

DEVELOPMENT OF WATERSHED AND SUBWATERSHED BOUNDARIES FOR MISSISSIPPI

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INTRODUCTION

Successful implementation of federal regulatory programs such as the Clean Water Act and the Safe Drinking Water Act mandates that federal, state, and local agencies, as well as scientists and consultants in the private sector, have appropriate hydrologic data to make informed decisions, do analyses, and address water-quality issues on a watershed basis. These hydrologic data are required to accomplish such tasks as establishing and implementing Total Maximum Daily Loads (TMDLs) and source-water protection. Drainage-area data, at the watershed scale, are not currently available in many states. Engineers need drainage-area data to design various hydraulic structures such as bridges, culverts, storm-sewer systems, and intake and effluent discharges for various industrial, manufacturing, and processing plants. Accurate drainage-area data is needed by regulators and managers to assess the effects of proposed water use, design and develop flood-control structures, measure and mitigate water quality, and develop surface-water models to assist in appropriate water-resource management decisions.

In 2003 the U.S. Geological Survey (USGS), in cooperation with the U.S. Department of Agriculture/Natural Resources Conservation Service (NRCS), the U.S. Department of Agriculture/Forest Service (USFS), the Mississippi Department of Environmental Quality/Office of Pollution Control (MSDEQ-OPC), and the Mississippi Automated Resources Information System (MARIS), will complete development of a watershed and subwatershed map of Mississippi attributed with 10- and 12-digit hydrologic unit codes (HUC). The base data for this map are 1:24,000-scale, 7.5-minute topographic quadrangle sheets. These data will be made available as hardcopy, CD-ROM, or direct view and download through the USGS Internet portal at:

<http://ms.water.usgs.gov/>

These watershed and subwatershed boundaries provide a standardized dataset for the state of Mississippi for use by water-resource managers, engineers and planners in locating, storing, retrieving, and exchanging hydrologic data. Also, these data, in a digital form, can be used in surface-water steady- and unsteady-flow modeling, runoff modeling, cataloging water-data acquisition, the computation and estimation of flood frequency, and low-flow duration, as well as many other water-quality and water-use projects. This report presents information on methodology and development of drainage and hydrography in the form of USGS hydrologic boundaries of water-resources regions, subregions, basins (formerly called accounting units), subbasins (formerly called cataloging units), watersheds, and subwatersheds.

BACKGROUND

The USGS Office of Water Data Coordination, the U.S. Water Resources Council, and the USGS Resources and Land Information Program initiated the original production of the standard map series called "hydrologic unit maps," which present codes, names, and boundaries of hydrologic units in the United States and U.S. territories in the Caribbean area (Seaber et al., 1975). In this national map series the United States is divided into 21 major regions. Mississippi is contained within three of these regions (the Mississippi regions are represented by 2-digit numbers: 03, 06, and 08). These 21 regions (each of these sub-divisions also being represented by 2-digit numbers) were then subdivided into 222 subregions, 352 accounting units, and 2,150 cataloging units (2 digits each) to establish the original 8-digit hydrologic unit code (HUC) region (ww), subregion (xx), accounting unit (yy), and cataloging unit (zz) for the United States and U.S. territories in the Caribbean area (U.S. Geological Survey, 1977).

In the 1970s, the NRCS (formerly named the U.S. Department of Agriculture Soil Conservation Service) adopted the use of HUCs for all NRCS investigations and surveys. Subsequently, the NRCS initiated a national program to further subdivide HUCs into watersheds for use in water-resource planning. A 3-digit extension was added to the 8-digit HUCs by the NRCS during this time period to designate watersheds as 11-digit HUCs. The trailing digit was later dropped and the HUC designation was changed from 11 digits to 10 digits. A 10-digit watershed encompasses from approximately 40,000 to 250,000 acres (62.5 to 391 square miles (mi²)). The NRCS successfully completed this program in the 1980s for Mississippi. During this period, the Mississippi District of the USGS delineated the drainage areas of many of the state's smaller streams using 1:24,000- and 1:62,500-scale topographic quadrangle sheets as base maps. These drainage areas are less than 1 mi² in many parts of the state.

In 2001, the USGS, in cooperation with the NRCS, the USFS, MSDEQ-OPC, and the MARIS, began development of a statewide dataset of watershed and subwatershed boundaries showing the hydrologic units for the 10- and 12-digit hydrologic unit codes (5th and 6th order basins). This project followed guidelines published by the Federal Geographic Data Committee (FGDC) Proposal, Version 1.0 entitled: *Federal Standards for Delineation of Hydrologic Units Boundaries* (U.S. Department of Agriculture, 2001). The 12-digit subwatersheds for Mississippi generally range in size from approximately 7,000 to 40,000 acres (10.9 to 62.5 mi²) and serve as a reference for drainage-area information. The dataset developed from this project will present information on drainage and hydrography in the form of USGS hydrologic boundaries of water-resource regions, sub-regions, basins, sub-basins, watersheds, and subwatersheds. The base maps used for these delineations are USGS 1:24,000-scale 7.5-minute topographic quadrangle sheets.

OBJECTIVES

This report describes the methods used in the development of watershed and subwatershed boundaries for Mississippi and presents examples of provisional results of this project. The report also discusses the development of the geographic information system (GIS) database for the basin, sub-basin, watershed and subwatersheds (6-, 8-, 10-, and 12-digit units). The data presented in this report are provisional and subject to change upon further review by personnel of the USGS.

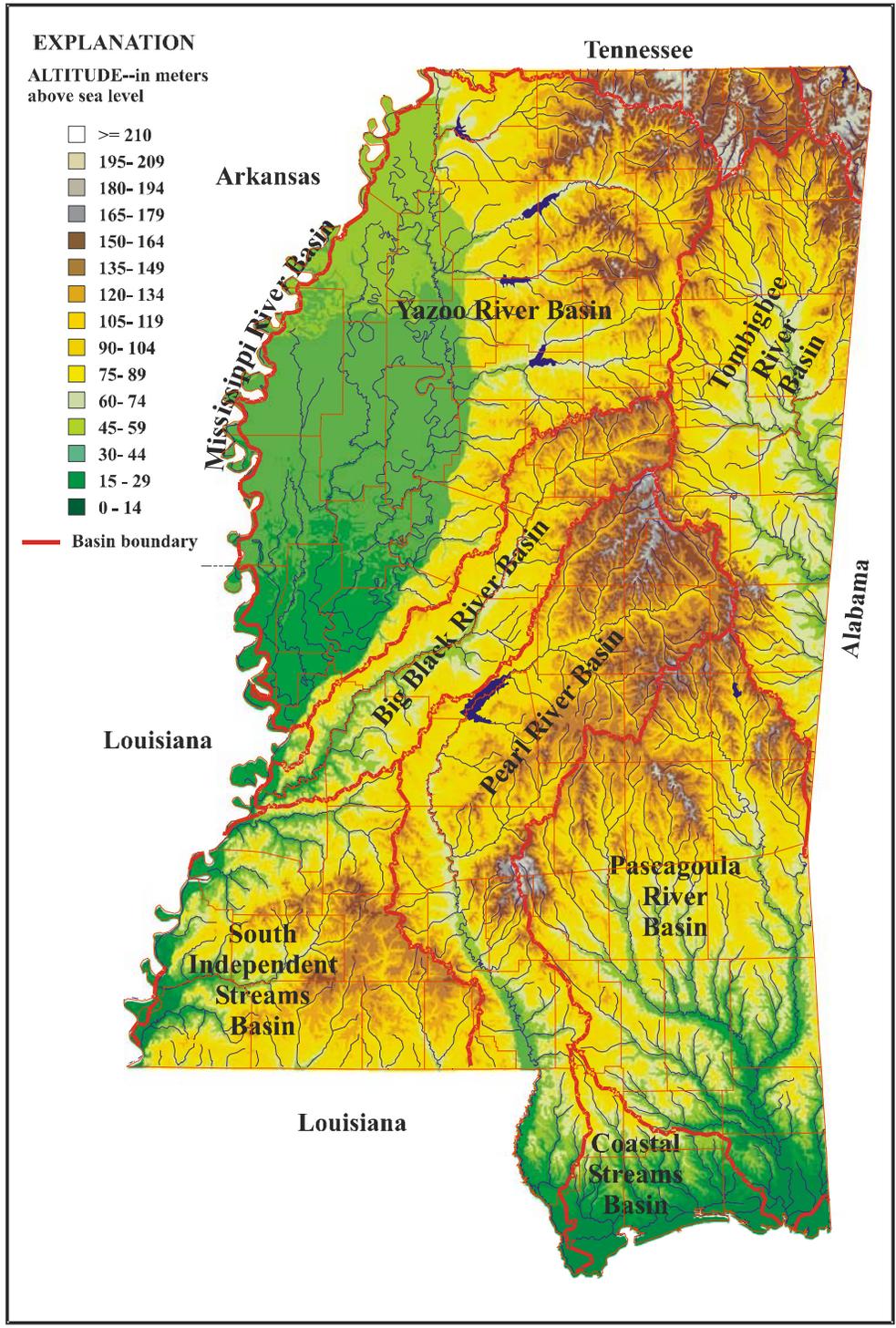


Figure 1. —Generalized land-surface elevation map of Mississippi showing the eight principal drainage basins in the state as designated by the MSDEQ (Strom, 1998).

STUDY AREA DESCRIPTION

Mississippi is located within the East Gulf Coastal Plain physiographic province and generally can be divided into two physiographic districts, the coastal plain uplands and the lower Mississippi River Alluvial Plain (known locally as the "Delta"). The state covers 47,716 mi² and is contained within the 30- and 35- degree north latitudes and the 88- and 92- degree west longitudes. The Coastal Plain Uplands District encompasses more than 40,000 mi² (about 85 percent of the state) and is predominantly rolling forested hills with undulating prairies that vary in natural species composition from predominantly pine in the lower third of the state, to pine-hardwood in other parts. The Delta contains approximately 7,000 mi² (about 15 percent of the state), is ellipsoidal in shape, extends 200 miles (mi) north-south, and is more than 60 mi at its widest point east-west. It extends from Vicksburg north to the state boundary south of Memphis, Tennessee. The Delta is an area of very low relief (less than 100 feet (ft) of rise in land-surface elevation from Vicksburg to Memphis) characterized by sloughs and old runs of the Mississippi River. A thick veneer of loess overlies the bedrock of the valley walls and forms an abrupt steep border between the Delta and the Coastal Plain Uplands (Thornbury, 1965). Land-surface elevations in the state range from sea level near the coast to more than 800 ft above sea level in the northeastern corner of the state. Mississippi's climate varies from humid to sub-tropical. Average annual rainfall ranges from approximately 50 inches (in.) in the northern part of the state to almost 70 in. near the coast (Wax, 1990).

The eight principal river basins in the State of Mississippi, as designated by the MSDEQ are the Big Black, Coastal Streams, Mississippi, Pascagoula, Pearl, South Independent Streams, Tombigbee, and the Yazoo (fig. 1). In the Coastal Plain Uplands, which contains all the above-mentioned basins except the Mississippi and Yazoo River Basins, the drainage pattern is fairly well developed. On streams in the state where the USGS maintains streamflow gaging stations, the median stream gradient is approximately 10 feet/mile (ft/mi) for streams draining less than 800 mi². The drainage pattern in the Delta region of the Yazoo River Basin is naturally not well defined and is greatly impacted by anthropogenic changes such as canalization, drainage canals, flood-control levees, and other agricultural and engineering practices. The median gradient for streams located in the Delta is approximately 1 ft/mi (Landers and Wilson, 1991). Streamflow patterns become tidally influenced near the Gulf of Mexico coast.

METHODOLOGY

From 2001 to 2003, the 8-digit HUCs (subbasins) in Mississippi were subdivided into watersheds and subwatersheds, which were then assigned unique 10-digit and 12-digit codes, respectively. The 12-digit code identifies each of the six levels of classification within six 2-digit fields. An example of the HUC numbering and naming system is given below for the Blytha Creek subwatershed (HUC 080602010301):

08 -	Region: Lower Mississippi; drainage area 101,324 mi ²
0806 -	Subregion: Lower Mississippi - Big Black drainage area 7,067 mi ²
080602 -	Basin (formerly called Accounting Unit) Big Black - Homochitto; drainage area 6,500 mi ²
08060201 -	Subbasin (formerly called Cataloging Unit): Upper Big Black River; drainage area 1,478 mi ²
0806020103 -	Watershed: Big Bywy Ditch; drainage area 159 mi ²
080602010301 -	Subwatershed: Blytha Creek; drainage area 56 mi ²

A “00” in the basin code indicates that the basin name and the subregion name are the same. Likewise, if the watershed code is “00”, it shares the same name as the subbasin. An example of an assigned 12-digit Hydrologic Unit Code for Mississippi is shown in figure 2.

Watershed and subwatershed boundaries for streams in Mississippi were digitized from an existing set of 1:24,000-scale maps containing drainage areas previously delineated by USGS personnel as part of ongoing water-resource investigations in the state. The USGS and NRCS worked jointly to review and check the digitized boundaries. The USGS assigned all 10- and 12-digit hydrologic unit codes to these watersheds and subwatersheds. Attribution tables listing the HUC and drainage area for each watershed and subwatershed were compiled and input by MARIS.

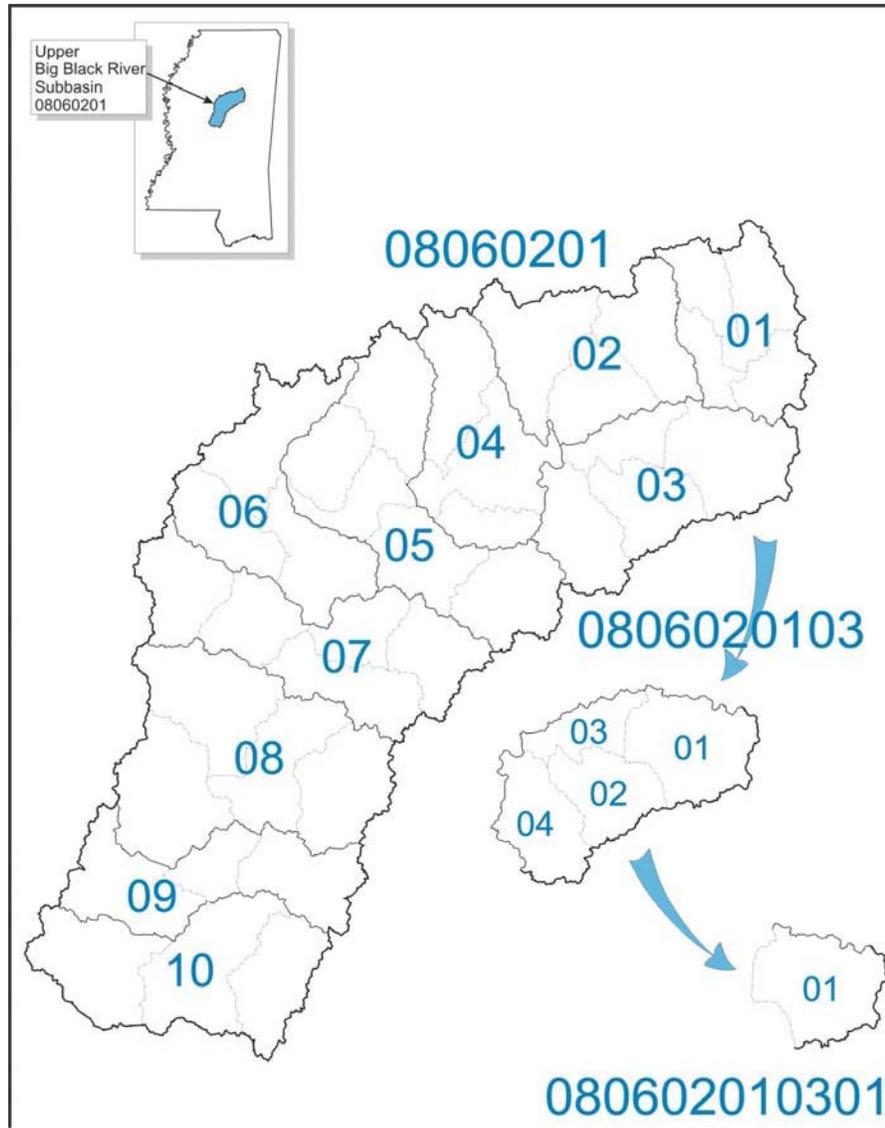


Figure 2. —Example of the 12-digit hydrologic unit numbering system for the HUC 080602010301 in the Upper Big Black River subbasin of Mississippi.

In several areas of Mississippi, 15-minute topographic quadrangles were used by the USGS to delineate watershed boundaries in the 1970s and 1980s. During the current project, it was necessary to transfer watershed and subwatershed boundaries from 15-minute topographic quadrangles to previously-unavailable 7.5-minute topographic quadrangles prior to digitizing and GIS processing.

The quality-assurance procedures used to delineate and code the 10- and 12-digit watersheds and subwatersheds followed guidelines set forth in the FGDC Proposal, Version 1.0 entitled: *Federal Standards for Delineation of Hydrologic Units Boundaries* (U.S. Department of Agriculture, 2001). As a final check, the dataset will be reviewed and certified by the NRCS National Cartography and Geospatial Center in Fort Worth, Texas.

This project further defines the existing 2-, 4-, 6-, 8-digit Hydrologic Unit Codes into 10-, 12-digit watersheds and subwatersheds, respectively. The hierarchal breakdown of Hydrologic Unit Codes for the State of Mississippi is shown in figure 3.

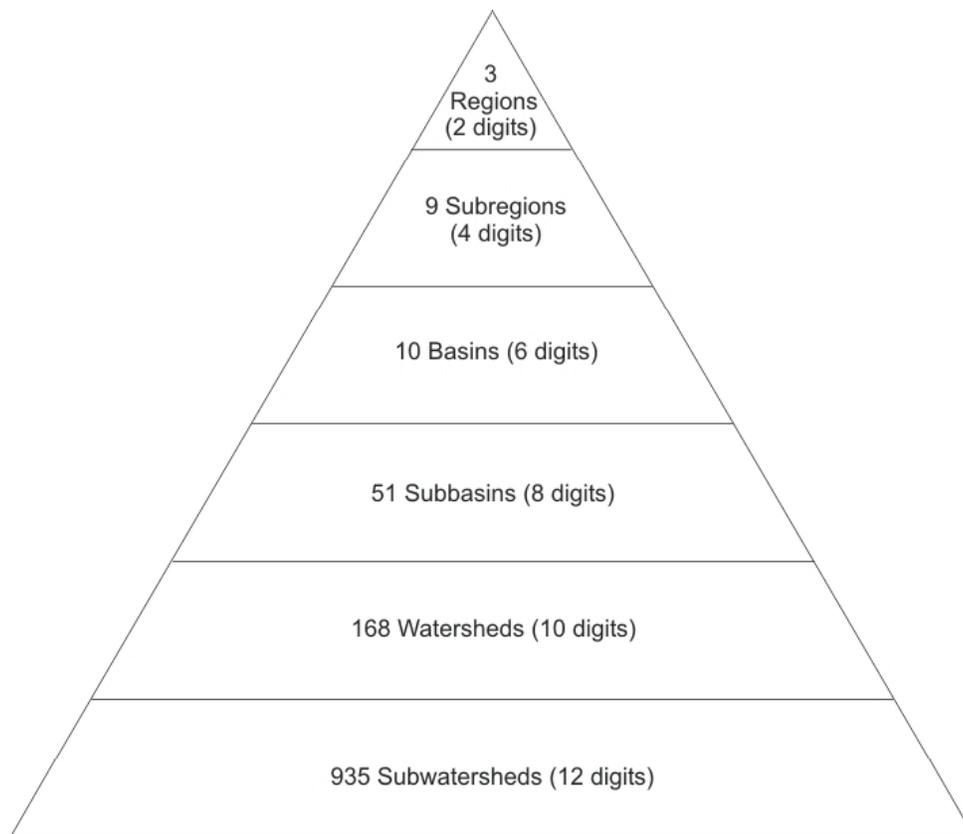


Figure 3. —Hierarchy for the hydrologic unit codes for the State of Mississippi (does not include watersheds and subwatersheds in Delta region of the Yazoo River basin below 8-digits).

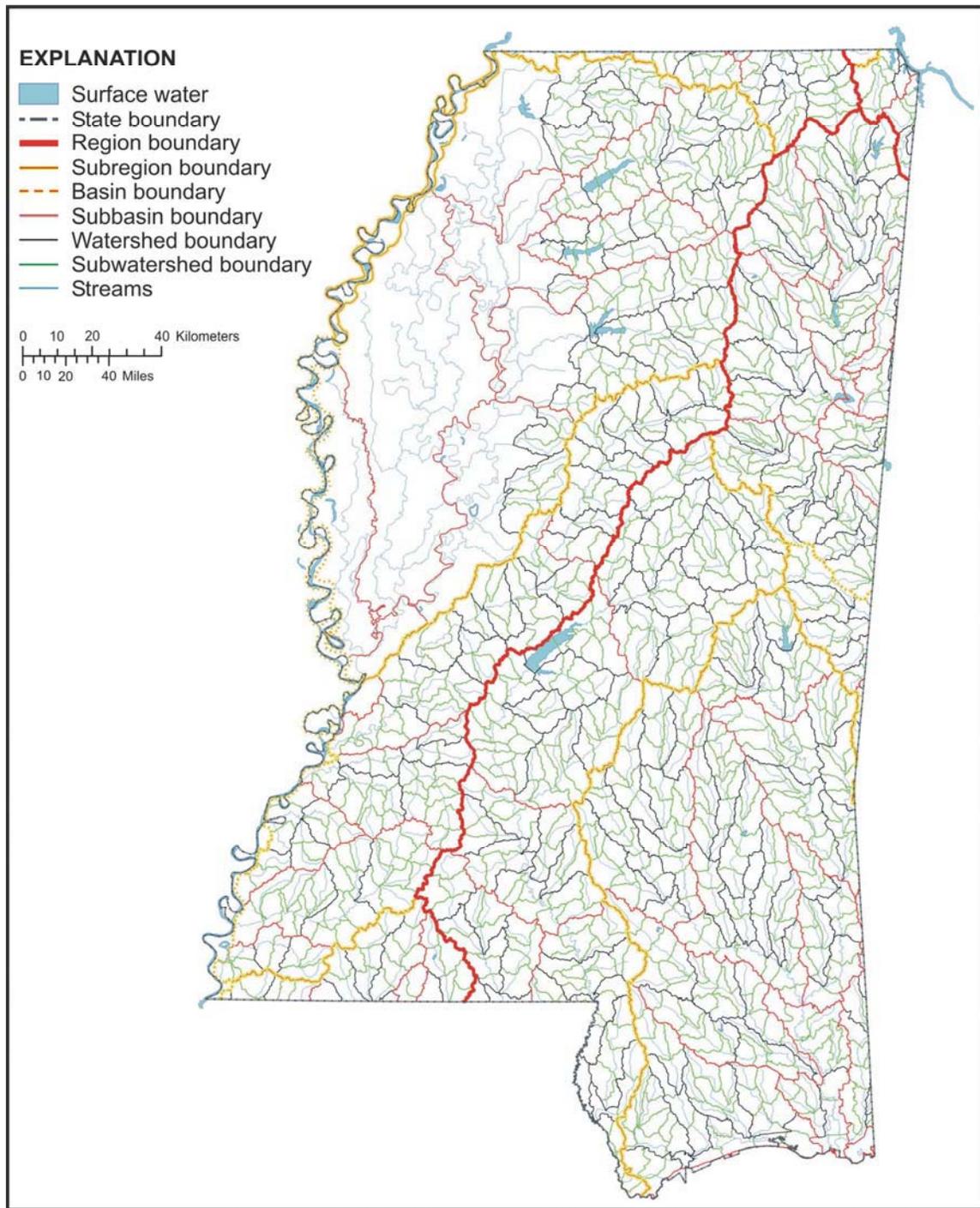


Figure 4. —Region, subregion, basin, subbasin, watershed, and subwatershed boundaries for the State of Mississippi.

SUMMARY

The USGS, in cooperation with the NRCS, the USFS, the MSDEQ-OPC, and the MARIS, will complete development of a watershed and subwatershed map of Mississippi attributed with 10- and 12-digit hydrologic unit codes in 2003. The original 8-digit hydrologic unit code containing 2 digits each for the region, subregion, basin (formerly called accounting unit), and subbasin (formerly called cataloging unit), has been enhanced by further subdividing the 8-digit subbasins into 10- and 12-digit watersheds and subwatersheds, respectively (fig. 4). For this report only subbasins were available for the Mississippi River Alluvial Plain.

Drainage areas originally delineated by personnel of the USGS Mississippi District in the 1970s and 1980s on 1:24,000-scale topographic quadrangles, were digitized and processed using GIS software. A total of 168 10-digit watersheds, ranging in size from 45,616 to 360,392 acres (71.28 to 563.11 square miles), and 935 12-digit subwatersheds, ranging in size from 7,083 to 54,773 acres (11.07 to 85.58 square miles), were delineated and digitized.

The hydrologic unit boundaries, hydrologic unit codes, and drainage-area data are stored in a GIS database, which will be made available on CD-ROM and on the Internet at the time of publication. The hydrologic unit map for Mississippi, provides a standard geographical framework for water-resources and selected land-resource planning.

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