

STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
OFFICE OF PUBLIC WORKS AND INTERMODAL
PUBLIC WORKS AND WATER RESOURCES DIVISION



WATER RESOURCES

TECHNICAL REPORT
NO. 72



**HYDROGEOLOGIC FRAMEWORK OF
SOUTHEASTERN LOUISIANA**



Prepared by the
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
In cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

2003

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Jason M. Griffith
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CONVERSION FACTORS, DATUMS, AND ABBREVIATED
WATER-QUALITY UNIT

Multiply	By	To obtain
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
foot (ft)	0.3048	meter (m)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per year (ft/yr)	0.3048	meter per year (m/yr)
square mile (mi ²)	2.590	square kilometer (km ²)
million gallons per day (Mgal/d)	3,785	cubic meter per day (m ³ /d)

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows: $^{\circ}\text{C} = (^{\circ}\text{F} - 32)/1.8$.

Transmissivity: In this report, the mathematically reduced form for transmissivity, foot squared per day (ft²/d), is used for convenience. The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness [(ft³/d)/ft²ft].

Horizontal coordinate information is referenced to the North American Datum of 1927.

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

Abbreviated water-quality unit:

milligrams per liter (mg/L)

HYDROGEOLOGIC FRAMEWORK OF SOUTHEASTERN LOUISIANA

By Jason M. Griffith

ABSTRACT

This report consolidates information from and builds upon previous reports to create a single document that illustrates the hydrogeologic framework of southeastern Louisiana. The location, thickness, areal extent, and correlation of aquifers in the region is illustrated on a series of 6 north-to-south, and 11 west-to-east hydrogeologic sections. The hydrogeologic framework of southeastern Louisiana consists of a sequence of complexly interbedded, interconnected, lenticular, alluvial, freshwater-bearing, clayey, sandy, and graveliferous strata. With the exception of the Mississippi River alluvium, sediments in the framework form a wedge that dips and thickens in a south to southwest direction. Aquifers in the region are composed of very fine sand to coarse sand and can contain pea- to cobble-size gravel. The lower boundary of the framework is the base of freshwater which abruptly changes near the Baton Rouge fault. The base of freshwater ranges from 500 to 3,500 feet below the National Geodetic Vertical Datum of 1929 (NGVD 29) north of the fault and from 200 to 1,000 feet below NGVD 29 south of the fault.

The hydrogeologic framework is composed of 31 regionally extensive aquifers that have been identified and named in three multiparish areas within the study area: the Baton Rouge area, the eastern Florida Parishes, and the New Orleans area. The Mississippi River alluvial aquifer and the shallow aquifers of the New Orleans area are the shallowest aquifers in the study area. Deeper aquifers in the study area have been grouped into aquifer systems which are, in order of depth, the Chicot, Evangeline, Jasper, and Catahoula equivalent aquifer systems. The Chicot equivalent aquifer system includes nine aquifers: the upland terrace aquifer in the Baton Rouge area and eastern Florida Parishes; the shallow, "400-foot," and "600-foot" sands of the Baton Rouge area; the upper Ponchatoula aquifer of the eastern Florida Parishes; and the Gramercy, Norco, and Gonzales-New Orleans aquifers and the "1,200-foot" sand of the New Orleans area. The Evangeline equivalent aquifer system includes 11 aquifers: the "800-foot," "1,000-foot," "1,200-foot," "1,500-foot," and "1,700-foot" sands of the Baton Rouge area and the lower Ponchatoula, Big Branch, Kentwood, Abita, Covington, and Slidell aquifers in the eastern Florida Parishes. The Jasper equivalent aquifer system includes seven aquifers: the "2,000-foot," "2,400-foot," and "2,800-foot" sands of the Baton Rouge area and the Tchefuncte, Hammond, Amite, and Ramsay aquifers in the eastern Florida Parishes. The Catahoula equivalent aquifer system includes the Catahoula aquifer in the Baton Rouge area and the Franklinton aquifer in the eastern Florida Parishes.

INTRODUCTION

Ground water constitutes a valuable and abundant natural resource in southeastern Louisiana. In this region, water from many aquifers requires little treatment for potable use or industrial purposes (Stuart and others, 1994, p. 1). In 1995, about 300 Mgal/d of ground water were pumped from wells for public supply, industrial use, power generation, and domestic uses in southeastern Louisiana. Public-supply use totaled about 114 Mgal/d, and industrial use totaled about 133 Mgal/d (J.K. Lovelace, U.S. Geological Survey, written commun., 2001). In the Baton Rouge (East and West Baton Rouge Parishes) and New Orleans (Jefferson and Orleans Parishes) metropolitan areas alone, about 143 and 22 Mgal/d of water were pumped from aquifers (Lovelace and Johnson, 1996, table 2).

Buono (1983) described the freshwater-bearing aquifers in the northern 10 parishes of southeastern Louisiana and the updip equivalent aquifers in Mississippi as an interdependent system, which he named the Southern Hills regional aquifer system. Local hydrologic stress in this system can have regional effects. Pumpage in the Baton Rouge area has caused water-level declines in Livingston, St. Helena, St. Tammany, and Tangipahoa Parishes (Nyman and Fayard, 1978, p. 57; Tomaszewski, 1988, p. 31). Previous studies also have shown that saltwater encroachment into freshwater areas has occurred in response to pumpage (Rollo, 1969; Whiteman, 1979; Tomaszewski, 1996).

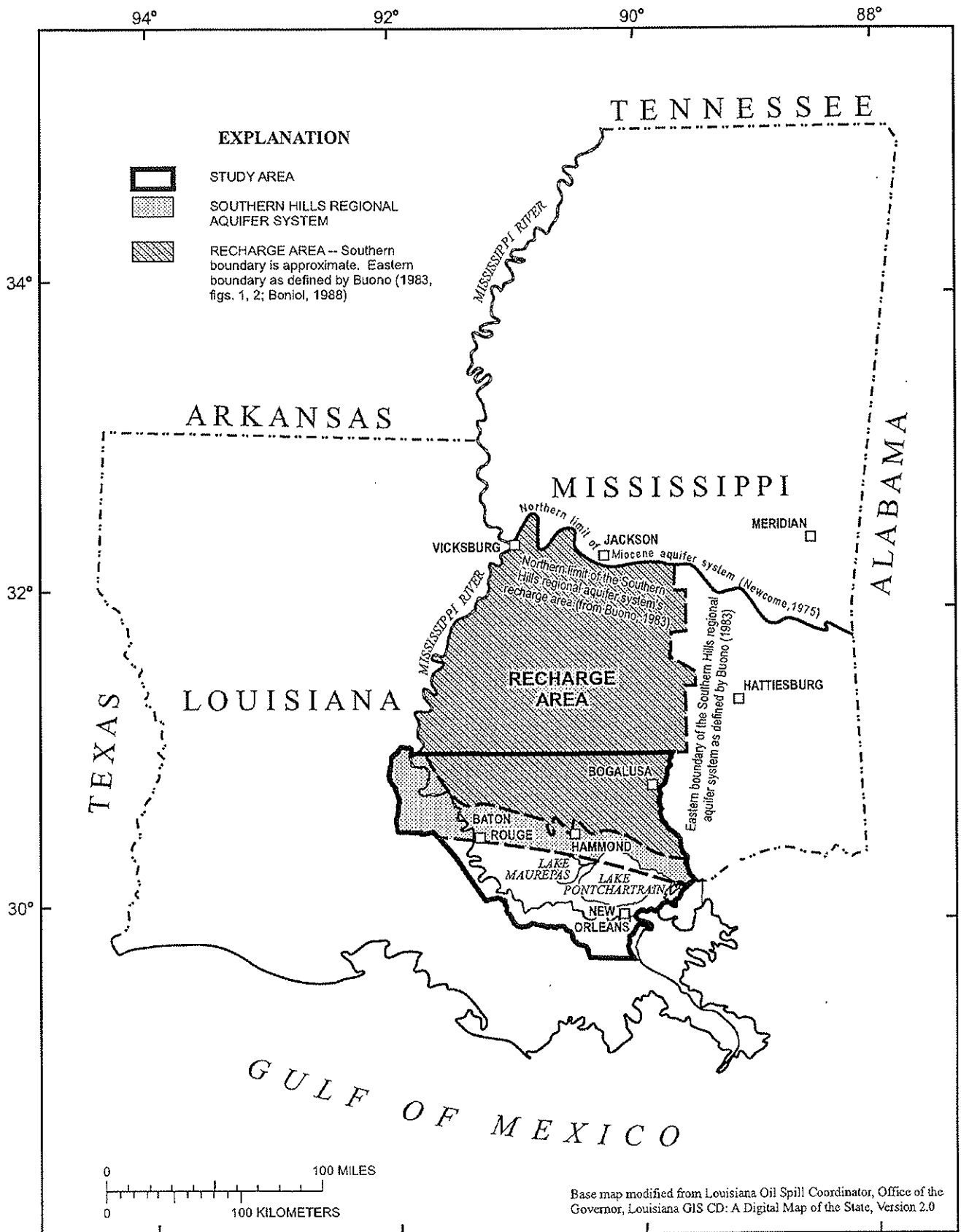
Although localized intense pumpage in southeastern Louisiana is known to have regional effects, sparse documentation of the regional hydrogeologic framework is available. Previously, the nomenclature, location, and characteristics of numerous aquifers in the study area were documented during local studies, which were typically limited to one to three parishes. Detailed regional maps or hydrogeologic sections showing the extent of locally named aquifers and their interconnections with other aquifers throughout southeastern Louisiana are needed to better understand and manage fresh ground-water resources in the region. In response to this need, the U.S. Geological Survey (USGS), in cooperation with the Louisiana Department of Transportation and Development (DOTD), began a study in 1997 to consolidate information from and build upon previous reports to create a single document that illustrates the hydrogeologic framework of southeastern Louisiana. Results of this study will improve knowledge of ground-water resources and aquifer relations in southeastern Louisiana and could be relevant to similar coastal settings.

Purpose and Scope

This report documents the hydrogeologic framework of the regionally extensive freshwater aquifers in southeastern Louisiana. The location, thickness, areal extent, and correlation of individual aquifers are shown on a series of 6 north-to-south and 11 west-to-east hydrogeologic sections. Information from previous reports and interpretations of electric logs and drillers' lithologic logs for 132 boreholes provide the basis for these hydrogeologic sections.

Description of Study Area

Although the aquifers underlying southeastern Louisiana extend from the Vicksburg-Jackson area in Mississippi to beyond the Louisiana-Mississippi shoreline (below the Gulf of Mexico), this study was limited to the area of Louisiana (fig. 1) in which these aquifers contain freshwater. The study area (pl. 1),



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Figure 1. Study area in southeastern Louisiana.

which includes about 7,000 mi² in southeastern Louisiana (Calhoun and Frois, 1997, p. 153), is bounded on the north by the Mississippi-Louisiana State border and on the east by the Pearl River. The study area extends west to the western border of Pointe Coupee Parish and south to New Orleans. The study area also includes all or parts of the parishes that flank the Mississippi River from Pointe Coupee Parish to Orleans Parish. All of Ascension, East Baton Rouge, East Feliciana, Livingston, Orleans, Pointe Coupee, St. Helena, St. James, St. John the Baptist, St. Tammany, Tangipahoa, Washington, West Baton Rouge, and West Feliciana Parishes are included in the study. Parts of Iberville, Jefferson, and St. Charles Parishes also are included in the study (pl. 1).

The terrain in the study area ranges from gently rolling hills covered with pine forests in the north to flat lowlands and swamps in the south. The Mississippi River dominates the setting near the western and southern boundaries of the study area. Ground-surface elevations range from more than 300 ft above to 5 ft below NGVD 29 (Calhoun and Frois, 1997, p. 272). The climate is subtropical, warm, and temperate with an average annual temperature of 68°F (20°C) and an average annual rainfall of 61 in. (National Oceanic and Atmospheric Administration, 1995, p. 7, 9).

About 1.9 million people live within the study area, with largest populations in the New Orleans and Baton Rouge metropolitan areas (Calhoun and Frois, 1997, p. 153). The area economy is dependent or partially dependent on the ground-water resources in the region. The large concentration of petrochemical manufacturers in the western part of the study area along the Mississippi River provides important revenue in the study area. In the northern and eastern parts of the study area, agriculture and forestry help sustain the economy. (See Calhoun and Frois, 1997, p. 206-268, 350.)

Methods of Study

For this report, a sand or aquifer is defined as a lithologic unit composed of material ranging from fine sand to gravel that is sufficiently permeable to conduct ground water and to yield economically substantial quantities of water to wells and springs (Bates and Jackson, 1984, p. 26). Also for this report, a clay or confining unit is defined as a lithologic unit composed of material ranging from solid clay to sandy and silty clay that impedes or obstructs ground-water flow. Generally, sands and clays less than 10 ft thick are excluded from the hydrogeologic sections. For this report, freshwater is defined as water that contains less than 250 mg/L chloride; concentrations of chloride less than 250 mg/L are less than the Secondary Maximum Contaminant Level¹ (SMCL) for drinking water (U.S. Environmental Protection Agency, 1977, 1992).

Several definitions for faults and fault-related features are necessary for this report. A fault is a fracture or fracture zone along which displacement has occurred. A fault zone is a zone of deformation along a single fault that could consist of distorted sediments and numerous small fractures. A fault set is composed of a group of faults that are parallel or nearly so, and are related to a particular deformational episode. A fault system consists of two or more interconnecting fault sets. (See Bates and Jackson, 1984, p. 178, 179.)

¹Secondary Maximum Contaminant Levels (SMCL's) for drinking water are established for contaminants that affect the aesthetic quality of drinking water. At high concentrations or values, health implications as well as aesthetic degradation might also exist. SMCL's are federally unenforceable, but are intended as guidelines for the states.

This investigation was conducted by consolidating information from previous reports, electric logs, and drillers' lithologic logs to present a detailed overview of the hydrogeologic framework of southeastern Louisiana. Most of the information presented was formed from interpretations of selected water-well logs throughout southeastern Louisiana. Petroleum test-well logs provided coverage for areas where water-well logs were unavailable. The location, depth, and thickness of sands and clays underlying southeastern Louisiana primarily were determined using single-point resistance (POIR), spontaneous potential (SP), short normal resistivity (SN), medium induction resistivity (ILM), and drillers' lithologic logs. The location of freshwater in sand primarily was determined using the long normal resistivity (LN) or the deep induction resistivity (ILD) logs. A long normal or deep induction resistivity value of 20 ohm-meters was used as an estimate of chloride concentration of about 250 mg/L (upper limit of freshwater) in the formation fluid for aquifers in southeastern Louisiana. Generally, a sand with a long normal resistivity or deep induction resistivity of more than 20 ohm-meters is reported as a freshwater sand; a sand with a value of less than 20 ohm-meters is labeled as a saltwater sand. Other logs used for interpretive analyses were the spherically focused induction resistivity (SFL), short guard resistivity (Guard), and induction resistivity (IND). Correlation of hydrogeologic units between logs was determined using several assumptions: the least complex correlation between logs is the most probable; hydrogeologic unit attitudes are probably similar to vertically adjacent unit attitudes; and, prospective correlations that contradict the preceding assumptions require substantial evidence.

The location of and displacement along the faults shown in this report are based on information from previous reports that document the faults at a few specific sites in the study area. In areas where information about the faults is sparse, the location of and displacement along the faults, as shown on the maps and sections in this report, are based on information from previous studies of nearby areas and a few assumptions that should apply for southeastern Louisiana. These assumptions are that abrupt changes in water quality at multiple depths between adjacent geophysical logs can be coincident with faulting; individual bed attitudes are probably the same or similar to adjacent bed attitudes on the other side of a fault; hydrogeologic unit attitudes are probably similar to vertically adjacent unit attitudes; and the least complex correlation across the fault is the most probable. Otherwise, affirming the location of and determining the displacement along the faults throughout the study area are beyond the scope of this investigation. Therefore, the faults are dashed where approximate and queried where probable on the map and sections in this report. Also, fault displacement is queried where uncertain on the sections in this report. (See Durham and Peebles, 1956; Murray, 1961, p. 188-191; Meyer and Rollo, 1965; Cardwell and others, 1967, p. 17, 18, 27, 28; Winner and others, 1968, p. 10-12; Rollo, 1969, p. 11; Whiteman, 1979, p. 3, 4; Hanor, 1982, p. 237-245; Smoot, 1988; McCulloh, 1991, p. 1-20; Rapp, 1994, p. 6, 7, 10, 11; and P.V. Heinrich, R.P. McCulloh and J.I. Snead, Louisiana Geological Survey, written commun., 1997.)

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The author would like to thank the many people who helped produce this report. All have given their ideas obligingly and have contributed substantially to a better understanding of the hydrogeology of southeastern Louisiana. Recognition is given to Zahir "Bo" Bolourchi, Chief, Public Works and Water Resources Division, Louisiana Department of Transportation and Development, for his unwavering support and practicable assistance in the creation and publication of this report. Thanks are given to Don C. Dial and George T. Cardwell of the Capital Area Ground Water Conservation Commission for sharing unreservedly their perceptive insight and immeasurable wealth of hydrogeologic knowledge of Louisiana.

A special thanks is given to Louisiana water-well drillers and loggers for collecting geophysical logs. Also, thanks are given to the Louisiana Department of Natural Resources for providing access to their collection of petroleum test-well geophysical logs for the State.

HYDROGEOLOGIC SETTING

The interconnected hydrogeologic units in the region dip to the south and southwest towards the Gulf of Mexico and the Mississippi River alluvial valley (figs. 1, 2). Precipitation in the northern part of the study area and north of the study area in Mississippi (fig. 2) is the primary source of recharge of freshwater to the system. The recharge area is shown in figure 1. Because the aquifers are interconnected, generally precipitation percolates down into and through the younger surficial aquifers in the recharge area to deeper interconnected aquifers. Water continues to move downdip in a southerly direction through the framework at rates that range from a few tens of feet per year to several hundreds of feet per year. (See Morgan, 1963, p. 11-13; Buono, 1983, p. 24.)

At least two major fault systems, the Tepehate-Baton Rouge and Bancroft fault systems, cross the central part of the study area (fig. 2, pl. 1). Each of these systems is composed of a series of east-to-west trending normal faults, along which the southern block has moved downward relative to the northern block. These are reactivated growth faults that dip toward the Gulf of Mexico and generally show increasing displacement with depth. (See Durham and Peeples, 1956; Murray, 1961, p. 188-191; Meyer and Rollo, 1965; Cardwell and others, 1967, p. 17, 18, 27, 28; Winner and others, 1968, p. 10-12; Rollo, 1969, p. 11; Whiteman, 1979, p. 3, 4; Hanor, 1982, p. 237-245; Smoot, 1988; McCulloh, 1991, p. 1-20; Rapp, 1994, p. 6, 7, 10, 11; and P.V. Heinrich, R.P. McCulloh and J.I. Snead, Louisiana Geological Survey, written commun., 1997.)

The Tepehate-Baton Rouge fault system extends from St. Tammany Parish, through Tangipahoa, Livingston, East Baton Rouge, West Baton Rouge, and Pointe Coupee Parishes, into southwestern Louisiana and consists of at least two active faults (pl. 1). The Tepehate (locally known as the Denham Springs-Scotlandville fault in the Baton Rouge area) and Baton Rouge faults each consist of a somewhat discontinuous network of parallel and en echelon² fault sets. The Bancroft fault system trends through southwestern Louisiana and probably terminates near the Mississippi River in Pointe Coupee Parish (Murray, 1961, fig. 4.33; Winner others, 1968, fig. 1). In the study area the Bancroft fault system includes only the Bancroft fault in Pointe Coupee Parish (pl. 1).

As sediments south of the faults in the Tepehate-Baton Rouge and Bancroft fault systems slump toward the Gulf of Mexico, displacement and deformation of the sediments at the faults can interrupt ground-water flow regimes, resulting in a general reduction in hydraulic interconnectivity and abrupt changes in water levels and water quality at the faults. In the Baton Rouge area, the Baton Rouge fault can act as a leaky barrier to southward ground-water flow (Whiteman, 1979, p. 12, 13). Where sands at the fault are conjoined, hydraulic connectivity across the fault, tempered by the deformation of sediments in the fault zone, could allow ground water to slowly leak across the fault. However, displacement by the Bancroft fault is indiscernible from ground surface to about 2,000 ft below NGVD 29; therefore, the fault probably has little effect on the freshwater aquifers in southeastern Louisiana (Winner and others, 1968, p. 10-12).

²A group of subparallel, closely-spaced, step-like, overlapping, or staggered arrangement of short faults that collectively form a linear fault zone (Bates and Jackson, 1984, p. 179).

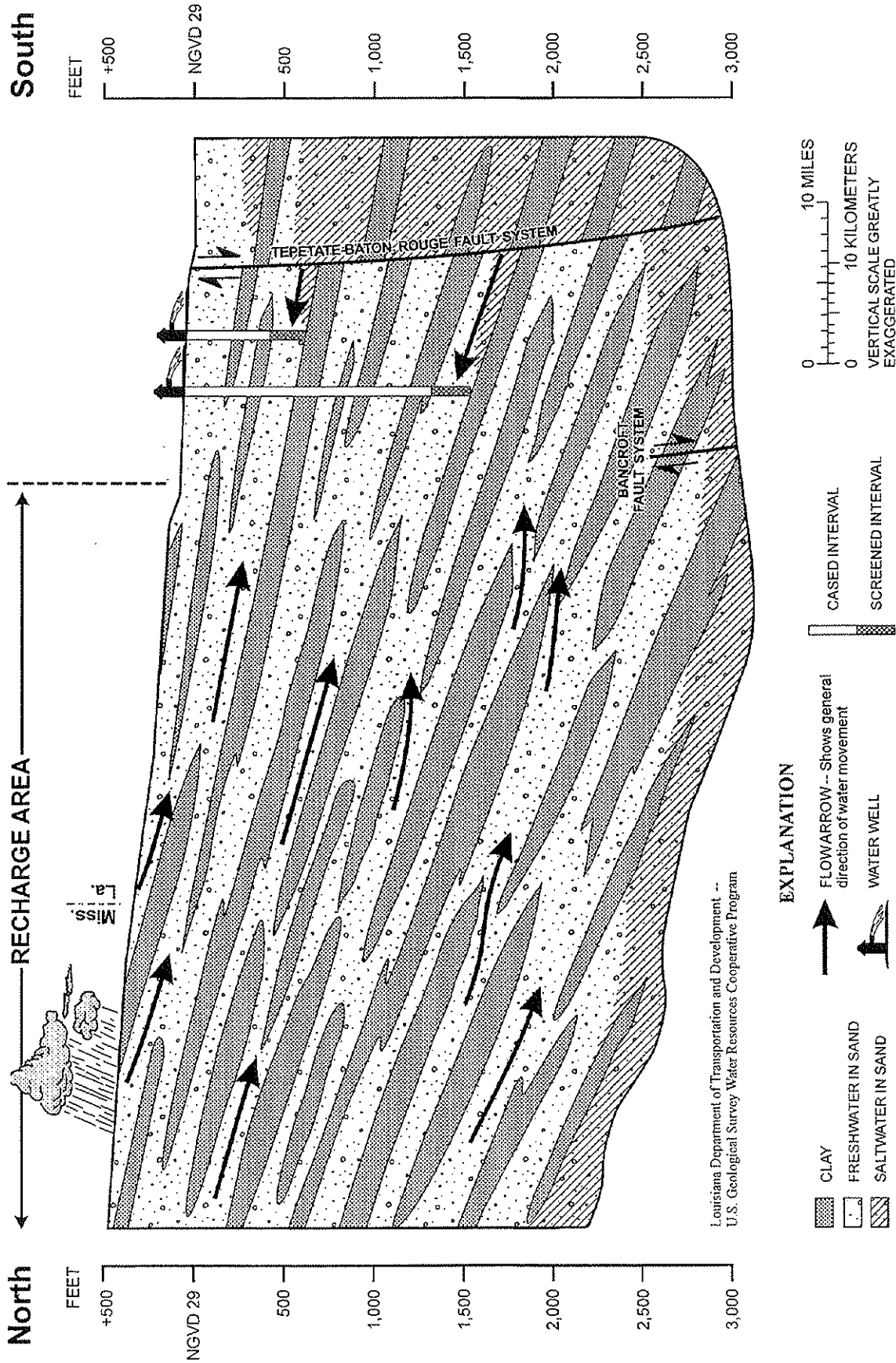


Figure 2. Generalized north-to-south hydrogeologic section showing general direction of ground-water movement from the recharge area to the Tepetate-Baton Rouge fault system, southeastern Louisiana (hydrogeology modified from Morgan, 1963, fig. 4; Buono, 1983, fig. 6).

Historically, north of the Baton Rouge fault, water in deeper aquifers had higher hydraulic head³ than water in shallower aquifers. Under these conditions, water would slowly seep upward toward the surface (Morgan, 1963, p. 13). Recently, however, ground-water withdrawals in the Baton Rouge area north of the fault have reduced the head gradient and, subsequently, the seepage of water from deeper to shallower aquifers has diminished (Morgan, 1963, p. 13). Also, large ground-water withdrawals north of the Baton Rouge fault have induced saltwater encroachment (horizontal movement) from south of the fault towards pumping centers north of the fault where aquifers previously contained freshwater (Winner and others, 1968, p. 10-12; Rollo, 1969, p. 11; Whiteman, 1979; Rapp, 1994, p. 11-13; Tomaszewski, 1996). The effects of the Tepehate-Baton Rouge fault on ground-water flow outside of the Baton Rouge area are uncertain.

HYDROGEOLOGIC FRAMEWORK

The hydrogeologic framework of southeastern Louisiana consists of a sequence of complexly interbedded, interconnected, lenticular (lens shaped), alluvial, freshwater-bearing, clayey, sandy, and graveliferous strata and part of the Mississippi River alluvial aquifer. Aquifers in the region (fig. 3) are composed of very fine sand to coarse sand and can contain pea- to cobble-size gravel (table 1). With the exception of the Mississippi River alluvium, sediments in the framework form a wedge that dips and thickens to the south and southwest toward the Gulf of Mexico and Mississippi River alluvial valley (fig. 2). Generally, updip, clayey confining units pinch out (disappear), and older, deeper aquifers coalesce with younger, shallower surficial aquifers.

The lower boundary of the framework is the base of freshwater. Generally the Baton Rouge fault coincides with an abrupt change in depth to the base of freshwater such that the base of freshwater is substantially deeper north of the fault than it is south of the fault. The base of freshwater ranges from 500 to 3,500 ft below NGVD 29 north of the fault (pls. 2, 4, 10, 11, 12, 13), and from 200 to 1,000 ft below NGVD 29 south of the fault (pls. 3-5, 7). The difference in depth to the base of freshwater across the Baton Rouge fault ranges from about 1,100 to about 2,600 ft. (See Smoot, 1988.)

In southeastern Louisiana, 31 regionally extensive aquifers have been documented in previous reports (fig. 3). These regionally extensive aquifers have been delineated based on the presence of interbedded clayey confining units. In this report, the aquifers have been identified and named in three multiparish areas within the study area: the Baton Rouge area, the eastern Florida Parishes, and the New Orleans area (pl. 1). Although locally occurring aquifers have been identified in the study area during previous studies, most are excluded from this report because they are not regionally extensive. The Mississippi River alluvial aquifer and the shallow aquifers of the New Orleans area are the shallowest aquifers in the study area. Deeper aquifers in the study area have been grouped and named in accordance with their correlative units in central and southwestern Louisiana, west of the Mississippi River. These systems include the Chicot, Evangeline, Jasper, and Catahoula equivalent aquifer systems.

³The elevation to which water rises (in a well) at a given point as a result of reservoir pressure (Bates and Jackson, 1984, p. 231).

Hydrogeologic units																
System	Series	Stratigraphic unit	Aquifer system or confining unit	Aquifer or confining unit												
				Baton Rouge area	Eastern Florida Parishes	New Orleans area										
Quaternary	Holocene ? Ma ¹ ?0.01	Mississippi River and other alluvial deposits	Near-surface aquifers or surficial confining unit	North	South	North	South	New Orleans aquifer system ²	Shallow aquifers Mississippi River alluvial aquifer ³ Gramerey aquifer Norco aquifer Gonzales-New Orleans aquifer "1,200-foot" sand							
		Unnamed Pleistocene deposits	Chicot equivalent aquifer system or surficial confining unit	No regionally extensive hydrogeologic units		No regionally extensive hydrogeologic units										
Tertiary	Pliocene ?5 Miocene ?24 Oligocene	Fleming Formation	Southern Hills regional aquifer system ²	Upland terrace aquifer	"400-foot" sand	Upland terrace aquifer	Upper Ponchatoula aquifer	Generally, no fresh ground water occurs in deeper units								
				"600-foot" sand												
				"800-foot" sand												
				"1,000-foot" sand												
				"1,200-foot" sand												
		Blounts Creek Member	Evangeline equivalent aquifer system or surficial confining unit	Lower Ponchatoula aquifer	Big Branch aquifer	Kentwood aquifer	Abita aquifer	Covington aquifer	Slidell aquifer							
										"1,500-foot" sand	"1,700-foot" sand	Unnamed confining unit	Tchucfunct aquifer	Hammond aquifer	Amite aquifer	Ramsay aquifer
		Catahoula aquifer	Unnamed confining unit	Catahoula equivalent aquifer system	Unnamed confining unit	Catahoula aquifer	Franklinton aquifer									

¹Age estimates in millions of years or Mega-annum (Ma) (Compton, 1983, p. 379).
²Buono, 1983.
³Dial and others, 1989, p. 6.
⁴The Mississippi River alluvial aquifer is considered part of the New Orleans aquifer system locally, in parts of Ascension, St. James, and St. John the Baptist Parishes.

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Figure 3. Correlation of hydrogeologic units in southeastern Louisiana (modified from Stuart and others, 1994, fig. 5; Lovelace and Lovelace, 1995, fig. 1).

Table 1. Hydraulic and lithologic characteristics of aquifers in southeastern Louisiana

[In this report, the mathematically reduced form for transmissivity, foot squared per day (ft^2/d), is used for convenience. The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness [$(ft^3/d)/ft^2$]. Underline indicates an estimate. ft, feet; ft/d, foot per day; --, no data]

Aquifer location	Aquifer	Aquifer thickness, in ft	Aquifer transmissivity, in ft^2/d	Hydraulic conductivity, in ft/d	Storativity, dimensionless	Lithologic description	Source of information
Baton Rouge area	Mississippi River alluvial aquifer	60 - 375	18,700 - 28,100	150 - 374	0.0009 - 0.02	Fine sand to pea gravel with a graveliferous base	Meyer and Turcan, 1955, table 4; Kumianski and others, 1989, p. 1
Baton Rouge area	Shallow sands of the Baton Rouge area	0 - 250	--	--	--	Sand and gravel, varies highly	Meyer and Turcan, 1953, p. 4, 6; Kazmann, 1970, p. 13-15
Baton Rouge area - Eastern Florida Parishes	Upland terrace aquifer	0 - 400	<u>9,400 - 50,000</u>	<u>70 - 140</u>	--	Fine sand to pea gravel	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"400-foot" sand	130 - 160	4,280 - 10,300	32 - 71	0.00026 - 0.00097	Fine sand to pea gravel	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"600-foot" sand	120 - 205	12,700 - 16,400	74 - 107	0.00034 - 0.00057	Fine sand to pea gravel	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"800-foot" sand	50 - 150	3,210 - 3,500	36	0.0001 - 0.001	Fine to medium sand	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"1,000-foot" sand	40 - 90	9,500	--	0.0001	Fine to coarse sand	Huntzinger and others, 1985, table 1
Baton Rouge area	"1,200-foot" sand	40 - 150	10,400 - 17,300	70 - 168	0.0002 - 0.0008	Fine to medium sand	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"1,500-foot" sand	65 - 95	10,230 - 12,090	128 - 155	--	Fine to medium sand	Morgan, 1961, table 2
Baton Rouge area	"1,700-foot" sand	130	4,280	33	--	Fine to medium sand	Meyer and Turcan, 1955, table 4;
Baton Rouge area	"2,000-foot" sand	100 - 300	21,600 - 38,900	147 - 203	0.00057 - 0.0008	Medium sand	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"2,400-foot" sand	50 - 250	12,970 - 13,000	79	0.0001	Fine to medium sand	Meyer and Turcan, 1955, table 4; Huntzinger and others, 1985, table 1
Baton Rouge area	"2,800-foot" sand	50 - 350	17,300	--	0.0001	Fine to coarse sand	Huntzinger and others, 1985, table 1
Baton Rouge area	Catahoula aquifer	--	--	--	--	--	--
Eastern Florida Parishes	Upper Ponchatoula aquifer	145 - 300	27,000	180	0.00045	Mostly sand and gravel	Nyman and Fayard, 1978, table 2, p. 14
Eastern Florida Parishes	Lower Ponchatoula aquifer	100 - 200	--	35 - 65	--	Mostly medium sand	Nyman and Fayard, 1978, table 2, p. 22

Table 1. Hydraulic and lithologic characteristics of aquifers in southeastern Louisiana -- Continued

Aquifer location	Aquifer	Aquifer thickness, in ft	Aquifer transmissivity, in ft ² /d	Hydraulic conductivity, in ft/d	Storativity, dimensionless	Lithologic description	Source of information
Eastern Florida Parishes	Big Branch aquifer	50 - 150	--	40 - 107	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2
Eastern Florida Parishes	Kentwood aquifer	400 - 500	54,000	135 - 140	--	Mostly sand and gravel	Nyman and Fayard, 1978, table 2, p. 28
Eastern Florida Parishes	Abita aquifer	50 - 100	11,000 - 13,000	120	--	Mostly medium to very coarse sand	Nyman and Fayard, 1978, table 2, p. 32
Eastern Florida Parishes	Covington aquifer	100 - 200	27,000	220	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 39
Eastern Florida Parishes	Slideil aquifer	100 - 200	13,000 - 27,000	190	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 44
Eastern Florida Parishes	Tchefuncte aquifer	100 - 150	8,000 - 27,000	70 - 120	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 46
Eastern Florida Parishes	Hammond aquifer	100 - 200	11,000 - 27,000	85 - 200	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 51
Eastern Florida Parishes	Amite aquifer	100 - 150	16,700 - 27,000	150	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 55
Eastern Florida Parishes	Ramsay aquifer	100 - 250	21,000	214	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 58
Eastern Florida Parishes	Franklinton aquifer	100 - 250	39,000	290	--	Mostly medium to coarse sand	Nyman and Fayard, 1978, table 2, p. 60
New Orleans area	Shallow aquifers of the New Orleans area	0 - 150	--	60 - 200	--	Very fine to medium sand	Dial and Kilburn, 1980, table 1
New Orleans area	Gramercy aquifer	0 - 225	--	100 - 250	0.0005	Fine to coarse sand, fining upward	Dial and Kilburn, 1980, table 1; Dial and Sumner, 1989, table 1
New Orleans area	Norco aquifer	0 - 275	--	130 - 210	0.0005	Fine to coarse sand, fining upward	Dial and Kilburn, 1980, table 1; Dial and Sumner, 1989, table 1
New Orleans area	Gonzales-New Orleans aquifer	150 - 300	--	100 - 150	0.0005	Mostly fine to medium sand	Dial and Kilburn, 1980, table 1; Dial and Sumner, 1989, table 1
New Orleans area	"1,200-foot" sand	50 - 130	--	100	0.0005	Fine to medium sand	Dial and Kilburn, 1980, table 1; Dial and Sumner, 1989, table 1

Delineation of aquifers through each multiparish area and correlation of aquifers between these areas is somewhat uncertain. Throughout the study area, lenticular shaped deposits abruptly change from sand to clay, and many aquifers merge with overlying and underlying aquifers. Also, vertical offset of aquifers along the numerous faults varies in the study area.

To correlate the aquifers north of the Tepehate-Baton Rouge and Bancroft fault systems (in the Baton Rouge area and eastern Florida Parishes) with aquifers to the south of the systems (in the New Orleans area), the vertical offset of aquifers by the faults must be assessed. Generally, fault displacement in the study area increases with depth and is often indiscernible near ground surface such that shallow aquifers maintain integrity across a fault. However, at depths greater than 1,000 ft below NGVD 29, faulted sands often terminate abruptly against a clay or other confining unit at a fault. Also, displacement along a fault plane can result in the juxtaposition of sand units north of a fault with stratigraphically overlying sand units south of the fault. (See Murray, 1961, p. 190; Cardwell and others, 1967, p. 18, 27, 28; Winner and others, 1968, p. 10-12; Rollo, 1969, p. 11; Whiteman, 1979, p. 3, 4; Hanor, 1982, p. 237-245; Smoot, 1988; McCulloh, 1991, p. 1-20; Rapp, 1994, p. 6, 7, 10-13; Tomaszewski, 1996; and P.V. Heinrich, R.P. McCulloh, and J.I. Snead, Louisiana Geological Survey, written commun., 1997).

The displacement of aquifers at the Tepehate fault, which ranges from a few feet near ground surface to about 50 ft at depths of 1,200 to 3,400 ft below NGVD 29, has been documented near Torbert, Louisiana, in Pointe Coupee Parish (Hanor, 1982, p. 244). The displacement of aquifers at the Baton Rouge fault, which ranges from about 20 ft near ground surface to about 300 ft at depths of 1,600 to 3,000 ft below NGVD 29, has been documented in the Baton Rouge area (Durham and Peebles, 1956, p. 65; Whiteman, 1979, p. 7; Roland and others, 1981, p. 6, 7, 9; McCulloh, 1991, p. 1-20). Even larger displacement at the Baton Rouge fault has been documented in the eastern Florida Parishes. In southern Tangipahoa Parish, aquifers have been shown to be offset at the Baton Rouge fault from a few feet at ground surface to about 380 ft at depths of 1,300 to 3,200 ft below NGVD 29 (Rapp, 1994, p. 11, 12).

The displacement of aquifers by the Bancroft fault of about 50 ft at depths of 2,200 to 2,800 ft below NGVD 29, has been documented in Pointe Coupee Parish. Displacement by the Bancroft fault is indiscernible from ground surface to about 2,000 ft below NGVD 29 (See Murray, 1961, p. 188, 190; Winner and others, 1968, p. 12).

Mississippi River Alluvial Aquifer and Shallow Aquifers of the New Orleans Area

The Mississippi River alluvial aquifer in the Baton Rouge and New Orleans areas and the discontinuous shallow aquifers of the New Orleans area are the shallowest aquifers in the study area and are absent in the eastern Florida Parishes (fig. 3). In 1995, 13.2 Mgal/d of water were pumped from the Mississippi River alluvial aquifer in the study area (Lovelace and Johnson, 1996, p. 88). No water withdrawals from the shallow aquifers of the New Orleans area were reported in a 1995 survey of ground-water withdrawals in Louisiana (J.K. Lovelace, U.S. Geological Survey, oral commun., 2001).

In southeastern Louisiana, the Mississippi River alluvial aquifer is a largely uninterrupted mass of sand (Saucier, 1994, p. 306) that is located west of the flood-plain boundary (pl. 1). Although most of the aquifer is outside the study area, it constitutes an enormous fresh ground-water resource in southeastern Louisiana. In the study area, the Mississippi River alluvial aquifer (pls. 2, 11) ranges in thickness from

about 125 ft (in northern Pointe Coupee Parish) to 300 ft, or possibly 375 ft (in eastern Pointe Coupee Parish near False River) (Kuniansky and others, 1989, p. 10, 11; Saucier, 1994, v. 2, pl. 24). The Mississippi River alluvial aquifer is in direct hydraulic connection with many older aquifers in the Baton Rouge area including the "400-foot," "600-foot," and "800-foot" sands of the Baton Rouge area (pl. 11). The Mississippi River alluvial aquifer might be hydraulically connected to aquifers down to the "1,500-foot" sand of the Baton Rouge area (pl. 2).

The shallow aquifers of the New Orleans area are present in St. James, St. John the Baptist, St. Charles, Jefferson, and Orleans Parishes. These aquifers consist of a group of small, discontinuous, near-surface point bar deposits; distributary-channel deposits; and discontinuous, near-surface beds of sand that contain water of poor quality and are subject to saltwater encroachment (Rollo, 1966, p. 9-12). Previous reports have documented that the shallow aquifers of the New Orleans area are as thick as 140 ft in some areas (Rollo, 1966, p. 9, 12). Although the shallow aquifers of the New Orleans area are not regionally extensive, they are included here because they yield the only fresh ground water in parts of the New Orleans area (Rollo, 1966, p. 9). The shallow aquifers are shown on hydrogeologic sections L-L' and L'-L'' (pls. 17, 18).

Chicot Equivalent Aquifer System

The Chicot equivalent aquifer system of southeastern Louisiana includes nine aquifers that have been named separately in the Baton Rouge, eastern Florida Parishes, and New Orleans areas (fig. 3). The Chicot equivalent aquifer system includes the upland terrace aquifer, which extends across the Baton Rouge area and eastern Florida Parishes. In the Baton Rouge area, the Chicot equivalent aquifer system also includes the shallow, "400-foot," and "600-foot" sands. The Chicot aquifer system includes the upper Ponchatoula aquifer which is unique to the eastern Florida Parishes. In the New Orleans area, the Chicot equivalent aquifer system includes the Gramercy, Norco, and Gonzales-New Orleans aquifers and the "1,200-foot" sand. Generally, the base of freshwater is at or near the bottom of the Chicot equivalent aquifer system in the New Orleans area, south of the Baton Rouge fault. Total withdrawal of ground water from the Chicot equivalent aquifer system in 1995 was about 106 Mgal/d (Lovelace and Johnson, 1996, p. 91). Total thickness of the Chicot equivalent aquifer system increases to the south, ranging from 75 ft in East and West Feliciana Parishes to about 1,100 ft in Ascension Parish (pls. 3, 4).

The Gonzales-New Orleans aquifer of the New Orleans area is correlative with some sporadically occurring shallow sands in the Baton Rouge area. No regionally extensive aquifers are present above the shallow sands in the Baton Rouge area. No regionally extensive aquifers are present in the eastern Florida Parishes that are correlative with the Gramercy, Norco, and Gonzales-New Orleans aquifers of the New Orleans area.

The upland terrace aquifer is a broad, somewhat discontinuous, near-surface aquifer that extends across the Baton Rouge area and eastern Florida Parishes (pls. 3-7, 9-12). Because the upland terrace aquifer is at the surface and many of the aquifers of the Baton Rouge area and eastern Florida Parishes coalesce with it, the aquifer is the primary source of recharge for aquifers in the region. The upland terrace aquifer is correlative with the "400-foot" and "600-foot" sands of the Baton Rouge area, and the upper Ponchatoula aquifer in the eastern Florida Parishes (pls. 3-6). The "400-foot" sand of the Baton Rouge area also is correlative with the "1,200-foot" sand of the New Orleans area (pls. 3, 4).

Evangeline Equivalent Aquifer System

The Evangeline equivalent aquifer system of southeastern Louisiana includes 11 aquifers that have been named separately in the Baton Rouge area and eastern Florida Parishes (fig. 3). In the Baton Rouge area, aquifers in this system include the "800-foot," "1,000-foot," "1,200-foot," "1,500-foot," and "1,700-foot" sands. The Evangeline equivalent aquifer system includes the lower Ponchatoula, Big Branch, Kentwood, Abita, Covington, and Slidell aquifers in the eastern Florida Parishes. Aquifers in this system mostly contain saltwater south of the Baton Rouge fault in the New Orleans area, and are excluded from the correlation of hydrogeologic units (fig. 3), but are shown on some hydrogeologic sections (pls. 3-5, 7, 15-17). Total withdrawal of ground water from the Evangeline equivalent aquifer system in 1995 was about 78 Mgal/d (Lovellace and Johnson, 1996, p. 93). Total thickness of the Evangeline equivalent aquifer system increases to the south, ranging from 150 ft near the Mississippi-Louisiana State line (pl. 2) to about 2,000 ft at LaPlace, west of New Orleans (pl. 5).

The "800-foot" and "1,000-foot" sands, and the upper part of the "1,200-foot" sand of the Baton Rouge area are correlative with the lower Ponchatoula aquifer in the eastern Florida Parishes. The lower part of the "1,200-foot" sand of the Baton Rouge area is correlative with the Big Branch aquifer in the eastern Florida Parishes (pls. 12, 14). The "1,500-foot" and "1,700-foot" sands of the Baton Rouge area are correlative with the Kentwood, Abita, Covington, and Slidell aquifers of the eastern Florida Parishes.

The Kentwood aquifer, located in Washington and northern Tangipahoa Parishes, divides into two distinct aquifers near the southern border of Washington Parish: the upper part becomes the Abita aquifer, and the lower part becomes the Covington aquifer (pls. 5, 7). Both the "1,500-foot" and upper part of "1,700-foot" sands of the Baton Rouge area are correlative with the Kentwood aquifer across the southern part of the St. Helena-Tangipahoa Parish border (pl. 10). To the south, the "1,500-foot" and "1,700-foot" sands of the Baton Rouge area are correlative with the Abita and Covington aquifers (pl. 12).

The lower part of the "1,700-foot" sand of the Baton Rouge area is correlative with the Slidell aquifer in the eastern Florida Parishes near Lake Pontchartrain (pl. 15). Below the Evangeline equivalent aquifer system is an unnamed confining unit that is apparently discontinuous in some parts of southeastern Louisiana; a thin, intermittent clay confining layer separates the "1,700-foot" sand of the Baton Rouge area from the "2,000-foot" sand of the Baton Rouge area (pl. 13).

Jasper Equivalent Aquifer System

The Jasper equivalent aquifer system of southeastern Louisiana includes seven aquifers that have been named separately in the Baton Rouge area and eastern Florida Parishes (fig. 3). In the Baton Rouge area, aquifers in this system include the "2,000-foot," "2,400-foot," and "2,800-foot" sands. In the eastern Florida Parishes, the Jasper equivalent aquifer system includes the Tchefuncte, Hammond, Amite, and Ramsay aquifers. Aquifers in this system south of the Baton Rouge fault are known to contain mostly saltwater and are excluded from the correlation of hydrogeologic units in the New Orleans area (fig. 3), but are shown on some hydrogeologic sections (pls. 3-5, 7, 15-17). Total withdrawal of water from the Jasper equivalent aquifer system in 1995 was about 114 Mgal/d (Lovellace and Johnson, 1996, p. 95). Total thickness of the Jasper equivalent aquifer system increases to the south, ranging from 780 ft near the Mississippi-Louisiana State line (pl. 3) to about 1,350 ft near Mandeville (pl. 6).

The “2,000-foot” sand of the Baton Rouge area is correlative with the Tchefuncte aquifer and the upper part of the Hammond aquifer in the eastern Florida Parishes (pls. 11-14). Underlying these units, the “2,400-foot” sand of the Baton Rouge area is correlative with both the lower part of the Hammond aquifer and the upper part of the Amite aquifer in the eastern Florida Parishes (pls. 11, 12). Also, the “2,800-foot” sand of the Baton Rouge area is correlative with the lower part of the Amite aquifer and the Ramsay aquifer in the eastern Florida Parishes (pls. 10-12).

Catahoula Equivalent Aquifer System

The Catahoula equivalent aquifer system of southeastern Louisiana includes the Catahoula and Franklinton aquifers that have been named separately in the Baton Rouge area and eastern Florida Parishes (fig. 3). The Catahoula aquifer extends across the Baton Rouge area and possibly into the eastern Florida Parishes. The Franklinton aquifer is present only in the eastern Florida Parishes. South of the Baton Rouge fault, the Catahoula equivalent aquifer system is known to contain only saltwater and is excluded from the correlation of hydrogeologic units in the New Orleans area (fig. 3). Generally, these aquifers are too deep and contain too much saltwater to be an economically viable water resource throughout southeastern Louisiana. Total withdrawal of water from the Catahoula equivalent aquifer system in southeastern Louisiana was about 0.5 Mgal/d in 1995 (J.K. Lovelace, U.S. Geological Survey, oral commun., 2001). The Catahoula equivalent aquifer system probably extends deeper than data used for this report. Based on data for this report, the total thickness of the Catahoula equivalent aquifer system ranges from 150 (pl. 2) to 400 ft (pl. 4) in southeastern Louisiana.

The Catahoula aquifer probably is correlative with the Franklinton aquifer in the eastern Florida Parishes (pl. 10). Also, a thin intermittent clay confining layer separates the Catahoula aquifer from the overlying “2,800-foot” sand of the Baton Rouge area (pl. 11). Aquifers underlying the Catahoula aquifer are known to contain only saltwater in the study area.

SUMMARY

This report consolidates information from and builds upon previous reports to create a single document that illustrates the hydrogeologic framework of the regionally extensive freshwater aquifers in southeastern Louisiana. The location, thickness, areal extent, and correlation of aquifers in the region is illustrated on a series of 6 north-to-south, and 11 west-to-east hydrogeologic sections. Interpretations of electric logs and drillers’ lithologic logs for 132 boreholes provide the basis of these hydrogeologic sections.

The hydrogeologic framework of southeastern Louisiana consists of a sequence of complexly interbedded, interconnected, lenticular, alluvial, freshwater-bearing, clayey, sandy, and graveliferous strata. Aquifers in the region are composed of very fine sand to coarse sand and can contain pea- to cobble-size gravel. With the exception of the Mississippi River alluvium, sediments in the framework form a wedge that dips and thickens to the south and southwest toward the Gulf of Mexico and Mississippi River alluvial valley. The lower boundary of the framework is the base of freshwater which abruptly changes near the Baton Rouge fault. The base of freshwater ranges from 500 to 3,500 ft (feet) below the National Geodetic Vertical Datum of 1929 (NGVD 29) north of the fault and from 200 to 1,000 ft below NGVD 29 south of the fault.

In southeastern Louisiana, 31 regionally extensive aquifers have been identified and named in three multi-parish areas within the study area: the Baton Rouge area, the eastern Florida Parishes, and the New Orleans area. The Mississippi River alluvial aquifer and the shallow aquifers of the New Orleans area are the shallowest aquifers in the study area. Deeper aquifers in the study area have been grouped into aquifer systems and, in order of increasing depth, are the Chicot, Evangeline, Jasper, and Catahoula equivalent aquifer systems.

In southeastern Louisiana delineation and correlation of aquifers in the region is somewhat uncertain because aquifers are offset at faults, abruptly terminate, and merge with vertically adjacent aquifers. Generally, fault displacement in the study area increases with depth and can be indiscernible near ground surface. However, at depths greater than 1,000 ft below NGVD 29, faulted sands can terminate abruptly against a confining unit or be adjacent to stratigraphically inequivalent sand units at a fault.

The displacement of aquifers at the Tepetate fault ranges from a few feet near ground surface to about 50 ft at depths of 1,200 to 3,400 ft below NGVD 29. The displacement of aquifers at the Baton Rouge fault ranges from about 20 ft near ground surface to about 300 or 380 ft at depths of 1,300 to 3,200 ft below NGVD 29. Displacement by the Bancroft fault is indiscernible from ground surface to about 2,000 ft below NGVD 29, below which displacement is only about 50 ft.

The Mississippi River alluvial aquifer in the Baton Rouge and New Orleans areas and the discontinuous shallow aquifers of the New Orleans area are the shallowest aquifers in the study area and are absent in the eastern Florida Parishes. The largely uninterrupted mass of sand within the Mississippi River alluvial valley that composes the alluvial aquifer constitutes an enormous fresh ground-water resource in the area and forms a hydraulic connection between the Mississippi River and many interconnected aquifers. Thickness of the Mississippi River alluvial aquifer in the study area ranges from about 125 ft to 300 ft, or possibly 375 ft. The shallow aquifers of the New Orleans area are not regionally extensive, but yield the only fresh ground water in parts of the New Orleans area. The shallow aquifers of the New Orleans area are as thick as 140 ft in some areas.

The Chicot equivalent aquifer system of southeastern Louisiana includes nine aquifers: the upland terrace aquifer in the Baton Rouge area and eastern Florida Parishes; the shallow, "400-foot," and "600-foot" sands of the Baton Rouge area; the upper Ponchatoula aquifer of the eastern Florida Parishes; and the Gramercy, Norco, and Gonzales-New Orleans aquifers and the "1,200-foot" sand of the New Orleans area. Generally, the base of freshwater is at or near the bottom of the Chicot equivalent aquifer system in the New Orleans area, south of the Baton Rouge fault. Total thickness of the Chicot equivalent aquifer system increases to the south, ranging from 75 ft to about 1,100 ft.

The Evangeline equivalent aquifer system of southeastern Louisiana includes 11 aquifers: the "800-foot," "1,000-foot," "1,200-foot," "1,500-foot," and "1,700-foot" sands of the Baton Rouge area and the lower Ponchatoula, Big Branch, Kentwood, Abita, Covington, and Slidell aquifers in the eastern Florida Parishes. The Evangeline equivalent aquifer system contains mostly saltwater south of the Baton Rouge fault in the New Orleans area. Total thickness of the Evangeline equivalent aquifer system increases to the south, ranging from 150 ft to about 2,000 ft.

The Jasper equivalent aquifer system of southeastern Louisiana includes seven aquifers: the "2,000-foot," "2,400-foot," and "2,800-foot" sands of the Baton Rouge area and the Tchefuncte, Hammond, Amite, and Ramsay aquifers in the eastern Florida Parishes. The Jasper equivalent aquifer system south of

the Baton Rouge fault is known to contain mostly saltwater. Total thickness of the Jasper equivalent aquifer system increases to the south, ranging from 780 ft to about 1,350 ft.

The Catahoula equivalent aquifer system of southeastern Louisiana includes the Catahoula aquifer in the Baton Rouge area and the Franklinton aquifer in the eastern Florida Parishes. The Catahoula equivalent aquifer system south of the Baton Rouge fault is known to contain only saltwater. Based on data for this report, the total thickness of the Catahoula equivalent aquifer system ranges from 150 to 400 ft in southeastern Louisiana.

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