U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

WATER-RESOURCES INVESTIGATIONS
REPORT 92-4181 (SHEET 1 OF 3)

Mermentau River Basin--Water Quality

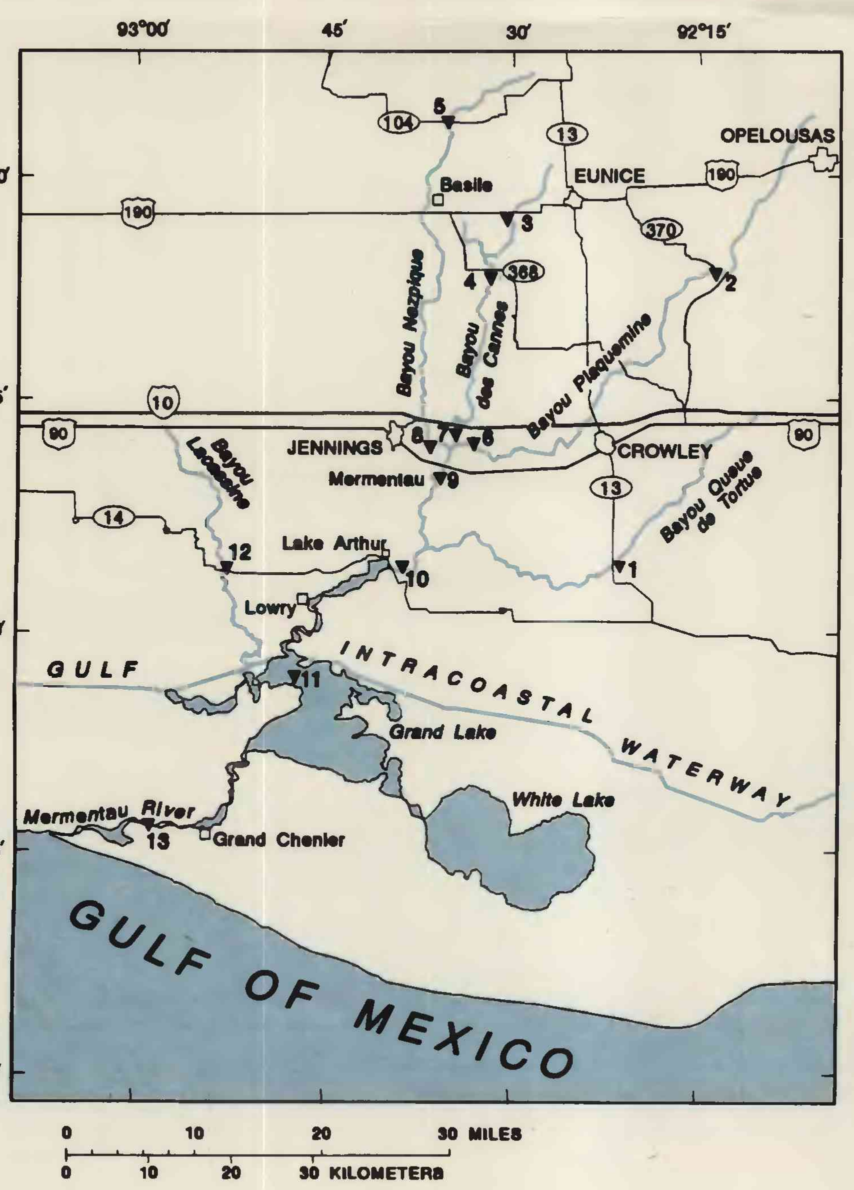
INTRODUCTION

The Mermentau River basin (fig. 1) is a predominantly agricultural area of coastal Louisiana with few industries and municipalities discharging wastewater to streams in the basin. Growing public awareness of the importance of the Mermentau River for recreational use and concern about the overall water quality of the river have prompted interest in management of the resource by Federal, State, and local officials.

The upper part of the basin, including Bayous Nezpique, des Cannes, Plaquemine, Queue de Tortue, and Lacassine, and the Mermentau River to Grand Lake (fig. 1), has dissolved-oxygen (DO), coliform-bacteria, and turbidity problems caused primarily by agricultural runoff from eroding cropland and pastureland (Louisiana Department of Transportation and Development, 1984, p. 388 and 393). These known problems, in addition to potential problems related to point-source discharges of wastewaters by municipalities and widespread pesticide use in the basin, indicate the need to periodically monitor the quality of water in the Mermentau River basin for the various constituents and properties that can limit the suitability of surface waters in the basin for some uses.

Streams in the Mermentau River basin receive large quantities of irrigation return flow, primarily from rice production. Concern about the effects of the return flow on water quality in the receiving streams prompted the Louisiana Department of Environmental Quality (DEQ) to include the main tributaries of the Mermentau River (Bayous Nezpique, des Cannes, Plaquemine, Queue de Tortue, and Lacassine) in a list of priority waterbodies to be protected and preserved. This priority list, which was based on the 1990 assessment of Louisiana's waters (Louisiana Department of Environmental Quality, 1990b), is used by State agencies for managing resources, setting priorities for projects and studies, and approving permits for effiuent discharges.

In response to the water-quality concerns described above, State and Federal agencies have initiated long-term data collection programs in the basin. The DEQ has collected water-quality data monthly at six sites in the basin (Louisiana Department of Environmental Quality, 1990a) since 1978. The data collected at these sites include concentrations of DO, major inorganic constituents, nutrients, trace elements, and fecal-coliform bacteria. The U.S. Geological Survey (USGS) has collected water-quality data at a site on the Mermentau River at Mermentau (site 9 in fig. 1) since 1983. Data collected at this site included streamflow, concentrations of suspended sediment and DO, biochemical oxygen demand (BOD), and concentrations of major inorganic constituents, nutrients, trace elements, and fecal-coliform bacteria. The USGS also collects daily streamflow data at five other sites within the basin, three of which (Bayou Nezpique near Basile, Bayou Lacassine near Lake Arthur, and Mermentau River at Mermentau) are equipped with directional-velocity flowmeters.



EXPLANATION

13 ▼ WATER-QUALITY SAMPLING SITE AND NUMBER (See table 1)

Figure 1. Location of sampling sites.

The USGS, in cooperation with the Louisiana Department of Transportation and Development (DOTD), began a study in 1989 to better define the water quality of surface waters in the basin. The study included the collection of water-quality data at 13 sites throughout the basin. Water and bottom material from these sites were analyzed for a variety of constituents to detect potential water-quality problems. The study was conducted during a period of high summer temperatures and low freshwater inflow. The comprehensive data base generated by this study provides background information that may be useful for other ongoing studies by other agencies and indicates areas where further investigation may be needed.

Purpose and Scope

This report presents the results of a study to describe water quality of streams in the Mermentau River basin during a period of low freshwater inflow. The report presents results of water-quality surveys during September 19-21, 1989, and May 16-17, 1990. Thirteen sites on the Mermentau River and its major tributaries were sampled for analysis of physical properties, inorganic and organic chemical constituents, and bacteria in September 1989. Nine of these sites were resampled for analysis of selected herbicides in May 1990. The 13 sites sampled included sites on the headwaters of the major tributaries and one site near the mouth of the Mermentau River.

Description of the Study Area

The Mermentau River basin lies in the flat Louisiana coastal plain. Land surface elevations are less that 100 ft above sea level in most of the basin and less than 25 ft above sea level along the Mermentau River main stem (Louisiana Department of Environmental Quality, 1990b). Stream gradients in the basin are low and flow velocities are generally less than 1 ft/s, which is typical of coastal Louisiana streams.

Bayous Nezpique, des Cannes, and Plaquemine combine to form the main stem of the Mermentau River east of Jennings (fig. 1). Bayou Queue de Tortue enters the Mermentau River near Lake Arthur, and Bayou Lacassine flows into Grand Lake. The Gulf Intracoastal Waterway crosses the Mermentau River just upstream from Grand Lake. Locks on the Gulf Intracoastal Waterway prevent the movement of saltwater eastward.

Land use varies in the Mermentau River basin. Agriculture is the predominant land use in the basin but much of the northern part of the basin is in scattered pine and mixed deciduous forest. The southern part of the basin consists largely of swamps, freshwater marsh, and saltwater marsh near the Gulf of Mexico (fig. 2). Several cattle ranches are scattered throughout the basin.

Rice and soybeans are the principal crops grown in the basin. An average of 67,500 acres of rice are flood-irrigated each year in the Bayou Queue de Tortue area. Of the approximately 135,000 acre-ft of water pumped each year for this irrigation, 46 percent is surface water and 54 percent is ground water (Louisiana Department of Environmental Quality, 1990b).

INDEX MAP

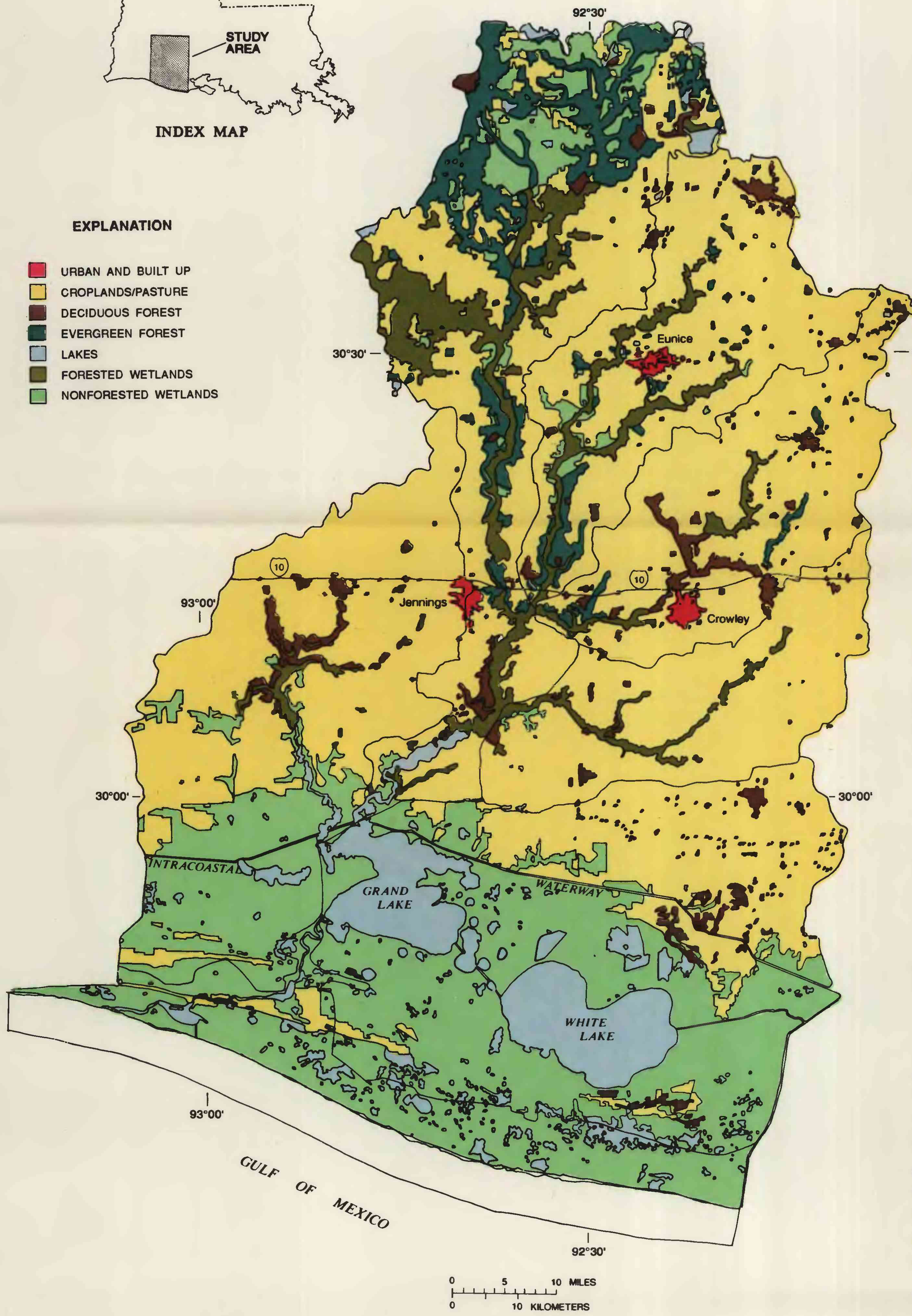


Figure 2. Land use in the Mermentau River basin.

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
foot (ft)	0.3048	meter
foot per second (ft/s)	0.3048	meter per second
mile (mi)	1.609	kilometer
acre	4,047	square meter
acre-foot (acre-ft)	1,233	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows: °F = 1.8 (°C + 32).

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.

Abbreviated water-quality units used in report:
colonies per 100 milliliters (cols/100 mL)
milligrams per kilogram (mg/kg)
milligrams per liter (mg/L)
milliliters (mL)
micrograms per gram (μg/g)
micrograms per liter (μg/L)
micrometer (μm)
microsiemens per centimeter at 25 degrees Celsius (μS/cm)
square meters per gram (m^2/g)

LOUISIANA HYDROLOGIC ATLAS MAP NO. 7:

WATER-QUALITY SURVEY OF THE MERMENTAU RIVER BASIN, 1989-90

By Dennis K. Demcheck
1994

Study Methods

Thirteen sampling sites were selected in the Mermentau River basin (fig. 1) to assess the water quality of the major streams in the basin. The sites were selected to detect contamination of the major streams by natural or synthetic constituents. Paired upstream and downstream sites were sampled on Bayous Nezpique, des Cannes, and Plaquemine to determine the effects of specific land use, in those basins on water quality. Samples collected at the 13 sites were analyzed for the following constituents: suspended sediments, inorganics, volatile organic compounds (VOC's), phenols, and fecal bacteria in water; and nutrients, trace elements, insecticides, herbicides, and other synthetic organic compounds in water and bottom material (table 1). The VOC's, acid-base/neutral extractable organic compounds (ABN's), and pesticides are collectively referred to as synthetic organic compounds in this report.

Instantaneous discharge was measured and water-quality samples were collected concurrently on the Mermentau River and its tributaries September 19-21, 1989. Conventional and directional-velocity flowmeters were employed for the discharge measurements. The measurements were supplemented by discharges computed from river-stage data at long-term USGS streamflow sites. Suspended-sediment samples were collected from the tributaries using a hand-held DH-59 sampler.Automated water-quality monitors were operated at five sites (sites 1, 6, 7, 8, and 12) on the tributaries and at one site on the main stem of the Mermentau River (site 13) September 15-27, 1989. Water temperature, pH, dissolved oxygen concentration, and specific conductance of water 3 ft below the surface at these sites were measured and recorded hourly to provide information on water-quality conditions before, during, and after sampling.

Because of the low water velocities, wire-basket samplers holding a glass bottle were used to collect depth-integrated samples. The bottle was cleaned and baked at 350 °C for 8 hours (h) to remove any organic residues. Water samples for the analysis of VOC's were collected using stainless-steel sewage samplers, containing 40-milliliter vials. After the VOC samples were collected, the vials were sealed with Teflon[1]-septum caps.

Samples for dissolved inorganic, nutrient, and trace-element analyses were filtered through 0.45-micrometer nitrocellulose filters and treated with the appropriate preservatives for later analysis by USGS laboratories using methods described by Fishman and Friedman (1989). Water samples for analysis of ABN's and pesticides were stored at 4 °C until they were analyzed at a Tennessee Valley Authority laboratory. All samples for synthetic organic compounds were analyzed according to methods described by Wershaw and others (1987) and the U.S. Environmental Protection Agency (USEPA) (1979a, 1979b).

Bottom-material samples were collected using Teflon-lined bottom samplers. All bottom-material samples analyzed consisted of composites of at least five subsamples: three subsamples collected across the channel (left bank, midchannel, and right bank), one subsample collected at midchannel one channel-width upstream, and one collected at midchannel one channel-width downstream.

Samples collected for analysis of coliform bacteria were collected in sterilized glass bottles and processed within 4 h of collection. The samples were analyzed using the membrane-filter method described by Britton and Greeson (1988). Separate tests were conducted to detect the presence of selected enteric pathogenic bacteria.

[1] Use of trade, product, industry, or firm names in this report is for identification or location purposes only, and does not constitute endorsement of products by the U.S. Geological Survey.

Table 1. Sites sampled and constituents analyzed in water and bottom material, September 19-21, 1989
[Sites 1, 6, 7, 8, 12, and 13 were sampled and monitored hourly for water temperature, pH, dissolved oxygen, and specific conductance, September 15-27, 1989. Sites 1, 2, 3, 5, 6, 7, 8, 10, and 12 were re-sampled for triazine herbicides and propanil, molinate, and thiobencarb in water May 16-17, 1990]

Site number and name	Constituents analyzed in water: Inorganics	Nutrients	Trace elements	Volatile organic compounds	Acid-base/neutral organic compounds	Polychlorinated biphenyl compounds	Phenols	Insecticides	Herbicides	Constituents analyzed in bottom material: Nutrients	Trace elements	Acid-base/neutral organic compounds	Polychlorinated biphenyl compounds	Insecticides
1 Bayou Queue de Tortue at Highway 13	x	x	x			x	x	x	x	x	x		x	x
2 Bayou Plaquemine at Highway 370	x	x	x			x	x	x	x	x	x		x	x
3 Bayou des Cannes at Highway 190 near Eunice	x	x	x			x	x	x	x	x	x		x	x
4 Bayou des Cannes at Highway 368 southeast of Basile	x	x	x	x	x	x	x	x	x	x		x	x	x
5 Bayou Nezpique at Highway 104	x	x	x			x	x	x	x	x	x		x	x
6 Bayou Plaquemine 2 miles above mouth	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7 Bayou des Cannes 1 mile above mouth	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8 Bayou Nezpique 2 miles above mouth	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9 Mermentau River at Mermentau	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10 Mermentau River at Lake Arthur	x	x	x			x	x	x	x	x	x	x	x	x
11 Grand Lake south of Lowry	x	x	x	x	x	x	x	x	x	x	x	x	x	x
12 Bayou Lacassine near Lake Arthur	x	x	x			x	x	x	x	x	x		x	x
13 Mermentau River at Grand Chenier	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Criteria and Standards for Constituents Analyzed

The water-quality criteria for selected constituents cited in this report (table 2) have been established for various categories of water use by the USEPA (1986) and the DEQ (1990b). In general, criteria have not yet been established for constituents in bottom material.

The following criteria for DO concentrations represent minimum standards established by DEQ (1990b) for the type of water specified:

1. Freshwater--For a diversified population of warmwater biota including sport fish, the DO concentrations shall be at or above 5 mg/L.

2. Estuarine waters--Concentrations of DO in estuarine waters shall not be less than 4 mg/L at any time.

The term "estuary" is defined, for the purposes of this report, as a drowned river valley in the coastal plain whose upper limit corresponds to the upper limit of tidal influence (Caspers, 1967). Using this definition, the Mermentau River basin south of Interstate Highway 10 is considered an estuary.

Standards for fecal-coliform bacteria concentrations in water in Louisiana, established by the DEQ (1984), are as follows:

1. Primary contact recreation--Based on a minimum of not less than five samples collected over not more than a 30-day period, the fecal-coliform content shall not exceed a log mean of 200 cols/100 mL, nor shall more than 10 percent of the total samples during any 30-day period exceed 400 cols/100 mL

2. Secondary contact recreation--Based on a minimum of not less than five samples collected over not more than a 30-day period, the fecal-coliform content shall not exceed a log mean of 1,000 cols/100 mL, nor shall more than 10 percent of the total samples during any 30-day period equal or exceed 2,000 cols/100 mL.

3. Public water supply--The monthly arithmetic mean of total coliform shall not exceed 10,000 cols/100 mL, nor shall the monthly arithmetic mean of fecal coliform exceed 2,000 cols/100 mL.

Table 2. Water-quality criteria for selected trace elements and synthetic organic compounds
[Concentrations in micrograms per liter; NE, no established criteria; source: U.S. Environmental Protection Agency, 1986]

Constituent	Chronic lowest observed effect level - freshwater aquatic organisms[1]	Chronic lowest observed effect level - saltwater aquatic organisms	Maximum contaminant level (MCL) for domestic water supply
Trace elements[2]			
Arsenic	190	36	50
Barium	NE	NE	1,000
Cadmium[3]	1.1	9.3	10
Chromium (hexavalent)	11	50	170
(trivalent)	210	NE	50
Cobalt	NE	NE	NE
Copper[3]	12	NE	1,000
Iron	1,000	NE	300
Lead[3]	3.2	5.6	50
Manganese	NE	NE	50
Mercury	.012	.025	2
Nickel[3]	96	7.1	NE
Selenium	35	54	10
Silver	4.1	2.3	50
Zinc	320	170	NE
Synthetic organic compounds[4]			
Atrazine	NE	NE	[5]2.0
2,4-D	NE	NE	[5]70.0
Propanil	NE	NE	NE
Molinate	NE	NE	NE
Thiobencarb	NE	NE	NE
Diazinon	NE	NE	NE
Parathion	0.013	NE	NE

[1] Chronic lowest observed effect level refers to 96-hour toxicity tests on a wide variety of aquatic organisms.
[2] Criteria are not established for some trace elements because toxicities are low.
[3] Toxicity is hardness-dependent. The indicated criterion assumes a hardness (as calcium carbonate) of 100 milligrams per liter.
[4] Criteria for synthetic organic compounds usually are not established due to insufficient information, not necessarily lack of toxicity.
[5] Proposed.

Acknowledgments

The author extends his appreciation to Mr. Zahir "Bo" Bolourchi of the Louisiana Department of Transportation and Development, and Mr. Dearl Sanders of the Louisiana State University Cooperative Extension Service for guidance and assistance provided during this study.

WATER QUALITY

Streamflow and Suspended Sediment

Instantaneous discharge at sites 1, 2, 6, and 13 measured during September 19-21, 1989, and computed daily mean discharges at long-term USGS streamflow stations at sites 3, 9, 10, and 12 for the dates of sample collection are shown in figure 3. The computed daily mean discharge from a USGS streamflow site (Bayou Nezpique near Basile) about 5 mi downstream from site 5 also is shown in figure 3 (Arcement and others, 1989). Computed discharges were determined from instantaneous river stages (gage heights) and stage-discharge relations.

Measurements of stream velocities indicated that flow was sluggish and occasionally was in an upstream direction at some sites. Measured streamflow velocities at sites 1, 2, and 6 never exceeded 0.33 ft/s. Velocities at site 13 were tidally affected and during an outgoing tide, were as high as 2.14 ft/s, but the flow at this site was upstream during an incoming tide. The upstream flows at sites 9, 10, and 12 (indicated by negative values in fig. 3) may have been caused by tidal effects or local withdrawal of water for irrigation.

Suspended-sediment samples were collected at sites 1, 2, 3, and 5. The total sediment concentrations ranged from 30 to 68 mg/L. The suspended sediment consisted almost entirely of fine silt and clays, because the stream velocities were insufficient to suspend sand. The near-stagnant conditions at the sites downstream from the headwaters could suspend only colloidal sediment particles, and visual inspection indicated that the greenish turbidity was caused primarily by phytoplankton.

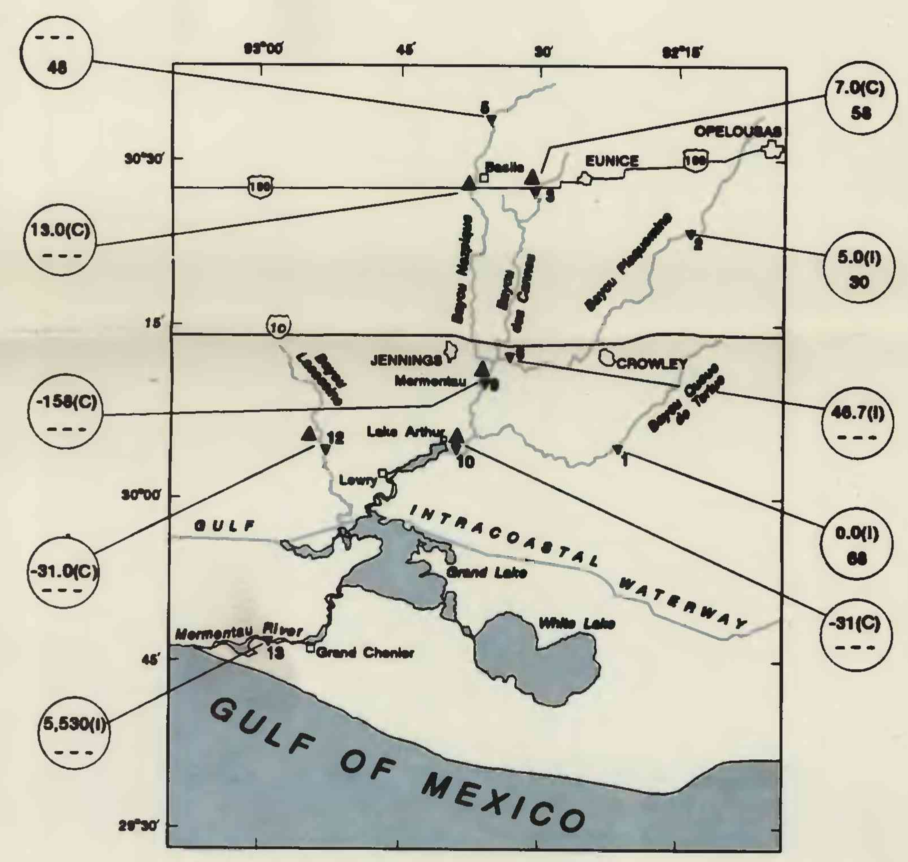


Figure 3. Distribution of discharge and suspended-sediment concentrations, September 19-21, 1989.

EXPLANATION

▲ USGS STREAMFLOW SITE (LONG TERM)

3 ▼ WATER-QUALITY SAMPLING SITE AND NUMBER (See Table 1)

5.0(I) — Discharge, in cubic feet per second (I), Instantaneous (C), Computed

30 — Total suspended sediment concentration, in milligrams per liter

--- No sample

For additional information write to:

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