BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTH-CENTRAL MISSISSIPPI, AUGUST 1985

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FACTORS FOR CONVERTING INCH-POUND UNITS TO
INTERNATIONAL SYSTEM (SI) UNITS

Factors for converting inch-pound units to metric units are shown below to four significant figures. In the text, metric equivalents are shown only to the number of significant figures consistent with the accuracy of analytical determinations or measurement.

Multiply	by	To obtain
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
cubic foot per second (ft^3/s)	0.0283	cubic meter per second (mi^3/s)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

INTRODUCTION

Lignite deposits occur in potentially commercial quantities in the outcrop areas of the Wilcox Group. The lignite deposits are present as tabular, discontinuous, irregularly shaped deposits overlain by unconsolidated sands, silts, and clays. Lignite seams thicker than 10 feet are exceptional and seams 4 to 7 feet are more common (Williamson, 1976, p. 1). Within the Wilcox Group outcrop area, lignite beds more than 2.5 feet and less than 250 feet deep have been observed in every county, with the exception of Webster County (Meissner and others, 1982, plate 9).

Using modern mining technology, these thick, relatively shallow lignite deposits may be profitably strip mined if economic conditions are favorable. Surface mining of lignite, however, requires the removal of large quantities of overburden and may require the disposal of large volumes of water. Overburden materials disturbed during the mining phase and sediment-laden water may enter streams, greatly increasing the sediment load and fill the stream channel. Overburden disposal in spoil banks may erode and produce a similar effect. Weathering and dissolution of newly exposed overburden materials and the large volumes of ground water that result from dewatering will impact the quality of water in streams that drain the mined area. To assess the potential impact of mining activities on local streams, it is essential that background hydrologic data be collected prior to any mining activity.

To establish background data in potential lignite mining areas, hydrologic data were collected at 15 stream sites in north-central Mississippi that were selected jointly by the Mississippi Department of Natural Resources, Bureau of Geology, and the U.S. Geological Survey. During the last 2 weeks of August 1985, water samples and bottom material samples were collected at all 15 sites and channel cross sections were defined at 13 sites.

This is the sixth and final report in a series. Data collected during 1980, 1981, 1982, 1983, and 1984 were published in open-file reports for respective years by the U.S. Geological Survey (Arthur, 1981 and 1982; Kalkhoff, 1983, 1984, and 1985). The locations of the background hydrologic data studies completed to date are shown in figure 1.

OBJECTIVE AND SCOPE

The objective of the 6-year study was to collect background data on water quality and channel characteristics in many small streams that drain potential lignite mining areas to document pre-mining conditions in areas where little information is available. This information will be an invaluable data base for future study of surface mining effects in Mississippi.

Background data on streams draining potential lignite mining areas were obtained by sampling 15 streams for this and each previous reports.

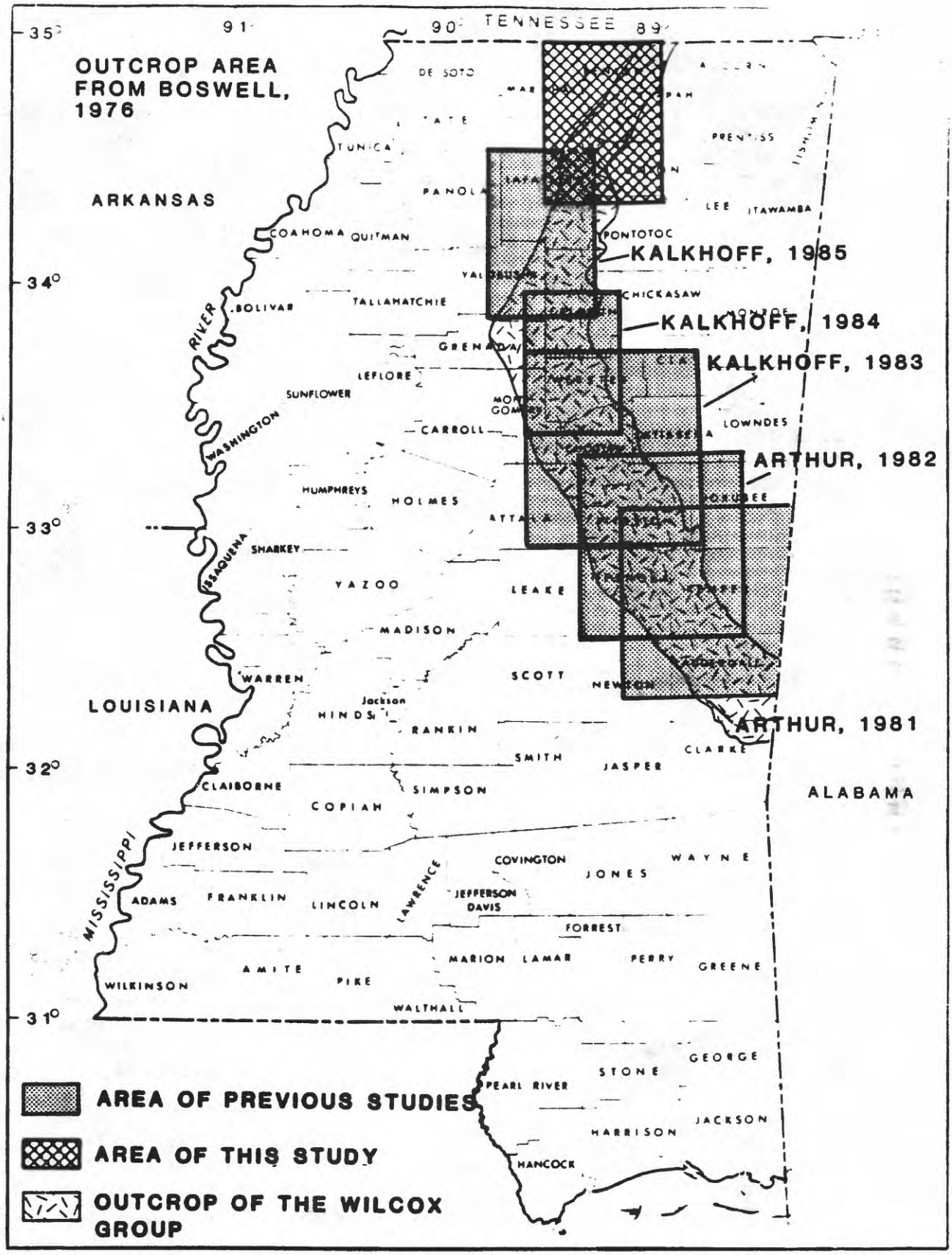

Figure 1.--Location of background hydrologic data studies in the outcrop area of the Wilcox Group.

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ABSTRACT

The U.S. Geological Survey, in cooperation with the Mississippi Department of Natural Resources, Bureau of Geology, is conducting a hydrologic data collection program in potential lignite-producing areas in the outcrops of the Wilcox Group in Mississippi. During August 1985, hydrologic data were collected at a total of 15 stream sites in Benton, Lafayette, Marshall, and Union Counties.

Main channel widths ranged from approximately 30 feet to 115 feet. Stream depths during low-flow periods were shallow, generally less than 1.0 foot at most sites. Discharges ranged from 0.04 to 74.8 cubic feet per second. The specific conductance of stream water ranged from 28 to 78 microsiemens and dissolved-solids concentrations ranged from 24 to 59 milligrams per liter. Major ion concentrations were less than 10 milligrams per liter. Turbidity values were 20 units or less. Chromium and copper concentrations in bottom material samples ranged from below detection limits (1 microgram per gram) to 5 microgram per gram and mercury concentrations ranged from 0.01 to 0.08 microgram per gram.

Water samples were collected and analyzed for selected dissolved constituents and bottom material samples were collected and analyzed for selected trace metals. Channel cross sections were delineated at each site at the time of sample collection. Hydrologic data were collected in August during a period of normally low streamflow; however, water and bottom material samples at sites 6, 7, 8, 9, and 11 were collected on August 20 and 21, 3 days after approximately 2.5 inches of rain fell in the area (National Oceanic and Atmospheric Administration, 1985, p. 7).

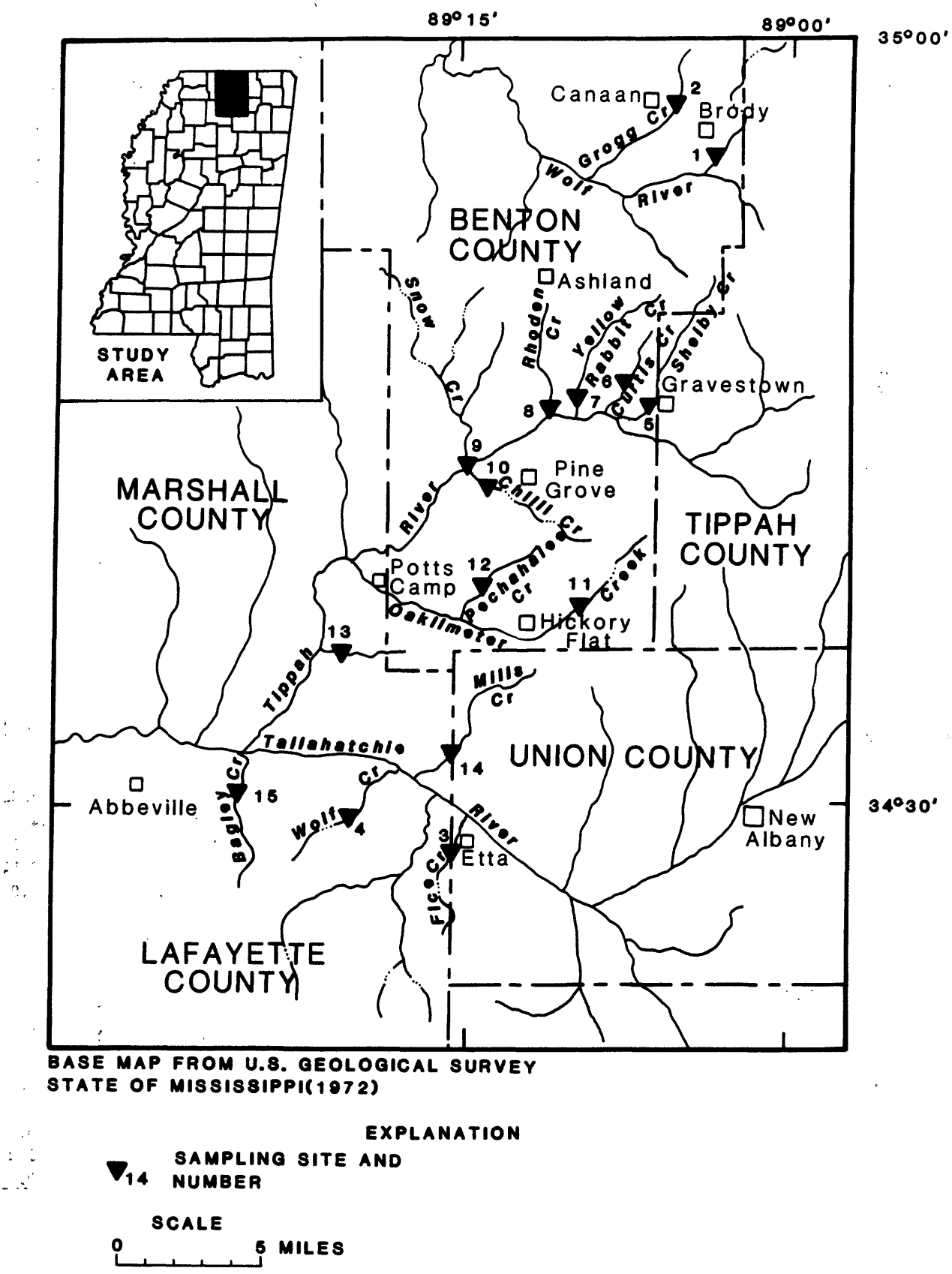
AREA OF STUDY

The 15 data collection sites visited in 1985 are located in four counties in north-central Mississippi (fig. 2). Ten sites are located on streams in Benton County, two each in Lafayette and Marshal Counties, and one on a stream in Union County. Sites on Wolf River and Grogg Creek are in the Tuscumbia River drainage basin and the remaining sites are in the Yazoo River drainage basin.

The sites are located in comparatively small subbasins draining less than 50 square miles (mi^2). The drainage areas range from 5.76 mi^2 at site 1 on Wolf River to 48.4 mi^2 at site 9 on Snow Creek (table 1).

Table 1.--Sampling sites and drainage areas in north-central Mississippi, August 1985

Site Number	Site ID	Station Name and Location	County	Latitude	Longitude	Drainage Area(mi2)
1	07030361	Wolf River on cnty road nr Brody	Benton	34 54 34	89 02 53	5.82
2	07030364	Grogg Creek near Canaan, Ms.	Benton	34 55 32	89 06 41	14.9
3	07268200	Fice Creek at Etta, Ms.	Union	34 28 20	89 14 10	9.18
4	07268750	Wolf Creek near Etta, Ms.	Lafayette	34 29 38	89 19 03	7.14
5	07269400	Shelby Creek nr Graveetown, Ms.	Benton	34 45 05	89 06 09	19.0
6	07269650	Curtis Creek near Ashland, Ms.	Benton	34 45 35	89 07 02	5.80
7	07269700	Yellow Rabbit Cr nr Ashland, Ms.	Benton	34 45 21	89 08 48	16.2
8	07269790	Rhoden Creek near Pine Grove, Ms.	Benton	34 45 22	89 10 13	7.73
9	07269815	Snow Creek near Pine Grove, Ms.	Benton	34 43 23	89 14 06	48.4
10	07269850	Chilli Creek near Pine Grove, Ms.	Benton	34 42 25	89 13 41	18.9
11	07269878	Oaklimeter Creek nr Hickory Flat	Benton	34 37 22	89 05 59	12.2
12	07269879	Pechahlee Creek nr Hickory Flat	Benton	34 37 38	89 13 51	6.92
13	07270000	Potts Creek nr Potts Camp, Ms.	Marshall	34 35 40	89 20 00	8.26
14	07270200	Mills Creek nr Cornersville, Ms.	Marshall	34 31 30	89 15 01	20.2
15	07270500	Bagley Creek nr Abbeville, Ms.	Lafayette	34 30 18	89 24 53	9.96



BASE MAP FROM U.S. GEOLOGICAL SURVEY
STATE OF MISSISSIPPI(1972)

EXPLANATION

▼14 SAMPLING SITE AND NUMBER

SCALE

0 5 MILES

Figure 2.--Location of the study area and sampling sites in potential lignite mining areas.

CHANNEL CROSS SECTIONS

Channel cross sections were delineated at 13 sites at the time of water quality sampling (fig. 3). The cross sections were determined by measuring down from a horizontal reference point on the bridge to the streambed. Stream channel widths ranged from approximately 30 ft at site 4 on Wolf Creek to approximately 115 ft at site 5 on Shelby Creek. Stream depths were shallow, generally less than 1.0 foot at most sites. Channel bottoms consisted mostly of sand and, in places, gravel. Most channel banks had a steep to vertical slope and were covered, in varying degrees, by trees, shrubs, and kudzu. Photgraphs that document the condition of the sites at time of sampling are available for inspection at the U.S. Geological Survey office in Jackson, Mississippi.

WATER QUALITY

Water temperature, specific conductance, dissolved oxygen concentrations, and streamflow were measured on-site and samples of water and bottom material samples were collected for laboratory analysis at each site. Discharge measured at the ten sites sampled before the rain ranged from 0.04 cubic feet per second (ft^3/s) at site 13 on Potts Creek to 7.17 ft^3/s at site 5 on Shelby Creek. Discharge measured at the five sites sampled 2 days after the rain ranged from 1.44 ft^3/s at site 11 on Oaklimeter Creek to 74.8 ft^3/s at site 9 on Snow Creek.

Water temperature at all sites ranged from 23.0 to 32.0° C (73.5° to 89.5°F). The lowest temperature measured was at site 8 on Rhoden Creek at 0905 hours on August 21. Maximum stream temperature was measured at site 14 on Mills Creek at 1545 hours on August 14. Specific conductance was less than 80 microsiemens per centimeter at 25°C (µS/cm). The specific conductance ranged from 28 µS/cm at site 8 on Rhoden Creek to 78 µS/cm at site 13 on Potts Creek (table 2 and fig. 4).

The dissolved oxygen concentrations at 10 sites was greater than 5.0 milligrams per liter (mg/L). The pH ranged from 6.1 to 6.8 units at 13 sites. The pH of water at site 10 on Chilli Creek was 7.1 units and at site 14 on Mills Creek was 7.5 units.

Turbidity in all streams was 20 NTU (nephlometric turbidity units) or less. Suspended-sediment concentrations in samples at the stream sites ranged from 3 to 74 mg/L (fig. 5).

Dissolved constituents were similar in type and quantity at all sites. The dissolved-solids concentration in samples ranged from 24 to 59 mg/L. Major ion concentrations were less than 10 mg/L, and nitrate plus nitrite concentrations were less than or equal to 0.10 mg/L. Dissolved aluminum concentrations were at or below the detection limit (100 µg/L). Total iron exceeded 1,000 µg/L in all samples.

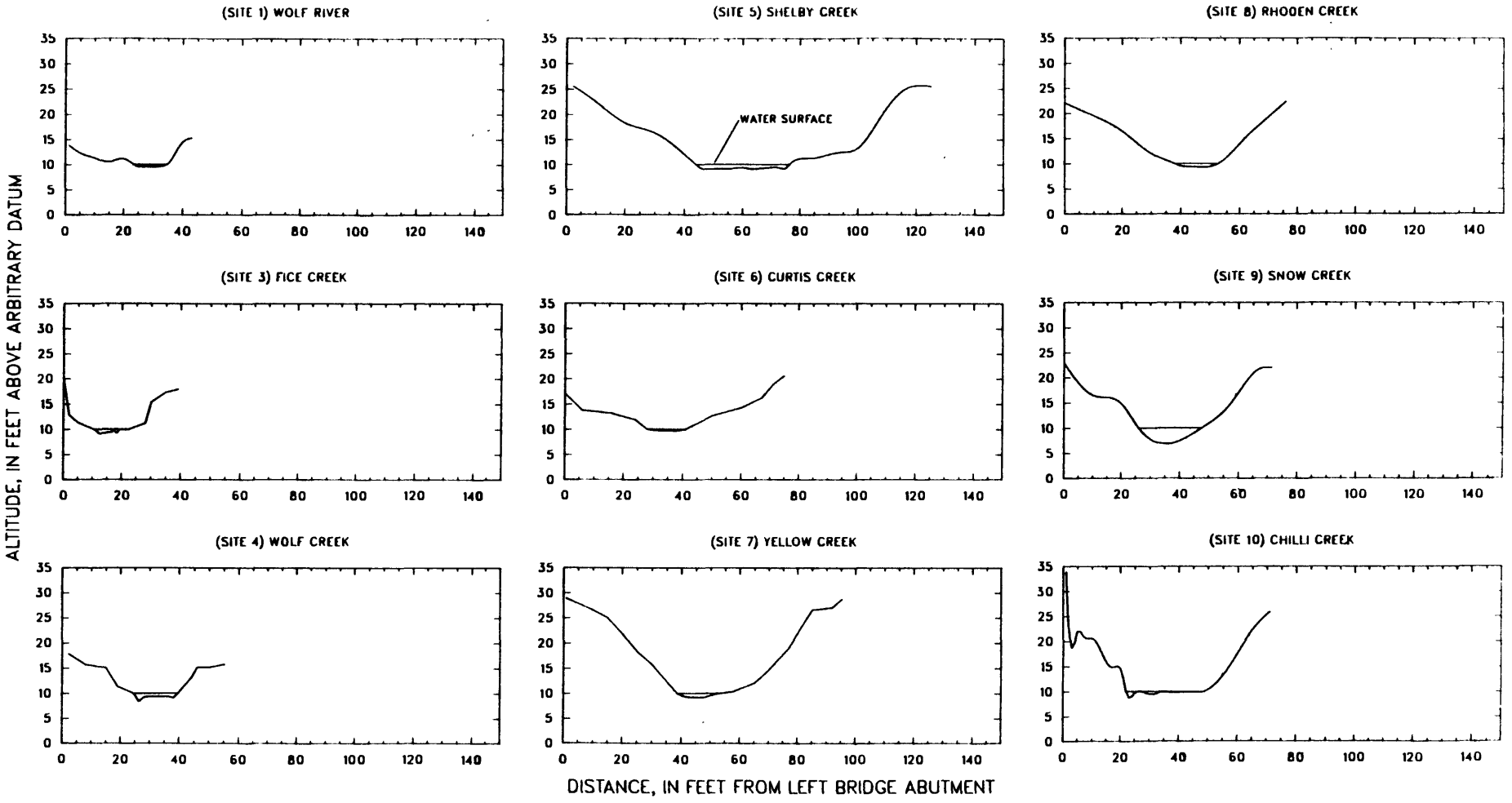


Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1985.

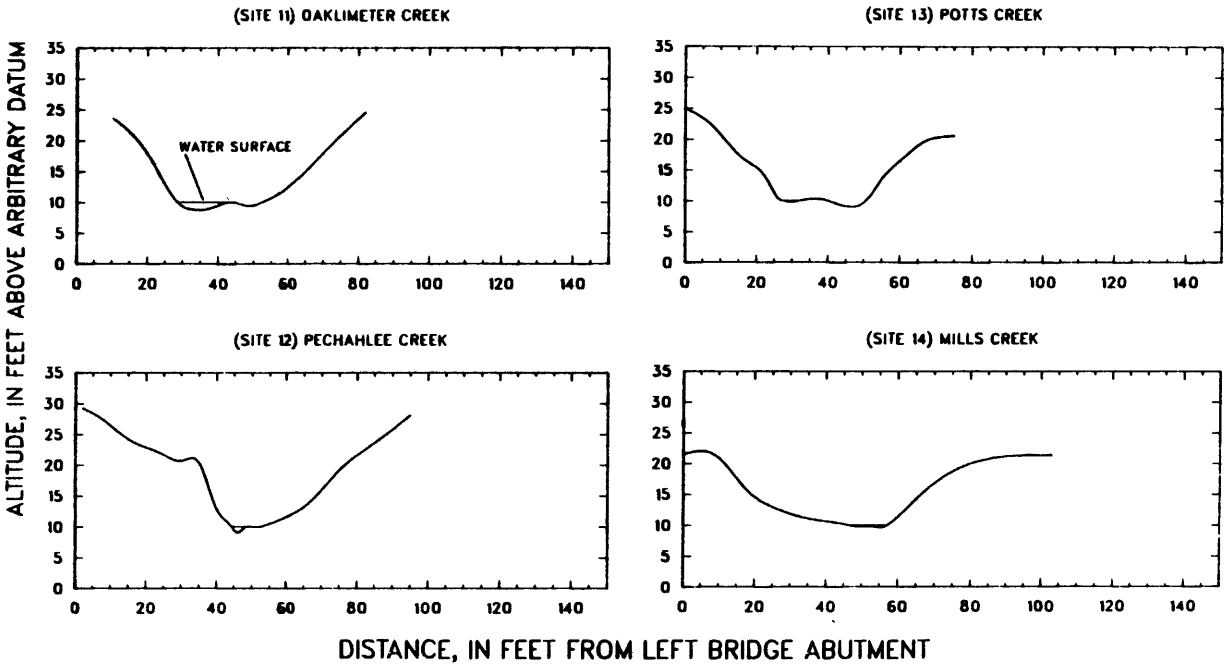


Figure 3.--Channel cross sections at sampling sites, north-central Mississippi, August 1985.--Continued

Table 2.--Field and laboratory measurements of water samples collected from streams in north-central Mississippi, August 1985

(Dissolved constituents in milligrams per liter)

Site Number	Date of Collection	Time (Hours)	Streamflow (ft3/s)	Specific Conductance (uS/cm)	pH (Units)	Temperature (C)	Color (Units)	Turbidity (NTU)	Oxygen Dissolved	Hardness (Mg/L as CaCO3)
1	08/15/85	1300	2.17	38	6.8	25.5	55	6.0	6.5	12
2	08/15/85	1445	4.08	60	6.4	29.0	75	10.0	6.0	17
3	08/14/85	0820	.84	44	6.5	25.5	70	20.0	6.0	12
4	08/14/85	1025	.65	58	6.7	25.0	30	4.0	7.2	19
5	08/15/85	1630	7.17	30	6.7	27.0	75	15.0	6.8	9
6	08/20/85	1330	2.48	30	6.1	24.0	30	3.5	--	10
7	08/20/85	1605	12.7	29	6.4	25.0	50	7.0	--	8
8	08/21/85	0905	10.0	28	6.4	23.0	40	12.0	--	7
9	08/21/85	1225	74.8	31	6.6	27.0	20	5.5	--	8
10	08/15/85	0955	3.71	67	7.1	25.5	20	5.0	7.5	23
11	08/21/85	1540	1.44	61	6.7	31.0	55	10.0	.	16
12	08/15/85	0815	.26	50	6.8	25.0	25	5.5	7.0	16
13	08/14/85	1445	.04	78	6.6	29.5	15	4.5	6.6	23
14	08/14/85	1545	2.09	69	7.5	32.0	55	15.0	7.2	22
15	08/14/85	1155	1.85	45	6.7	27.0	35	10.0	7.2	14

Site Number	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Sodium, Percent	Potassium (K)	Sulfate (SO4)	Chloride (Cl)	Dissolved Solids, Residue at 180°C
1	2.7	1.3	2.0	25	0.8	0.7	2.2	31
2	3.9	1.8	2.1	20	0.9	0.4	1.6	43
3	2.5	1.3	3.3	34	1.6	2.3	3.9	41
4	3.8	2.2	3.1	25	1.5	2.7	2.6	43
5	1.9	1.1	1.9	29	0.7	1.5	2.1	32
6	2.0	1.1	1.7	26	0.9	<0.2	0.2	25
7	1.7	1.0	1.5	26	0.9	2.1	1.7	30
8	1.6	0.9	1.8	31	0.9	0.6	2.0	27
9	1.7	0.9	1.9	32	0.9	0.6	1.8	24
10	4.9	2.6	3.6	24	1.3	4.9	3.5	54
11	3.6	1.8	4.4	34	1.6	4.6	4.6	48
12	3.3	2.0	2.9	26	1.1	3.2	4.1	39
13	5.2	2.5	4.5	27	2.0	5.3	6.6	56
14	4.9	2.4	4.9	31	1.7	3.6	4.2	59
15	2.9	1.7	3.0	29	1.2	3.6	2.7	42

Table 2.--Field and laboratory measurements of water samples collected from streams in north-central Mississippi, August 1985--Continued

Site Number	Solids, Vol. on Ignition	Nitrite (N)	Nitrite Plus Nitrate (N)	Organic Carbon Total	Sediment Suspended	Aluminum (Al)	Iron Total (Fe)	Iron, Dissolved (Fe)	Manganese, Total (Mn)	Manganese, Dissolved (Mn)
	Milligrams per liter					Micrograms per liter				
1	16	<0.01	0.10	3.4	18	<100	3100	230	1100	1100
2	14	<.01	<.10	3.5	19	<100	3600	1200	4000	4000
3	18	.01	<.10	--	15	100	2200	780	180	180
4	19	.01	.10	3.8	3	<100	1200	470	140	140
5	14	<.01	<.10	3.4	24	100	2400	350	120	130
6	15	<.01	.10	--	14	100	1200	690	250	210
7	18	<.01	<.10	--	71	100	2200	720	50	47
8	17	<.01	<.10	--	50	100	2100	680	190	89
9	12	<.01	<.10	--	74	100	1600	500	180	50
10	16	<.01	<.10	4.0	20	<100	1500	95	90	89
11	20	<.01	<.10	--	12	100	1300	580	150	160
12	18	<.01	<.10	--	8	<100	1300	410	140	140
13	17	<.01	<.10	3.4	8	100	1700	610	430	420
14	21	<.01	<.10	--	16	100	1700	290	70	67
15	--	<.01	<.10	3.6	14	100	1400	510	90	82

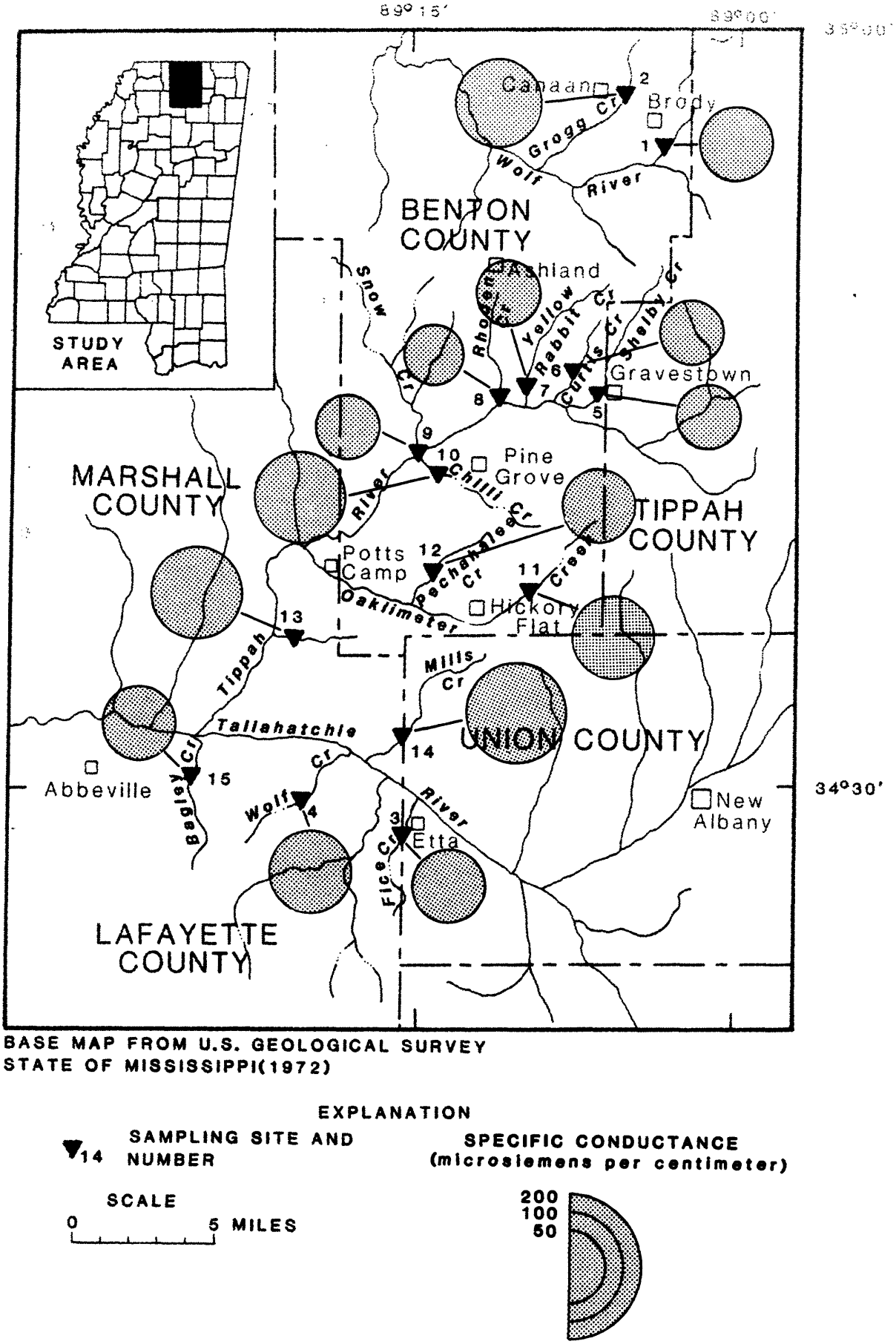
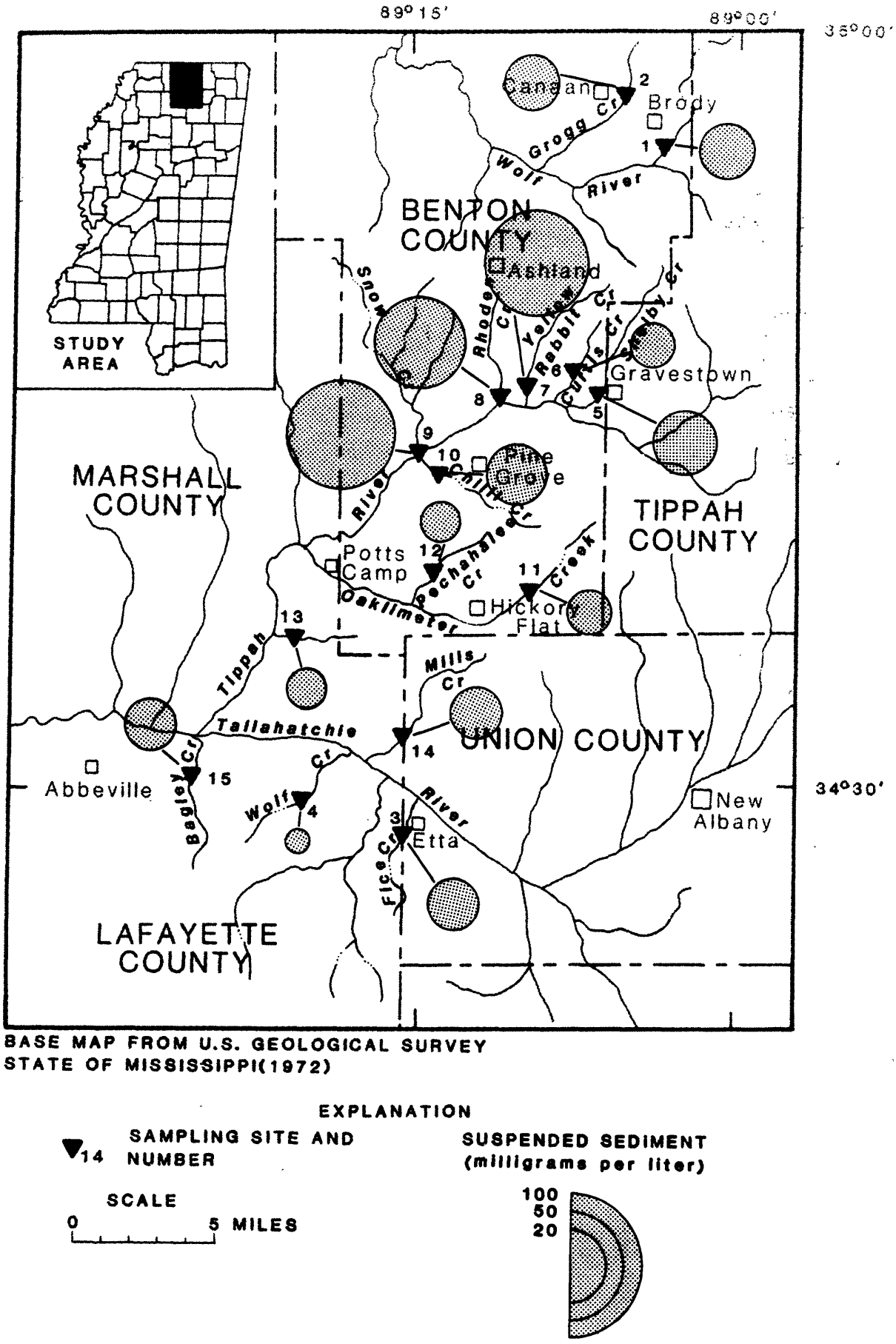


Figure 4.--Specific conductance of streams at sampling sites, August 1985.



BASE MAP FROM U.S. GEOLOGICAL SURVEY
STATE OF MISSISSIPPI(1972)

EXPLANATION

▼14 SAMPLING SITE AND NUMBER

SUSPENDED SEDIMENT (milligrams per liter)

100
50
20

SCALE

0 5 MILES

Figure 5.--Suspended sediment concentrations of streams at sampling sites, August 1985.

The results of laboratory analysis of bottom material samples indicate that arsenic, cadmium, cobalt, and selenium concentrations were below detection limits at all sites (table 3). Chromium concentrations were at or below the detection limit (1 µg/g) at nine sites and ranged from 2 to 5 µg/g at the remaining sites. Copper concentrations were at or below the detection limit (1 µg/g) at 14 sites. The copper concentration at site 3 on Fice Creek was 3 µg/g. Lead concentrations were below the detec-tion limit (10 µg/g) except site 12 on Pechahalee Creek where the concentration was 20 µg/g. Mercury concentrations ranged from 0.01 µg/g at site 7 on Yellow Rabbit Creek to 0.08 µg/g at site 3 on Pechahalee Creek. Zinc concentrations ranged from 2 to 10 µg/g. Iron concentrations exceeded 1,000 µg/g at 12 sites. Manganese concentrations ranged from 190 to 1,700 µg/g.

Table 3.--Laboratory analysis of bottom material samples collected from streams in north-central Mississippi, August 1985
(Micrograms per gram)

Site Number	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Zinc (Zn)
1	<1	<1	<1	<10	<1	1200	<10	1300	0.03	<1	2
2	<1	<1	4	<10	<1	1700	<10	240	0.04	<1	4
3	<1	<1	3	<10	3	4800	<10	1700	0.08	<1	10
4	<1	<1	2	<10	1	2900	<10	320	0.05	<1	4
5	<1	<1	<1	<10	<1	1100	<10	350	0.04	<1	2
6	<1	<1	1	<10	<1	1100	<10	280	0.02	<1	2
7	<1	<1	<1	<10	<1	640	<10	330	0.01	<1	3
8	<1	<1	<1	<10	<1	1200	<10	470	0.04	<1	2
9	<1	<1	<1	<10	<1	980	<10	430	0.05	<1	3
10	<1	<1	<1	<10	<1	1400	<10	260	0.05	<1	3
11	<1	<1	2	<10	<1	1100	<10	190	0.03	<1	2
12	<1	<1	1	<10	<1	1300	20	360	0.05	<1	3
13	<1	<1	2	<10	<1	1600	<10	220	0.02	<1	2
14	<1	<1	5	<10	1	8400	<10	1200	0.03	<1	8
15	<1	<1	<1	<10	<1	840	<10	550	0.02	<1	2

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GLOSSARY

Color is expressed in units of the platinum-cobalt scale. A color unit is produced by one milligram per liter of platinum in the form of the choloroplatinate ion.

Cubic feet per second (ft^3/s) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 449 gallons per minute.

Dissolved is that material in a representative water sample that passes through a 0.45 um membrane filter. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

Hardness of water is a physical-chemical characteristic that is commonly recognized by the increased quantity of soap required to produce lather. It is attributable to the presence of alkaline earths (principally calsium and magnesium) and is expressed as equivalent calcium carbonate ($CaCO^3$).

Micrograms per gram (µg/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 that comprises a stream's bottom material.

Micrograms per liter (µg/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) is a unit expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water. Concentration of suspended sediment is also expressed in mg/L, and is based on the mass of sediment per liter of water-sediment mixture.

Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.

Specific conductance is a measure of the ability of water to conduct an electric current and is expressed in microsiemens per centimeter at 25°C (umhos). Microsiemens and umhos are equivalent units of measurements because the specific conductance is related to the number and specific chemical types of ions in solution it can be used for approximating the dissolved solids content in the water. Commonly, the amount of dissolved solids (in mg/L) is 65 percent of the specific conductance value (in uS/cm). This relation is not constant from stream to stream and may vary in the same source with changes in the composition of the water.

Turbidity of water is the reduction of transparency due to the presence of suspended particulate matter. The unit of measure is the nephelometric turbidity unit (NTU) and is the measure of light scatter of a beam of light passed through a water sample.