STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

WATER RESOURCES
TECHNICAL REPORT
No. 48

MAPS OF THE "400-FOOT," "600-FOOT," AND ADJACENT AQUIFERS AND CONFINING BEDS, BATON ROUGE AREA, LOUISIANA

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

1989

STATE OF LOUISIANA

DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

and

CAPITAL AREA GROUND WATER CONSERVATION COMMISSION

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By

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U.S. Geological Survey

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For the convenience of readers who prefer to use metric (International System) units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
foot (ft)	0.3048	meter (m)
foot per second (ft/s)	0.3048	meter per second (m/s)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
gallon (gal)	0.003785	cubic meter (m^3)
million gallons per day (Mgal/d)	3,785	cubic meter per day (m^3/d)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD 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."

MAPS OF THE "400-FOOT," "600-FOOT," AND ADJACENT AQUIFERS AND CONFINING BEDS, BATON ROUGE AREA, LOUISIANA

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ABSTRACT

Withdrawals of water from the "400-foot" and "600-foot" aquifers in the Baton Rouge industrial district have caused significant declines in the potentiometric levels. To evaluate the effect of future pumpage from the "400-foot" and "600-foot" aquifers, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development and the Capital Area Ground Water Conservation Commission, is developing a digital model of these aquifers. The "400-foot," "600-foot," and adjacent aquifers and confining beds were mapped for developing the digital model.

From top to bottom, the four layers mapped are: (1) the Mississippi River alluvial aquifer and the shallow Pleistocene deposits, (2) the "400-foot" aquifer, (3) the "600-foot" aquifer, and (4) the "800-foot" aquifer. Maps were prepared on a 1:24,000 scale base map of the industrial area at Baton Rouge and on a 1:125,000 scale base map of part of the five-parish study area. For each of the four layers, the altitude of the base of the unit, net sand thickness, and thickness of the clay between that unit and the next deeper unit were determined and contoured.

The "400-foot" aquifer has the most continuous sands, ranging from 25 to 400 feet in thickness. Both the "600-foot" and "800-foot" aquifers have large areas where no sand was found in the stratigraphic interval of the two aquifers. Clays of the shallow Pleistocene deposits form the confining unit above the "400-foot" aquifer. The shallow Pleistocene sands are discontinuous sand lenses within the shallow Pleistocene deposits. The Mississippi River alluvial aquifer is a thick sand and gravel aquifer (200 to 600 feet in thickness) that is in hydraulic connection with the "400-foot" and "600-foot" aquifers beneath parts of the Mississippi River alluvial plain. Confining beds between aquifers range from 0 feet in thickness, where sands of two aquifers coalesce, to over 400 feet in thickness, where one or more aquifers contain no sand.

INTRODUCTION

Withdrawals of water from the "400-foot" and "600-foot" aquifers in the Baton Rouge industrial district have caused significant declines in the potentiometric levels. Pumpage from the "400-foot" and "600-foot" aquifers by industrial users ranged from 22 to 36 Mgal/d during 1940-60.

To evaluate the effect of future pumpage from the "400-foot" and "600-foot" aquifers, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development and the Capital Area Ground Water Conservation Commission, is developing a digital model of these aquifers within the five-parish study area that is shown in figure 1. The aquifers and confining layers of the "400-foot," "600-foot," and adjacent aquifers were mapped for developing the digital model.

Purpose and Scope

The purpose of this report is to present maps and geohydrologic sections that define the "400-foot," "600-foot," and adjacent aquifers and confining beds in the Baton Rouge area. By use of geophysical well logs and drillers' logs, the deposits (unconsolidated clays, silts, sands, and gravels) of Quaternary and late Tertiary age within 1,000 ft below land surface at Baton Rouge were mapped as four layers. From top to bottom these layers are: (1) the Mississippi River alluvial aquifer and the shallow Pleistocene deposits, (2) the "400-foot" aquifer, (3) the "600-foot" aquifer, and (4) the "800-foot" aquifer. For each of the four layers, the altitude of the base of the layer, net sand thickness, and thickness of the clay below each layer were determined and contoured. The net sand thickness does not include the thicknesses of thin intercalated clay lenses within the sand layer; therefore, altitude of the base plus the net sand thickness and confining clay thickness will not always equal the altitude of the base of the sand above any given layer.

Maps for each layer were developed on a 1:24,000 scale base map of the industrial area at Baton Rouge and on a 1:125,000 scale base map of part of the study area. Plates 1 and 2 show the locations of well logs used for the mapping. The locations shown differ from control points used in previously published maps because of the unavailability of some of the logs used by other authors and the use of additional geophysical logs.

The maps and cross sections are intended for geohydrologic use. They indicate where the different aquifers are connected vertically and horizontally in the Baton Rouge industrial area. Over the larger area, the maps provide approximate information about net sand thickness within each aquifer and about vertical-hydraulic connection between aquifers.

Previous Investigations

Most of the aquifers at Baton Rouge are named for the depth from land surface to the bottom of each extensive sand and gravel unit in the industrial district (Meyer and Turcan, 1955, p. 12-13). Morgan (1963) later developed the zonal concept for the freshwater-bearing aquifers of the deposits in East and West Feliciana Parishes and correlated the zones with the aquifers of East Baton Rouge Parish as named by Meyer and Turcan (1955).

Meyer and Turcan (1955) presented sand thickness and structure maps for the recent deposits, the "400-foot" aquifer, and the "600-foot" aquifer in the

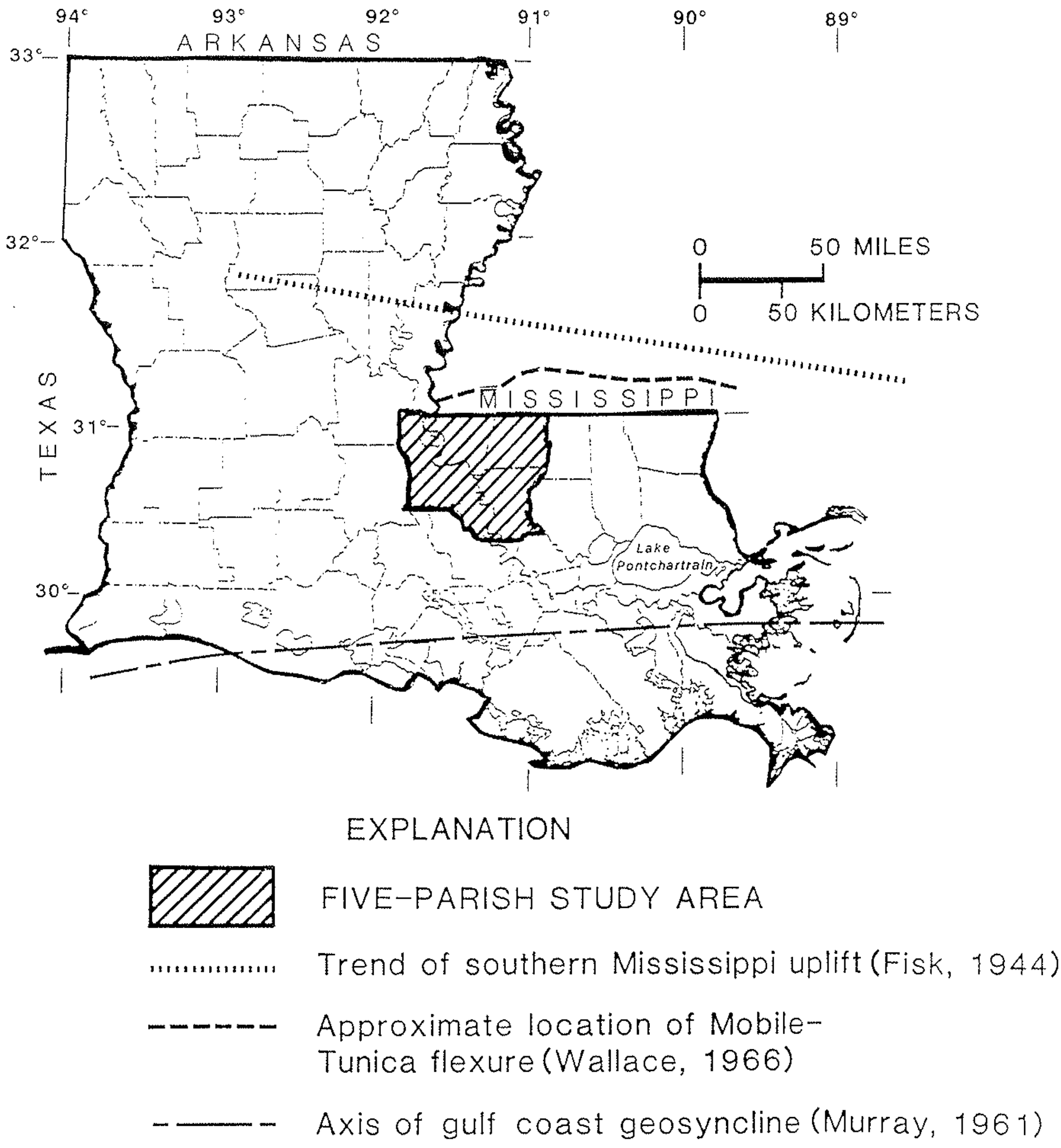

Figure 1.--Study area and location of structural features.

industrial district at Baton Rouge. Parsons (1967) mapped the base of the Citronelle Formation in East and West Feliciana Parishes and the northern part of East Baton Rouge Parish. Smith (1969) mapped the sand thickness and base altitudes of the University sand, the "400-foot" aquifer, and the "600-foot" aquifer in a small area of East Baton Rouge Parish. Whiteman (1979) mapped the base of the "600-foot" aquifer. None of the previous studies, however, provided thickness maps of confining beds between any aquifers. Table 1 shows the correlation of aquifer names from previous investigations.

Many previous reports describe the geohydrology of the Baton Rouge area. Parsons (1967) provides a good summary of the geology of the area east of the Mississippi River. Harris (1905), Meyer and Turcan (1955), Rollo (1960), Morgan (1961), Smith (1969), Wintz and others (1970), Kazmann (1970), Dial (1970), Walter (1982), and Buono (1983) describe the geohydrology and water use. Reports by Morgan and Winner (1964), Meyer and Rollo (1965), Rollo (1969), and Whiteman (1979) describe saltwater encroachment in the Baton Rouge area. Cushing and Jones (1945), Morgan and Winner (1962), and Hanor (1980) describe aquifer geochemistry.

GENERAL GEOLOGY

The Baton Rouge area is within the Gulf Coastal Plain where Pleistocene and Pliocene sediments were deposited by fluvial, deltaic, and coastal processes, resulting in sand and gravel aquifers interfingered with leaky clay and silt confining beds. The area is characterized by two distinct physiographic features--the Mississippi River alluvial plain and the coastwise Pleistocene terraces. The eastern limit of the Mississippi River alluvial plain is shown in figure 2 by a dashed line that follows the bluffs at the western edge of the Pleistocene terraces.

There are four coastal terraces (Fisk, 1938). The deposits which underlie the terraces were built up by braiding, coalescing streams crossing a gently sloping coastal plain (Parsons, 1967). Eustatic changes in sea level created episodes of erosion and alluviation during which the Pleistocene terraces were formed (Fisk, 1938). The "400-foot" and "600-foot" aquifers at Baton Rouge are considered to be the subsurface equivalent of the Pleistocene terrace deposits exposed at land surface in northern East and West Feliciana Parishes (Morgan, 1963). The transition from continental deposition to near shore deposition of the lower Pleistocene sediments occurs at the northern border of East Baton Rouge Parish (Parsons, 1967). These deposits are older and higher in altitude than the Mississippi River alluvium. They were eroded by the Mississippi River during a regression of the sea.

The terraces in East and West Feliciana Parishes have been eroded to rolling hills that decrease in altitude from approximately 300 ft in the north to 100 ft above sea level in the south. The terraces in East Baton Rouge Parish have undergone less erosion and decrease to an altitude of 25 ft near the southern border of the parish.

Table 1.--Correlation of aquifer names from previous investigations in East and West Baton Rouge, East and West Feliciana, and Pointe Coupee Parishes

System	Series	East and West Baton Rouge Parishes	East and West Feliciana Parishes	Pointe Coupee Parish	This report (all five parishes)
Quaternary	Holocene	Holocene alluvium[1]	Quaternary alluvium[2]	Alluvial aquifer[5]	
	Pleistocene	Shallow Pleistocene sands[1,3,4] University sand[4,6]			Mississippi River alluvial aquifer Shallow Pleistocene deposits
		"400-foot" sand[1,3,4,6]	Quaternary upland deposit[2]		"400-foot" aquifer
		"600-foot" sand[1,3,4,6]	Citronelle Formation[7]	"600-foot" sand[5]	"600-foot" aquifer
		"800-foot" sand[1,3,4,6]	Unnamed	"800-foot" and/or "1,000-foot" sand[5]	"800-foot" aquifer
Tertiary	Pliocene	"1,000-foot" sand[1,3,4,6] "1,200-foot" sand[1,3,4,6] "1,500-foot" sand[1,3,4,6]	Zone 1[2]	"1,200-foot" sand[5] "1,500-foot" sand[5]	"1,000-foot" aquifer "1,200-foot" aquifer "1,500-foot" aquifer

1 Morgan, 1961.
2 Morgan, 1963.
3 Meyer and Turcan, 1955.
4 Whiteman, 1979.
5 Winner and others, 1968.
6 Smith, 1969.
7 Parsons, 1967.

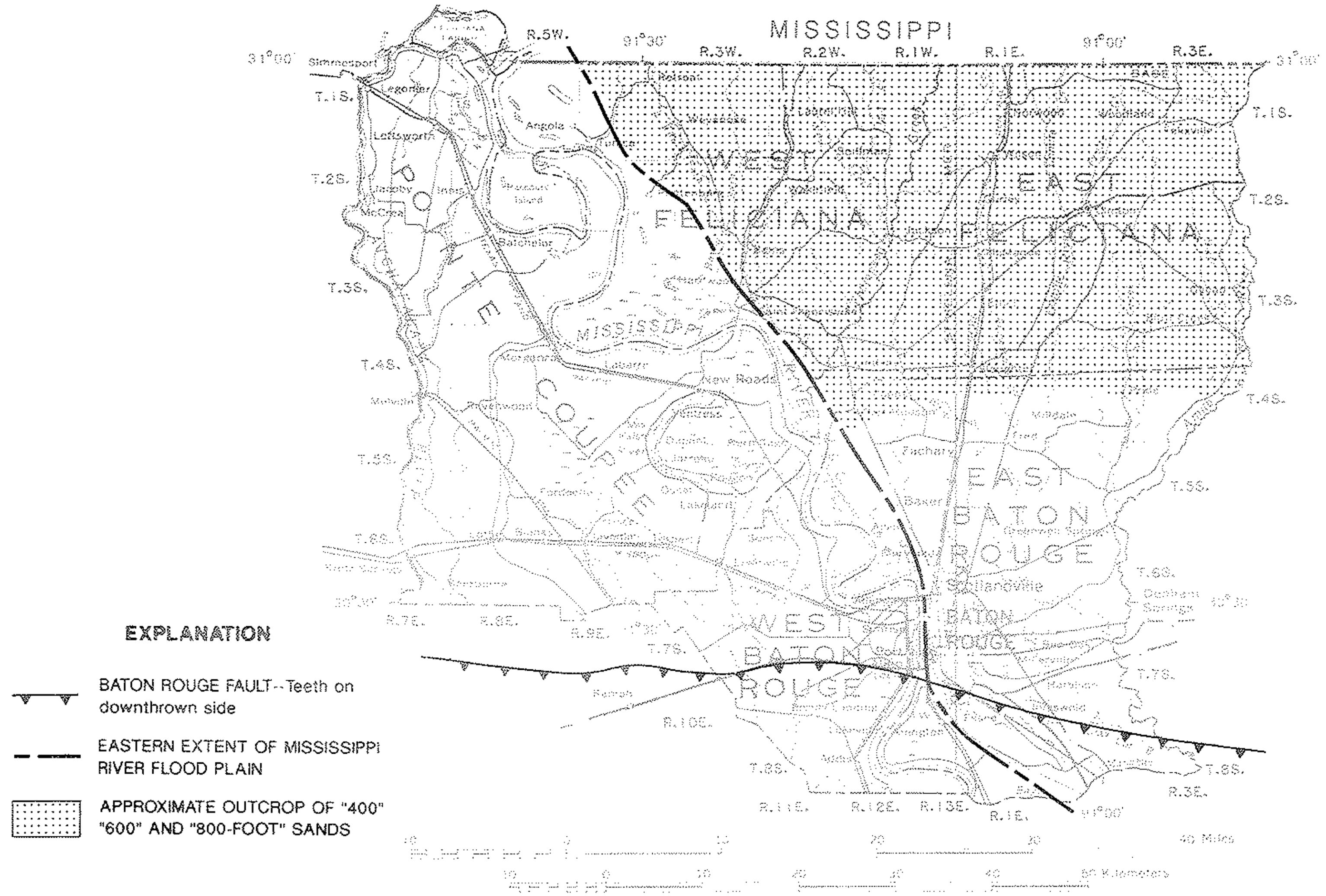

Figure 2.--Five-parish study area including the location of the Baton Rouge fault, the eastern extent of the Mississippi River alluvial plain, and the outcrop of the "400-, 600-, and 800-foot" aquifers.

The terrace deposits dip southerly as a result of the Southern Mississippi uplift and thicken southerly towards the axis of the Gulf Coast geosyncline, forming a wedge of unconsolidated materials. The dip increases southward of the Mobile-Tunica flexure (Fisk, 1944). The Mobile-Tunica flexure extends northwestward from Mobile Bay, Alabama, to the Tunica Hills in the southwestern corner of Mississippi near the Louisiana border (fig. 1). According to Fisk (1944), the dip of the base of the Pleistocene sediments is 20 to 40 ft/mi southward from the Mississippi border to Baton Rouge.

The Baton Rouge fault (fig. 2), an east-west trending growth fault with the south side downthrown, has an impact on ground-water flow. Displacement increases from about 30 ft at the surface to 225 ft at the top of the "400-foot" aquifer and to 350 ft at the top of the "2,000-foot" aquifer (Whiteman, 1979). The top of the "400-foot" aquifer south of the fault is adjacent to the bottom of the "600-foot" aquifer north of the fault.

The Mississippi River alluvial plain is essentially flat; it dips to the south at a lower rate than the Pleistocene terrace deposits. The surface of the alluvial plain at the northern border of Pointe Coupee Parish has an altitude of about 50 ft, and about 25 ft above sea level in the southern part of West Baton Rouge Parish.

The Mississippi River alluvial aquifer, characterized by 200- to 600-ft thick deposits of sand and gravel, is stratigraphically adjacent to the terrace deposits. At the northern border of the study area, the alluvium is in contact with deposits of Pliocene age. At the southern border of the study area, the Mississippi River alluvial aquifer is in contact with the shallow Pleistocene deposits and the top of the "400-foot" aquifer. Generalized geohydrologic cross sections through the study area are shown on plates 3 and 4. The generalized fence diagram in figure 3 best shows the stratigraphic relation of the Mississippi River alluvial aquifer and the older Pleistocene and Pliocene sediments.

GEOHYDROLOGY

Figure 4 shows the general geohydrologic framework for the aquifers east of the Mississippi River within the study area. The "400-foot" and "600-foot" aquifers are within the Quaternary zone. The "1,000-, 1,200-, and 1,500-foot" aquifers comprise zone 1. The "1,700-foot" and "2,000-foot" aquifers were included in zone 2, and all the deeper freshwater-bearing sands of East Baton Rouge Parish were included in zone 3. Figure 4 shows that the "800-foot" aquifer actually is in the clay zone separating the Quaternary zone from zone 1.

The "400-, 600-, and 800-foot" aquifers are interconnected in many places. Sands of the "400-foot" aquifer are the most continuous, and sands of the "800-foot" aquifer are the least continuous. Clayey surface deposits may thicken locally and contain discontinuous sand and gravel lenses of the shallow Pleistocene sands that reduce the confinement above the "400-foot" aquifer. The "800-foot" and "1,000-foot" aquifers are discontinuous, and clays dominate the sediments deposited at this stratigraphic position. Thus,

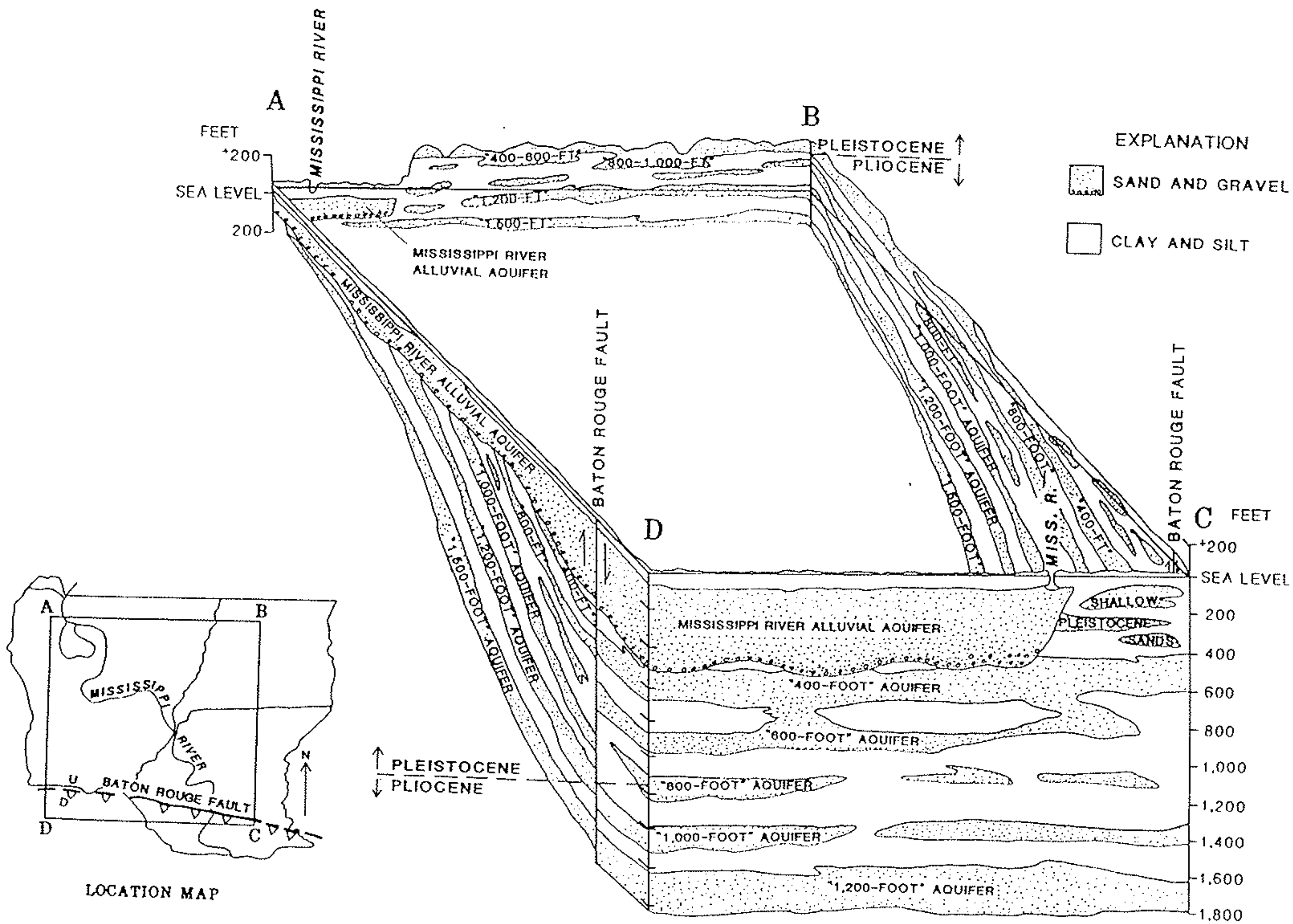

Figure 3.--Generalized fence diagram of the aquifers in the five-parish study area.

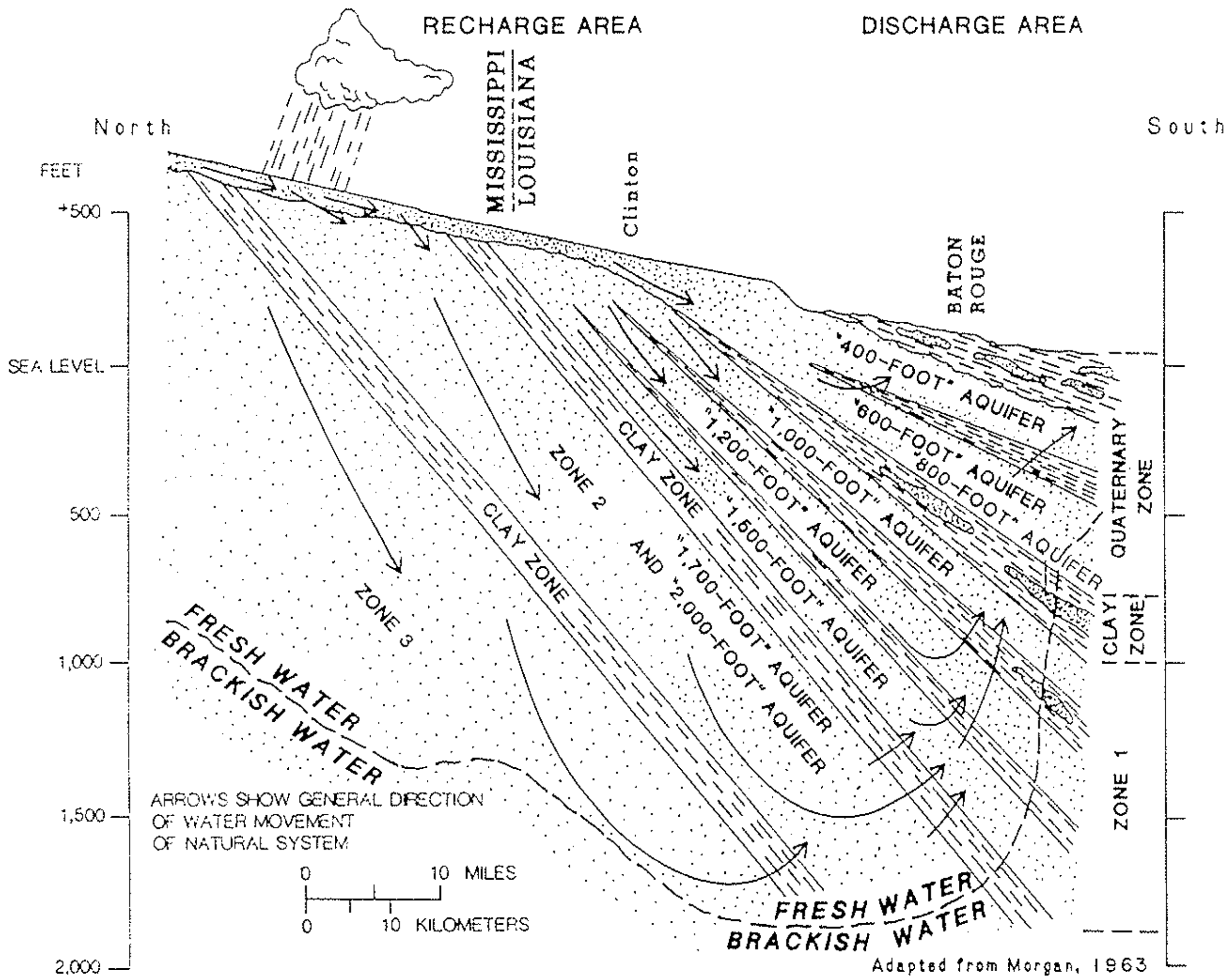

Figure 4.--Generalized section showing movement of ground water from the recharge area to the discharge area, southeastern Louisiana.

the "800-foot" aquifer and to some extent the "1,000-foot" aquifer are part of a semiconfining zone between the "600-foot" aquifer and the zone 1 aquifers, where vertical leakage may occur through local interconnections.

The outcrop area of the "400-foot" and "600-foot" aquifers in East and West Feliciana Parishes serves as an excellent area for recharge from rainfall. The materials near the surface in the area are predominantly sand and gravel. The potentiometric map developed by Morgan (1963) indicates water-table conditions in the northern part of East and West Feliciana Parishes and more confined aquifer conditions in the southern part of these parishes because the "400-foot" and "600-foot" layers are covered by the shallow Pleistocene deposits. In the outcrop area, the "400-foot" and "600-foot" aquifers coalesce. The flow path of ground water is in a general north to south-southwesterly direction and toward streams. Water levels in the "400-

foot" and "600-foot" aquifers tend to be at the same altitude in the northern part of East Baton Rouge Parish and in East and West Feliciana Parishes where they coalesce. Water levels are different in these sands in the areas where they are separated by a clay layer and are pumped separately.

The Baton Rouge fault is a significant barrier to ground-water movement in the "400-foot" and "600-foot" aquifers. The "400-foot" aquifer south of the fault is connected to the "600-foot" aquifer north of the fault. The differences between water levels in these aquifers indicate that the fault restricts flow from the south into the cone of depression in the industrial district of Baton Rouge. Whiteman (1979) determined that there is a northward component to flow in the "400-foot" aquifer south of the fault, which indicates that some leakage does occur through the fault. Effects of the fault on the "800-foot" aquifer have not been studied.

The major hydrologic boundaries for the "400-foot" and 600-foot" aquifers are the northern limit of the aquifers in southern Mississippi, the Baton Rouge fault on the south, and the Mississippi River via the Mississippi River alluvial aquifer, which merges with these aquifers west of the Mississippi River. No natural hydrologic boundary exists to the east within the study area.

South of the Baton Rouge fault the "400-foot" aquifer is hydraulically connected to the Mississippi River alluvial aquifer as shown on cross-section B-B' on plate 3. Water levels in wells screened in the "400-foot" aquifer south of the fault and in shallow Pleistocene sands near the river fluctuate with the Mississippi River stage.

North of the Baton Rouge fault in the industrial district, the "400-foot" and "600-foot" aquifers are not directly connected to the Mississippi River alluvial aquifer at the Mississippi River (pl. 4, section B-B' and C-C'). Historically, pumpage increased when river stage was low. Thus, fluctuations in water levels in the "400-foot" aquifer north of the fault could be caused by river stage or pumpage or both.

Detailed geohydrologic sections through the industrial district at Baton Rouge are shown on plate 4. The west to east sections are north of the fault and generally show that the "400-foot" and "600-foot" aquifers are not everywhere directly connected to the Mississippi River.

The Mississippi River alluvial aquifer is confined or semiconfined at the top by clayey surficial and backswamp deposits. Water levels in the aquifer fluctuate with the stage of the Mississippi River. The Baton Rouge fault probably does not affect ground-water flow in the Mississippi River alluvial aquifer, but water-level data in the aquifer near the fault are not available.

Mississippi River Alluvial Aquifer and the Shallow Pleistocene Sands

The Mississippi River alluvial aquifer and the shallow Pleistocene deposits are mapped as two separate units, but together they will constitute the top layer of the model. Mapping as separate units results in two discontinuities on the six maps of the top layer, one at the eastern boundary of the Mississippi River alluvial plain and the other at the Baton Rouge fault.

The northern extent of the shallow Pleistocene deposits (which is essentially the same as the southern boundary of the outcrop of the "400-, 600-, and 800-foot" aquifers) occurs near the East Feliciana-East Baton Rouge Parish border (fig. 2). The western limit is the Mississippi River alluvial plain. These deposits thicken southward, as shown on the north-south geohydrologic sections on plates 3 and 4. Clay and silt dominate this surficial material which contains a series of lenticular discontinuous sands that may or may not be hydraulically connected. The University sand (Smith, 1969), an aquifer within these deposits that overlies the "400-foot" aquifer, occurs near Louisiana State University and is hydraulically connected to the Mississippi River north and south of the Baton Rouge fault. (See plate 4.)

Because the shallow Pleistocene sands are lenticular and discontinuous, they do not provide a good mappable horizon, so the base of the shallow Pleistocene deposits was mapped (this horizon is equivalent to the top of the "400-foot" aquifer). The confining clay below the shallow Pleistocene sands represents the clay between the bottom sand and the "400-foot" aquifer.

The base of the Mississippi River alluvial aquifer consistently deepens to the south. This aquifer is characterized by very thick deposits of sand and gravel that are thinnest in northern Pointe Coupee Parish and thickest in West Baton Rouge Parish south of the Baton Rouge fault. Where well logs indicated massive sands to depths stratigraphically adjacent to the "400-, 600-, or 800-foot" aquifers, the area is designated as merged with the underlying aquifer (pls. 5 and 6).

The Mississippi River alluvial aquifer is a continuous sand; whereas, the shallow Pleistocene sands are not continuous north of the fault. South of the fault the shallow Pleistocene sands include a continuous sand. Almost every well log indicated some sand within the shallow material (pls. 7 and 8). The clay thickness under the Mississippi River alluvial aquifer is generally less than 50 ft in the study area. The interbedded clays under the shallow Pleistocene sands are variable in thickness (pls. 9 and 10).

"400-Foot" Aquifer

The "400-foot" aquifer is hydraulically connected with the Mississippi River alluvial aquifer which was deposited in a valley incised into the "400-foot" aquifer over a large area west of the alluvial plain boundary. In this area, the altitude of the base of the "400-foot" aquifer is the same as the Mississippi River alluvial aquifer. The "400-foot" aquifer merges with the underlying "600-foot" aquifer in several places (pls. 11 and 12). In the East and West Feliciana Parishes, the "400-foot," "600-foot," and possibly "800-foot" aquifers coalesce to form one unit which has been called the Quaternary upland deposits (Morgan, 1963) and also the Citronelle Formation (Parsons, 1967).

On the sand thickness maps, the "400-foot" layer is continuous across the area except in a few places where sands are thin (pls. 13 and 14). The industrial district is one of the places where only a few sand lenses occur within the stratigraphic position of the "400-foot" aquifer (cross-section C-C', pl. 4).

Clays below the "400-foot" aquifer are irregular in thickness. Where the "600-foot" aquifer is absent, the clays tend to be very thick. Where the "400-foot" aquifer is shown as merged with the underlying sand, the clay is shown to have 0 ft in thickness (pls. 15 and 16).

"600-Foot" Aquifer

The "600-foot" aquifer extends throughout the study area, except in the northern part of Pointe Coupee Parish where it is replaced by Mississippi River alluvial deposits. There are several places where no sand is in the strata, such as the large clay anomaly underlying the Mississippi River alluvial aquifer just north of the fault in West Baton Rouge Parish (pls. 17 and 18). The "600-foot" aquifer interfingers with the "800-foot" aquifer just north of the fault in West Baton Rouge Parish and to a lesser extent in a small area to the north of the fault in East Baton Rouge Parish (pl. 17). The sands within the "600-foot" aquifer are less continuous than in the "400-foot" aquifer, and sand is thin or absent in places (pls. 17 and 18). The thickness of sands in this aquifer ranges from 0 to 200 ft where the aquifer is not merged with other aquifers (pls. 19 and 20). Clays below the "600-foot" aquifer are irregular and thicker in large areas where the "800-foot" aquifer is absent (pls. 21 and 22).

"800-Foot" Aquifer

The "800-foot" aquifer extends over the same areas as the "600-foot" aquifer and is more irregular in thickness than the "600-foot" aquifer. The sands of this strata in some places were merged with the "600-foot" aquifer and in other places were merged with the "1,000-foot" aquifer. In many places, the "800-foot" aquifer is thin or absent (pls. 23 and 24), or the thickness is variable (pls. 25 and 26). Clays beneath the "800-foot" aquifer are variable because of large areas where the "1,000-foot" aquifer is absent (pls. 27 and 28). There were fewer control points for mapping the "800-foot" aquifer because fewer wells have been drilled to sands below the "400-foot" and "600-foot" aquifers.

SUMMARY AND CONCLUSIONS

The Pleistocene and upper Pliocene deposits were mapped to provide a basis for developing a digital model of the "400-foot" and "600-foot" aquifers at Baton Rouge, Louisiana. These deposits are composed of many different sand units that coalesce to form semicontinuous aquifers. The sediments were mapped in four layers: (1) the Mississippi River alluvial aquifer and the shallow Pleistocene deposits, (2) the "400-foot" aquifer, (3) the "600-foot" aquifer, and (4) the "800-foot" aquifer.

Because the shallow Pleistocene sands are lenticular and discontinuous, they are a difficult horizon to map; therefore, the base of the shallow Pleistocene deposits was mapped (this horizon is equivalent to the top of the "400-foot" aquifer). The Mississippi River alluvial aquifer is a thick sand and gravel aquifer (200 to 600 ft in thickness) that is in hydraulic connection with the "400-foot" and "600-foot" aquifers beneath parts of the Mississippi River alluvial plain. The sands of the "400-foot" aquifer are 25 to 400 ft in thickness and are the most continuous of the Pleistocene terrace deposits. The "600-foot" aquifer ranges from 0 to 200 ft in thickness where the aquifer is not merged with other aquifers. Both the "600-foot" and "800-foot" aquifers include large areas where sand is thin or absent in the stratigraphic position of these two aquifers.

Confining beds between aquifers range from 0 ft in thickness, where sands of two aquifers coalesce, to slightly more than 400 ft in thickness, where one or more aquifers contain no sand. The confining clay below the shallow Pleistocene sands varies in thickness and represents the clay between the bottom sand and the "400-foot" aquifer. The clay thickness under the Mississippi River alluvial aquifer generally is less than 50 ft. Clays below the "400-foot" aquifer are irregular in thickness; where the "600-foot" aquifer is absent, the clays tend to be very thick; and where the "400-foot" aquifer is merged with the underlying sand, the clay is absent. Clays below the "600-foot" aquifer are irregular and thick in large areas where the "800-foot" aquifer is absent. Clays beneath the "800-foot" aquifer are variable because of large areas where the "1,000-foot" aquifer is absent.

Although many reports have been written about the ground-water resources of Baton Rouge, few have presented maps of the shallow aquifers. Maps of the clay thicknesses between aquifers were not presented in the previous reports. The 24 maps presented in this report are not in full agreement with previous maps because of the use of different control points and the irregular nature of the deposits. In general, agreement as to the altitude of the base of layers is best and agreement in net sand thickness is reasonable. These maps and cross sections, intended for geohydrologic use, provide an indication of where the different sands are connected vertically and horizontally in the Baton Rouge industrial area. Over the larger area, the maps provide approximate information about net sand thickness within each aquifer and about vertical-hydraulic connection between aquifers.

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