conducted by the U.S. Geological Survey in cooperation with the Arkansas Soil and Water Conservation Commission and the Arkansas Geological Commission to determine the water level associated with the aquifers in the Cockfield Formation and the Wilcox Group in southern and northeastern Arkansas. This report presents the results of the water-level measurements made during 2003 and displays the water levels in potentiometric-surface maps and in hydrographs for wells with data from 1983 to 2003.

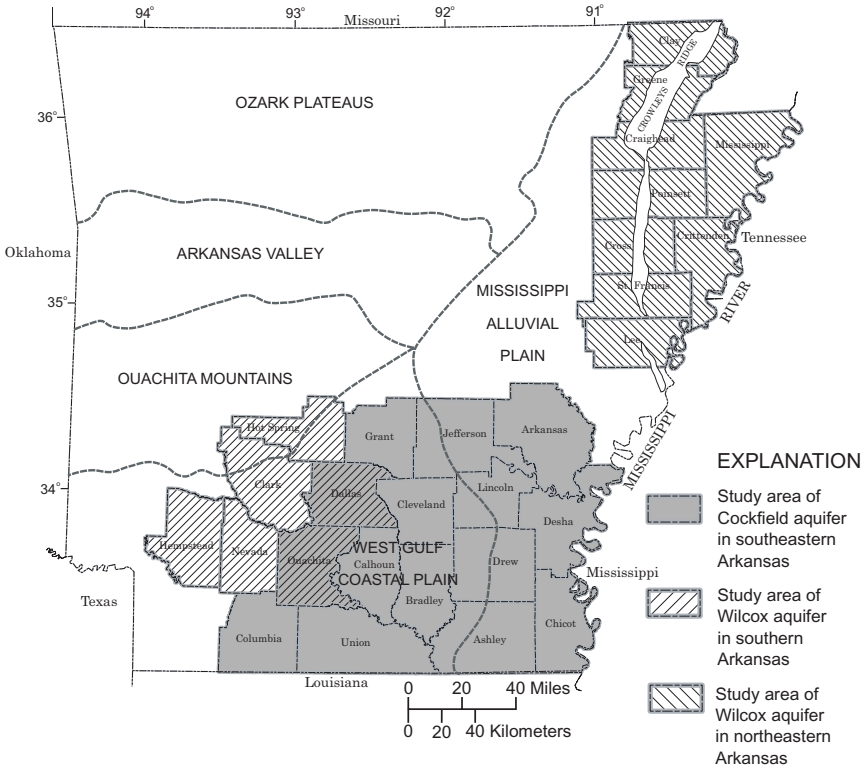


Figure 1. Location of study areas.

The study areas of the Cockfield and Wilcox aquifers (fig. 1) include much of the West Gulf Coastal Plain and the Mississippi Alluvial Plain in Arkansas. The study area boundary of the Cockfield aquifer in southeastern Arkansas is bounded on the east by the Mississippi River and on the south by the Louisiana State line. The western and northern boundaries are defined by the western and northern extent of the outcrop and subcrop (Hosman, 1982) of the Cockfield Formation and by locations of observation wells. The study area boundary of the Wilcox aquifer in southern Arkansas is defined by the outcrop of the Wilcox Group and the locations of observation wells in Clark, Hempstead, Hot Spring, Nevada, and Ouachita Counties. The study area of the Wilcox aquifer in northeastern Arkansas is bounded on the north by the Missouri State line and on the east by the Mississippi River. The western and southern boundaries of the study area are defined by the extent of the outcrop at or near Crowleys Ridge, and by the location of observation wells that penetrate the Wilcox aquifer.

A previous report (Schrader and Joseph, 2000) describing the potentiometric surfaces of the Cockfield and Wilcox aquifers showed data measured during January through April, 2000. For that report, 54 and 56 wells completed in the Cockfield and Wilcox aquifers, respectively, were measured for water levels.

Methods

The well-numbering system used in this report is based upon the location of the wells according to the Public Land Survey System used in Arkansas. The component parts of a well number are the township number, the range number, the section number, three letters which indicate, respectively, the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section in which the well is located, and a sequence number. 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. 2) is located in Township 1 South, Range 3 West, and 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.

The horizontal coordinate information of wells was determined using a global positioning system (GPS) referenced to the North American Datum of 1983 (NAD 83), with accuracy to about one-tenth of a second of latitude and longitude (approximately 10-20 feet). The vertical coordinate information was determined with accuracy to about 5 feet from topographic maps referenced to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)[1].

[1]In this report, NGVD of 1929 refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

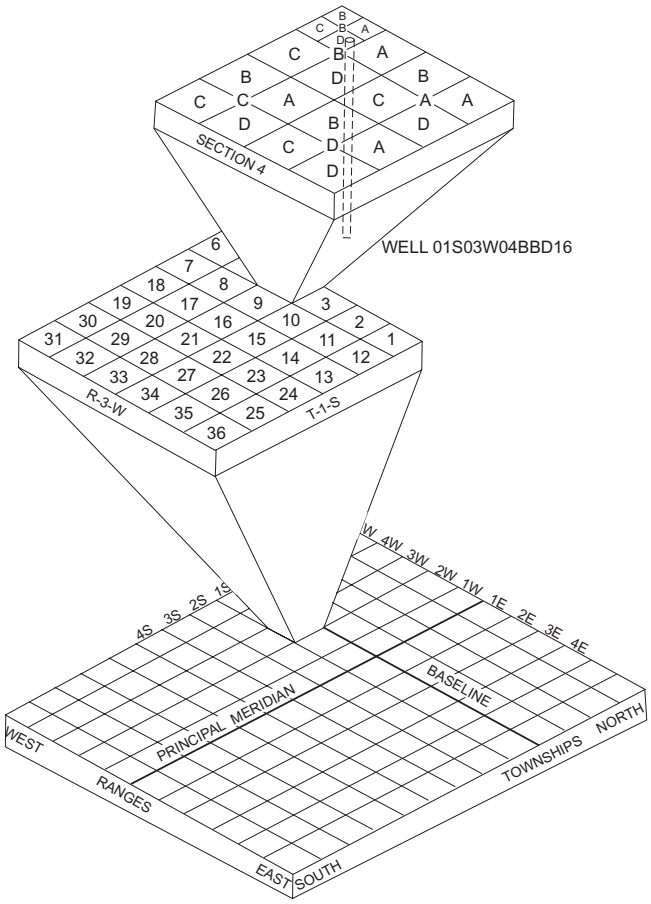


Figure 2. Well-numbering system.

Water levels were measured by U.S. Geological Survey personnel at public water supply, industrial, commercial, domestic, and observation wells open to the Cockfield or Wilcox aquifers. Measurements were made using steel or electric tapes graduated to hundredths of a foot. The steel and electric tapes were calibrated during January 2003.

Cockfield Formation

Hydrogeologic Setting

The Cockfield Formation is Eocene age and generally consists of discontinuous fine- to medium-grained sand units interbedded with silt, clay, and lignite in southeastern Arkansas. Most of the sand beds constitute the Cockfield aquifer media, and are found near the base of the Cockfield Formation. The Cockfield Formation generally ranges from 100 to 400 feet (ft) thick near the outcrop area and thickens downdip of the outcrop area reaching 625 ft thick in northeastern Chicot County (Onellion and Criner, 1955). Total sand thickness in the Cockfield Formation generally ranges from 20 to 150 ft. The Cockfield Formation is underlain throughout the study area by calcareous and sandy marl, limestone, and carbonaceous clay of the Cook Mountain Formation. The Cockfield Formation is overlain by silty clays of the Jackson Group throughout much of southeastern Arkansas. Sand beds at the base of the overlying Jackson Group in parts of southeastern Arkansas may be in hydraulic connection with the Cockfield aquifer (Ackerman, 1987).

The Cockfield Formation outcrops in the northwestern extent of the study area and dips southeastward. In the subcrop area, the Cockfield Formation is overlain by terrace deposits and alluvium of Quaternary age. The terrace deposits may attain a thickness of 40 ft, and as much as 60 ft of alluvium overlies the Cockfield Formation in some of the larger river valleys. The Cockfield Formation dips southeastward from the outcrop and subcrop areas and is confined above by the Jackson Group. In the confined part of the aquifer, the potentiometric surface can be near, or above, land surface.

Most recharge to the Cockfield aquifer occurs by infiltration of rainfall on the upland outcrop areas and by inflow from the overlying alluvium; most discharge is to rivers in outcrop areas, to vertically adjacent units where the Cockfield aquifer is confined, and to wells (Ackerman, 1987). Well depths are shallow and yields of most wells in the outcrop areas are small, less than 30 gallons per minute (gal/min), but in other areas downdip of the outcrop, wells screened the full thickness of the aquifer often yield 100 to 500 gal/min (Westerfield, 1994).

Withdrawals from the Cockfield aquifer in the study area during 2000 totaled about 9 Mgal/d (T.W. Holland, U.S. Geological Survey, written commun., 2003). Adjacent to Arkansas, the State of Mississippi pumped about 27 Mgal/d from the Cockfield aquifer in 1999 (D.E. Burt, U.S. Geological Survey, written commun., 2003). Immediately across the Arkansas/Mississippi State line, the city of Greenville, Mississippi pumped about 11 Mgal/d from the Cockfield aquifer in 1999 (D.E. Burt, U.S. Geological Survey, written commun., 2003), or about as much as all of Arkansas pumped from the Cockfield aquifer in 2000. The large amount of withdrawal from Greenville probably contributes to lower water levels in Arkansas (Ackerman, 1987; Joseph, 1998; Schrader and Joseph, 2000). Most wells completed in the Cockfield aquifer study area provide small volumes of water for domestic and livestock use. In some locations, the Cockfield aquifer yields volumes large enough to supply industrial and public supply systems.

Potentiometric Surface

The potentiometric-surface map shows the altitude of the water surface in tightly cased wells screened in the Cockfield aquifer (fig. 3). The map is based upon water-level data collected at 55 wells in the Cockfield aquifer during March and April 2003, in southeastern Arkansas (table 1). The potentiometric surface was constructed by determining the water-level altitude at wells, and constructing contour lines along points of equal water-level value. The direction of ground-water flow is perpendicular to the contours in the direction of decreasing water level.

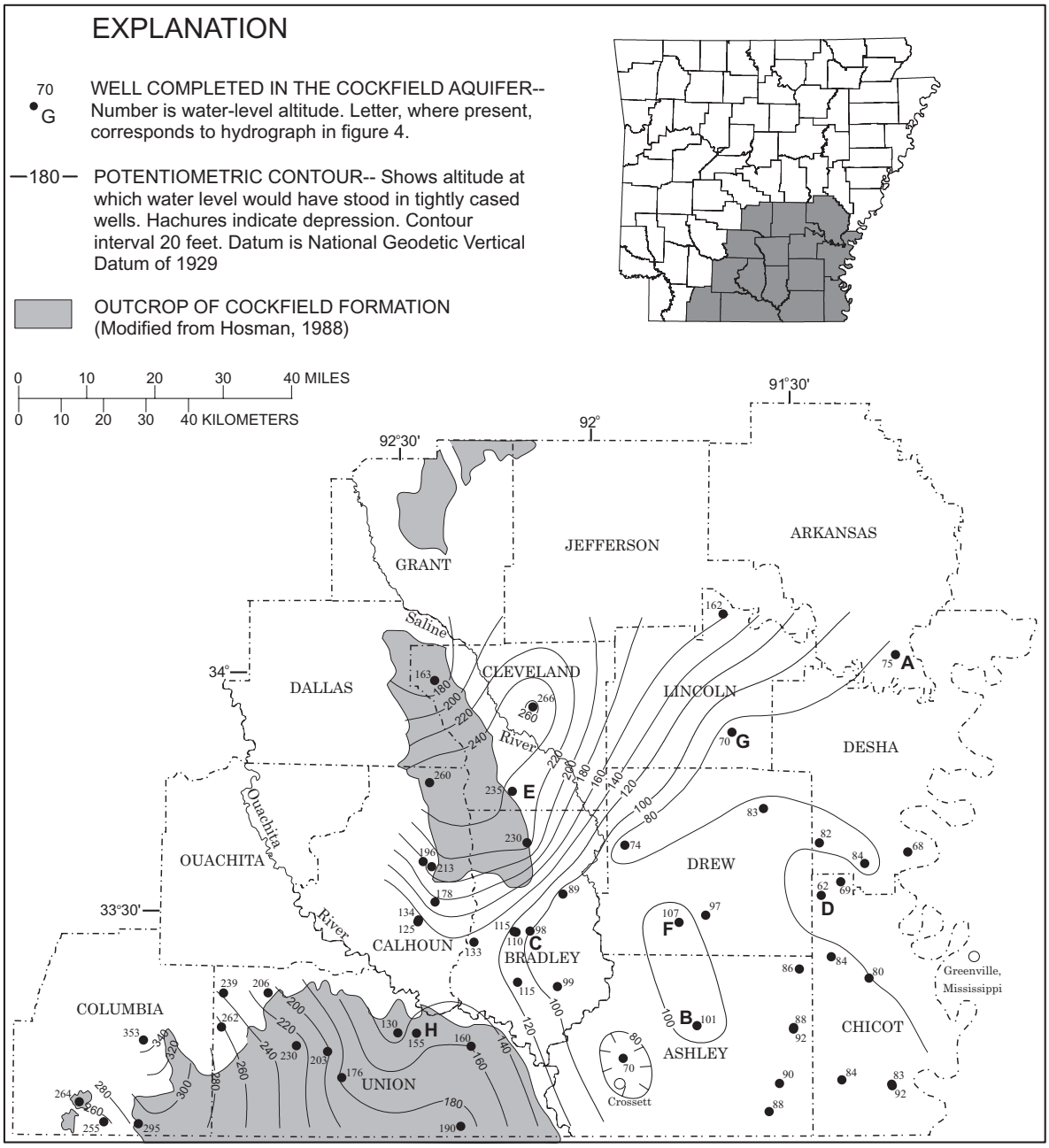


Figure 3. Potentiometric surface of the Cockfield aquifer in southeastern Arkansas, 2003.

Table 1. Information pertaining to measured wells completed in the Cockfield aquifer in southeastern Arkansas, 2003.

[In this report, the well latitudes and longitudes were measured using a global positioning system referenced to the North American Datum of 1983. ddmmss, degrees, minutes, seconds; NGVD of 1929 refers to the National Geodetic Vertical Datum of 1929; --, no data]

Latitude (ddmmss)	Longitude (ddmmss)	Local well number	Well depth (feet)	Land-surface datum altitude (feet above NGVD of 1929)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land-surface datum)	Date of measurement
			Arkansas County				
340138	911405	08S02W04ACA1	453	165	75	89.53	4/08/2003
			Ashley County				
330336	913425	19S05W12CAC1	320	115	88	27.24	3/20/2003
330710	913247	18S04W19DAA2	356	116	90	25.75	3/20/2003
331038	915627	18S08W04BBC1	314	149	70	78.95	3/20/2003
331406	913033	17S04W10CBA1	360	125	92	32.96	3/20/2003
331417	913030	17S04W10BCD2	340	125	88	37.04	3/20/2003
331442	914510	17S06W07ADA1	426	174	101	73.05	3/20/2003
332144	912932	15S04W26CBC1	409	128	86	41.99	3/20/2003
			Bradley County				
331951	920619	16S10W11DCB1	152	152	99	53.20	3/19/2003
332027	921223	16S11W11ACA1	140	141	115	26.45	3/19/2003
332536	921858	15S12W11CAB1	225	155	133	22.19	3/19/2003
332650	921233	14S11W35DAC1	345	174	110	63.94	3/19/2003
332656	921251	14S11W35CAB1	320	190	115	74.73	3/19/2003
332658	921025	14S10W31DBA1	349	193	98	94.86	3/19/2003
333139	920522	14S10W01BAD1	540	231	89	141.96	3/19/2003
333815	921046	12S10W30CAC1	58	240	230	10.49	3/19/2003
			Calhoun County				
332815	922729	14S13W29DAC1	--	139	125	13.53	3/14/2003
332829	922722	14S13W29ADA1	81	160	134	25.72	3/14/2003
333045	922451	14S13W11CAC1	105	205	178	27.11	4/30/2003
333517	922520	13S13W15DBA1	122	232	213	19.11	3/14/2003
333555	922638	13S13W09CBD1	147	232	196	36.47	3/14/2003
334560	922534	11S13W15BBC1	70	310	260	50.33	3/14/2003
			Chicot County				
330640	911541	18S02W25ABB3	332	135	92	43.42	3/24/2003
330652	911547	18S02W24CDB1	364	129	83	45.99	3/24/2003
330731	912319	18S03W14CCC1	320	98	84	13.66	3/24/2003
332027	911857	16S02W04BAC1	330	125	80	45.12	3/21/2003
332314	912438	15S03W21ABA1	400	122	84	38.20	3/21/2003
333106	912602	14S03W05BBA1	510	139	62	76.91	3/21/2003
333247	912301	13S03W26BBB1	422	139	69	70.10	3/21/2003

Table 1. Information pertaining to measured wells completed in the Cockfield aquifer in southeastern Arkansas, 2003.—Continued

[In this report, the well latitudes and longitudes were measured using a global positioning system referenced to the North American Datum of 1983. ddmmss, degrees, minutes, seconds; NGVD of 1929 refers to the National Geodetic Vertical Datum of 1929; --, no data]

Latitude (ddmmss)	Longitude (ddmmss)	Local well number	Well depth (feet)	Land-surface datum altitude (feet above NGVD of 1929)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land-surface datum)	Date of measurement
			Cleveland County				
334449	921258	11S11W23BBD1	148	275	235	40.10	3/26/2003
335534	920942	09S10W17CDD1	361	270	266	3.57	3/26/2003
335902	922444	08S13W34BDA1	181	248	163	85.46	4/03/2003
			Columbia County				
330233	930958	19S20W34ADC1	40	313	295	17.71	3/18/2003
330247	931513	19S21W35ADC1	30	256	255	0.91	3/18/2003
330520	931857	19S21W17CBB1	55	306	264	42.47	3/18/2003
331313	930914	17S20W35BBD1	--	361	353	7.57	3/18/2003
			Desha County				
333504	911921	13S02W08CAA1	515	147	84	62.62	3/25/2003
333628	911245	12S01W32DCA1	495	136	68	67.78	3/25/2003
333747	912611	12S03W30ADC1	280	153	82	70.89	3/25/2003
			Drew County				
332754	914744	14S07W26BAB1	440	230	107	122.87	3/26/2003
332846	914339	14S06W21BDC1	--	216	97	118.77	3/26/2003
333750	915551	12S08W33AAB1	543	173	74	99.26	3/26/2003
334216	913438	11S05W35DDB1	500	180	83	96.66	3/26/2003
			Lincoln County				
335204	913918	10S05W06CAC1	550	170	70	99.90	3/27/2003
340709	914026	07S06W14BBC1	483	182	162	19.89	3/27/2003
			Union County				
330207	922109	19S12W28CBA1	25	200	190	10.35	4/30/2003
330824	923909	18S15W21DAC1	40	200	176	24.43	4/30/2003
331144	924116	17S15W31DCA2	110	253	203	49.92	3/05/2003
331219	921929	17S12W27DCA1	24	170	160	9.81	4/30/2003
331229	924601	17S16W33BBA2	31	255	230	25.25	4/30/2003
331402	922746	17S13W17DDC1	156	193	155	38.02	4/30/2003
331406	923037	17S14W14DDD1	20	135	130	4.59	4/30/2003
331453	925723	17S18W15CDA1	35	290	262	27.83	4/30/2003
331913	925704	16S18W22DCD1	36	247	239	7.86	3/06/2003
331915	925018	16S17W23BCC1	21	220	206	14.43	4/30/2003

The regional direction of ground-water flow generally is towards the east and southeast, away from the outcrop, except in areas of intense ground-water withdrawals, such as near Crossett, Arkansas (Schrader and Joseph, 2000). A cone of depression is indicated by a relatively low water level near Crossett in Ashley County. Some local ground-water flow in the outcrop area is toward rivers that have eroded into the Cockfield Formation and deposited alluvium in south Bradley and Calhoun Counties (Ouachita River), and in north Dallas County (Saline River). The lowest water-level altitude measured was 62 ft above NGVD of 1929 in Chicot County, near the Mississippi River; the highest water-level altitude measured was 353 ft above NGVD of 1929 in Columbia County, at the outcrop area.

Water-Level Trends

Water-level trends in the Cockfield aquifer are illustrated by plotting the water levels in hydrographs, and evaluating the change in water level over a period of time. Historical water-level data from eight wells (wells A-H, fig. 3) in the Cockfield aquifer were plotted to illustrate the water-level trend in selected areas of southeastern Arkansas (fig. 4). An evaluation of 20 wells with water-level data from 1983 to 2003 shows that water levels in 15 wells have declined at a rate of -0.04 to -0.97 ft/yr, and water levels in 5 wells have risen at a rate of 0.07 to 0.32 ft/yr (table 2). Four of the 5 wells with rising water levels from 1983-2003 are within or near the recharge area of the Cockfield aquifer. An evaluation of the same 20 wells from 2000 to 2003 shows that water levels have declined in only 8 wells, and water levels have risen in 12 wells.

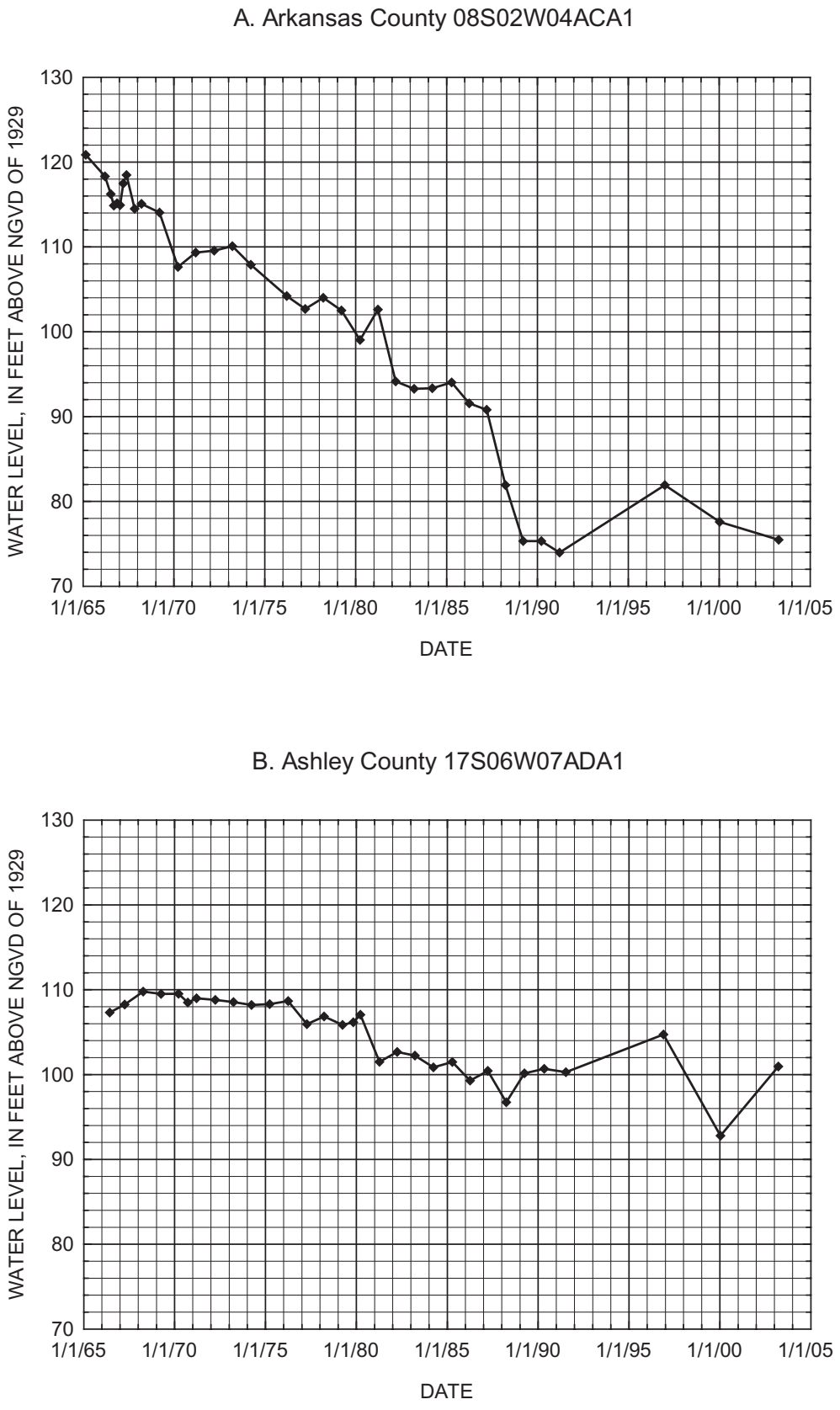
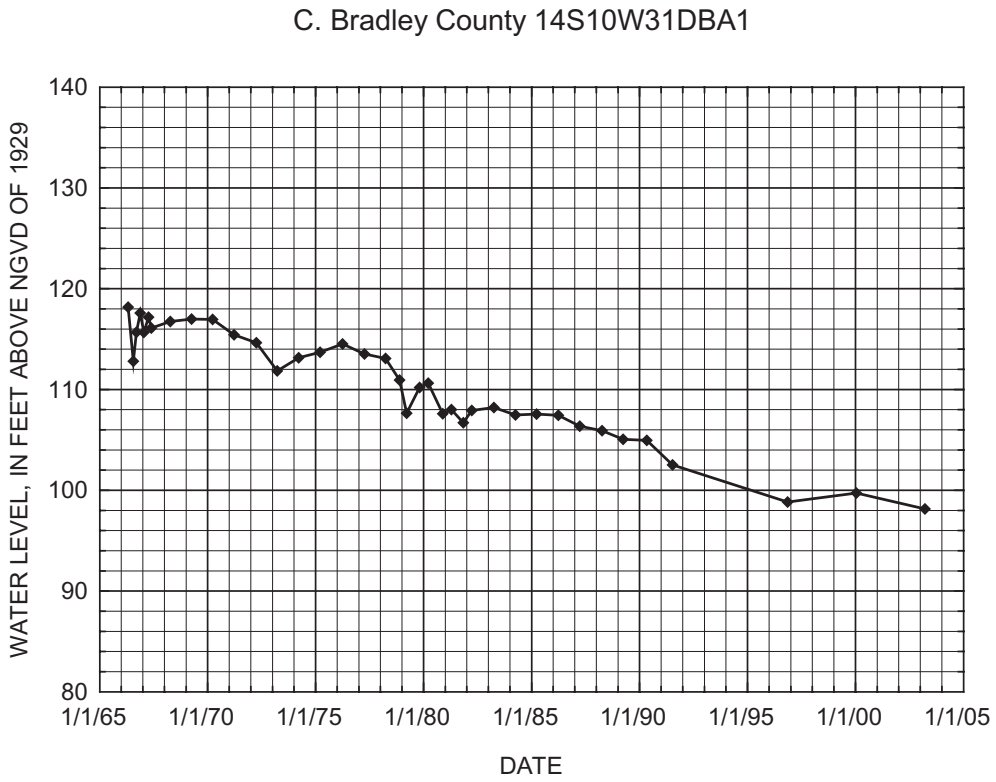


Figure 4. Water-level altitudes for selected wells completed in the Cockfield aquifer in southeastern Arkansas.



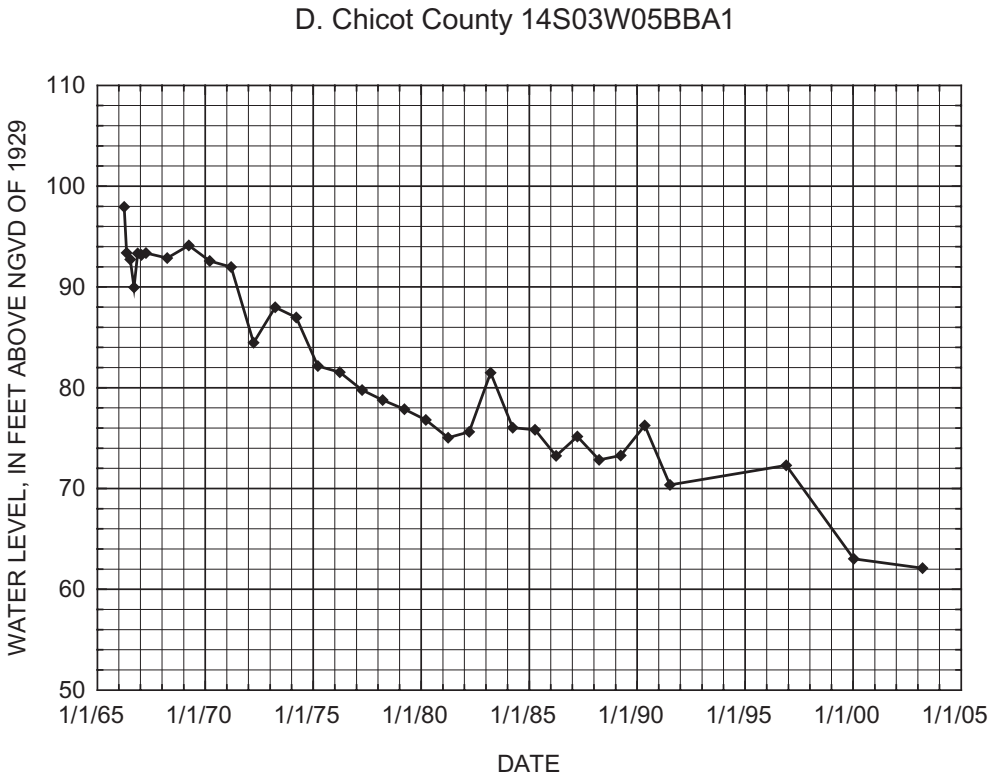
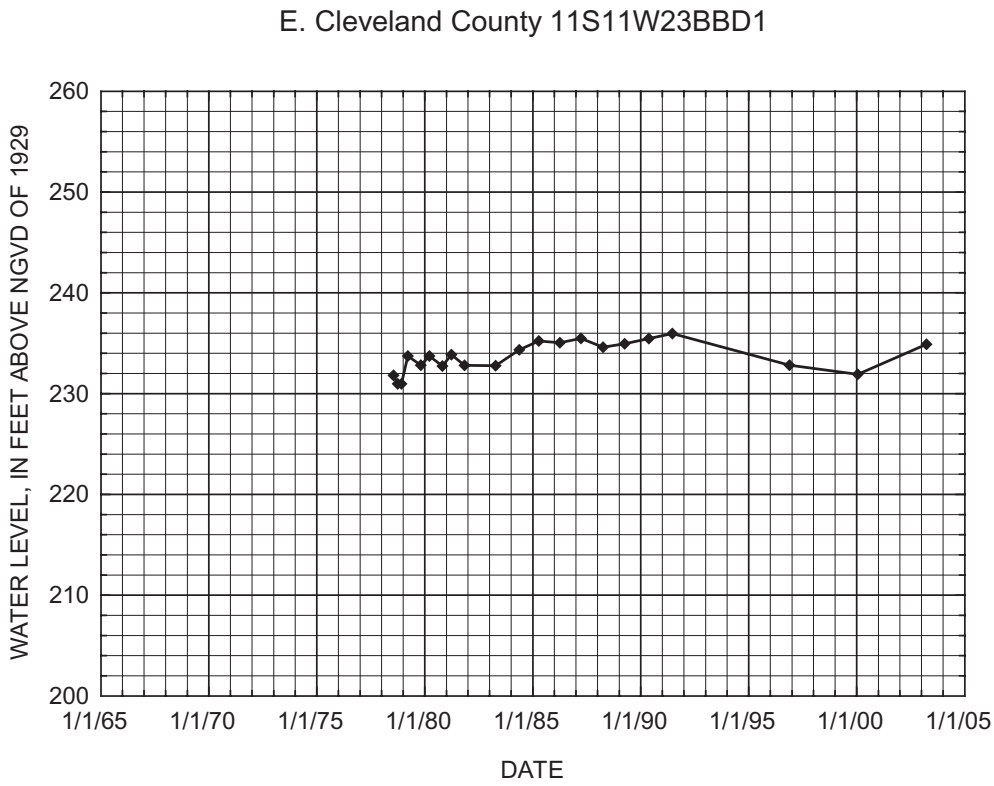


Figure 4. Water-level altitudes for selected wells completed in the Cockfield aquifer in southeastern Arkansas.—Continued



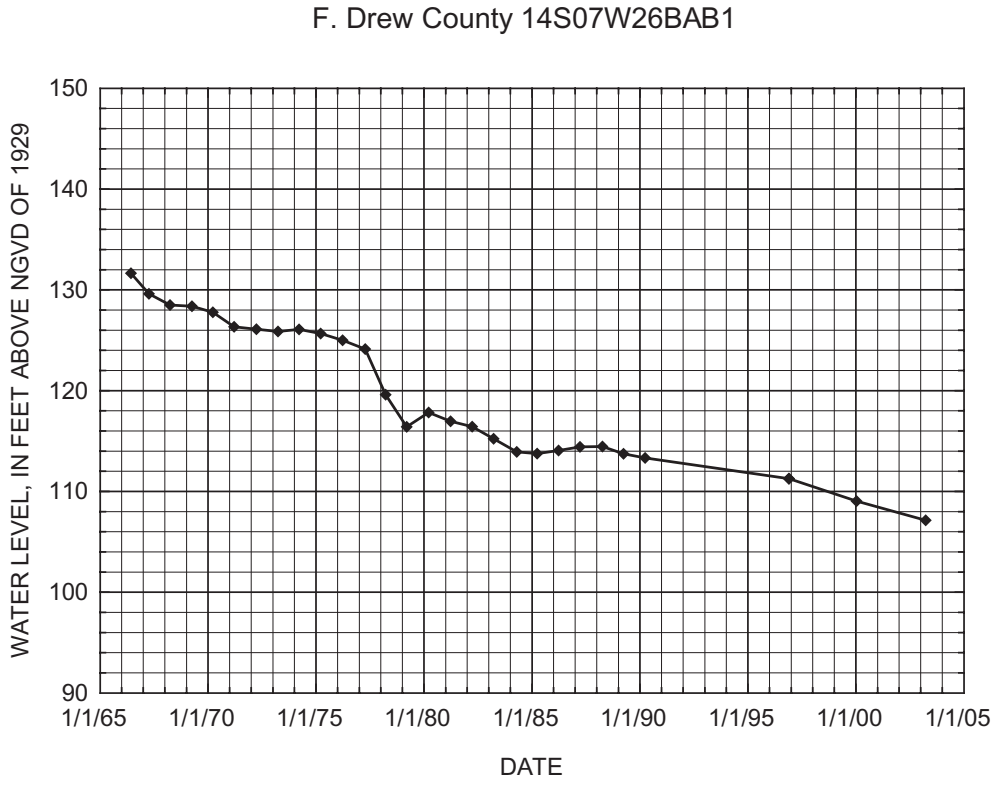
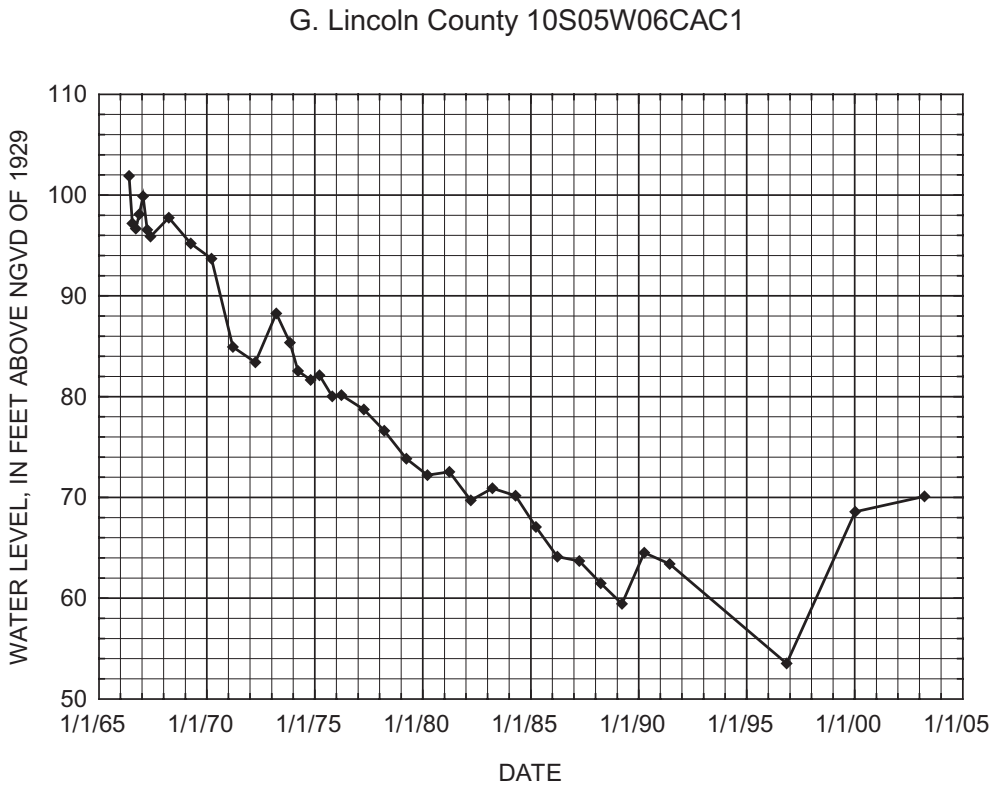


Figure 4. Water-level altitudes for selected wells completed in the Cockfield aquifer in southeastern Arkansas.—Continued



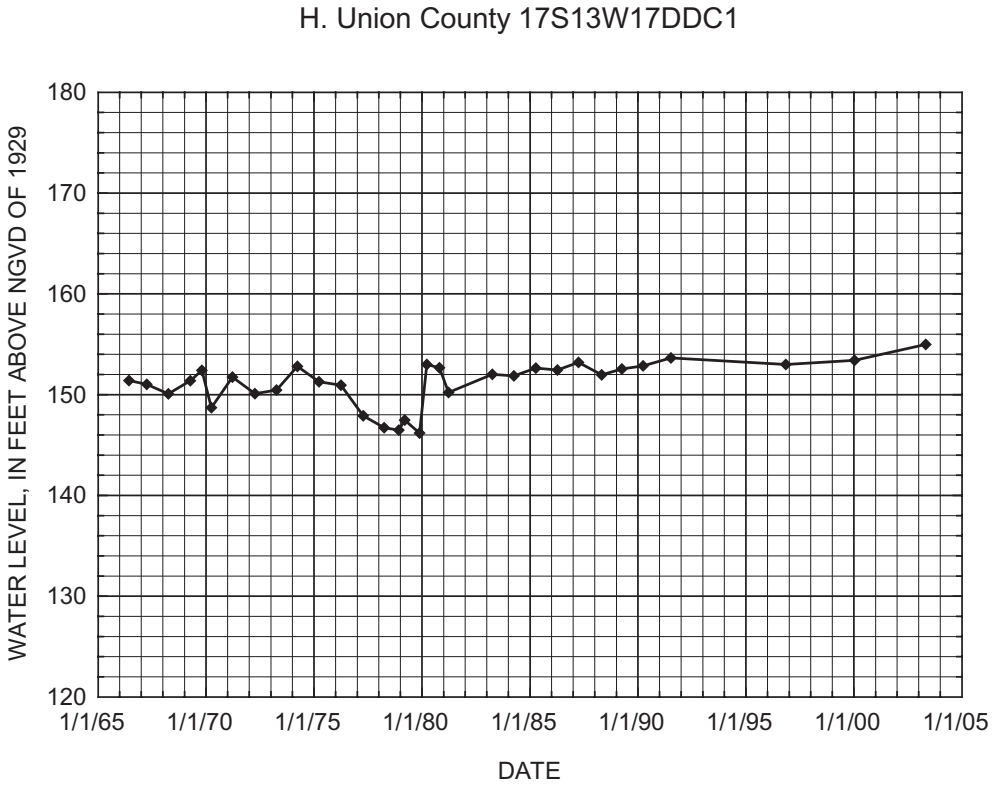


Figure 4. Water-level altitudes for selected wells completed in the Cockfield aquifer in southeastern Arkansas.—Continued

Table 2. Water-level trends for wells in the Cockfield aquifer that have water levels for the 20-year period from 1983 to 2003.

[In this report, negative values for change in water level refer to declines and positive values refer to rises]

Local well number	Difference in water level from 1983 to 2003 (feet)	Average annual change in water level from 1983 to 2003 (feet/year)	Difference in water level from 2000 to 2003 (feet)	Average annual change in water level from 2000 to 2003 (feet/year)	Letter corresponding to hydrograph in figure 4
Arkansas County					
08S02W04ACA1	-17.81	-0.89	-2.12	-0.71	A
Ashley County					
19S05W12CAC1	-2.75	-0.14	2.20	0.73	
18S04W19DAA2	-3.75	-0.19	-0.64	-0.21	
18S08W04BBC1	6.39	0.32	2.84	0.95	
17S04W10BCD2	-11.73	-0.59	0.50	0.17	
17S06W07ADA1	-1.29	-0.06	8.15	2.72	B
15S04W26CBC1	-11.34	-0.57	-2.97	-0.99	
Bradley County					
16S10W11DCB1	-2.57	-0.13	-8.55	-2.85	
16S11W11ACA1	4.38	0.22	6.57	2.19	
15S12W11CAB1	-0.90	-0.05	0.90	0.30	
14S10W31DBA1	-10.07	-0.50	-1.58	-0.53	C
Chicot County					
18S02W25ABB3	-1.49	-0.07	2.60	0.87	
18S03W14CCC1	-2.10	-0.11	0.47	0.16	
15S03W21ABA1	-11.23	-0.56	8.45	2.82	
14S03W05BBA1	-19.39	-0.97	-0.93	-0.31	D
Cleveland County					
11S11W23BBD1	2.13	0.11	2.98	0.99	E
Drew County					
14S07W26BAB1	-8.10	-0.41	-1.91	-0.64	F
Lincoln County					
10S05W06CAC1	-0.80	-0.04	1.53	0.51	G
Union County					
17S15W31DCA2	1.32	0.07	-0.69	-0.23	
17S13W17DDC1	2.96	0.15	1.57	0.52	H

Wilcox Group

Hydrogeologic Setting

The Wilcox Group is Eocene age and distributed throughout most of southern and eastern Arkansas. There are two study areas for the potentiometric surface of the Wilcox in the southern and northeastern portions of Arkansas. The Wilcox Group in central Arkansas is not extensively used, and water-level data are insufficient to determine the potentiometric surface.

The Wilcox Group in the southern study area consists of interbedded layers of clay, sandy clay, sand, and lignite. Formations in the southern study area are undifferentiated. Sand beds generally are thin and are not continuous over large areas. In most of the southern study area, the Wilcox Group overlies the Midway Group and is overlain by terrace deposits and alluvium of Quaternary age or crops out in discontinuous bands that are 1 to 3 miles wide. The Wilcox Group becomes progressively thicker down slope from the outcrop, ranging in thickness from a few feet in the outcrop to about 750 ft in northeastern Bradley County (Albin, 1964).

Recharge to the southern study area occurs by infiltration of rainfall in the outcrop areas and by inflow from overlying terrace and alluvial deposits; discharge flows to streams in the outcrop, to other formations where the aquifer is confined, and to wells (Westerfield, 1994). Well depths are shallow and well yields range from 10 to 100 gal/min (Schrader, 2002).

The Wilcox Group in most of the northeastern study area consists of thin interbedded layers of lignitic sand and clays. The Wilcox Group outcrops at or near Crowleys Ridge in Clay, Greene, and Craighead Counties (Broom and Lyford, 1981). East of Crowleys Ridge, the middle to lower part of the Wilcox Group contains a sand bed of 200 ft or more in thickness (Petersen and others, 1985) referred to as the "1,400-foot sand" (Ryling, 1960; Plebuch, 1961) or the "lower Wilcox aquifer" (Hosman and others, 1968). The Wilcox aquifer in the northeastern study area is confined above by a clay bed of the Wilcox Group and confined below by a clay bed of the Wilcox Group or the Midway Group.

Recharge to the northeastern study area occurs by infiltration of rainfall in the outcrop areas along the western side of Crowleys Ridge; discharge is mainly to wells and to flow beneath the Mississippi River into Mississippi (Westerfield, 1994). Well depths range from 120 ft on Crowleys Ridge in Greene County to 1,750 ft in Crittenden County. Well yields range from 100 to 2,000 gal/min (Schrader, 2002).

Withdrawals from the Wilcox aquifer in the study areas totaled about 24 Mgal/d during 2000, most of which came from the northeastern study area (T.W. Holland, U.S. Geological Survey, written commun., 2003). In the southern study area, withdrawals were about 1 Mgal/d and the primary use of water from the aquifer was for domestic supplies, usually from wells on or near the outcrop areas. In the northeastern study area, withdrawals were about 23 Mgal/d and the primary use of water from the aquifer was for public supplies, but the aquifer is also a source of water for some commercial, domestic, and industrial users.

Potentiometric Surface

The potentiometric-surface maps show the altitude of the water surface in tightly cased wells screened in the Wilcox aquifer (figs. 5 and 6). The maps are based upon water-level data collected during March and April 2003, at 13 wells in the Wilcox aquifer southern study area and at 43 wells in the Wilcox aquifer northeastern study area (tables 3 and 4). The potentiometric surface was constructed by determining the water-level altitude in wells and constructing contour lines along points of equal water-level values. The direction of ground-water flow is perpendicular to the contours in the direction of decreasing water level.

The direction of ground-water flow in the southern study area generally is south and east, except in Clark County where flow is towards the Ouachita River that has eroded into the Wilcox Group and deposited alluvium. The lowest water-level altitude measured in southern Arkansas was 212 ft above NGVD of 1929 near the Ouachita River in Clark County; the highest water-level altitude measured was 401 ft above NGVD of 1929 in the outcrop area of Hempstead County.

The regional direction of ground-water flow in the northeastern study area generally is south and east. Ground-water withdrawals may have altered the natural direction of flow near the centers of pumping at Paragould and West Memphis (Joseph, 1998). The lowest water-level altitude measured in northeastern Arkansas was 121 ft above NGVD of 1929 near West Memphis in Crittenden County; the highest water-level altitude measured was 367 ft above NGVD of 1929 on Crowleys Ridge in Clay County. Crowleys Ridge represents an erosional remnant elevated as high as 200 ft above the Mississippi Alluvial Plain. Water levels measured in wells on Crowleys Ridge are higher because of the higher elevation of the Wilcox Group and influence of direct recharge to outcrops and subcrops on the ridge. The water levels on Crowleys Ridge were not included in the construction of the potentiometric surface because of limited control (four wells).

Water-Level Trends

Water-level trends in the Wilcox aquifer northeastern study area are illustrated by plotting the water levels in hydrographs, and evaluating the change in water level over a period of time. Historical water-level data from six wells (wells I-N, fig. 6) in the Wilcox aquifer were plotted to illustrate the water-level trend in selected areas of northeastern Arkansas (fig. 7). An evaluation of 27 wells with water-level data from 1983 to 2003 in the northeastern study area shows that water levels in all 27 wells have declined at a rate of -0.17 to -1.73 ft/yr (table 5). An evaluation of the same 27 wells from 2000 to 2003 shows that the water level rose in 18 wells and declined in 9 wells. Most of the wells that show water-level decline are near the center of pumping at West Memphis. The water-level trends for the Wilcox aquifer southern study area were not evaluated because of an insufficient period of data.

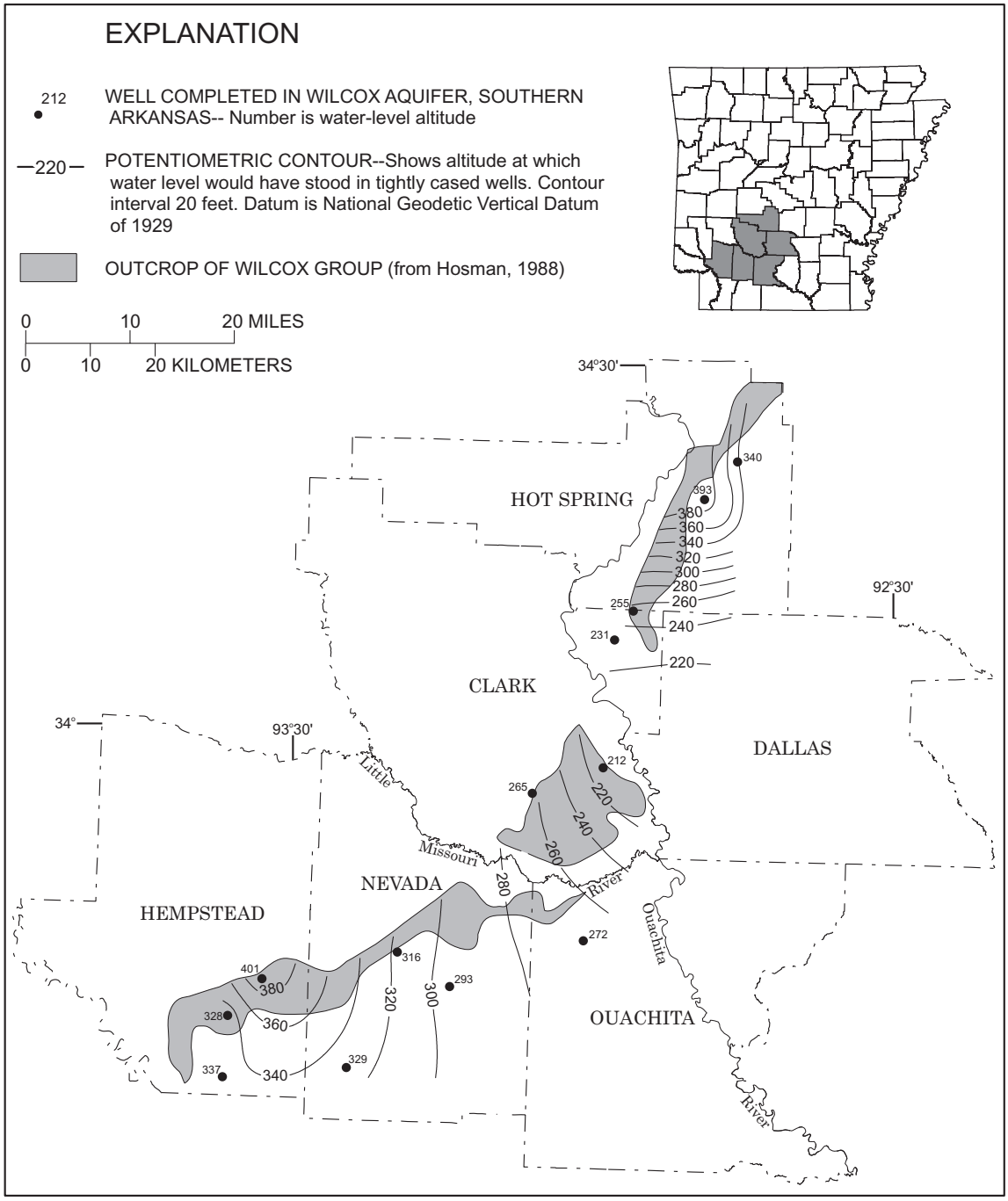


Figure 5. Potentiometric surface of the Wilcox aquifer in southern Arkansas, 2003.

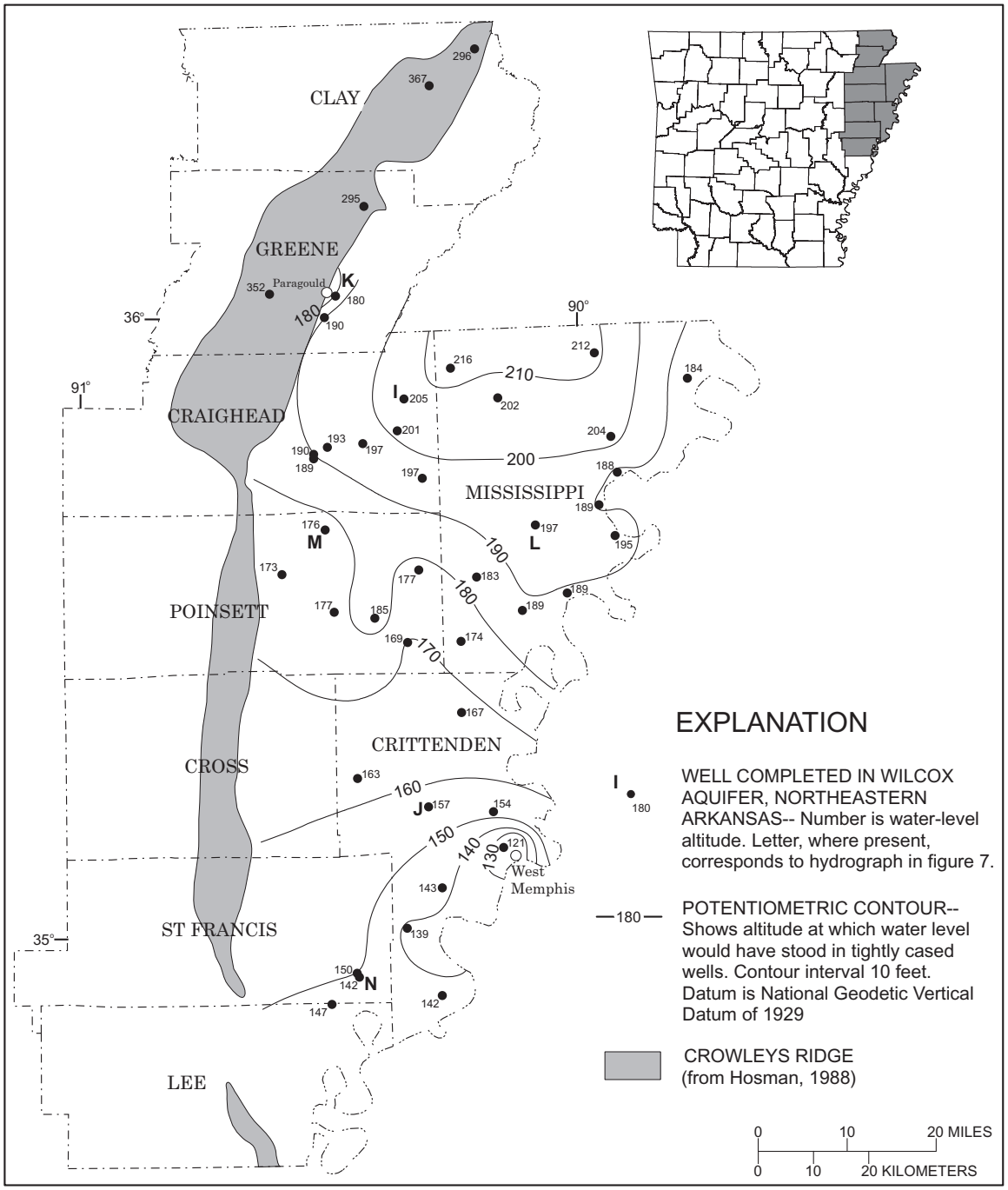


Figure 6. Potentiometric surface of the Wilcox aquifer in northeastern Arkansas, 2003.

Table 3. Information pertaining to measured wells completed in the Wilcox aquifer in southern Arkansas, 2003.

[In this report, the well latitudes and longitudes were measured using a global positioning system referenced to the North American Datum of 1983. ddmmss, degrees, minutes, seconds; NGVD of 1929 refers to the National Geodetic Vertical Datum of 1929]

Latitude (ddmmss)	Longitude (ddmmss)	Local well number	Well depth (feet)	Land-surface datum altitude (feet above NGVD of 1929)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land-surface datum)	Date of measurement
			Clark County				
335403	930612	10S20W01BAC1	53	295	265	29.75	03/25/2003
335611	925905	09S18W20CBB1	26	230	212	17.97	03/24/2003
340652	925757	07S18W20ABB2	19	242	231	11.29	03/24/2003
340917	925604	07S18W03BBD1	47	270	255	14.51	03/24/2003
			Hempstead County				
333017	933704	14S24W29BCA1	31	355	337	17.70	03/10/2003
333524	933635	13S24W29ACC1	60	371	328	43.08	03/10/2003
333829	933311	13S24W02DCA2	63	446	401	45.43	03/10/2003
			Hot Spring County				
341836	924853	05S17W10AAC1	26	410	393	17.23	03/03/2003
342144	924532	04S16W20CBB1	18	345	340	4.62	03/24/2003
			Nevada County				
333105	932443	14S22W19AAA1	75	337	329	8.25	03/12/2003
333754	931426	13S21W02DCC1	240	315	293	22.50	03/11/2003
334046	931941	12S22W24CDA1	41	344	316	27.58	03/11/2003
			Ouachita County				
334144	930105	12S19W11DCD1	533	288	272	15.59	03/13/2003

Table 4. Information pertaining to measured wells completed in the Wilcox aquifer in northeastern Arkansas, 2003.

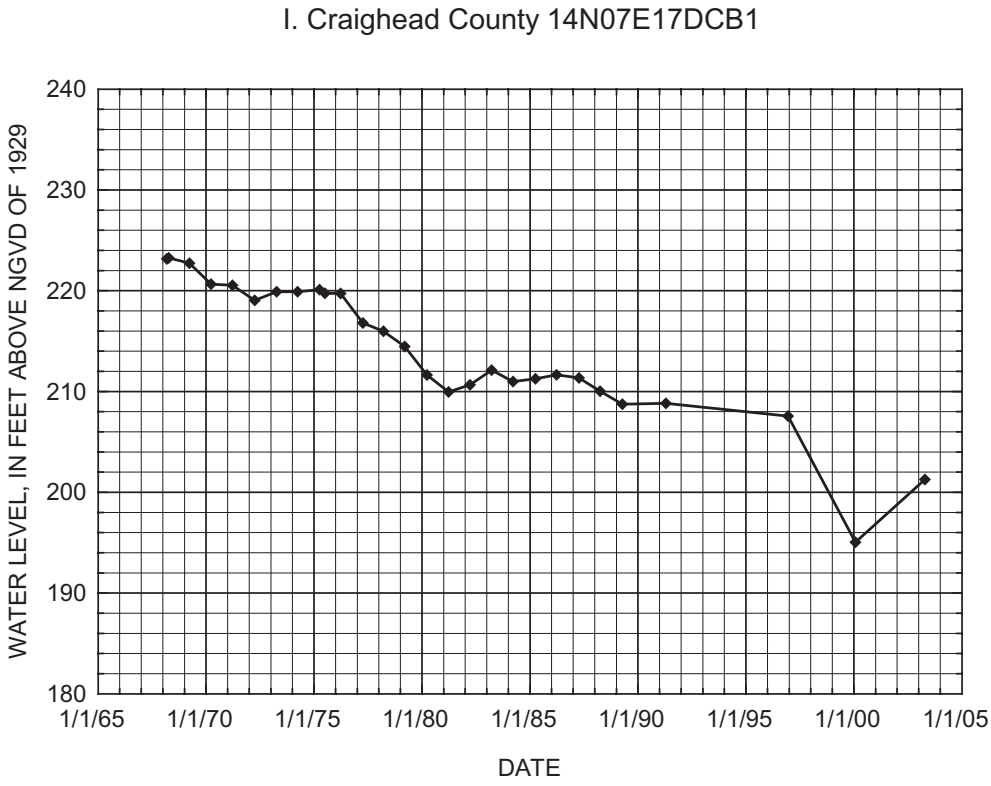
[In this report, the well latitudes and longitudes were measured using a global positioning system referenced to the North American Datum of 1983. ddmmss, degrees, minutes, seconds; NGVD of 1929 refers to the National Geodetic Vertical Datum of 1929]

Latitude (ddmmss)	Longitude (ddmmss)	Local well number	Well depth (feet)	Land-surface datum altitude (feet above NGVD of 1929)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land-surface datum)	Date of measurement
			Clay County				
362347	901703	20N07E01CBB1	200	460	367	92.85	04/17/2003
362716	901126	21N08E14CBB1	157	380	296	84.08	04/17/2003
			Craighead County				
354526	901911	13N07E14BBA2	1,028	221	197	23.71	04/16/2003
354737	903209	14N05E34DDD1	874	229	189	39.67	04/16/2003
354803	903208	14N05E34DAA1	865	230	190	39.64	04/16/2003
354843	903029	14N05E25DCB1	890	233	193	39.96	04/16/2003
354858	902613	14N06E27ACB2	999	227	197	30.36	04/16/2003
355008	902202	14N07E17DCB1	1,070	232	201	30.74	04/16/2003
355315	902107	15N07E33BAD1	1,034	232	205	26.87	04/16/2003
			Crittenden County				
345449	901828	04N07E36ADB1	1,638	201	142	58.87	04/14/2003
350129	902225	05N07E29ACC1	1,700	200	139	60.72	04/14/2003
350520	901807	06N07E01ABB1	1,541	207	143	64.25	04/14/2003
350907	901042	06N09E07CAC1	1,470	210	121	89.08	04/14/2003
351238	901148	07N08E24CAB1	1,540	221	154	66.87	04/14/2003
351318	901930	07N07E14CCC1	1,584	223	157	66.46	04/14/2003
351614	902752	08N06E33CBD1	1,750	215	163	52.39	04/14/2003
352225	901516	09N08E29ADD1	1,564	225	167	57.89	04/14/2003
			Greene County				
360123	903026	16N05E13BAB1	545	290	190	100.38	04/17/2003
360328	902902	17N06E31DCB1	462	285	180	104.85	04/17/2003
360348	903658	17N04E36BCA1	311	505	352	153.38	04/17/2003
361209	902520	18N06E10DCD1	120	320	295	24.63	04/17/2003
			Lee County				
345413	903136	03N05E01BAB1	1,702	196	147	49.44	04/09/2003

Table 4. Information pertaining to measured wells completed in the Wilcox aquifer in northeastern Arkansas, 2003.—Continued

[In this report, the well latitudes and longitudes were measured using a global positioning system referenced to the North American Datum of 1983. ddmmss, degrees, minutes, seconds; NGVD of 1929 refers to the National Geodetic Vertical Datum of 1929]

Latitude (ddmmss)	Longitude (ddmmss)	Local well number	Well depth (feet)	Land-surface datum altitude (feet above NGVD of 1929)	Water-level altitude (feet above NGVD of 1929)	Depth to water (feet below land-surface datum)	Date of measurement
			Mississippi County				
352923	901505	10N08E17ADD1	1,521	225	174	51.03	04/15/2003
353214	900739	11N09E33AAB1	1,560	237	189	47.98	04/15/2003
353349	900213	11N10E20ADA1	1,417	235	189	45.62	04/15/2003
353538	901301	11N08E10AAC2	1,380	220	183	37.09	04/15/2003
353917	895618	12N11E17CDD1	1,500	245	195	50.40	04/15/2003
354033	900548	12N09E11DBB1	1,452	230	197	33.07	04/15/2003
354221	895807	13N11E31CCC1	1,500	241	189	52.17	04/15/2003
354528	895547	13N11E08DDA1	1,445	245	188	56.52	04/15/2003
354859	895626	14N11E20CCA1	1,518	240	204	35.53	04/15/2003
355306	900952	15N09E31ACD1	1,158	240	202	37.98	04/15/2003
355426	894701	15N12E23DBC1	1,491	238	184	54.23	04/15/2003
355607	901527	15N08E08DBC3	1,060	238	216	22.24	04/15/2003
355712	895806	15N10E01ADC1	1,350	248	212	36.25	04/15/2003
			Poinsett County				
352925	902129	10N07E16CBB2	1,500	218	169	49.40	04/21/2003
353152	902520	11N06E35CDA3	1,301	215	185	29.87	04/21/2003
353234	903009	11N05E36AAA1	1,175	214	177	36.57	04/21/2003
353622	903618	11N05E06CCD1	992	214	173	41.50	04/21/2003
353629	901955	11N07E03BDD1	1,456	216	177	38.92	04/21/2003
354038	903059	12N05E13BBB1	1,071	222	176	45.59	04/21/2003
			St. Francis County				
345649	902815	04N06E21BAD2	1,740	201	142	59.38	04/09/2003
345712	902830	04N06E16CCB1	1,615	202	150	51.86	04/09/2003



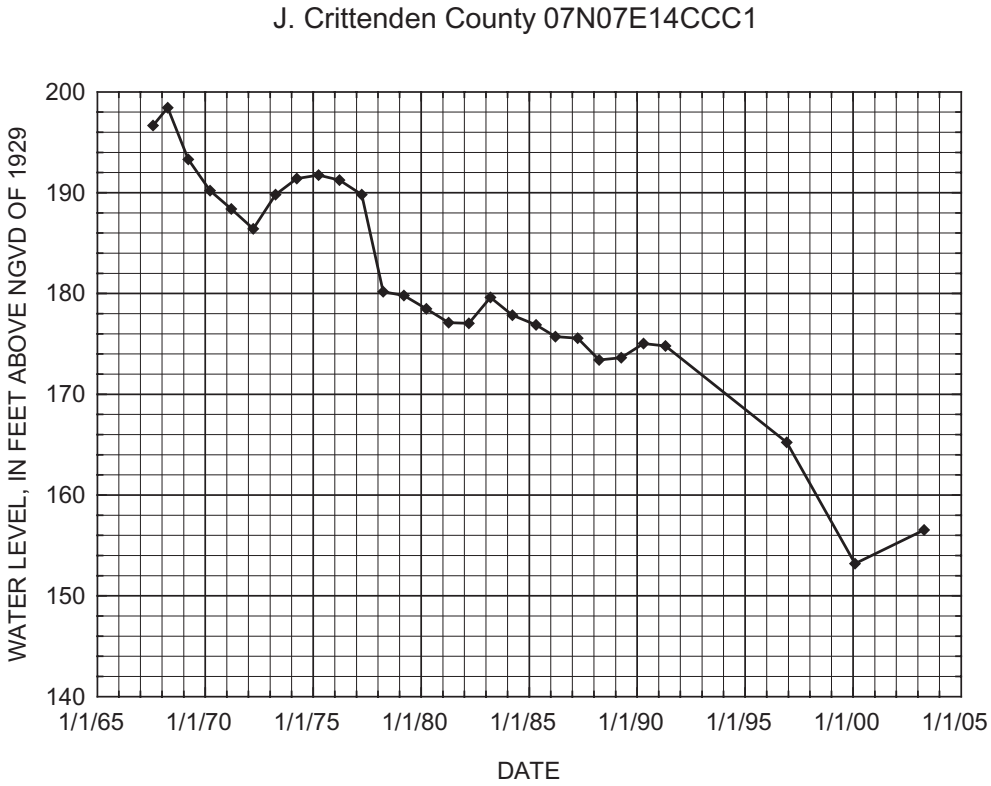
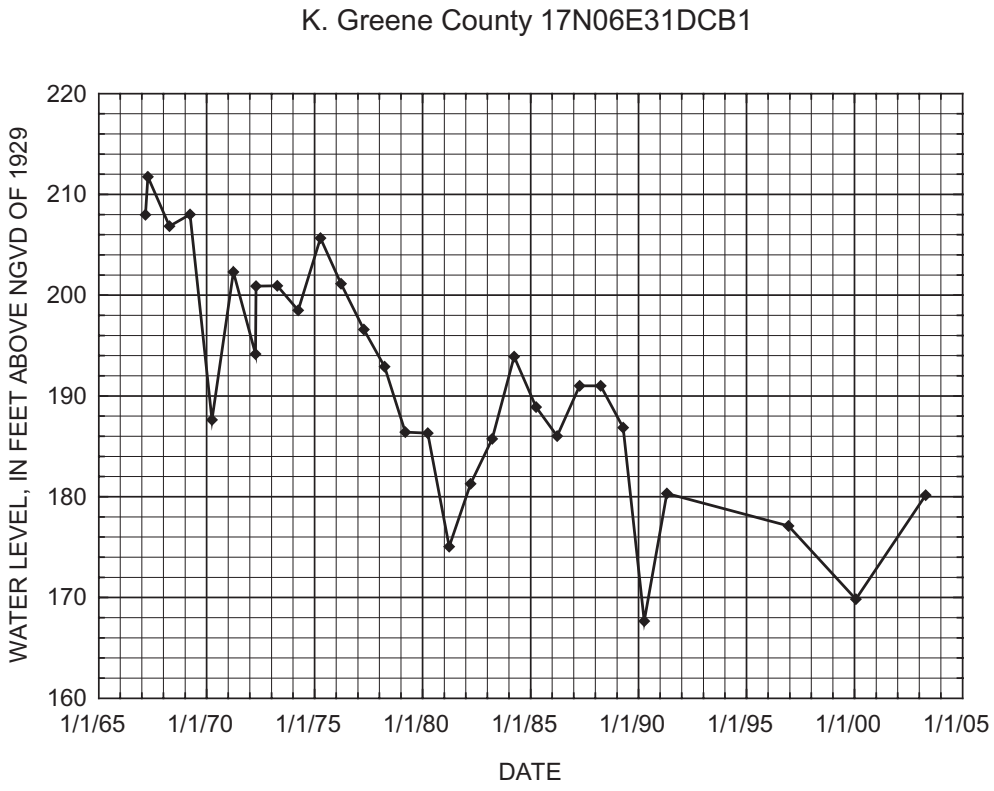


Figure 7. Water-level altitudes for selected wells completed in the Wilcox aquifer in northeastern Arkansas.



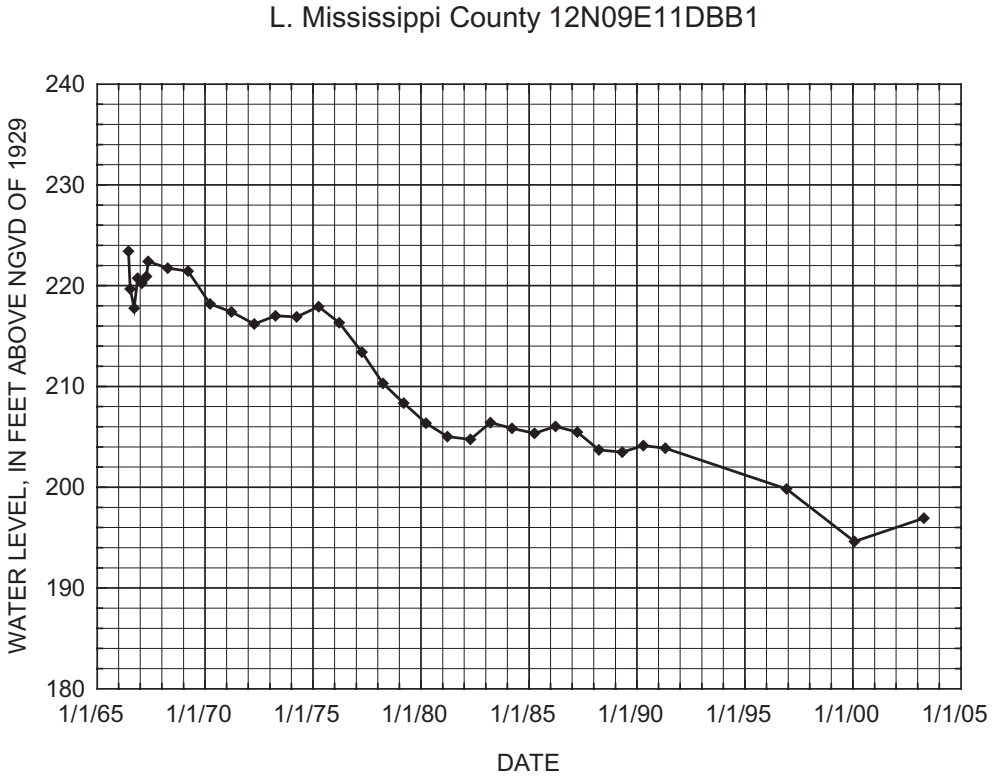
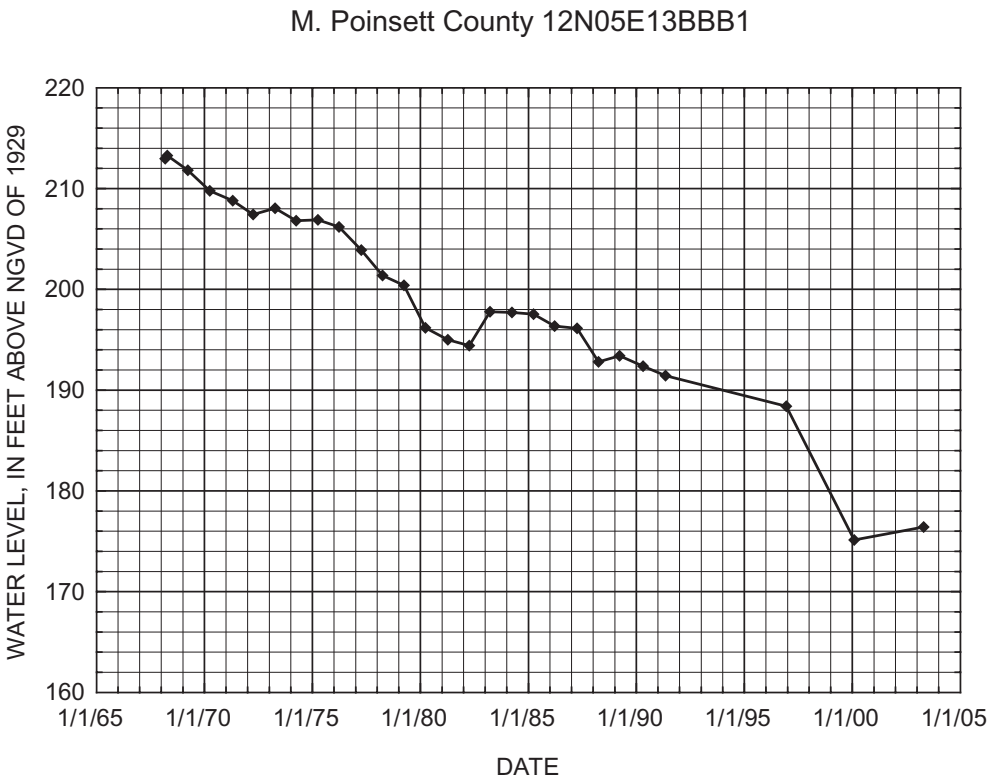


Figure 7. Water-level altitudes for selected wells completed in the Wilcox aquifer in northeastern Arkansas.—Continued



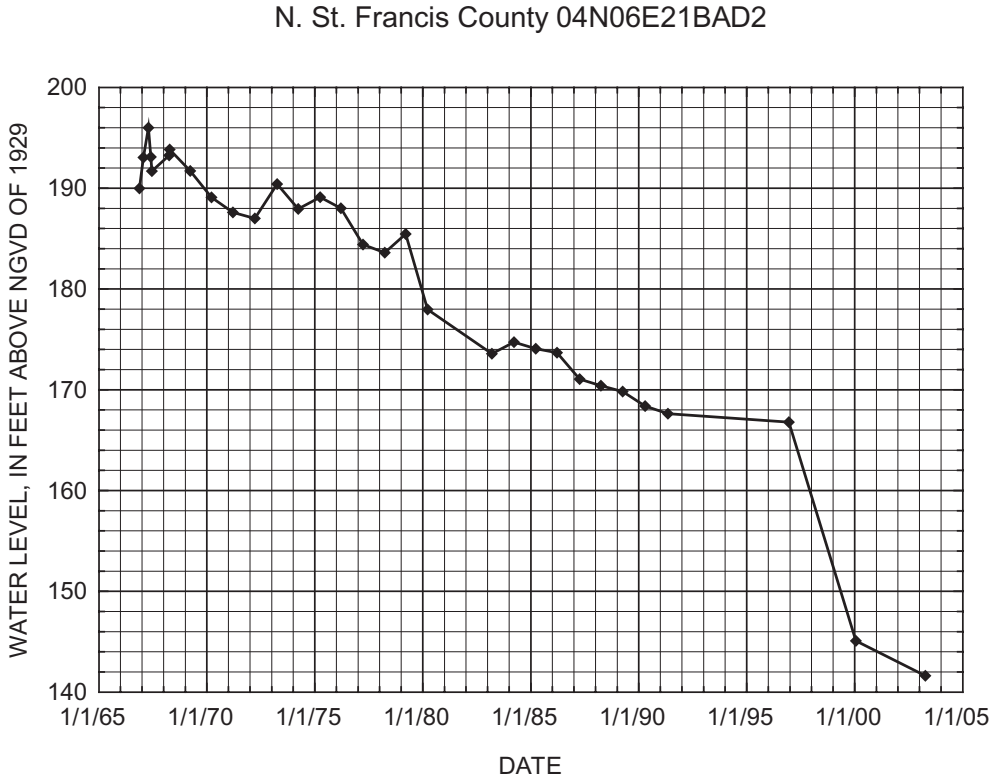


Figure 7. Water-level altitudes for selected wells completed in the Wilcox aquifer in northeastern Arkansas.—Continued

Table 5. Water-level trends for wells in the Wilcox aquifer that have water levels for the 20-year period from 1983 to 2003.

[In this report, negative values for change in water level refer to declines and positive values refer to rises; ft, feet; ft/yr, feet per year]

Local well number	Difference in water level from 1983 to 2003 (ft)	Average annual change in water level from 1983 to 2003 (ft/yr)	Difference in water level from 2000 to 2003 (ft)	Average annual change in water level from 2000 to 2003 (ft/yr)	Letter corresponding to hydrograph in figure 7
Craighead County					
13N07E14BBA2	-8.62	-0.43	14.95	4.98	
14N06E27ACB2	-12.83	-0.64	6.08	2.03	
14N07E17DCB1	-10.86	-0.54	6.22	2.07	I
Crittenden County					
04N07E36ADB1	-34.54	-1.73	-3.99	-1.33	
05N07E29ACC1	-32.59	-1.63	-4.25	-1.42	
06N07E01ABB1	-30.59	-1.53	-3.32	-1.11	
06N09E07CAC1	-28.15	-1.41	-3.36	-1.12	
07N08E24CAB1	-20.84	-1.04	-0.19	-0.06	
07N07E14CCC1	-23.07	-1.15	3.35	1.12	J
08N06E33CBD1	-20.42	-1.02	1.65	0.55	
09N08E29ADD1	-21.04	-1.05	-2.69	-0.90	
Greene County					
17N06E31DCB1	-5.59	-0.28	10.32	3.44	K
17N04E36BCA1	-3.43	-0.17	4.83	1.61	
Mississippi County					
10N08E17ADD1	-21.85	-1.09	-0.61	-0.20	
11N09E33AAB1	-10.18	-0.51	6.29	2.10	
11N10E20ADA1	-11.62	-0.58	1.66	0.55	
11N08E10AAC2	-15.40	-0.77	14.19	4.73	
12N11E17CDD1	-4.66	-0.23	22.06	7.35	
12N09E11DBB1	-9.47	-0.47	2.31	0.77	L
13N11E08DDA1	-24.72	-1.24	5.70	1.90	
14N11E20CCA1	-11.50	-0.58	0.58	0.19	
15N09E31ACD1	-12.36	-0.62	1.41	0.47	
Poinsett County					
10N07E16CBB2	-18.01	-0.90	-5.53	-1.84	
11N06E35CDA3	-3.47	-0.17	8.81	2.94	
11N07E03BDD1	-15.37	-0.77	7.50	2.50	
12N05E13BBB1	-21.36	-1.07	1.28	0.43	M
St. Francis County					
04N06E21BAD2	-31.96	-1.60	-3.46	-1.15	N

Summary

During March and April 2003, water levels were measured in 55 wells in the Cockfield aquifer, 13 wells in the Wilcox aquifer of southern Arkansas, and 43 wells in the Wilcox aquifer of northeastern Arkansas. Major withdrawals are made from the aquifers for industrial and public supply, with lesser but locally significant withdrawals for domestic and livestock uses. This report presents the results of the water-level measurements made during 2003 and displays the water levels in potentiometric-surface maps, in hydrographs, and describes water-level trends for wells with data from 1983 to 2003.

The Cockfield Formation generally consists of discontinuous sand units interbedded with silt, clay, and lignite in southeastern Arkansas. Most recharge occurs by rainfall infiltration on the outcrop and by inflow from overlying alluvium. Sand beds near the base of the Cockfield Formation constitute most of the Cockfield aquifer. Withdrawals from the Cockfield aquifer study area during 2000 totaled about 9 million gallons per day.

The potentiometric surface of the Cockfield aquifer constructed from the 2003 water levels shows that regional direction of ground-water flow generally is towards the east and southeast, away from the outcrop, except in areas of intense ground-water withdrawals, such as near Crossett, Arkansas. A cone of depression is indicated by a relatively low water level near Crossett in Ashley County. Some local ground-water flow in the outcrop area is toward rivers that eroded into the Cockfield Formation and deposited alluvium in south Bradley and Calhoun Counties (Ouachita River), and in north Dallas County (Saline River). Water-level measurements at wells completed in the Cockfield aquifer ranged in altitude from 62 to 353 ft above NGVD of 1929. An evaluation of 20 wells with water-level data from 1983 to 2003 shows that water levels in 15 wells have declined at a rate of -0.04 to -0.97 ft/yr, and water levels in 5 wells have risen at a rate of 0.07 to 0.32 ft/yr. Four of the 5 wells with rising water levels are within or near the recharge area of the Cockfield Formation. An evaluation of the same 20 wells from 2000 to 2003 shows that water levels in the wells have declined in only 8 wells and risen in 12 wells.

The Wilcox Group is distributed throughout most of southern and eastern Arkansas. There are two study areas in southern and northeastern Arkansas. The Wilcox Group of the southern study area consists of interbedded clay, sandy clay, sand, and lignite. Recharge occurs by rainfall infiltration in the outcrop or inflow from overlying terrace and alluvial deposits. Thin discontinuous sand units constitute the Wilcox aquifer in the southern study area. Withdrawals from the aquifer in the southern study area were about 1 million gallons per day in 2000. The potentiometric surface of the Wilcox aquifer in the southern study area shows that regional ground-water flow generally is south and east, except in Clark County where flow is towards the Ouachita River. Water-level measurements in the southern study area ranged from 212 to 401 ft above NGVD of 1929. There was an insufficient period of data to evaluate water-level trends for the Wilcox aquifer southern study area.

The Wilcox Group in the northeastern study area consists of thin interbedded lignitic sand and clays. Recharge occurs by rainfall infiltration in the outcrop along Crowleys Ridge. A sand bed about 200 ft thick in the middle to lower part of the Wilcox Group constitutes the major producing unit of the Wilcox aquifer in the northeastern study area. Withdrawals from the aquifer in the northeastern study area were about 23 million gallons per day during 2000.

The potentiometric surface of the Wilcox aquifer in the northeastern study area shows that ground-water flow generally is south and east, except where ground-water withdrawals may have altered the natural direction of flow near the centers of pumping at Paragould and West Memphis. Water-level measurements at wells completed in the northeastern study area ranged from 121 to 367 ft above NGVD of 1929. An evaluation of 27 wells with water-level data from 1983 to 2003 in the northeastern study area shows that water levels in all 27 wells have declined at a rate of -0.17 to -1.73 ft/yr. An evaluation of the same 27 wells from 2000 to 2003 shows that water levels in 18 wells have risen and in 9 wells have declined. Most of the water-level declines in wells are near the center of pumping at West Memphis.

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