U.S. DEPARTMENT OF THE INTERIOR
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PUBLIC WORKS AND FLOOD CONTROL DIRECTORATE
WATER RESOURCES SECTION

WATER-RESOURCES INVESTIGATIONS
REPORT 95-4241 (SHEET 1 OF 2)
COCKFIELD AQUIFER--POTENTIOMETRIC SURFACE

INTRODUCTION

The Cockfield aquifer, an important source of ground water in northern Louisiana, contains freshwater in three distinct areas that are separated from each other by the Ouachita River Valley and Red River Valley. In 1990, 5.8 Mgal/d was withdrawn from the aquifer in Louisiana. The greatest development of the aquifer has been in the parishes east of the Ouachita River. In this area, the aquifer provides water for municipalities and water districts (J.K. Lovelace, U.S. Geological Survey, written commun., 1993).

Additional knowledge about ground-water flow and the effects of withdrawal on the Cockfield aquifer is needed for assessment of ground-water development potential and protection of the resource. To meet this need, the potentiometric surface of the aquifer and water-level changes in that surface are being monitored as part of the U.S. Geological Survey's cooperative program with the Louisiana Department of Transportation and Development.

This report presents data and maps that illustrate the potentiometric surface (water level) during November 1992 through January 1993 and water-level changes during 1968-93 for the Cockfield aquifer. Hydrographs of water levels in selected wells completed in the aquifer also are presented.

The maps in this report can be used for determining the direction of ground-water flow, hydraulic gradients, and the effects of withdrawals on the ground-water system. The rate of ground-water movement can be estimated from the gradient when the hydraulic conductivity of the aquifer is known. Previous studies of northern Louisiana with emphasis on the Cockfield aquifer are included in the Selected References.

HYDROGEOLOGY

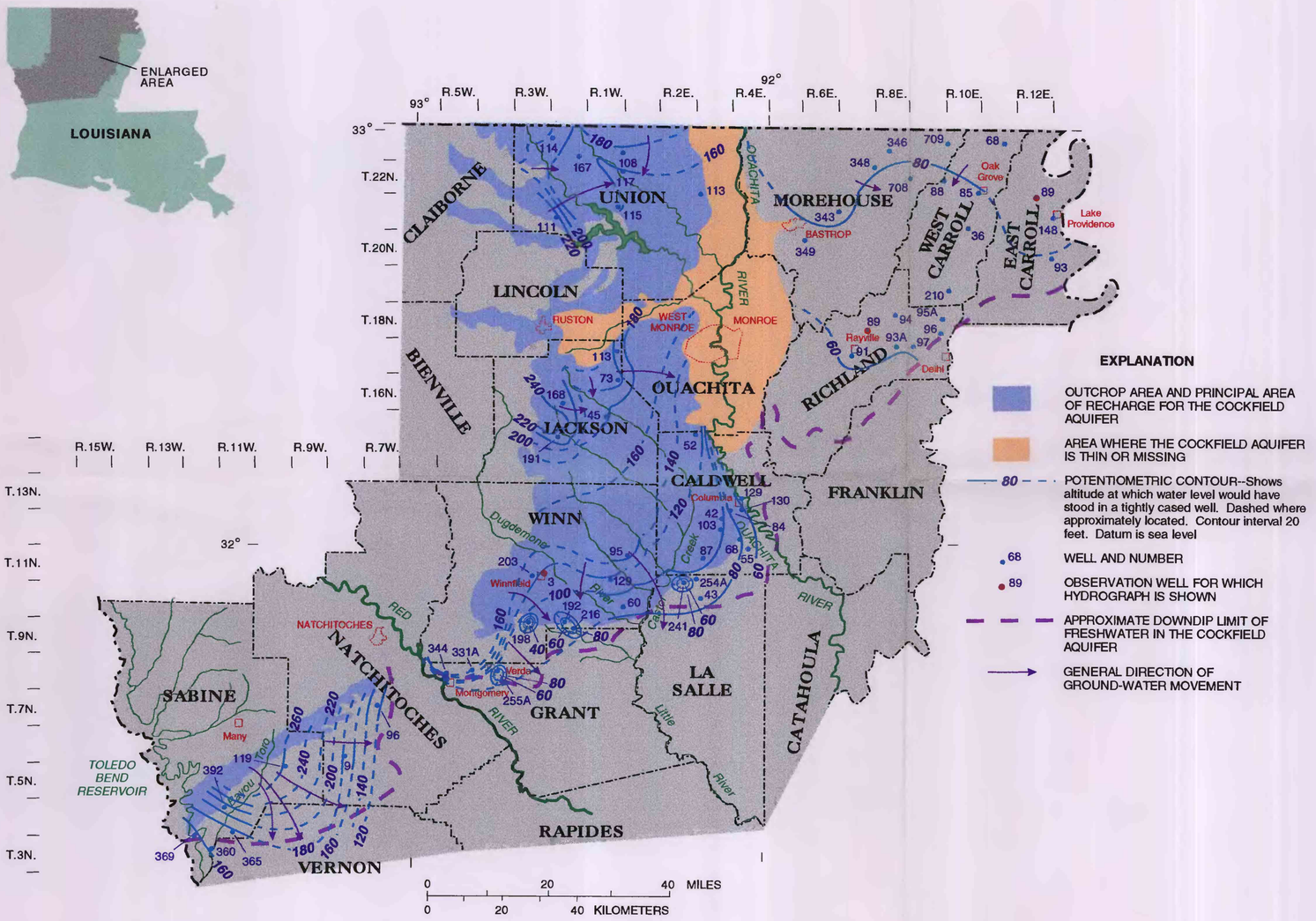
This section briefly describes the general hydrogeology of the Cockfield aquifer and presents specific discussions of each of the three areas. The Cockfield aquifer is composed of interbedded sands and silts and contains discontinuous layers of clay and lignite of Eocene age (Sanford, 1973). The Cockfield aquifer is overlain by the Vicksburg-Jackson confining unit and is underlain by the Cook Mountain confining unit (fig.1). In the area east of the Ouachita River (parts of East Carroll, West Carroll, Richland, and Morehouse Parishes), the Vicksburg-Jackson confining unit has been eroded, and the Cockfield aquifer is unconformably overlain by terrace or alluvial deposits of Pleistocene age (Poole, 1961, p. 64).

The Cockfield aquifer ranges from 0 to 900 ft in total thickness. Individual sands within the aquifer range in thickness from a few feet to more than 200 ft, but average from 20 to 50 ft (Gaydos and others, 1973, p. 14). The size of sand grains in the aquifer ranges from very fine to medium (Covay, 1985, p. 7).

Hydraulic conditions within the Cockfield aquifer can vary greatly from one area to another; the hydraulic conductivity for the aquifer ranges from 30 to 55 ft/d (Covay, 1985, p. 15). A well completed in a Cockfield sand 50 ft thick could produce water at a rate of at least 250 gal/min (Gaydos and others, 1973, p. 37). Some wells completed in the aquifer in East Carroll Parish and West Carroll Parish have yielded 700 gal/min (Poole, 1961, p. 76). Yields of several hundred gallons per minute from wells in the Rayville-Delhi area also have been reported (Covay, 1985, p. 19).

In the area east of the Ouachita River, the upper surface of the Cockfield is in direct contact with the unconformably overlying Mississippi River alluvial aquifer. The Cockfield aquifer dips southeasterly and discharges toward the Mississippi River, and water generally flows in a southerly direction. East of the Ouachita River, the Cockfield aquifer is recharged by infiltration of water downward from the Mississippi River alluvial aquifer (Covay, 1985, p. 15). Water levels in the Cockfield aquifer closely parallel those in the overlying alluvial aquifer (Poole, 1961, p. 69).

The Cockfield aquifer crops out in a large part of the area between the Red River and Ouachita River. In this area, the aquifer is recharged by rainfall. Water from the aquifer moves down gradient and discharges into the numerous streams that dissect the area (Snider and others, 1972, p. 28).



EXPLANATION

- OUTCROP AREA AND PRINCIPAL AREA OF RECHARGE FOR THE COCKFIELD AQUIFER
- AREA WHERE THE COCKFIELD AQUIFER IS THIN OR MISSING
- 80 — POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in a tightly cased well. Dashed where approximately located. Contour interval 20 feet. Datum is sea level
- 68 — WELL AND NUMBER
- 89 — OBSERVATION WELL FOR WHICH HYDROGRAPH IS SHOWN
- APPROXIMATE DOWNDIP LIMIT OF FRESHWATER IN THE COCKFIELD AQUIFER
- GENERAL DIRECTION OF GROUND-WATER MOVEMENT

Figure 2. Potentiometric surface of the Cockfield aquifer from November 1992 through January 1993, in northern Louisiana.

In the southwestern part of the study area, the Cockfield aquifer crops out along a band approximately 4 mi wide, in a southwesterly direction from the Red River Valley in central Natchitoches Parish to the Sabine River in southern Sabine Parish (Snead and McCulloh, 1984). In this area, the aquifer dips to the south, away from the Sabine uplift, at about 330 ft/mi (Page and others, 1963, p. 63; Newcome and others, 1963, p. 49). Water moves downdip and laterally toward the Sabine River Valley and Red River Valley (Rollo, 1960, p. 31).

Freshwater is contained in the Cockfield aquifer throughout most of the study area. In Natchitoches, Sabine, and Vernon Parishes, freshwater is present at a greater depth in the Cockfield than in any other aquifer in western Louisiana. Freshwater is produced at depths of almost 2,000 ft in southwestern Natchitoches Parish and northwestern Vernon Parish (Rollo, 1960, p. 31). In a small part of northeastern Louisiana where the aquifer is overlain by the Vicksburg-Jackson confining unit, the basal sand of the Cockfield aquifer contains brackish water (Poole, 1961, p. 33).

POTENTIOMETRIC SURFACE

The map of the potentiometric surface of the Cockfield aquifer (fig. 2) was constructed using water- level measurements from selected wells completed in the aquifer (table 1). Measurements are reported to tenths or hundredths of a foot, depending on the method of measurement used. The water levels ranged from 31 to 259 ft above sea level. The parishes with the lowest water levels included northern Grant Parish and southern Winn Parish. The highest water levels were in Jackson, Union, and southern Sabine Parishes.

Direction of ground-water flow is perpendicular to the potentiometric-surface contours, as shown by the flow lines in figure 2. Water movement in the aquifer generally is to the southeast. The direction of ground-water flow is influenced by the Red River and Ouachita River. Locally, water movement through the aquifer is toward numerous streams that dissect the outcrop area.

System	Series	Stratigraphic unit		Hydrogeologic unit
Quaternary	Pleistocene	Red River alluvial deposits Mississippi River alluvial deposits Northern Louisiana terrace deposits Unnamed Pleistocene deposits		Red River alluvial aquifer or surficial confining unit Mississippi River alluvial aquifer or surficial confining unit Upland terrace aquifer or surficial confining unit
Tertiary	Pliocene	Fleming Formation	Blounts Creek Member	Pliocene-Miocene aquifers are absent in this area
	?		Castor Creek Member	
	Miocene		Williamson Creek Member Dough Hills Member Carnahan Bayou Member	
	?		Lena Member	
	Oligocene	Catahoula Formation		
		Vicksburg Group, undifferentiated		Vicksburg-Jackson confining unit
	Eocene	Jackson Group, undifferentiated		
		Claiborne Group	Cockfield Formation	Cockfield aquifer or surficial confining unit
			Cook Mountain Formation	Cook Mountain aquifer or confining unit
			Sparta Sand	Sparta aquifer or surficial confining unit
			Cane River Formation	Cane River aquifer or confining unit
			Carrizo Sand	Carrizo-Wilcox aquifer or surficial confining unit
	Paleocene	Wilcox Group, undifferentiated		
		Midway Group, undifferentiated		Midway confining unit

From Lovelace and Lovelace, 1995

Figure 1. Stratigraphic and hydrogeologic units in northern Louisiana.

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot (ft)	0.3048	meter
foot per day (ft/d)	0.3048	meter per day
foot per year (ft/yr)	0.3048	meter per year
foot per mile (ft/mi)	0.1894	meter per kilometer
gallon per minute (gal/min)	0.06308	liter per second
million gallons per day (Mgal/d)	3,785	cubic meters per day
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Table 1. Water-level data used to construct potentiometric-surface map of the Cockfield aquifer in northern Louisiana, November 1992 through January 1993

[+, water level is above land surface]

Well number	Well depth (in feet)	Water level (in feet below land surface)	Water level (in feet above sea level)	Date
Caldwell Parish				
Ca-42	360	85.80	104	11-30-92
Ca-52	160	86.13	129	11-24-92
Ca-55	520	114.60	70	12-29-92
Ca-68	387	115.15	90	11-24-92
Ca-84	325	134.96	78	11-23-92
Ca-87	396	54.35	106	11-23-92
Ca-103	372	75.84	87	11-23-92
Ca-129	276	20.52	45	12-01-92
Ca-130	260	25.29	65	11-23-92
East Carroll Parish				
Ec-89	335	20.56	85	12-01-92
Ec-93	465	20.65	79	12-29-92
Ec-148	436	39.82	64	12-08-92
Grant Parish				
G-216	380	87.92	57	12-22-92
G-255A	326	109.74	50	12-18-92
G-331A	370	89.25	141	12-18-92
G-344	303	91.50	164	01-07-93
Jackson Parish				
Ja-45	102	+0.4	180	12-09-92
Ja-73	120	28.78	201	12-09-92
Ja-113	163	70.95	184	12-09-92
Ja-168	128	46.62	233	12-09-92
Ja-191	52	9.39	241	12-09-92
La Salle Parish				
La-43	417	70.82	91	12-01-92
La-241	285	99.3	56	12-01-92
La-254A	510	75.1	85	12-01-92
Morehouse Parish				
Mo-343	176	5.36	83	11-24-92
Mo-346	167	20.39	86	11-24-92
Mo-348	311	17.47	81	11-24-92
Mo-349	217	68.27	74	11-24-92
Mo-708	376	27.62	68	11-24-92
Mo-709	255	15.23	84	11-24-92
Natchitoches Parish				
Na-9	1,300	8 .17	177	01-21-93
Na-96	440	+10.5	121	01-06-93
Richland Parish				
Ri-89	300	19.27	65	11-24-92
Ri-91	180	10.05	70	11-24-92
Ri-93A	239	17.62	62	11-25-92
Ri-94	345	16.08	64	12-07-92
Ri-95A	200	24.87	65	11-25-92
Ri-96	170	16.15	74	11-25-92
Ri-97	239	16.25	64	11-25-92
Sabine Parish				
Sa-119	307	11.13	259	12-30-92
Sa-360	769	+8.3	173	01-06-93
Sa-365	687	24.75	175	12-29-92
Sa-369	240	57.35	153	12-29-92
Sa-392	544	23.12	219	01-06-93
Union Parish				
Un-108	60	33.67	171	12-30-92
Un-111	28	9.10	221	12-30-92
Un-113	520	31.79	153	12-30-92
Un-114	32	14.68	190	12-30-92
Un-115	34	7.10	178	12-30-92
Un-117	45	26.39	159	12-30-92
Un-167	110	45.99	164	12-30-92
West Carroll Parish				
WC-36	383	30.33	76	11-25-92
WC-68	217	27.12	90	12-01-92
WC-85	330	41.47	79	11-30-92
WC-88	255	23.65	79	12-08-92
WC-210	340	30.43	72	11-30-92
Winn Parish				
W-3	122	16.66	118	12-02-92
W-60	230	+6.2	91	12-10-92
W-95	147	54.77	145	12-28-92
W-129	246	45.05	115	12-10-92
W-192	210	82.34	58	12-29-92
W-198	445	159.39	31	12-18-92
W-203	218	28.29	132	12-18-92

LOUISIANA GROUND-WATER MAP NO. 9: POTENTIOMETRIC SURFACE, 1993, OF THE COCKFIELD AQUIFER IN NORTHERN LOUISIANA

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1996

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