UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ANALYSES OF WATER, BANK MATERIAL, AND BOTTOM MATERIAL ELUTRIATE SAMPLES COLLECTED NEAR MORGAN CITY, MISSISSIPPI (UPPER YAZOO PROJECTS)

by Gene A. Bednar and Paul E. Grantham

Open-File Report 80-580

Prepared in cooperation with the
U.S. Army Corps of Engineers

Jackson, Mississippi
1980

UNITED STATES DEPARTMENT OF THE INTERIOR
CECIL D. ANDRUS, Secretary
GEOLOGICAL SURVEY
H. William Menard, Director

For additional information write to:

U.S. Geological Survey
Water Resources Division
Suite 710, Federal Building
100 W. Capitol Street
Jackson, MS 39201

CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION FACTORS AND DEFINITION OF TERMS

Conversion Factors

For those who prefer to use international system (SI) units rather than the inch-pound system, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound units	by	to obtain SI units
inch (in)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Fahrenheit (°F)	(F°-32)5/9	Celsius (°C)

Definition of Terms

Terms related to the analytical data given in this report are defined below:

Bottom (bed) material is the unconsolidated material of which a stream lake, pond, reservoir, or estuary bottom is composed.

Core material are soil samples collected with a drill-rig mounted hollow core barrel sampler from the bank of the Yazoo River in areas where the bank will be dredged during a proposed channel enlargement project.

Dissolved is that material in a water sample which passes through a 0.45 um (micrometers) membrane filter. Dissolved pesticides and selected organic material refers to that material which passes through a 0.50 um glass-fiber filter.

Micrograms per gram (UG/G, ug/g) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (gram) of sediment.

Micrograms per kilogram (UG/KG, ug/kg) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (kilogram) of sediment.

Micrograms per liter (UG/L, ug/l) is a unit expressing the concentration of chemical constituents in solution as mass (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Milligrams per liter (MG/L, mg/l) is a unit expressing the concentration of chemical constituents in solution. Milligrams per liter represent the mass of solute per unit volume (liter) of water.

Native water is Yazoo River water that was flowing through the study reach during the study.

Particle-size (grain-size) distribution is the frequency distribution of the relative amounts of particles in a sample that are within specified size ranges, or a cumulative frequency distribution of the relative amounts of particles coarser or finer than specified sizes. Relative amounts are expressed as percentage by mass.

Total, in core and bottom material, is the total amount of a given constituent in a representative sample. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined.

Total, in native water, is the amount of a given constituent that is in solution after a representative water-suspended sediment sample has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolution of all particulate matter is not achieved by the digestion treatment, and thus the determination may represent something less than the "total" amount (that is, less than 95 percent) of the constituent present in the dissolved and suspended phases of the sample.

NOTE:

The terms micrograms per gram, milligrams per liter, and milligrams per kilogram are essentially equivalent to the unit "parts per million"; the terms micrograms per kilogram and micrograms per liter are essentially equivalent to the unit "parts per billion."

ANALYSES OF WATER, DREDGE MATERIAL, AND ELUTRIATE SAMPLES COLLECTED NEAR MORGAN CITY, MISSISSIPPI (UPPER YAZOO PROJECTS)

by Gene A. Bednar and Paul E. Grantham

ABSTRACT

The U.S. Geological Survey in cooperation with the U.S. Army Corps of Engineers conducted an elutriate study during December 3-6, 1979. The study was conducted along an 18.8-mile reach of the Yazoo River near Morgan City, Mississippi, for the purpose of assessing possible environmental effects of proposed channel-enlargement projects.

Ten elutriate test samples were prepared and were analyzed in conjunction with an appropriate core material or bottom-material sample. The methods of sample collection, procedures for elutriate sample preparation, and analyses are presented. The results of laboratory analyses for major constituents, selected metals, pesticides, organic compounds, and physical properties of these samples are given without interpretation.

INTRODUCTION

The U.S. Geological Survey in cooperation with the U.S. Army Corps of Engineers, Vicksburg District, conducted an elutriate study along an 18.8-mile reach of the Yazoo River near Morgan City, Mississippi. This was the third elutriate study conducted along the Yazoo River. The two previous studies were conducted downstream of the study area in December 1977 and June 1979. Data collected during the first study were published in the report entitled "Analyses of water, core material, and elutriate samples collected near Yazoo City, Mississippi (Yazoo Headwater Project)" by Leone and Dupuy, 1978. The report for the second study is in preparation. The data presented in this report were collected during December 3-6, 1979, at 8 sites in the study area extending from river mile 133.6 to river mile 152.4. The sampling sites were selected by the U.S. Army Corps of Engineers at locations that would provide representative data relevant to the study. This study was intended to provide data on some of the possible influences that dredging might have on the water quality in the study area. No attempt is made to evaluate these influences as either beneficial or detrimental.

The purpose of this report is to describe the field and laboratory procedures and to present the analytical results. The procedure for the standard elutriate test was developed by the Corps of Engineers, and the guidelines for its use were mutually agreed upon by the Corps and the U.S. Environmental Protection Agency. Keeley and Engler (1974) briefly describe the procedure as follows: "The standard elutriate is the

supernatant resulting from the vigorous 30-minute mixing of 1 part bottom sediment with 4 parts water from the proposed disposal site followed by 1 hour of letting the mixture settle and appropriate filtration or centrifugation."

The basic procedure described above was followed with some modifications. First, core or bottom material samples taken along a reach of a proposed bank cut were used instead of actual dredged material. Second, the procedure states that analyses will be completed using a filtered mixture of (1) the water at the proposed disposal site, and (2) the material proposed for the dredging. In this study, both unfiltered and filtered mixtures were used in the various analyses, which are described by Wells and Gogel (1975).

FIELD PROCEDURE

The U.S. Army Corps of Engineers, with the assistance of the U.S. Geological Survey, collected samples at sites shown in figure 1. The eight sampling sites were selected to provide data representative of the Yazoo River water (native water), the bottom material in the river channel, and the bank material that will be excavated along the Yazoo River. The location and description of the sampling sites are given in table 1.

A native-water sample for the preparation of the standard elutriate was collected at each site. Native-water samples representing the quality-of-water in the study reach during the study were collected at all sites, except site 18. Bottom-material samples were collected using a teflon-coated pipe-dredge sampler at sites 13 and 18 and core-material samples were collected at all sites except sites 13 and 18. The bank core samples are representative of the proposed bank cut (excavation) at a specific site. Shallow bank core samples also were taken in proximity to the deeper core at sites 11 and 12. These shallow core samples were collected at sites 11A and 12A to gain information concerning the distribution, physical properties, and concentration of selected constituents in the first 3 feet (0.9 m) of the bank cores.

The core material was sampled with a split-spoon sampler on a truck mounted Failing drilling rig. Core samples were collected top bank at proposed dredge sites. The metal split-spoon sampler contained a removable plastic cylinder 1.25 x 18.5 in. (32 x 470 mm). The shoe of the sampler was teflon-coated to prevent the core material entering the sampler from contacting any metal. The core material was forced into the shoe and up into the plastic tube by hydraulic press action. After each 18-inch (460 mm) sample was taken, the drill stem and split-spoon assembly was drawn out of the hole, and the shoe was disconnected from the sampler to facilitate removal of the plastic tube containing the core. The core material was pushed from the plastic tube using a teflon-tipped rod and placed in a large plastic container. The deeper core samples were composites of 18-inch (460 mm) increments ranging in depth from 34-½ to 39 ft (10-½ to 12 m). The depths cored at respective sampling sites are given in table 1. The core material segments were collected in a clean, acetone-rinsed, 5-gallon plastic container, sealed, and transported to a U.S. Geological Survey mobile laboratory,

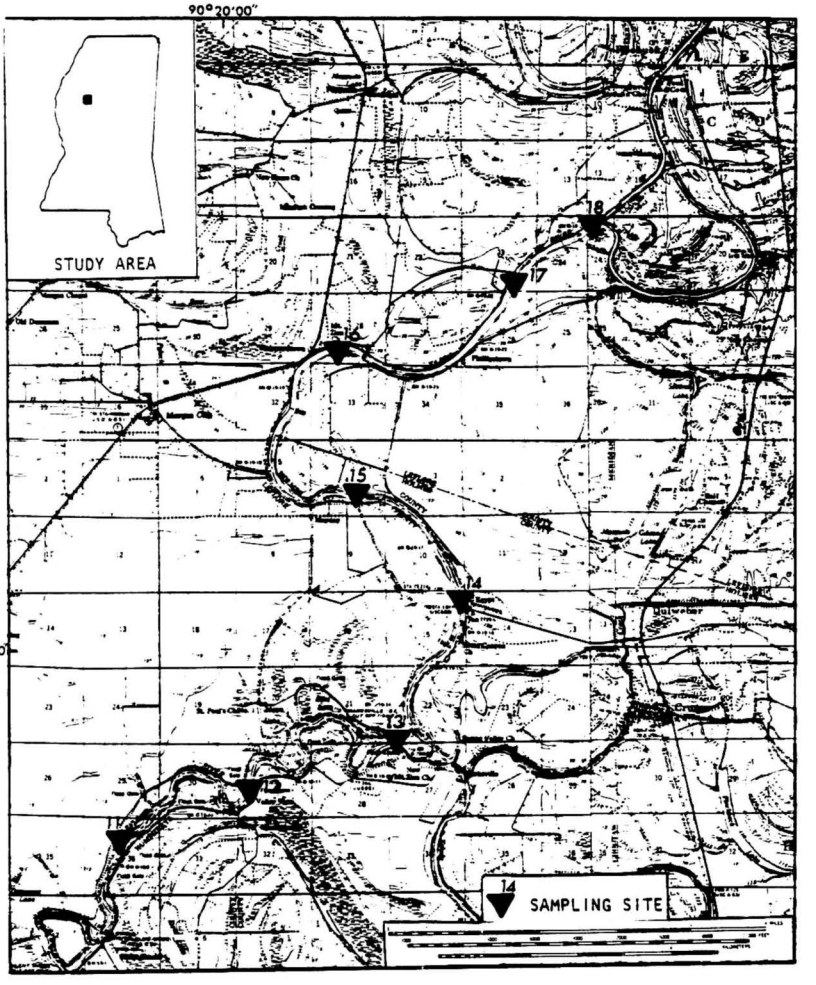

FIGURE 1.--LOCATION OF WATER-QUALITY AND CORE MATERIAL SAMPLING SITES ON YAZOO RIVER NEAR MORGAN CITY, MISSISSIPPI.

Table 1.--Location and description of sampling sites

Site number	River Mile	Latitude	Longitude	Native Water	Core and Bottom material	
					Depth (ft)	Site Description
11	133.6	33°17'47"	090°21'26"	Near left bank	34.5	Left bank adjacent to cotton field
11A	133.6	33°17'47"	090°21'26"	---	3.0	Left bank adjacent to cotton field, near site 11
12	136.2	33°18'24"	090°19'43"	Near right bank	39.0	Right bank at drainage depression from cotton field
12A	136.2	33°18'24"	090°19'43"	---	3.0	Right bank at drainage depression from cotton field, near site 12
13	140.3	33°18'54"	090°17'44"	Near right bank	--	Midstream opposite upper end of Tchula Lake
14	143.0	33°20'59"	090°16'59"	Near right bank	39.0	Right bank adjacent to cotton field
15	144.6	33°21'43"	090°18'06"	Near left bank	39.0	Left bank adjacent to cotton field
16	147.9	33°23'26"	090°18'35"	Near left bank	36.0	Left bank downhill from cotton field
17 1/	149.8	33°23'48"	090°16'19"	Midstream	35.5	Right bank south of bridge in slough adjacent to cotton field
18	152.4	33°24'54"	090°14'52"	Near right bank	--	Midstream at mouth of Fish Lake

1/ U.S. Geological Survey National stream-quality accounting network station (No. 07287120) and Environmental Protection Agency National pesticide monitoring site.

located near the study area, for sample preparation. Samples not prepared on the day of collection were chilled and stored until the following morning.

The native water for laboratory analyses and for the elutriate mix was collected at the time of either the core or the bottom material sampling. The water samples were collected in the appropriate sample container for a specific determination and transported to the mobile laboratory.

Sample collection, treatment, and preservation was in accordance with approved U.S. Geological Survey procedures and recommendations by the National Handbook of Recommended Methods for Water-Data Acquisitions, U.S. Geological Survey, (1977). The samples requiring laboratory analyses were packed in ice and shipped by bus to the appropriate U.S. Geological Survey Laboratory.

SAMPLE PREPARATION

The core or bottom-material sample collected at respective sites were placed in a 20-quart teflon-lined mixing bowl and shells and large debris were removed. The sample was then slowly mixed using a Hobart-300 [1/] mixer and Hobart teflon-coated "B" beater until the material was homogeneous (about 15 minutes). Subsamples of the well-mixed samples were taken in the appropriate sample containers for particle-size determinations and laboratory analyses. A 500-milliliter subsample also was taken for preparation of the insecticide, herbicide, and selected organic compounds elutriate. The results of particle-size analyses are presented in figures 2-7. The results of laboratory analyses of core or bottom-material samples are given in tables 2-6. The volume of the remaining mixture was then adjusted to about 2 liters. The native water (8 liters) collected at the sampling site was added to the subsample. The ratio of 4 volumes of native water to one volume of solids was used because in actual dredging operations the dredged material consists of approximately 80 percent water and 20 percent solids (Keeley and Engler, 1974, p. 3).

The native water and solids were mixed for 30 minutes. The mixture was then allowed to settle for one hour. The settling rate was slow - much of the particulate material remained in suspension after one hour. Unfiltered samples were withdrawn from the supernatant for analysis of selected minor elements, nutrients, chemical oxygen demand, and oil and grease. An additional sample was withdrawn from the supernatant, filtered through a membrane filter (pore size, 0.45 micrometer), for analysis of selected dissolved minor elements.

The preparation of samples prior to analysis of acid-soluble metals in either unfiltered native-water samples or core and bottom material requires that the metals be desorbed and dissolved from the particulate matter. Metals are removed from the particulate matter in the

---

1/ The use of the brand name in this report is for identification purposes only and does not imply endorsement by the U.S. Geological Survey.

laboratory by digesting the sample in a hot, dilute solution of hydrochloric acid. The analysis of metals associated with the core material and bottom material also requires preliminary destruction and removal of organic matter, followed by acid digestion. The removal or destruction of the organic matter is accomplished by a strong oxidizing agent which has minimal effect on the mineral composition of the particulate matter (Skougstad and others, 1979).

To prepare the elutriate sample for analysis of insecticides, herbicides, and selected organic compounds, the well-mixed core material or bottom-material subsample (500 milliliters) was transferred to a 4-liter glass beaker. Two liters of native water, collected in glass bottles at the respective sampling sites, were added to the subsample. The mixture was placed on a magnetic stirrer and mixed for 30 minutes. The mixture was covered and allowed to stand for one hour. The supernatant was then filtered through an organic-free 0.50 um glass-fiber filter and transferred to glass sample bottles for laboratory analyses. The results of pesticide and organic compound analyses are presented in tables 3 and 4.

LABORATORY METHODS

Laboratory analyses were performed by the U.S. Geological Survey National Water-Quality Laboratories in Atlanta, Ga., and Denver, Co. The particle-size analyses were performed by the U.S. Geological Sediment Laboratory in Baton Rouge, La., using a hydrometer method requested by the U.S. Army, Corps of Engineers. The U.S. Geological Survey laboratory analyses were performed as follows:

1. Native water, elutriate, core material, and bottom- material samples were analyzed for total and dissolved minor elements, nitrogen compounds, physical properties, cyanide, chemical oxygen demand, and the commonly occuring elements using methods outlined by Skougstad and others(1979).

2. Native water, elutriate, core material, and bottom material samples were analyzed for phenols, pesticides, and other organic compounds using methods outlined by Goerlitz and Brown (1972).

3. Native water samples were analyzed for chlorophyl A and B using the methods outlined by Greeson (1979)

4. Native water, core material, and bottom material were analyzed for oil and grease using the method outlined in U.S. Environmental Protection Agency, Methods for Chemical Analyses of Water and Wastes (1979).

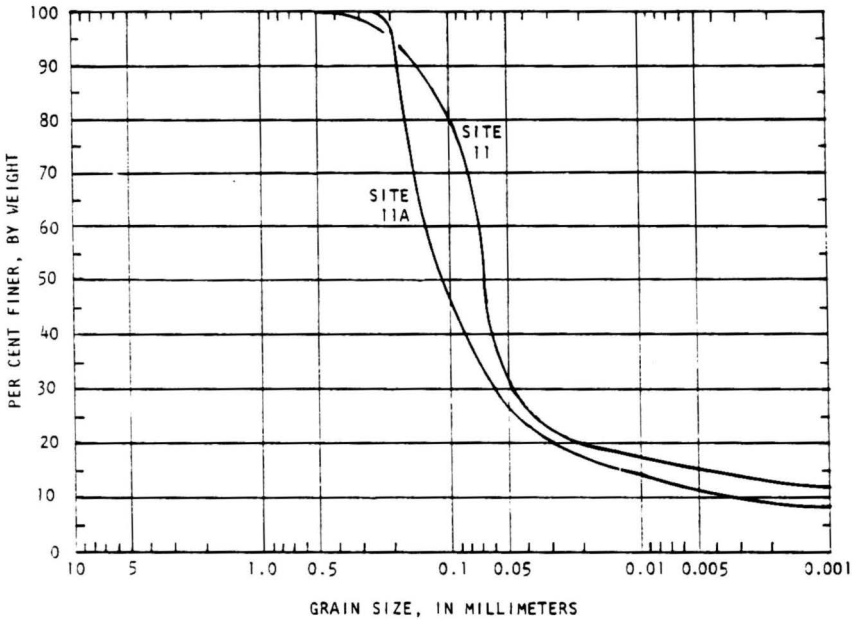

FIGURE 2.--PARTICLE-SIZE DISTRIBUTION OF CORE MATERIAL COLLECTED AT SITES 11 AND 11A ON YAZOO RIVER NEAR MORGAN CITY, MISSISSIPPI.

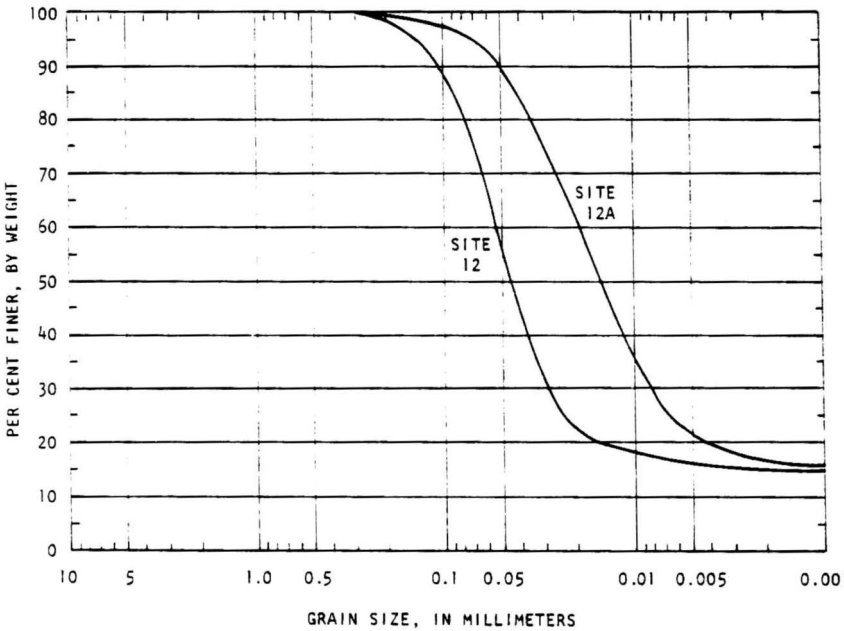

FIGURE 3.--PARTICLE-SIZE DISTRIBUTION OF CORE MATERIAL COLLECTED AT SITES 12 AND 12A ON YAZOO RIVER NEAR MORGAN CITY, MISSISSIPPI.

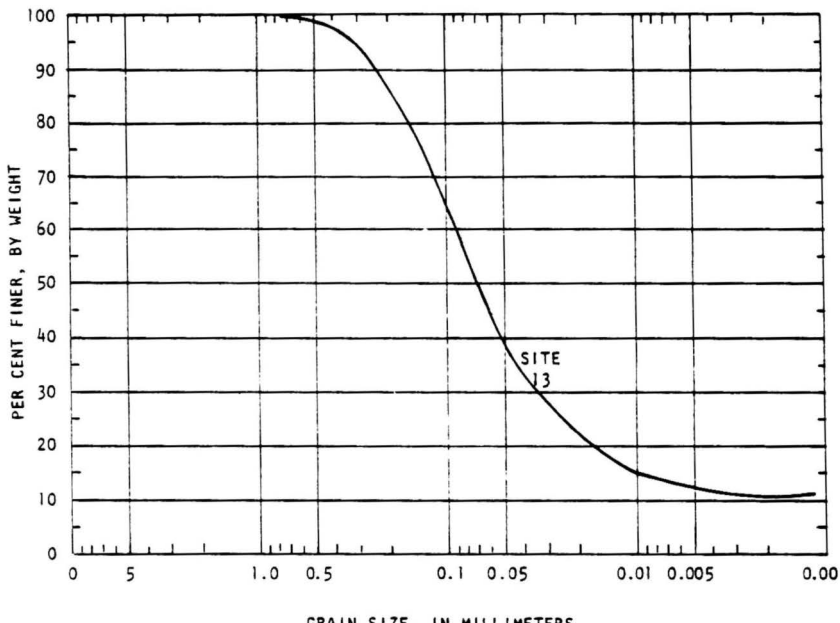

FIGURE 4.--PARTICLE-SIZE DISTRIBUTION OF BOTTOM MATERIAL COLLECTED AT SITE 13 ON YAZOO RIVER NEAR MORGAN CITY, MISSISSIPPI.

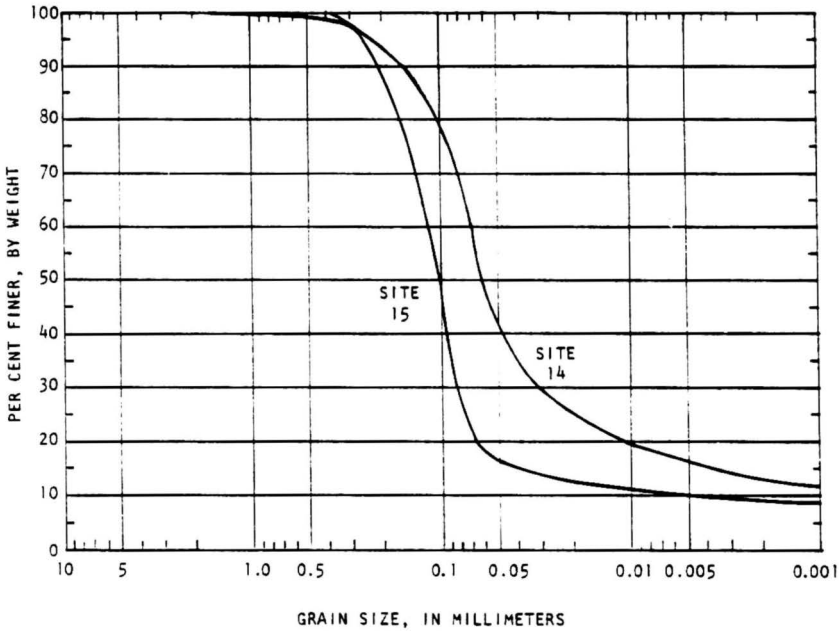

FIGURE 5.--PARTICLE-SIZE DISTRIBUTION OF CORE MATERIAL COLLECTED AT SITES 14 AND 15 ON YAZOO RIVER NEAR MORGAN CITY, MISSISSIPPI.

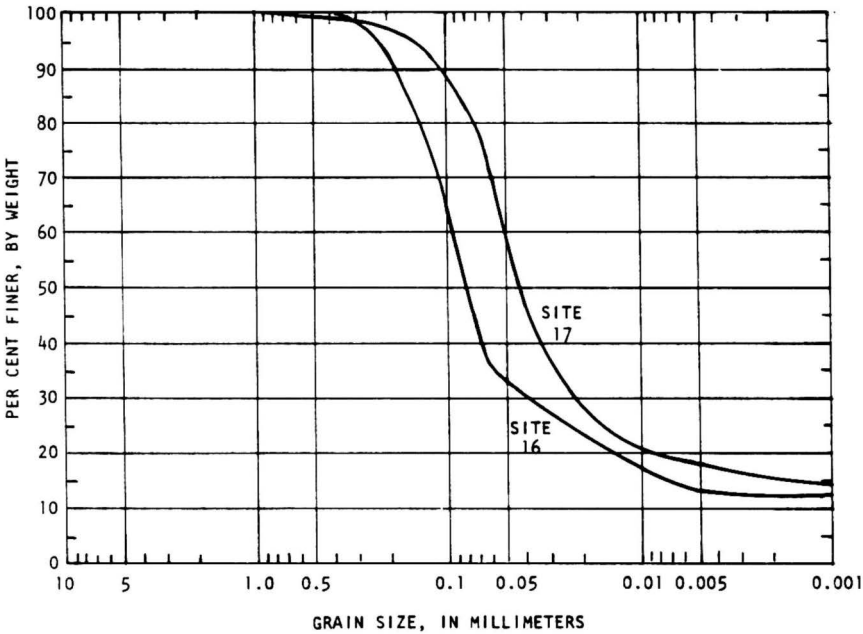

FIGURE 6.--PARTICLE-SIZE DISTRIBUTION OF CORE MATERIAL COLLECTED AT SITES 16 AND 17 NEAR MORGAN CITY, MISSISSIPPI.

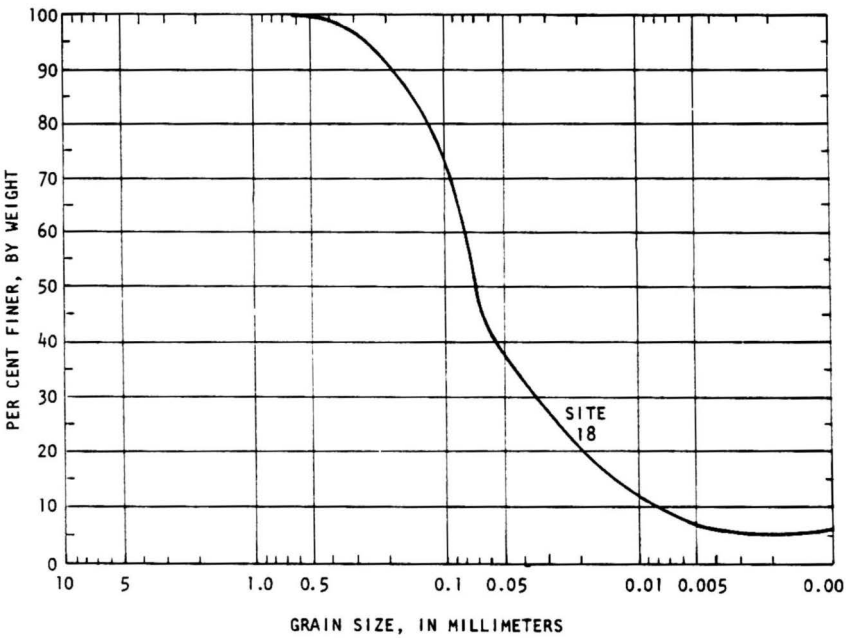

FIGURE 7.--PARTICLE-SIZE DISTRIBUTION OF BOTTOM MATERIAL COLLECTED AT SITE 18 ON YAZOO RIVER NEAR MORGAN CITY, MISSISSIPPI.

RESULTS

The results of field and laboratory analyses are given in the tables at the back of the report. The results of analyses for selected chemical constituents (total and dissolved), and physical properties of core material, bottom material, and elutriate samples are given in tables 2-6. The tables are arranged by site and sample type to facilitate comparison of analytical data for a standard elutriate test with the appropriate native water and core or bottom-material sample. The results of analyses of samples of native water in the Yazoo River during the study are given in tables 7 and 8.

SELECTED REFERENCES

Goerlitz, D. F., and Brown, Eugene, 1972, Methods for analysis of organic substances in water: U.S. Geological Survey Techniques Water-Resources Investigations, Book 5, Chapter A3, 40 p.

Greeson, P. E., 1979, A supplement to - Methods for collection and analyses of aquatic and microbiological samples: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A4, Open-File Report 79-1279, p. 44-51.

Keeley, J. W., and Engler, R. M., 1974, Discussion of regulatory criteria for ocean disposal of dredged materials: Elutriate test rationale and implementation guidelines: U.S. Army Corps of Engineers, Waterways Experiment Station, Office of Dredged Material Research, Vicksburg, Mississippi., Miscellaneous Paper D-74-14, 13 p.

Leone, H. L., Jr., and Dupuy, A. J., 1978, Analyses of water, core material, and elutriate samples collected near Yazoo City, Mississippi (Yazoo Headwater Project): Baton Rouge, Louisiana, U.S. Geological Survey Open-File Report 78-792, 10 p.

Skougstad, M. J., and others, 1979, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Chapter A1, Book 5, 626 p.

U.S. Environmental Protection Agency, 1979, Methods for chemical analysis of water and waste: Washington, U.S. Environmental Protection Agency, Office of Research and Development, p. 413.1-1 - 413.1-3.

_____1975, Navigable waters: Discharge of dredged or fill material: Federal Register, September 5, 1975, v.40, no. 173, pt. 230, p. 41292-41298.

U.S. Geological Survey, Office of Water Data Coordination, 1977, National Handbook of Recommended Methods for Water Data Acquisition: Interagency Advisory Committee on Water-Data, p. 5-1 - 5-186.

Wells, F. C., and Gogel, A. J., 1975, Analyses of selected constituents in native water and soil in the Bayou Boeuf-Chene-Black area near Morgan City, Louisiana, including a modified standard elutriate test: Baton Rouge, Louisiana, U.S. Geological Survey Open-File Report 75-176, 23 p.

HYDROLOGIC DATA

Table 2.--Minor element analyses of core and bottom material, native water, and elutriate samples

Sample Type	Site number	Arsenic (As)	Beryllium (Be)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Nickle (Ni)	Selenium (Se)	Vanadium (V)	Zinc (Zn)
						Micrograms per gram							
Core material	11	1	1	0.18	<10	8	10	500	0.00	20	0.0	--	40
	12	0	3	0.15	13	10	14	420	0.00	14	0.0	--	60
	14	0	3	0.31	11	9	13	540	0.00	13	0.0	--	70
	15	0	3	0.15	10	8	13	460	0.00	13	0.0	--	40
	16	0	6	0.15	14	17	28	840	0.00	28	0.0	--	60
	17	0	3	0.15	12	10	17	620	0.00	17	0.0	--	40
Shallow core material	11A	1	1	0.17	<10	7	10	460	0.00	10	0.0	--	30
	12A	0	2	0.28	11	9	12	540	0.00	12	0.0	--	30
Bottom material	13	0	3	0.11	12	7	15	470	0.00	15	0.0	--	30
	18	0	3	0.09	13	6	13	480	0.00	0	0.0	--	20
						Micrograms per liter							
Native water (dissolved)	11	1	0	0	10	4	0	30	<0.1	1	0	0	20
	12	0	0	1	10	4	0	30	<0.1	2	0	0	8
	13	1	0	4	10	4	0	20	<0.1	0	0	0	10
	14	1	0	4	10	4	0	30	<0.1	0	0	0	8
	15	1	0	3	10	5	0	20	<0.1	0	0	0	0
	16	1	0	4	10	5	0	10	<0.1	0	0	0	0
	17	1	0	0	20	3	0	40	<0.1	1	0	0	0
Native water (total)	11	2	0	0	20	4	2	140	<0.1	4	0	--	20
	12	2	10	0	20	4	4	120	0.2	7	0	--	20
	13	2	10	0	20	7	3	160	0.2	8	0	--	20
	14	2	10	0	20	5	5	130	0.1	7	0	--	20
	15	2	10	0	20	5	4	120	0.3	8	0	--	10
	16	2	10	0	20	4	3	120	0.2	7	0	--	10
	17	2	10	0	30	5	10	220	0.1	9	0	--	20
Elutriate (core material)	11	0	0	2	10	3	0	50	<0.1	2	0	0	450
	12	1	0	4	10	1	0	10	<0.1	1	0	0	4
	14	1	0	1	10	2	0	400	<0.1	1	0	0	40
	15	0	0	3	20	2	0	60	<0.1	1	0	0	10
	16	3	2	1	10	1	0	610	<0.1	1	0	0	320
	17	1	0	5	10	2	0	370	<0.1	1	0	0	20
Elutriate (shallow core)	11A	0	0	2	20	5	0	30	0.2	3	0	0	60
	12A	0	0	6	20	7	0	40	<0.1	2	0	0	7
Elutriate (bottom material)	13	1	1	1	<10	5	0	2	<0.1	0	0	0	260
	18	3	0	5	<10	2	0	1,200	0.2	1	0	0	20

Table 3.--Insecticide analyses of core and bottom material, native water, and elutriate samples

Sample type	Site number	Aldrin	Chlordane	DDD	DDE	DDT	Diazinon	Dieldrin	Endosulfan	Endrin	Ethyl parathion	Ethyl trithion	Ethion	Heptachlor epoxide	Methachlor	Lindane	Malathion	Methyl parathion	Methyl trithion	Mirex	Methoxychlor	Perthane	Toxaphene
		Micrograms per Kilogram																					
Core material	11	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	12	0.0	0	0.3	0.1	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	14	0.0	0	2.7	2.1	5.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	15	0.0	0	2.2	2.1	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	16	0.0	0	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	17	0.0	0	1.5	2.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Shallow core material	11A	0.0	0	8.2	12	9.9	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	12A	0.0	0	59	71	74	0.0	0.6	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Bottom material	13	0.0	0	7.2	5.1	15	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	18	0.0	5	13	7.8	8.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
		Micrograms per liter																					
Native water (dissolved)	11	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	12	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	13	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	14	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	15	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	16	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	17	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
Native water (total)	11	0.000	0.0	0.002	0.000	0.003	0.04	0.003	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	12	0.000	0.0	0.000	0.000	0.002	0.00	0.001	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	13	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	14	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	15	0.000	0.0	0.002	0.000	0.004	0.00	0.002	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	16	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	17	0.000	0.0	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
Elutriate (core material)	11	0.000	0.0	0.007	0.000	0.005	0.27	0.027	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	12	0.000	0.0	0.000	0.000	0.000	0.02	0.002	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	14	0.000	0.0	0.011	0.000	0.009	0.16	0.021	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	15	0.000	0.0	0.028	0.000	0.240	0.05	0.073	0.000	0.023	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	16	0.000	0.0	0.000	0.000	0.000	0.08	0.006	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	17	0.000	0.0	0.010	0.000	0.012	0.04	0.019	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
Elutriate (Shallow core)	11A	0.000	0.0	0.046	0.000	0.031	0.08	0.128	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	12A	0.000	0.0	0.204	0.000	0.230	0.20	0.258	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.5
Elutriate (Bottom material)	13	0.000	0.0	0.000	0.000	0.000	0.11	0.007	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0
	18	0.000	0.0	0.000	0.000	0.000	0.05	0.005	0.000	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.0

Table 4.--Herbicide and organic compound analyses of core and bottom material, native water, and elutriate samples

Sample Type	Site number	Silvex	2, 4-D	2, 4-DP	2, 4, 5-T	PCB	PCN	Phenols
		Micrograms per kilogram						
Core material	11	--	--	--	--	1	0	--
	12	--	--	--	--	1	0	--
	14	--	--	--	--	0	0	--
	15	--	--	--	--	0	0	--
	16	--	--	--	--	0	0	--
	17	--	--	--	--	0	0	--
Shallow core material	11A	--	--	--	--	1	0	--
	12A	--	--	--	--	2	0	--
Bottom material	13	--	--	--	--	3	0	--
	18	--	--	--	--	2	0	--
		Micrograms per liter						
Native water (dissolved)	11	0.00	0.03	0.00	0.01	0.0	0.0	--
	12	0.00	0.03	0.00	0.01	0.0	0.0	--
	13	0.00	0.03	0.00	0.01	0.0	0.0	--
	14	0.00	0.03	0.00	0.01	0.0	0.0	--
	15	0.00	0.03	0.00	0.01	0.0	0.0	--
	16	0.00	0.03	0.00	0.01	0.0	0.0	--
	17	0.00	0.03	0.00	0.01	0.0	0.0	--
Native water (total)	11	0.00	0.03	0.00	0.01	0.0	0.0	3
	12	0.00	0.03	0.00	0.01	0.0	0.0	2
	13	0.00	0.03	0.00	0.01	0.0	0.0	0
	14	0.00	0.03	0.00	0.01	0.0	0.0	0
	15	0.00	0.03	0.00	0.01	0.0	0.0	0
	16	0.00	0.03	0.00	0.01	0.0	0.0	1
	17	0.00	0.03	0.00	0.01	0.0	0.0	1
Elutriate (core material)	11	0.00	0.00	0.00	0.00	0.0	0.0	0
	12	0.00	0.03	0.00	0.01	0.0	0.0	1
	14	0.00	0.01	0.00	0.00	0.0	0.0	1
	15	0.00	0.01	0.00	0.00	0.0	0.0	0
	16	0.00	0.02	0.00	0.00	0.0	0.0	1
	17	0.00	0.00	0.00	0.00	0.0	0.0	0
Elutriate (shallow core)	11A	0.00	0.02	0.00	0.01	0.0	0.0	1
	12A	0.00	0.00	0.00	0.00	0.0	0.0	0
Elutriate (bottom material)	13	0.00	0.02	0.00	0.01	0.0	0.0	0
	18	0.00	0.03	0.00	0.01	0.0	0.0	0

Table 5.--Chemical oxygen demand, nitrogen compounds, oil and grease, and cyanide analyses of core and bottom material, native water, and elutriate samples

Sample type	Site number	Chemical oxygen demand	Nitrogen, ammonia, total as N	Nitrogen, ammonia, dissolved as N	Nitrogen, total organic as N	Nitrogen, dissolved organic as N	Nitrogen, total kjeldahl as N	Nitrogen dissolved kjeldahl as N	Oil and grease	Cyanide (CN), total	Cyanide (CN), dissolved
		Milligrams per kilogram								Micrograms per gram	
Core material	I1	9,500	5	--	--	--	2,200	--	0	0	--
	I2	10,000	14	--	--	--	2,100	--	0	0	--
	I4	6,400	14	--	--	--	1,500	--	0	0	--
	I5	7,200	4.7	--	--	--	1,600	--	0	0	--
	I6	22,000	46	--	--	--	5,200	--	0	3	--
	I7	11,000	8.6	--	--	--	1,900	--	0	0	--
Shallow core material	I1A	11,000	6.4	--	--	--	2,600	--	0	0	--
	I2A	12,000	6.3	--	--	--	2,500	--	0	0	--
Bottom material	I3	8,900	15	--	--	--	3,000	--	0	0	--
	I8	9,400	19	--	--	--	2,000	--	0	0	--
		Milligrams per liter									
Native water	I1	17	0.05	0.06	0.43	0.40	0.48	0.46	0.0	0.00	0.00
	I2	130	0.07	0.01	0.59	0.34	0.66	0.35	0.0	0.00	0.00
	I3	27	0.07	0.04	0.51	0.33	0.58	0.37	0.0	0.00	0.00
	I4	46	0.20	0.01	0.59	0.49	0.79	0.50	0.0	0.01	0.00
	I5	31	0.08	0.00	0.41	0.36	0.49	0.36	0.0	0.01	0.00
	I6	21	0.12	0.07	0.63	0.43	0.75	0.50	0.0	0.01	0.01
	I7	28	0.08	0.04	0.53	0.23	0.61	0.27	0.0	0.00	0.00
Elutriate (core material)	I1	160	--	0.00	--	0.36	--	0.36	--	--	0.00
	I2	13	--	0.12	--	0.77	--	0.89	--	--	0.00
	I4	23	--	0.17	--	0.39	--	0.56	--	--	0.01
	I5	39	--	0.01	--	0.24	--	0.25	--	--	0.00
	I6	30	--	1.0	--	0.90	--	1.9	--	--	0.00
	I7	19	--	0.00	--	0.37	--	0.37	--	--	0.00
Elutriate (shallow core)	I1A	62	--	0.01	--	0.99	--	1.0	--	--	0.00
	I2A	120	--	0.11	--	0.87	--	0.98	--	--	0.01
Elutriate (bottom material)	I3	38	--	0.67	--	0.93	--	1.6	--	--	0.00
	I8	25	--	0.78	--	0.42	--	1.2	--	--	0.00

Table 6.--Volatile-solids analyses of core and bottom material and native water samples

Sample type	Site number	Solids, volatile on ignition, total (MG/KG)	Solids residue at 105°C, suspended (MG/L)	Solids, volatile on ignition, suspended (MG/L)	Solids, non-volatile on ignition, suspended (MG/L)
Core material	11	16,200	--	--	--
	12	19,600	--	--	--
	14	18,600	--	--	--
	15	14.900	--	--	--
	16	19,200	--	--	--
	17	20,900	--	--	--
Shallow core material	11A	18,300	--	--	--
	12A	23,000	--	--	--
Bottom material	13	17,200	--	--	--
	18	15,200	--	--	--
Native water	11	--	39	31	8
	12	--	38	30	8
	13	--	131	119	12
	14	--	59	49	10
	15	--	51	40	11
	16	--	36	27	9
	17	--	63	49	14

Table 7.--Specific conductance, pH, water temperature, and dissolved oxygen measurements of native water

Site number	Date of collection	Specific conductance (micromhos) at 25°C	pH (Units)	Temperature (°C)	Dissolved oxygen (MG/L)
11	12-6-69	57	6.8	8.5	10.5
12	12-4-79	59	6.9	9.0	10.2
13	12-5-79	58	6.9	8.0	9.6
14	12-3-79	60	6.8	9.0	10.2
15	12-5-79	58	6.7	9.5	9.8
16	12-5-79	59	7.0	--	--
17	12-4-79	59	6.9	--	--

Table 8.--Major constituents and chlorophyll analyses and physical properties of native water

Site number	Date of collection	Alkalinity as $CaCO_3$	Calcium (Ca), dissolved	Magnesium (mg), dissolved	Sodium (Na), dissolved	Potassium (K), dissolved	Chloride (Cl), dissolved	Sulfate (SO_4), dissolved	Nitrite + Nitrate ($NO_2 + NO_3$), total	Phosphorus (P), total	Phosphorus (P), dissolved	Hardness (Ca, mg), total	Hardness, Non-carbonate	Iron (fe), dissolved	Chlorophyll A	Chlorophyll B
		Milligrams per liter												Micrograms per liter		
11	12-6-79	24	4.9	1.7	2.9	2.7	3.2	6.4	0.21	0.12	0.04	19	0	160	4.22	0.000
12	12-4-79	19	5.1	1.8	2.6	2.9	3.1	6.5	0.18	0.14	0.04	20	1	190	7.60	0.000
13	12-5-79	25	4.9	1.8	3.0	2.9	3.2	6.5	0.19	0.14	0.03	20	0	150	4.05	0.000
14	12-3-79	24	5.0	1.8	3.0	2.9	3.2	6.7	0.26	0.22	0.03	20	0	230	2.83	0.000
15	12-5-79	26	4.9	1.8	2.7	2.8	3.1	6.4	0.12	0.14	0.02	20	0	250	4.87	0.000
16	12-5-79	17	5.0	1.9	2.8	3.0	3.1	6.7	0.19	0.14	0.04	20	2	--	4.50	0.000
17	12-4-79	21	5.5	2.3	3.1	2.9	3.2	6.2	0.18	0.12	0.02	23	2	--	3.00	0.000