U.S. DEPARTMENT OF THE INTERIOR
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Mississippi Department of Environmental Quality, Office of Land and Water Resources

WATER-RESOURCES INVESTIGATIONS REPORT 96-4305
Arthur, J.K., and Strom, E.W., Thickness of the Mississippi River alluvium and thickness of the coarse sand and gravel in the Mississippi River alluvium in northwestern Mississippi

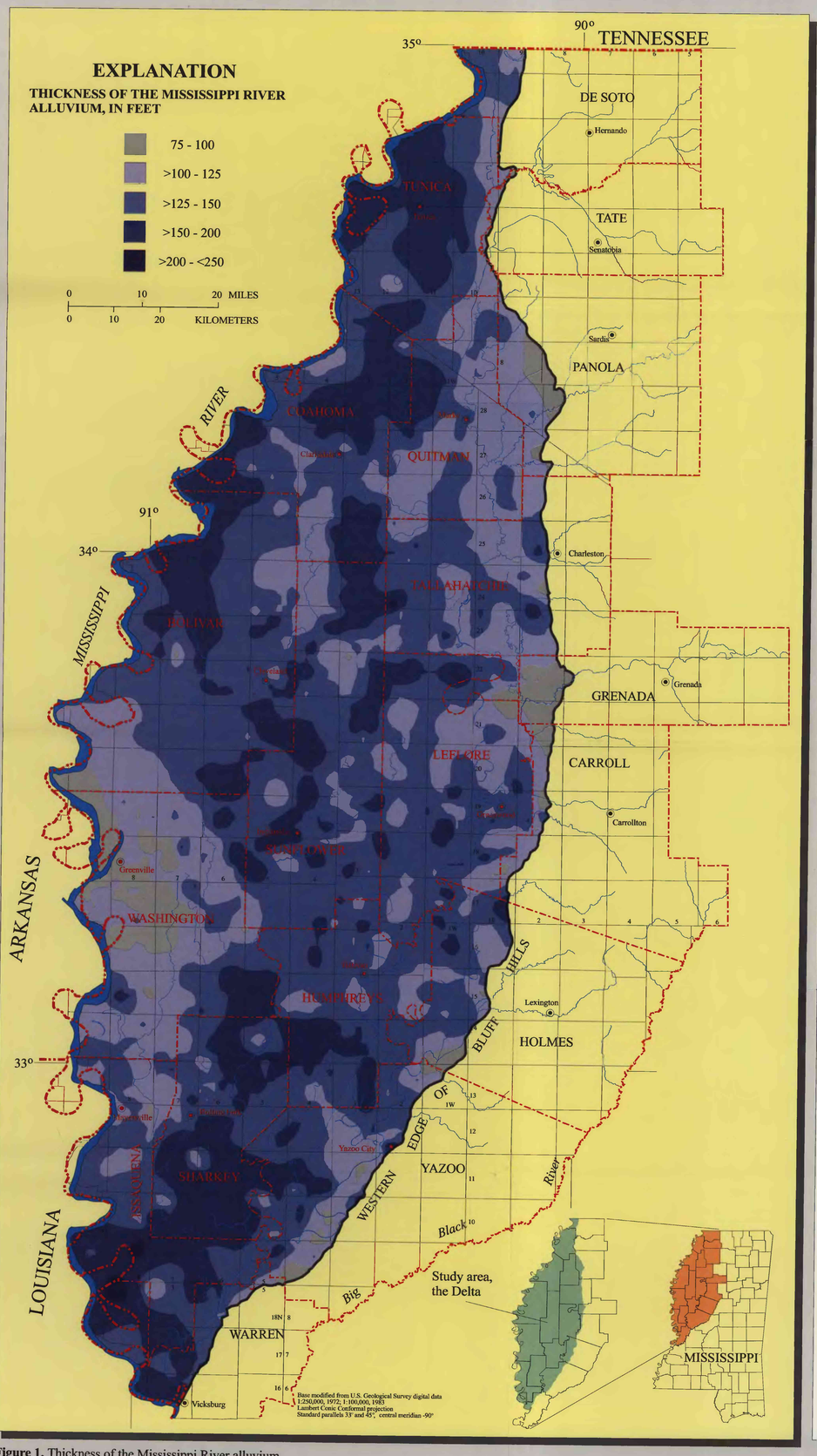

Figure 1. Thickness of the Mississippi River alluvium.

INTRODUCTION

The Mississippi River alluvium in northwestern Mississippi underlies about 7,000 square miles of the Mississippi River alluvial plain in all or parts of 19 counties in northwestern Mississippi. The Mississippi River alluvial plain in Mississippi, locally called the "Delta," slopes about ½ foot per mile from north to south. The Delta is a lens-shaped area that extends from the Tennessee boundary southward to Vicksburg, Mississippi (fig. 1). The Delta is about 66 miles wide at its midpoint, and is bounded on the east by the Bluff Hills and on the west by the Mississippi River.

Underlying the Delta is the Mississippi River alluvial aquifer, which consists of the coarse sand and gravel of the Mississippi River alluvium. The alluvial aquifer is the most heavily pumped aquifer in the State (Arthur, 1994). Most of the pumpage from the aquifer is for agriculture—rice and catfish production and irrigation of cotton, corn, and soybeans. Other uses of water from the alluvial aquifer are for industry, electric power generation, and public supply at Vicksburg. Water pumped from the aquifer has increased from about 745 millions gallons per day in 1975, to about 2,000 million gallons per day in 1994 (Arthur, 1994). Although the rate of increase in pumpage has probably decreased since 1994, pumping from the aquifer is expected to increase with the projected increase in industry, row crop irrigation, rice, and catfish production (Dean Pennington, Yazoo Mississippi Delta Joint Water Management District, oral commun., 1996).

In response to concern about keeping a sustainable economical supply of water for the growth of agriculture and industry in the Delta, the U.S. Geological Survey (USGS) in cooperation with the Mississippi Department of Environmental Quality, Office of Land and Water Resources (OLWR), the Yazoo Mississippi Delta Joint Water Management District, and the Natural Resources Conservation Service began a study in 1995 to describe the hydrogeology and to analyze the flow in the Mississippi River alluvial aquifer. Major components of the investigation are determining the spatial variation in thickness of the upper and lower clays confining the alluvial aquifer (Arthur, 1994), the thickness of the Mississippi River alluvium, and the thickness of the coarse sand and gravel in the Mississippi River alluvium.

This report presents two maps: one showing the thickness of the Mississippi River alluvium and the other showing the thickness of the coarse sand and gravel in the Mississippi River alluvium. The map showing the thickness of the alluvium (fig. 1) can be used to estimate the maximum depth of a well completed in the alluvial aquifer. The map showing the thickness of the coarse sand and gravel (fig. 2) can be used to help determine the areas in the Delta with the potential for relatively high yields of water from the alluvial aquifer. Assuming equivalent hydraulic properties, the areas with the thickest section of coarse sand and gravel generally have the potential to yield more water than the areas with a lesser thickness of coarse sand and gravel.

COMPILATION OF INFORMATION AND MAP PREPARATION

Hydrogeologic information from more than 4,000 sites in the Delta was reviewed during this study. The maps showing the thickness of the alluvium and the thickness of the coarse sand and gravel in the Mississippi River alluvium were prepared based on information gathered and analyzed during the investigation. Most of the information came from the analysis of drillers' logs and borehole geophysical logs from the files of the OLWR and the USGS. The remainder of the information came from soil logs of corings made by the U.S. Army Corps of Engineers and the Mississippi Department of Transportation.

Hydrogeologic information and other identifying information for each site were tabulated and entered into a computer data file. The file included the following information specific to each site:

- County identifier
- Well number
- Geophysical log number
- Land-surface altitude
- Upper confining unit thickness
- Depth-to-base of upper confining unit
- Depth-to-top of coarse sand and gravel
- Depth-to-base of alluvial aquifer
- Lower confining unit thickness
- Thickness of first sand of Tertiary age below base of alluvial aquifer
- Geologic unit directly underlying the alluvial aquifer
- Latitude
- Longitude

A complete array of data was not available for every site, but the minimum data for each site consisted of a county identifier, land-surface altitude, latitude, longitude, and at least one of the other attributes listed above.

The map showing the thickness of the Mississippi River alluvium (fig. 1) was prepared based on information from 3,970 locations. The map showing the thickness of the coarse sand and gravel of the Mississippi River alluvium (fig. 2) was prepared based on thickness information from 3,698 locations. Most of the data were reported by water-well drillers on drillers' logs submitted to the OLWR.

The maps were prepared by first developing a matrix of thickness values with each value in the matrix representing the thickness at the center of a 1-square-mile grid cell. The value at the center of each grid cell was determined by averaging the values from surrounding data points based on a constrained inverse-distance-squared weighting function. The maps were constructed by contouring the points of equal thickness and shading areas representing a selected range of values.

GEOLOGIC DESCRIPTION

The Mississippi River alluvium of Quaternary age is the product of large-scale erosion and deposition during several periods of glaciation in the northern United States and subsequent seasonal melting that released large volumes of water. As sea level gradually rose, gradients decreased, aggradation began, and the eroded valley filled with gravel, sand, silt, and clay (Krinitzsky and Wire, 1964). The upper part of the alluvium is predominantly clay and silt. The basal part of the alluvuim is usually composed of coarse sand and gravel. The average thickness of the alluvium is about 134 feet.

The Mississippi River valley resulted from erosion of geologic units that form the present uplands around the periphery of the valley. These Tertiary age units directly underlie the alluvium and regionally dip to the west in the northern two-thirds of the Delta and to the southwest and south in the southern one-third.The subcropping units consist of unconsolidated sand, silt, and clay beds of varying thicknesses and are as follows: Zilpha Clay, Sparta Sand, Cook Mountain Formation, Cockfield Formation, and Jackson Group (fig. 3). The Cockfield Formation and Sparta Sand consist of sand beds that form two of the major aquifers in Mississippi that supply drinking water.

THICKNESS OF THE ALLUVIUM

The Mississippi River alluvium is the result of the deposition of gravel, sand, silt, and clay into the entrenched surface of the Mississippi River valley. The thickness of the alluvium is related to the configuration of the entrenched surface of the Mississippi River valley upon which the deposits lie. The configuration of the entrenched valley surface was affected by the planation of the meandering streams during periods of entrenchment, and the structural features and lithology of various strata underlying the entrenched valley surface.

The thickness of the alluvium ranges from 75 to greater than 200 feet, but throughout most of the Delta the thickness ranges from 125 to 150 feet (fig.1). The alluvium generally is thickest in the southwestern and northwestern parts of the Delta. Sharkey, Coahoma, and Tunica Counties have the greatest average thickness of alluvium with 156, 149, and 145 feet, respectively. The alluvium generally is thinnest near the edge of the Delta adjacent to the Bluff Hills and in the west-central part of the Delta. Washington County, in the west-central part of the Delta, has the smallest average thickness of alluvium of the 10 counties that lie entirely within the Delta. Average alluvial thickness in Washington County is 121 feet, and a large area where the alluvium thickness ranges between 75 and 100 feet is present in the county.

THICKNESS OF THE COARSE SAND AND GRAVEL

The coarse sand and gravel in the Mississippi River alluvium were deposited during the early stages of valley fill by streams with considerable load carrying capacity. The sand and gravel in the alluvium become coarser with depth, and cobbles as large as 4 inches in diameter are present at the base of the alluvium. Thickness of the coarse sand and gravel is highly variable, especially where deep channels were eroded into the entrenched valley.

The thickness of the coarse sand and gravel in the Delta ranges from 0 to greater than 150 feet (fig. 2). Throughout most of the area the thickness is greater than 50 feet. Maximum thickness of the coarse sand and gravel generally is where the alluvium is thickest in deep channels eroded in the Mississippi River valley. An exception is in southwestern Issaquena County where the alluvium thickness is greater than 150 feet, and the thickness of the coarse sand and gravel ranges from 0 to 25 feet. Large areas where the coarse sand and gravel thickness is greater than 100 feet are in Tunica, Coahoma, Bolivar, Sunflower, and Sharkey Counties. Large areas where the thickness of the coarse sand and gravel is less than 50 feet are in Washington and northern Issaquena County and at the eastern edge of the Delta adjacent to the Bluff Hills.

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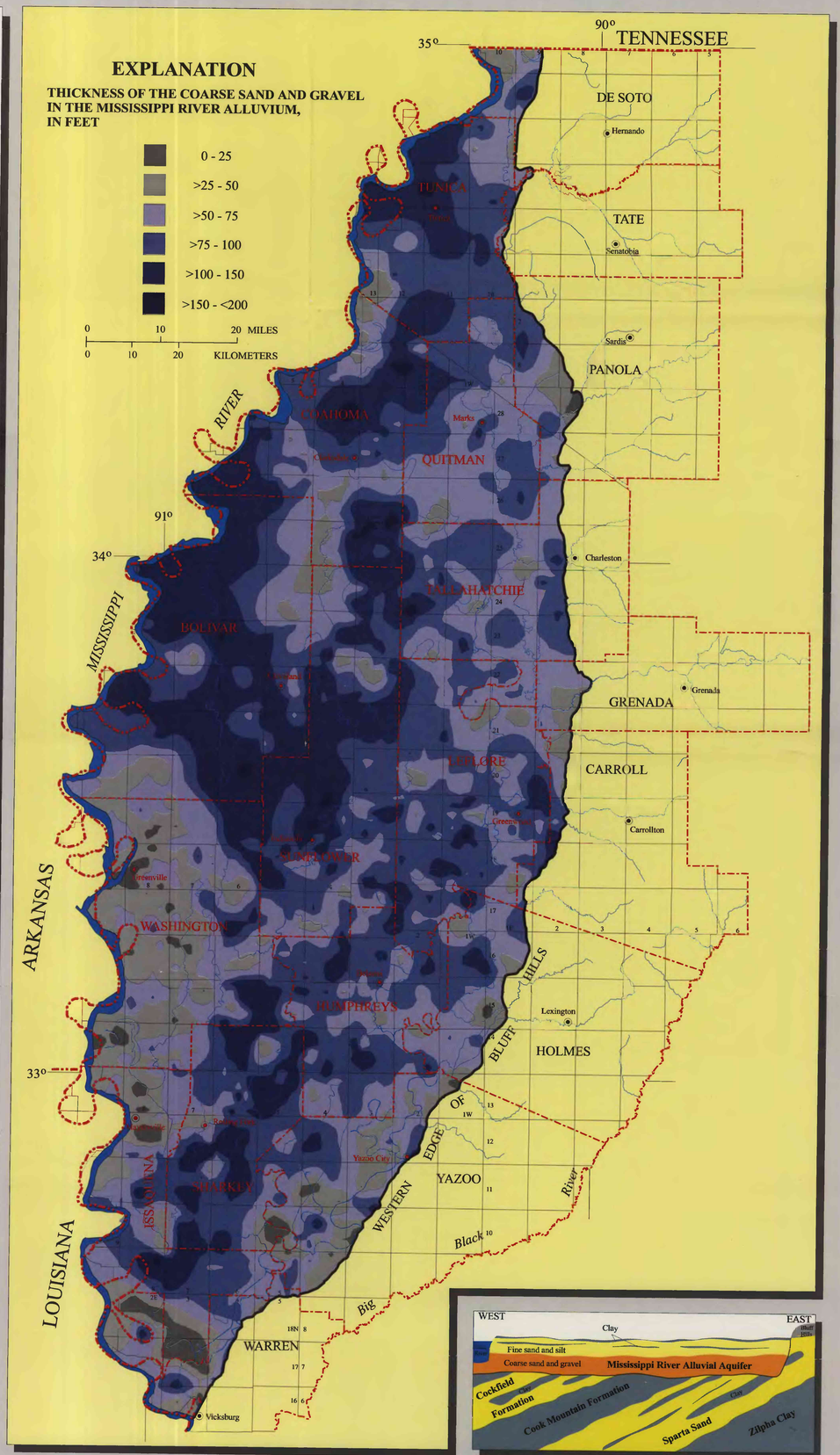

Figure 2. Thickness of the coarse sand and gravel in the Mississippi River alluvium.

Figure 3. Generalized geohydrologic section of the Mississippi River alluvial aquifer and underlying units.

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Thickness of the Mississippi River Alluvium and Thickness of the Coarse Sand and Gravel in the Mississippi River Alluvium in Northwestern Mississippi

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