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REPORT 99-4109

BATHYMETRIC SURVEY AND PHYSICAL AND CHEMICAL-RELATED PROPERTIES OF MILL CREEK RESERVOIR

INTRODUCTION

Mill Creek Reservoir, formed from an earthen dam built in 1971 on Mill Creek in northwestern Louisiana, is used for water-based activities such as water skiing, fishing, boating, and swimming. An understanding of current hydrologic conditions of this reservoir and other reservoirs and lakes in Louisiana is essential to the management and protection of these valuable natural resources. Water quality and quantity are important concerns to those who use these bodies of water for municipal, recreational, agricultural, or industrial purposes. Current and accurate information regarding the physical and chemical-related properties and conditions of freshwater reservoirs and lakes in Louisiana is fundamental to planners and managers for evaluating these resources. In October 1996, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development, began a study to conduct a bathymetric survey and determine the physical and chemical-related properties of Mill Creek Reservoir.

The purpose of this report is to present the results of the bathymetric survey and the results of vertical profiles of physical and chemical-related properties, including depth, water temperature, dissolved oxygen, specific conductance, and pH, which were measured at two sites in the reservoir. Hydrographic surveying software was used for combining differential global positioning system (DGPS) information with digital survey fathometer data to accurately map the bathymetry of the reservoir. The bathymetric map was produced using geographic information systems (GIS), and lines of equal depth of water were reviewed and edited for accuracy and consistency. On-site physical and chemical-related properties were measured at the two selected locations using a water-quality monitor. This report is one in a series of planned map reports describing current bathymetry and physical and chemical-related properties of reservoirs and lakes in Louisiana.

Description of Study Area

Mill Creek Reservoir (fig. 1) is located in southern Bienville Parish, about 1 mile west of the town of Saline, Louisiana. A recent census estimates a population of 15,707 for Bienville Parish (1997) and 295 for the town of Saline (1996) (Northeast Louisiana University, Uniform Resource Locator accessed December 1, 1998). This area has a subtropical transitional climate with a mean annual rainfall of 54.2 inches and a mean annual temperature of 63.3°F (degrees Fahrenheit) (Sean Helfrich, Louisiana Office of State Climatology, written commun., 1997).

Mill Creek Reservoir has a drainage area of 12.6 square miles and receives inflow from Mill Creek and unnamed tributaries entering at the western end of the reservoir. The earthen dam has a top elevation of 215 feet above sea level and is 1,400 feet in length. The reservoir level is controlled by a spillway constructed from two 8- by 9-foot reinforced concrete box culverts that create a weir 50 feet in length at a crest elevation of 200 feet above sea level. The maximum discharge for the spillway structure is 4,680 cubic feet per second (Ray Elifami, Louisiana Department of Transportation and Development, written and oral communs., 1998). Approximately half of the reservoir-surface area has stumpy remnants of the once densely forested basin of Mill Creek. Boat access is limited with well demarcated channels. Boat ramps are available at two locations on the reservoir (fig. 1).

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BATHYMETRY

Bathymetric data for Mill Creek Reservoir were collected during May 27-29, 1997. Accurate position and depth data were obtained to comprehensively describe the bathymetry of the reservoir; 45,365 data points of latitude, longitude, and depth were recorded. The bathymetry of the reservoir is shown in figure 1; water depths are referenced to the water-surface elevation of 200.7 feet above sea level, which existed throughout the bathymetric survey. The normal pool elevation of the reservoir is 200 feet above sea level.

Equipment used during the bathymetric survey included a Starlink DNAV-212 DGPS, an Odom digital survey fathometer, and HYPACK software. The DGPS measured spatial position in latitude and longitude with routine accuracy of 5 feet; horizontal control points were established at the beginning and rechecked at the end of each survey day to maintain that accuracy. The survey fathometer measured the depth with routine accuracy of 0.1 foot; the fathometer was calibrated at the start and verified at the end of each survey day to maintain that accuracy. The HYPACK software was used for survey planning, survey execution, and storage and editing of data. Data were exported to ARC/INFO for drawing lines of equal depth of water and subsequent reviewing and editing of the results.

Surface area and volume spatial analyses also were performed within ARC/INFO. The water-surface area of Mill Creek Reservoir was 560 acres, and the water volume was 6,350 acre-feet. The depth-surface area and depth-volume relations are shown in figure 2. The average depth of the reservoir was 11.3 feet, with a depth of 8.5 feet or greater over more than 50 percent of the reservoir-surface area. Greatest depths are located in the eastern part of the reservoir near the earthen dam spillway structure.

PHYSICAL AND CHEMICAL-RELATED PROPERTIES

Data on physical and chemical-related properties were collected on May 29, 1997, at selected sites in Mill Creek Reservoir. At these sites (1 and 2 in fig. 1), multiple points along a vertical profile were sampled to establish the occurrence and depth of stratification. The HYDROLAB, a water-quality monitor, was calibrated at the beginning of the day prior to physical and chemical-related property data collection.

Data were collected along a vertical profile from above the reservoir bed to 1.6 feet below the water surface, with additional sampling points within the stratification zone. The deepest measurements at the two sampling sites were 31.8 feet at site 1 and 21.3 feet at site 2. Water temperature was approximately 78°F from the surface to approximately 5 to 9 feet in depth, then decreased with depth to approximately 57°F at 31.8 feet, which was the deepest measurement (fig. 3).

Dissolved-oxygen (DO) concentration profiles indicated a distinct stratification existed during the May 29, 1997, profiling. Within the range from 5 to 15 feet below water surface, DO concentrations decreased markedly. Shallow-water DO concentrations varied between 7.1 and 7.6 mg/L (milligrams per liter), and bottom-water DO concentrations varied between 0.14 and 0.23 mg/L. DO concentrations vary considerably with depth, location, and season (Demas, 1985). The U.S. Environmental Protection Agency's criterion for DO is 5 mg/L for freshwater aquatic life (U.S. Environmental Protection Agency, 1976; 1986). Water visibility, measured with a Secchi disk, was 4.5 feet.

Specific conductance profiles showed stratification beginning at a depth of 10 feet. The specific conductance remained constant at 25.6 µS/cm (microsiemens per centimeter at 25 degrees Celsius) from the surface to about 10 feet, then increased with depth; the bottom-water measurements ranged from 51.4 to 67.5 µS/cm. The pH was about 6.3 (standard units) near the surface, decreased with depth from the surface to about 10 feet, then increased with depth.

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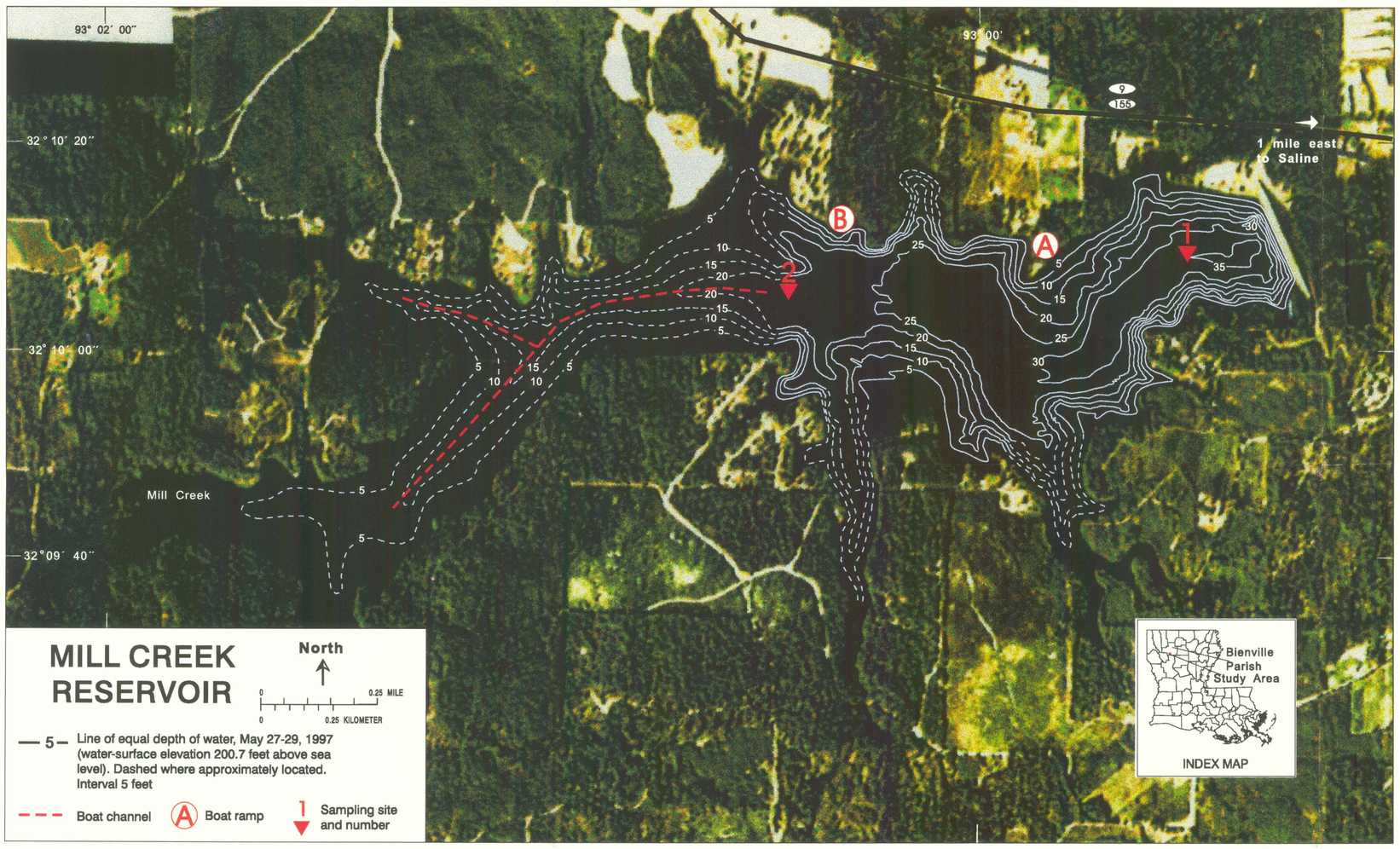

Figure 1. Bathymetry of Mill Creek Reservoir, May 27-29, 1997.

Aerial photomap by the U.S. Geological Survey.
Aerial photograph provided by National Aeronautics and Space Administration, January 1995

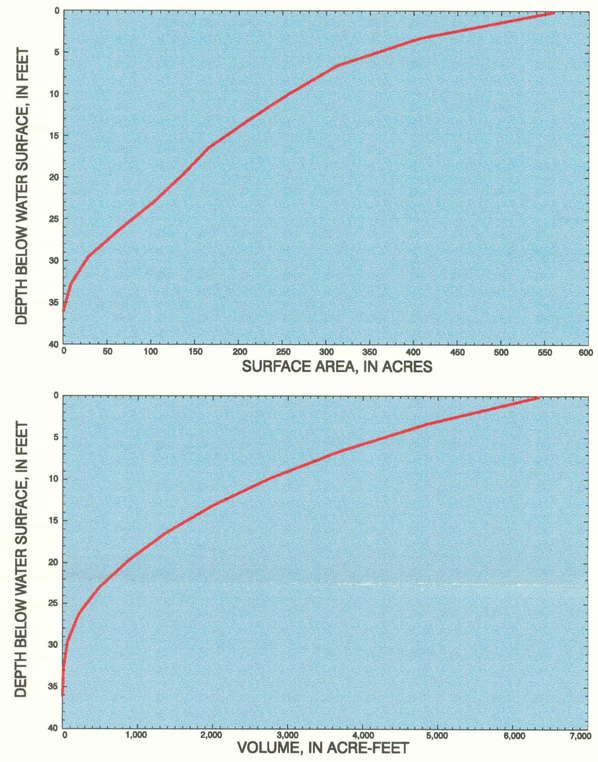

Figure 2. Depth-surface area and depth-volume relations for Mill Creek Reservoir. Water-surface elevation was 200.7 feet above sea level during the bathymetric survey of May 27-29, 1997.

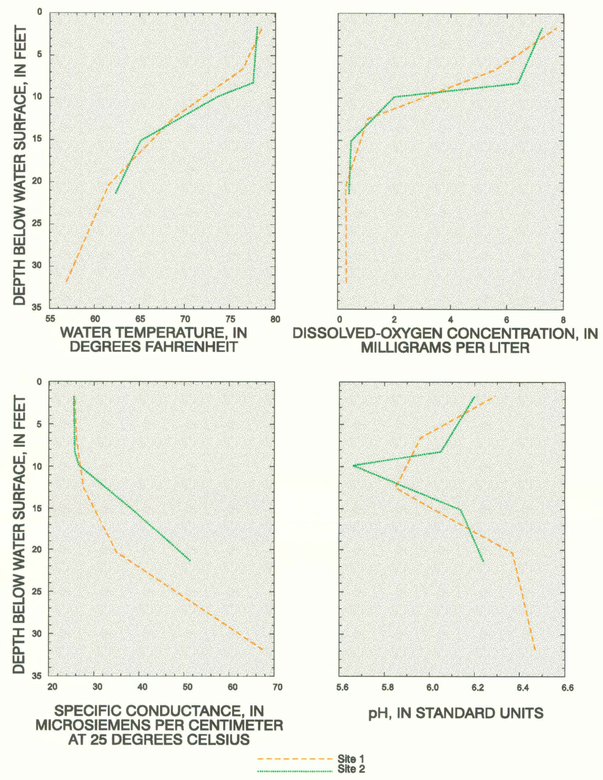

Figure 3. Variation of water temperature, dissolved-oxygen concentration, specific conductance, and pH in Mill Creek Reservoir, May 29, 1997.

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

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Louisiana Department of Transportation and Development - U.S. Geological Survey Water Resources Cooperative Program

Bathymetric Survey and Physical and Chemical-Related Properties of Mill Creek Reservoir, Louisiana, May 27-29, 1997

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