UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN MISSISSIPPI, JULY 1982

by

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GEOLOGICAL SURVEY

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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)	.3048	meter (m)
cubic foot per second (ft^3/s)	.02832	cubic meter per second (m^3/s)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

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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 Mississippi. During the period July 27-30, 1982, hydrologic data were collected at 17 stream sites draining potential lignite mining areas in east-central Mississippi.

Main channel widths ranged from less than 50 feet on Golden Horn Creek near Sturgis to approximately 320 feet on Pigeon Roost Creek at Mathiston. Maximum water depths at the sampling sites ranged from about 0.5 foot on Nanih Waiya Creek near Boon to 7 feet in Crape Creek near Kilmichael. The maximum stream discharge was 23 cubic feet per second in Big Bywy Ditch near Mathiston. Golden Horn Creek near Sturgis had no streamflow.

Specific conductance at two sites, Lick Creek near Adaten (860 micromhos) and Pigeon Poost Creek at Mathiston (130 micromhos) was much higher than in the other streams. At the remaining sites specific conductance of the water averaged 52 micromhos. The pH ranged between 6.2 and 7.2 units. Dissolved oxygen concentrations ranged from 3.6 to 6.7 milligrams per liter (mg/L). Turbidity of the streams was less than 100 nephelometric turbidity units in all but two streams (Middle Bywy Creek and Besa Chitto Creek). Suspended sediment concentrations ranged from 39 mg/L in Nanih Waiya Creek to 250 mg/L in Big Bywy Ditch. Dissolved-solids concentratons were less than 80 mg/L at all sampled sites except in Pigeon Roost Creek where the concentration was 105 mg/L. Pigeon Roost Creek also contained the greatest concentration of nitrate plus nitrite (1.8 mg/L). Nitrate plus nitrite concentrations in samples from the remaining sites were 0.30 mg/L or less. Cobalt and lead concentrations in bottom material exceeded 10 micrograms per gram (ug/g) in samples from Nanih Waiya Creek, Lick Creek, and Pigeon Roost Creek. Zinc, copper, and chromium concentrations also exceeded 10 ug/g at several sites. Iron exceeded 1000 ug/g at all sites and manganese exceeded 1000 ug/g at five sites.

INTRODUCTION

Lignite deposits occur in potentially commercial quantities in the outcrop of the Wilcox Group (fig. 1). Williamson (1976, p.1) states that lignites are present as tabular, discontinuous, irregularily shaped deposits overlain by unconsolidated sands, silts, and clays. Williamson also reports that the presence of lignite seams thicker than 10 ft is exceptional. Lignite seams 4 to 7 ft thick are more common. Within the Wilcox Group outcrop area (Meissner and others, 1982, plate 9) lignite beds 2.5 ft or more thick and less than 250 ft deep occur in every county, with the exception of Webster county.

Using modern mining technology these thick, relatively shallow, lignite deposits may be profitably strip mined under the proper economic conditions. However, surface mining of lignite may require the removal of large quantities of overburden and the disposal of large volumes of water. Overburden materials distrubed during the mining phase and sediment-laden water may enter streams filling the stream channel and greatly increasing the sediment load. Overburden disposal in spoil banks may erode, producing a similar effect. Weathering of newly exposed overburden and large volumes of dewatered groundwater will have an impact on the water quality of streams draining the mined area. To assess the impact of mining activities on the local streams, it is essential that background hydrologic data be collected prior to any mining activity.

To determine background data in potential lignite mining areas, hydrologic data were collected from 17 stream sites in east-central Mississippi during the period of July 27-30, 1982. Water samples and stream bottom-material samples were collected at 16 sites. One stream had no streamflow. Channel cross sections were determined at 15 sites. These hydrologic data sites were selected jointly by the Mississippi Department of Natural Resources, Bureau of Geology and the U.S. Geological Survey. This report is the third in a series. Data collected during 1980 and 1981 were published in open-file reports for respective years by the U.S. Geological Survey (Arthur, 1981 and 1982). The locations of the background hydrologic data studies completed to date are shown in figure 1.

OBJECTIVE AND SCOPE

The objective of this planned 5-year study is 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 any future study of surface mining effects in Mississippi.

Background data on streams draining potential lignite mining areas are being obtained by sampling about 15 streams yearly. The water samples collected for this and previous reports were analyzed for selected dissolved constituents, and bottom-material samples were analyzed for selected metals. Channel cross sections were delineated at each site at the time of sample collection.

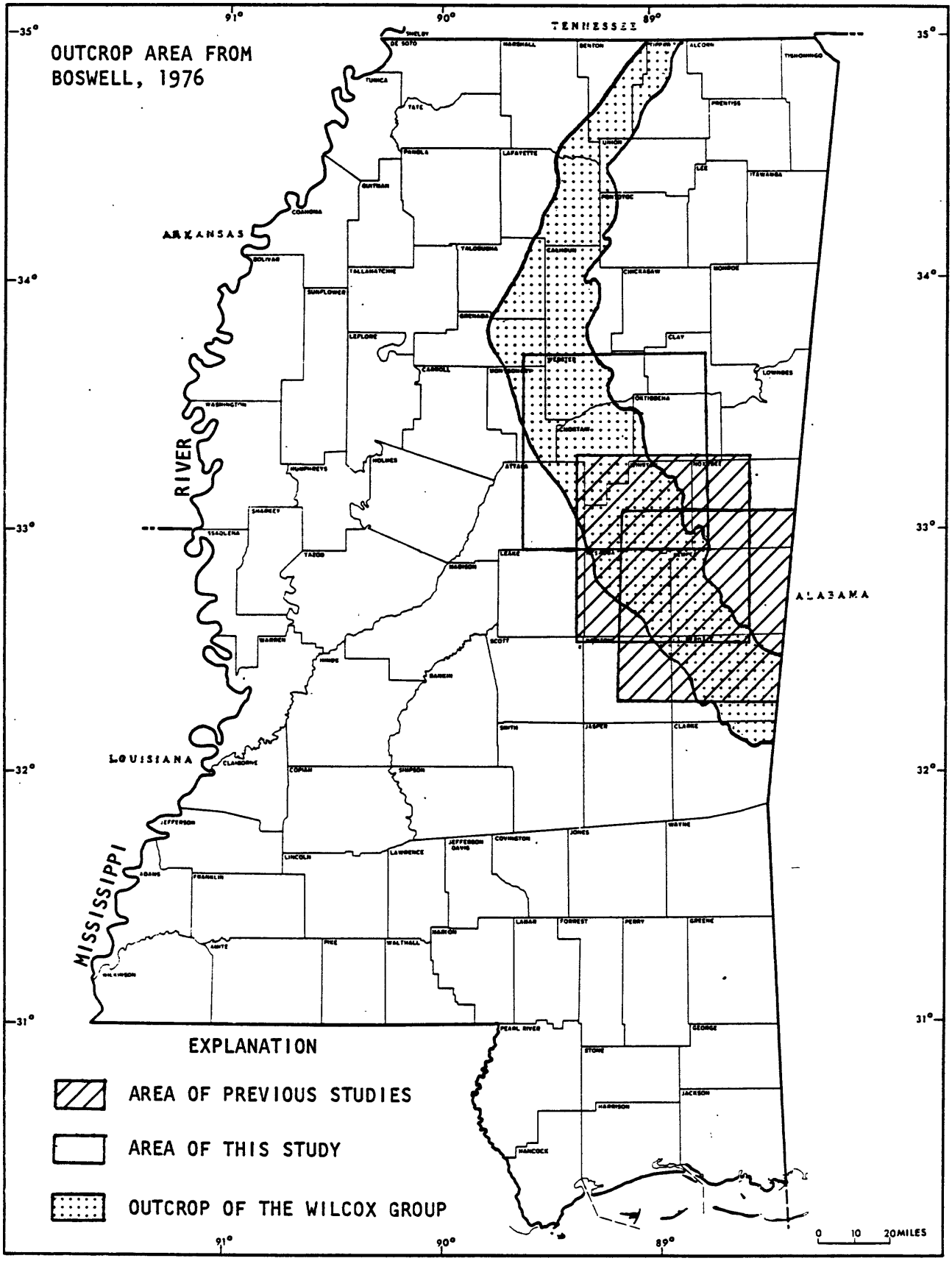

FIGURE 1.--LOCATION OF BACKGROUND HYDROLOGIC DATA STUDIES IN THE OUTCROP AREA OF THE WILCOX GROUP.

AREA OF STUDY

The 17 data collection sites visited in 1982 are located in five counties in east-central Mississippi (fig. 2). Eight sites are in Choctaw county, five in Oktibbeha, two in Montgomery and one each in Noxubee and Winston counties (table 1). Six sites are in Tombigbee River basin, four in the Pearl River basin, and seven in the Big Black River basin.

All sites are located on small streams at bridge crossings. The drainage area at all sites is less than 50 square miles (mi^2) and ranges in size from 4.09 mi^2 on Blytha Creek to 43.7 mi^2 on Poplar Creek. The drainage areas for all sites are listed in table 1.

Most sites are located in rural areas and drain farm and forest land. However, Pigeon Roost Creek at Mathiston receives runoff from Mathiston and Maben, and the Yockanookany River northwest of Ackerman receives runoff from Ackerman. These sites also may receive varying amounts of treated sewage discharge from lagoons.

CHANNEL CROSS SECTIONS

Channel cross sections were delineated at 15 sites at the time of water-quality sampling (fig. 3). One site (Golden Horn Creek) had no streamflow. The cross sections were determined by measuring down from a horizontal reference point on the bridge to the streambed. Main channel widths ranged from less than 50 ft on Golden Horn Creek to approximately 320 ft on Pigeon Roost Creek. Maximum water depths ranged from about 0.5 ft in Nanih Waiya Creek to about 7 ft in Crape Creek. Channel bottoms consisted of sand and some gravel. Decaying vegetation was also present in varying amounts. Most channel banks were steep and heavily vegetated. Photographs were taken at all sites and are available from the Mississippi Bureau of Geology and the U.S. Geological Survey in Jackson, Mississippi.

WATER QUALITY

Water temperature, specific conductance, pH, and dissolved oxygen were measured at 16 sites. Water and bottom-material samples were collected for laboratory analysis. Major chemical constituents and suspended-sediment concentrations in water samples and selected metals in bottom-material samples were determined (table 2). Stream discharge was measured at 11 sites where there was adequate control. Discharge was estimated to be less than 0.5 cubic feet per second (ft^3/s) at the unmeasured sites. Golden Horn Creek had no discharge when visited. The largest discharges measured were 23 and 16 ft^3/s at Big Bywy Ditch and McCurtain Creek, respectively. Discharge at the other sites was less than 10 ft^3/s (table 2). Streamflow may have been supplemented by runoff from light rainshowers that occurred during the 4-day sampling period.

Water temperature ranged from 20.5 to 28.0°C (about 69 to 82°F during the study. The lowest temperature was in Sand Creek near Sturgis at 1145 hours on July 28. The maximum temperature was measured in Blackwater Creek near Fearns Springs at 1500 hours on July 27.

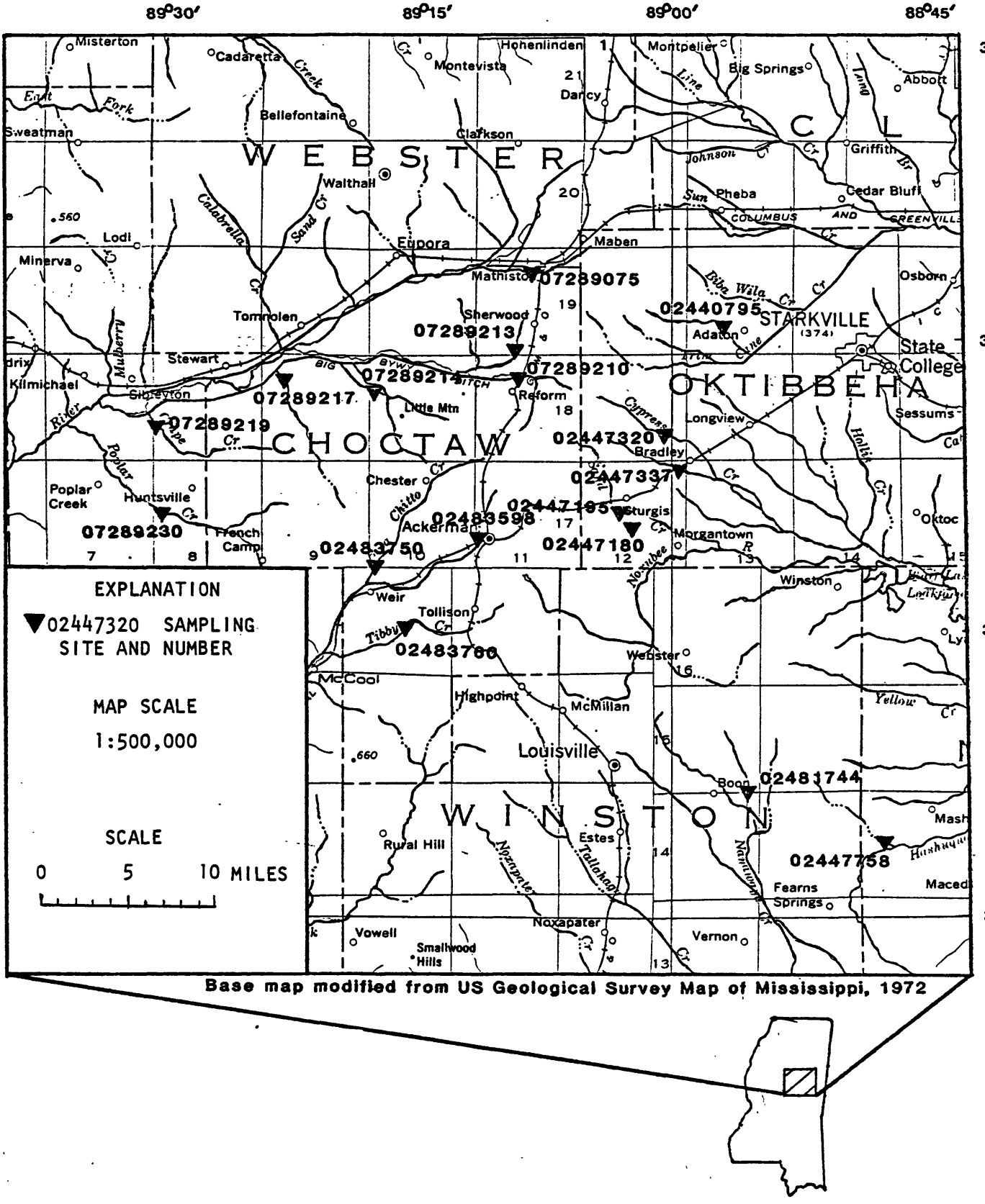

FIGURE 2.--LOCATION OF STUDY AREA AND SAMPLING SITES IN A POTENTIAL LIGNITE MINING AREA IN EAST-CENTRAL MISSISSIPPI.

Table 1.--Sampling sites and drainage areas in the study area, east-central Mississippi, July 27-30, 1982

Site Number	Station name and location	County	Latitude	Longitude	Drainage area (mi^2)
02440795	Lick Creek nr Adaton, MS	Oktibbeha	33°28'35"	88°56'37"	12.1
02447180	Golden Horn Creek nr Sturgis, MS	Oktibbeha	33°18'16"	89°00'22"	5.37
02447195	Sand Creek nr Sturgis, MS	Oktibbeha	33°19'58"	89°02'14"	43.6
02447320	Big Creek nr Sturgis, MS	Oktibbeha	33°23'53"	89°01'09"	8.27
02447337	Cypress Creek nr Bradley, MS	Oktibbeha	33°22'10"	88°59'37"	9.89
02447758	Blackwater Creek nr Fearns Springs, MS	Noxubee	33°03'22"	88°48'06"	10.4
02481744	Nanih Waiya Creek nr Boon, MS	Winston	33°06'13"	88°54'12"	11.0
02483598	Yockanookany River nw of Ackerman, MS	Choctaw	33°18'58"	89°11'30"	7.93
02483750	Besa Chitto Creek nr Weir, MS	Choctaw	33°17'19"	89°17'25"	18.3
02483760	Tibby Creek nr McCool, MS	Choctaw	33°14'20"	89°15'34"	30.2
07289075	Pigeon Roost Creek at Mathiston, MS	Choctaw	33°31'28"	89°07'55"	17.2
07289210	Big Bywy Ditch nr Mathiston, MS	Choctaw	33°26'28"	89°09'06"	21.6
07289213	Blytha Creek nr Reform, MS	Choctaw	33°27'36"	89°08'56"	4.09
07289214	Middle Bywy Creek nr Tomnolen, MS	Choctaw	33°25'51"	89°17'39"	30.7
07289217	McCurtain Creek nr Stewart, MS	Choctaw	33°26'07"	89°22'34"	41.3
07289219	Crape Creek nr Kilmichael, MS	Montgomery	33°24'06"	89°30'14"	18.6
07289230	Poplar Creek nr French Camp, MS	Montgomery	33°19'41"	89°28'53"	43.7

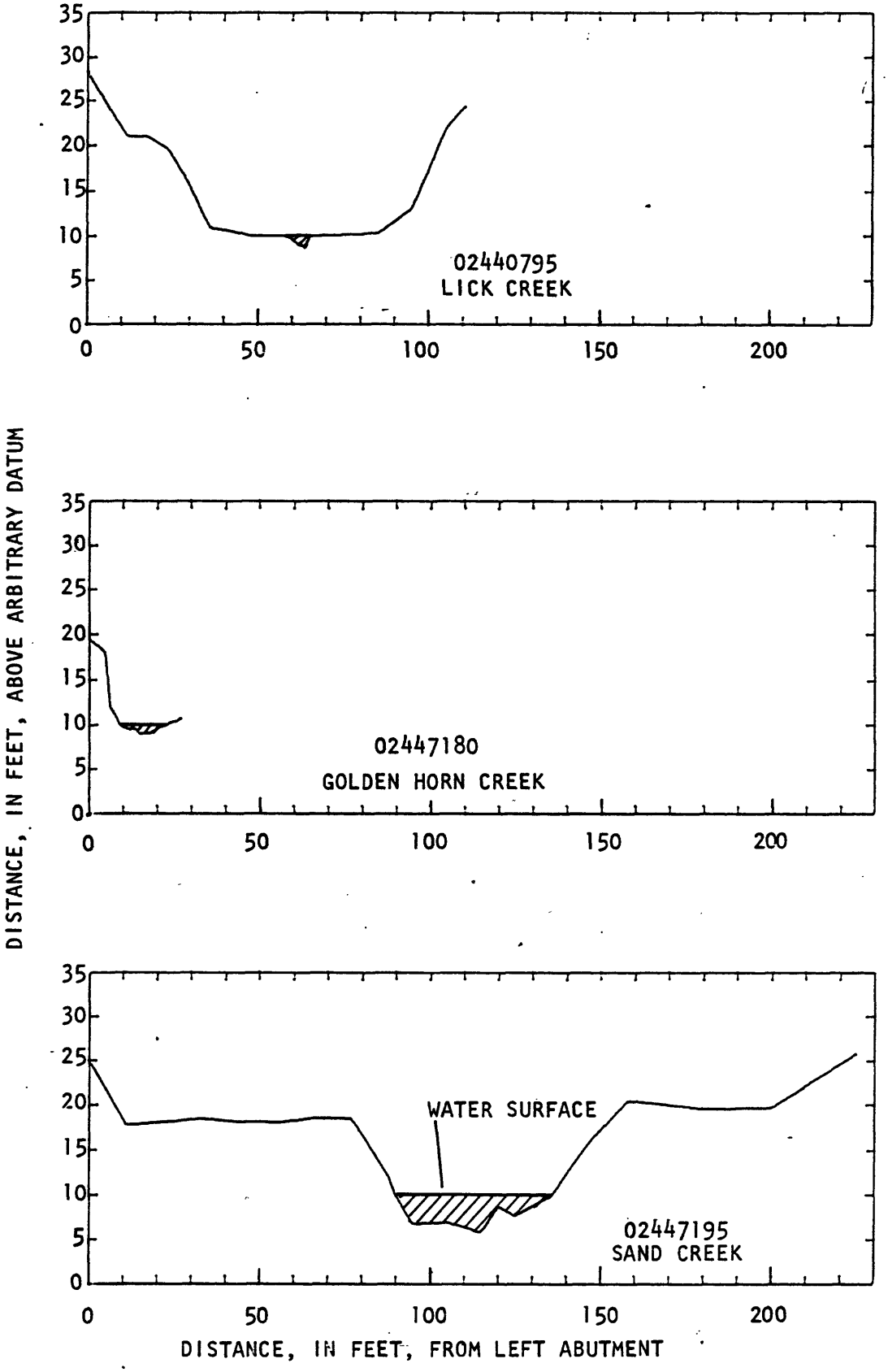

FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES, EAST CENTRAL MISSISSIPPI, JULY 27-30, 1982.

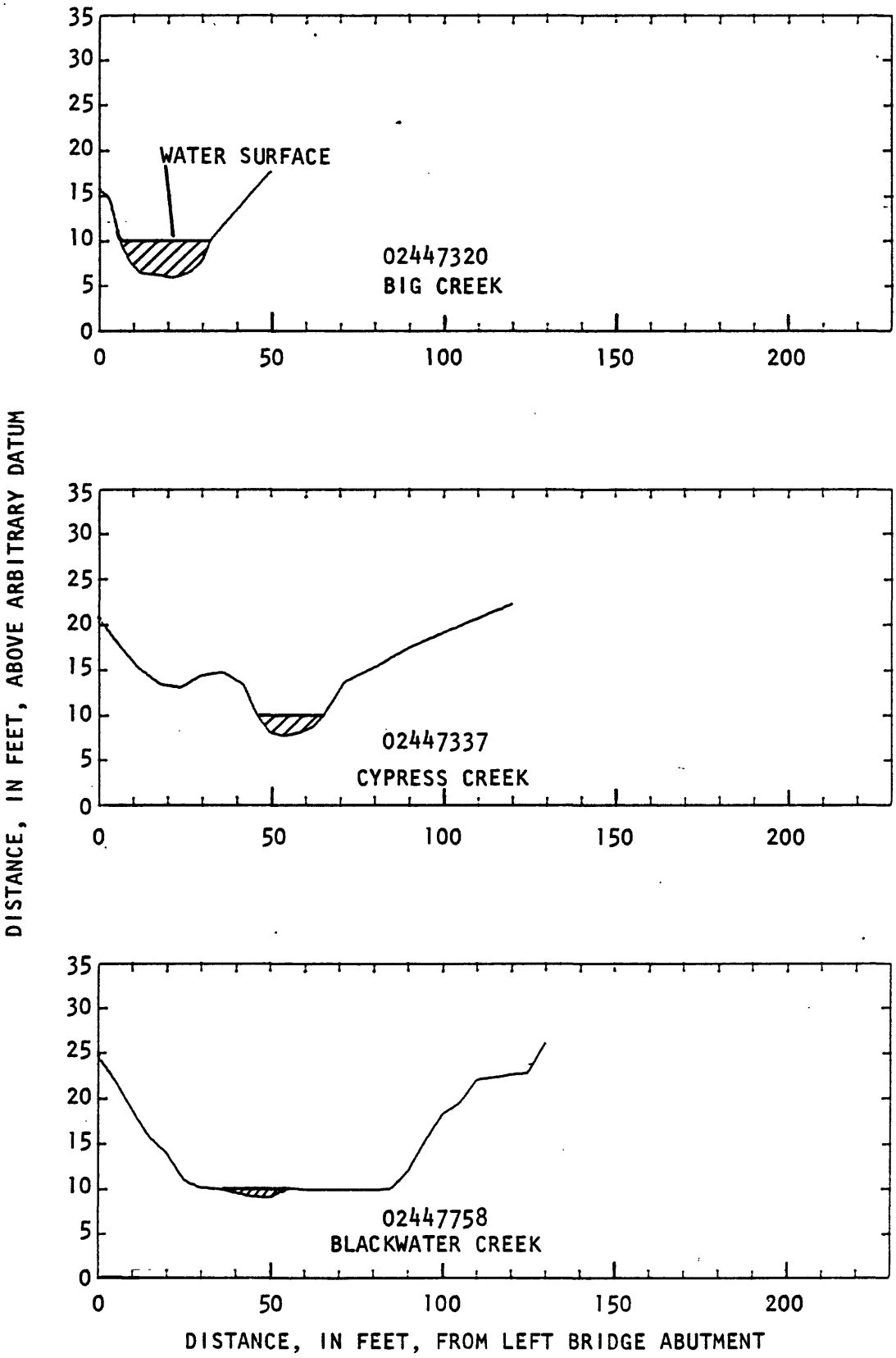

FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES, EAST CENTRAL MISSISSIPPI, JULY 27-30, 1982. --Continued.

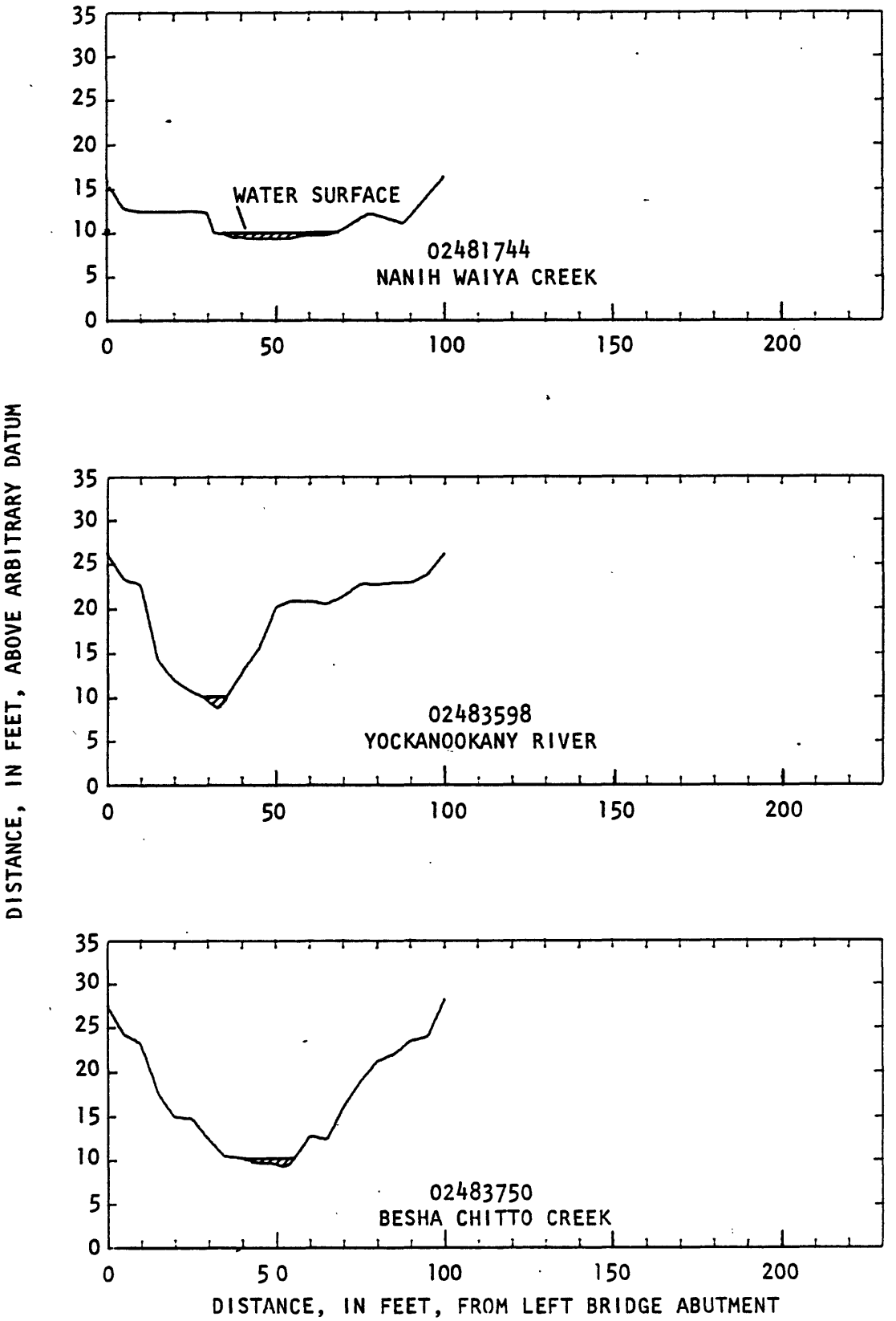

FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES, EAST CENTRAL MISSISSIPPI, JULY 27-30, 1982. --Continued.

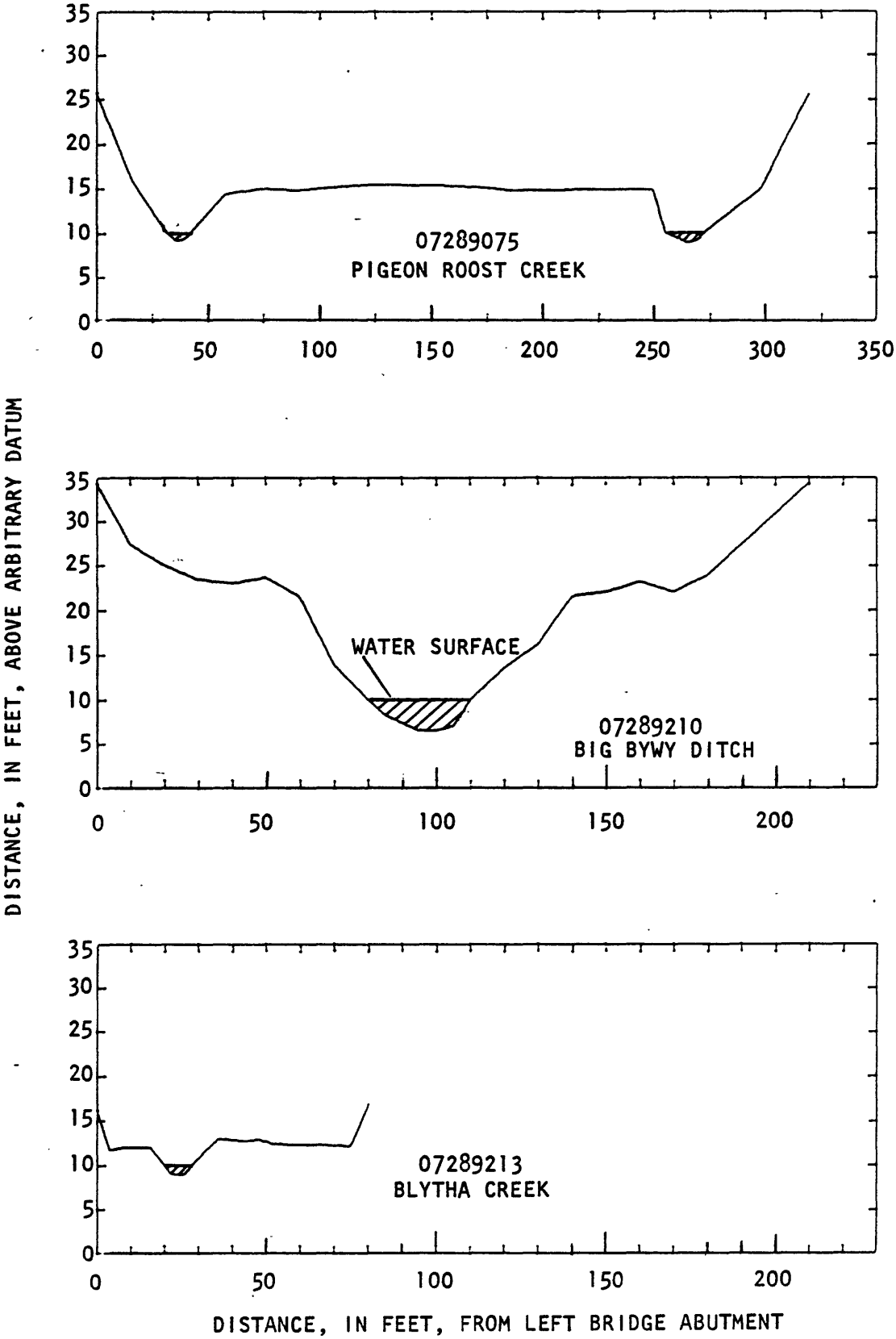

FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES, EAST-CENTRAL MISSISSIPPI, JULY 27-30, 1982.--Continued.

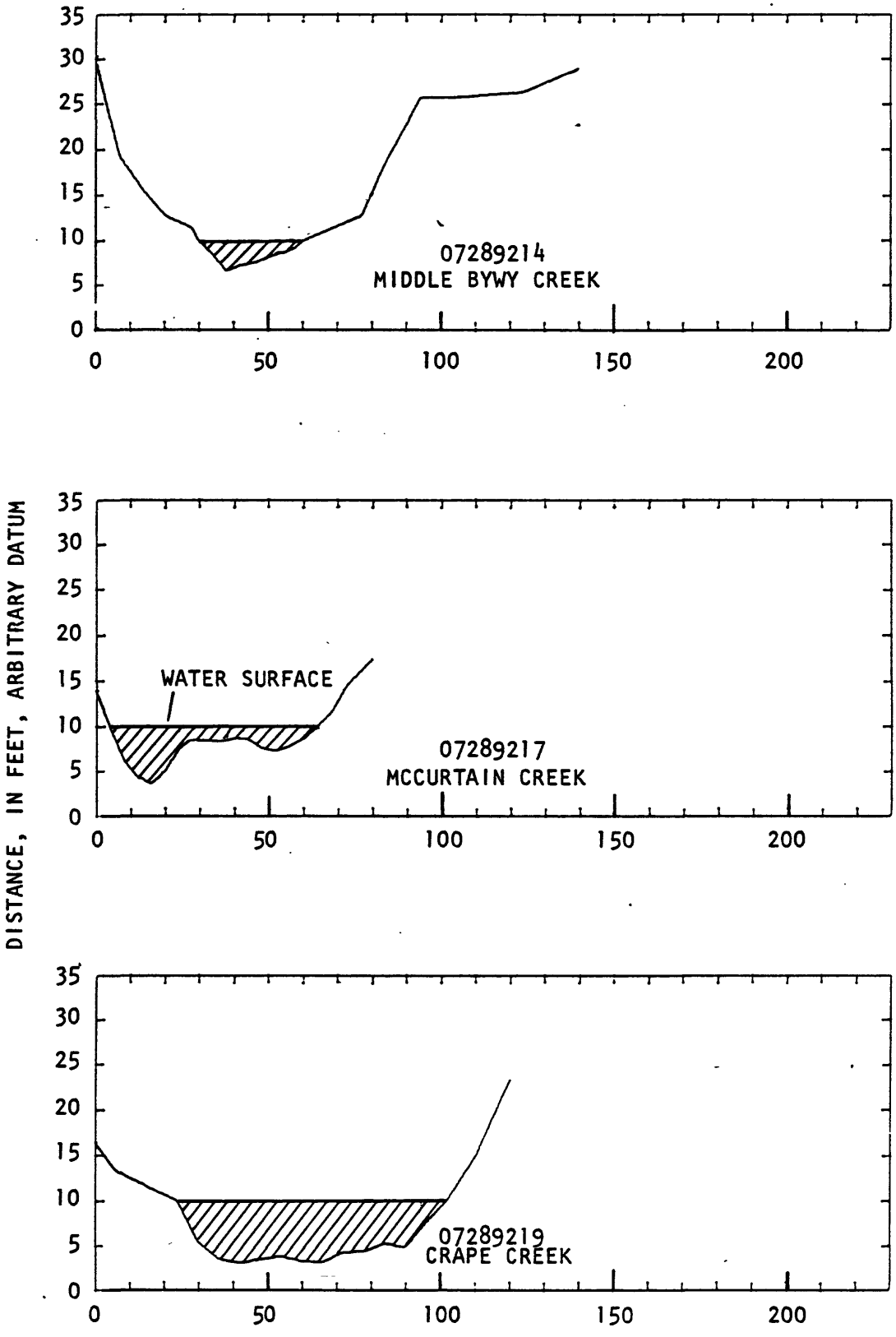

FIGURE 3.--CHANNEL CROSS SECTIONS AT SAMPLING SITES, EAST-CENTRAL MISSISSIPPI, JULY 27-30, 1982.--Continued.

TABLE 2.--FIELD AND LABORATORY MEASUREMENTS OF WATER SAMPLES COLLECTED FROM STREAMS IN EAST-CENTRAL MISSISSIPPI, JULY 27-30, 1982

SITE NUMBER	DATE	TIME (HOURS)	STREAM DISCHARGE (FT^3/S)	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	WATER TEMPERATURE (°C)	COLOR (UNITS)	TURBIDITY (NTU)	DISSOLVED OXYGEN (MG/L)
02440795	07/28/1982	1635	E <0.5	860	7.0	.	5	1.5	6.4
02447195	07/28/1982	1145	1.6	40	6.8	20.5	80	70	5.2
02447320	07/28/1982	1500	E <0.5	95	6.7	26.0	40	35.	3.6
02447337	07/28/1982	1330	E <0.5	94	6.5	25.0	30	24	4.2
02447758	07/27/1982	1500	2.8	62	6.9	28.0	60	20	6.7
02481744	07/27/1982	1700	E <0.5	48	6.5	26.5	80	6.0	4.4
02483598	07/27/1982	1215	5.6	34	6.7	24.5	60	25	5.8
02483750	07/27/1982	0730	4.8	48	6.2	22.5	130	100	5.7
02483760	07/27/1982	0945	E <0.5	32	6.8	23.5	110	60.	5.2
07269075	07/29/1982	1245	2.7	130	7.1	25.5	75	62	4.3
07289210	07/29/1982	0815	23	41	6.5	23.5	75	85	6.5
07289213	07/29/1982	1110	0.8	54	7.2	24.5	50	14	5.2
07289214	07/29/1982	1445	7.7	42	7.0	27.0	120	130.	6.4
07289217	07/29/1982	1645	16	35	6.5	25.5	55	30	6.1
07289219	07/30/1982	0945	1.6	48	6.6	26.5	75	48	4.6
07289230	07/30/1982	0745	6.8	58	6.5	25.5	85	49	6.1

E - ESTIMATED DISCHARGE

TABLE 2.--CONTINUED

SITE NUMBER	MILLIGRAMS PER LITER, EXCEPT AS INDICATED								
	HARDNESS AS $CaCO_3$	CALCIUM DISSOLVED	MAGNESIUM DISSOLVED	SODIUM DISSOLVED	SODIUM PERCENT	POTASSIUM DISSOLVED	SULFATE DISSOLVED	CHLORIDE DISSOLVED	DISSOLVED SOLIDS RESIDUE AT 180°C
02440795	320	72	35	45	23	6.9	360	26	.
02447195	10	2.0	1.3	2.7	32	1.7	3	2.4	38
02447320	33	6.4	4.1	4.9	23	3.0	21	4.5	73
02447337	28	5.3	3.6	5.9	29	2.3	15	3.6	77
02447758	19	3.7	2.4	3.0	24	1.4	7	2.9	58
02481744	14	3.3	1.3	2.7	29	0.7	3	3.5	58
02483598	8	1.9	0.9	1.7	26	1.9	4	2.2	46
02483750	9	2.2	0.9	3.6	40	1.7	5	3.5	51
02483760	8	1.7	0.8	2.6	40	0.6	1	2.9	36
07289075	30	7.1	2.9	16	49	4.7	16	12	105
07289210	24	5.1	2.7	4.8	29	1.8	4	2.7	48
07289213	16	3.7	1.6	5.9	43	1.1	3	4.0	56
07289214	14	2.8	1.6	3.6	31	3.2	5	3.0	52
07289217	9	1.9	1.1	3.5	43	0.8	3	2.7	44
07289219	15	2.9	1.8	2.5	24	2.1	8	2.2	49
07289230	19	4.1	2.1	4.1	29	2.1	10	2.7	62

TABLE 2.--CONTINUED

SITE NUMBER	MILLIGRAMS PER LITER						MICROGRAMS PER LITER			
	DISSOLVED SOLIDS (VOL. ON IGNITION)	NITRATE AS N	NITRITE AS N	NITRATE PLUS NITRITE AS N	ORGANIC CARBON TOTAL	SUSPENDED SEDIMENT	IRON TOTAL	IRON DISSOLVED	MANGANESE TOTAL	MANGANESE DISSOLVED
02440795	88	0.18	0.02	0.20	2.5	198	90	17	57	57
02447195	17	0.17	0.03	0.20	5.4	108	3000	320	160	160
02447320	26	0.08	0.02	0.10	7.1	48	2600	890	870	740
02447337	27	.	.	0.10	5.4	124	1900	710	380	370
02447758	20	0.09	0.01	0.10	5.9	44	2700	630	360	360
02481744	32	.	0.01	0.10	14.0	39	3900	3100	1600	1600
02483598	26	0.18	0.02	0.20	11.0	71	1700	490	330	300
02483750	28	0.25	0.05	0.30	12.0	170	5400	300	450	260
02483760	16	0.17	0.03	0.20	5.0	148	2900	470	700	540
07289075	39	1.70	0.11	1.80	8.3	154	2500	360	580	450
07289210	24	0.06	0.04	0.10	5.6	250	3700	420	480	270
07289213	26	.	0.01	0.10	6.6	52	2700	890	500	390
07289214	26	0.16	0.04	0.20	9.8	192	8300	290	250	150
07289217	20	.	.	0.10	4.1	56	3000	530	150	79
07289219	24	0.17	0.03	0.20	5.6	62	3900	220	500	420
07289230	28	0.17	0.03	0.20	7.7	76	4000	550	500	350

Specific conductance at two sites, Lick Creek near Adaton (860 umhos) and Pigeon Roost Creek at Mathiston (130 umhos), was much higher than in the other streams. At the remaining sites specific conductance of the water averaged 52 umhos. The specific conductance of samples collected during the study are tabulated in table 2 and shown graphically in figure 4.

The pH of the water in the streams ranged between 6.2 and 7.2 units during the study. The pH of the water in 12 streams was less than 7.0 units and the pH of water in four streams ranged between 7.0 and 7.2 units. The lowest pH value was measured in Besa Chitto Creek near Weir, and the highest value was measured in Blytha Creek near Reform.

Dissolved oxygen concentrations ranged from 3.6 to 6.7 mg/L. The lowest concentration was in Big Creek near Sturgis. The mean dissolved oxygen concentration of water at all sampling sites was 5.4 mg/L.

Turbidity of the streams was less than 100 NTU (nephlometric turbidity units) at all but two sites. The water in Middle Bywy Creek had a turbidity value of 130 units and Besa Chitto Creek had a turbidity value of 100 units.

Suspended-sediment concentrations ranged from 39 mg/L in Nanih Waiya Creek near Boon to 250 mg/L in Big Bywy Ditch near Mathiston. Suspended-sediment concentrations for samples collected during the study are shown graphically in figure 5 and listed in table 2. Color values ranged from 5 units in Lick Creek to 130 units in Besa Chitto Creek.

The quantity and kinds of dissolved constituents were similar at most sites. Dissolved-solids concentrations were less than 80 mg/L, at all sites except Pigeon Roost, where the concentration was 105 mg/L. Dissolved-solids concentration for Lick Creek was not determined but the concentration of calcium (72 mg/L), magnesium (35 mg/L), sodium (45 mg/L), potassium (6.9 mg/L), sulfate (360 mg/L), and chloride (26 mg/L) were much greater than at the other sites. The sample collected from Pigeon Roost Creek contained the greatest concentration of nitrate plus nitrite (1.8 mg/L). Nitrate plus nitrite concentrations in samples from the remaining sites were 0.30 mg/L or less.

The results of laboratory analysis of bottom-material samples indicate that concentrations of arsenic, cadmium, mercury, and selenium were below detectable limits at all sites (table 3). Cobalt and lead also were at or below detectable limits at eight sites. Cobalt and lead concentrations exceeded 10 ug/g in bottom-material samples from Nanih Waiya Creek, Lick Creek, and Pigeon Roost Creek. Zinc, copper, and chromium concentrations exceeded 10 ug/g in bottom-material samples at several sites. Iron exceeded 1000 ug/g at all sites, and manganese exceeded 1000 ug/g at five sites.

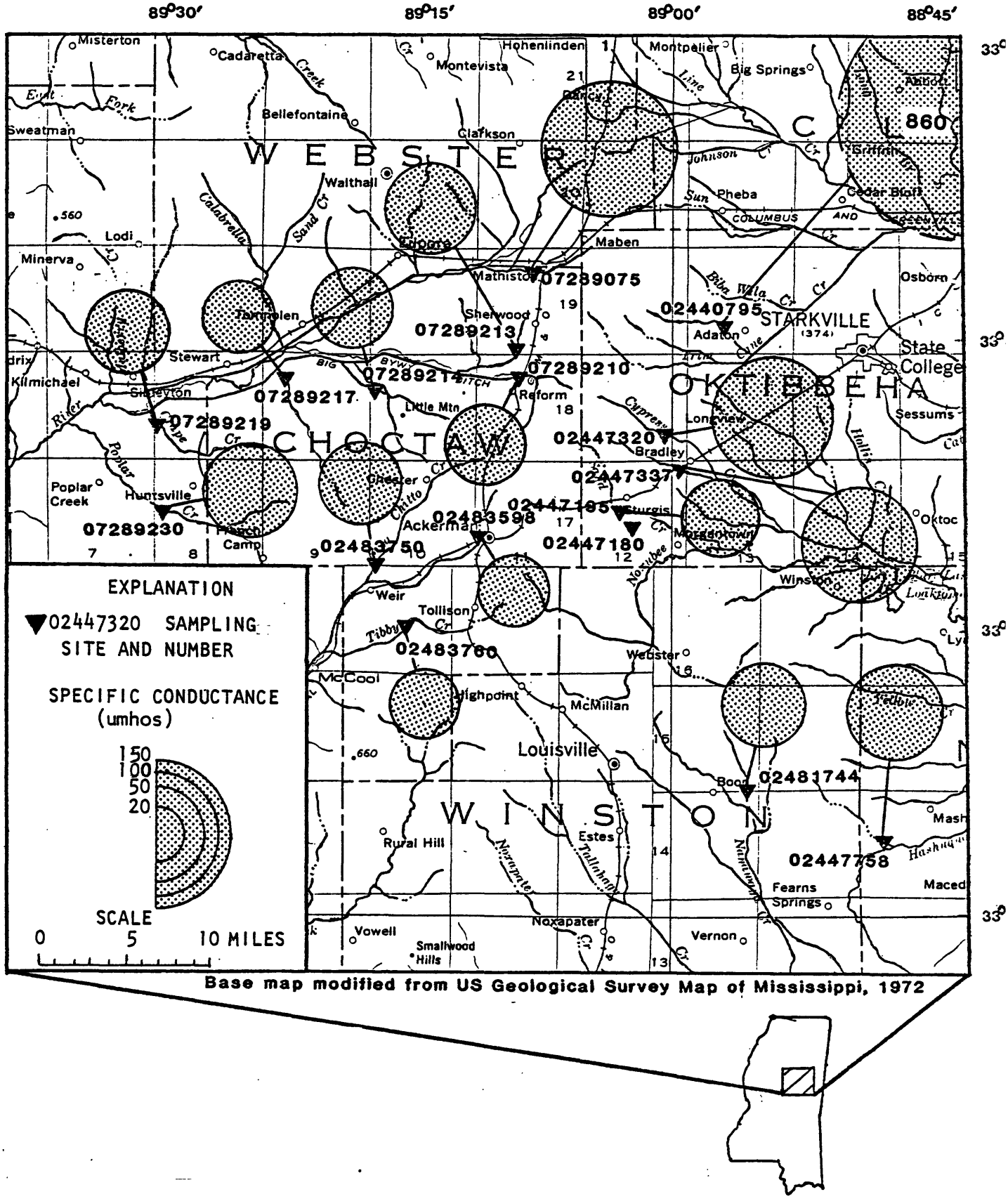

FIGURE 4.--SPECIFIC CONDUCTANCE OF STREAMS AT SAMPLING SITES, JULY 27-30, 1982.

TABLE 3.--LABORATORY ANALYSIS OF BOTTOM-MATERIAL SAMPLES COLLECTED FROM STREAMS IN EAST-CENTRAL MISSISSIPPI, JULY 27-30, 1982

SITE NUMBER	MICROGRAMS PER GRAM										
	ARSENIC	CADMIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD	MANGANESE	MERCURY	SELENIUM	ZINC
02440795	<1	<1	10	20	12	13000	30	3600	<0.01	<1	84
02447195	<1	<1	4	10	5	8700	10	810	<0.01	<1	18
02447320	<1	<1	3	10	47	6600	10	26	<0.01	<1	20
02447337	<1	<1	4	<10	1	4200	<10	120	<0.01	<1	9
02447758	<1	<1	1	<10	1	1900	<10	110	<0.01	<1	4
02481744	<1	<1	8	30	5	16000	10	2200	<0.01	<1	33
02483598	<1	<1	1	<10	1	1500	<10	210	<0.01	<1	1
02483750	<1	<1	3	<10	2	4100	<10	200	<0.01	<1	6
02483760	<1	<1	4	10	3	16000	10	4400	<0.01	<1	16
07289075	<1	<1	30	20	5	14000	30	2600	<0.01	<1	44
07289210	<1	<1	3	10	1	7900	10	660	<0.01	<1	5
07289213	<1	<1	2	<10	1	3800	<10	1300	<0.01	<1	7
07289214	<1	<1	1	<10	1	2100	<10	200	<0.01	<1	3
07289217	<1	<1	1	<10	1	2000	<10	890	<0.01	<1	6
07289219	<1	<1	3	10	3	3600	10	810	<0.01	<1	9
07289230	<1	<1	1	<10	1	1700	<10	200	<0.01	<1	4

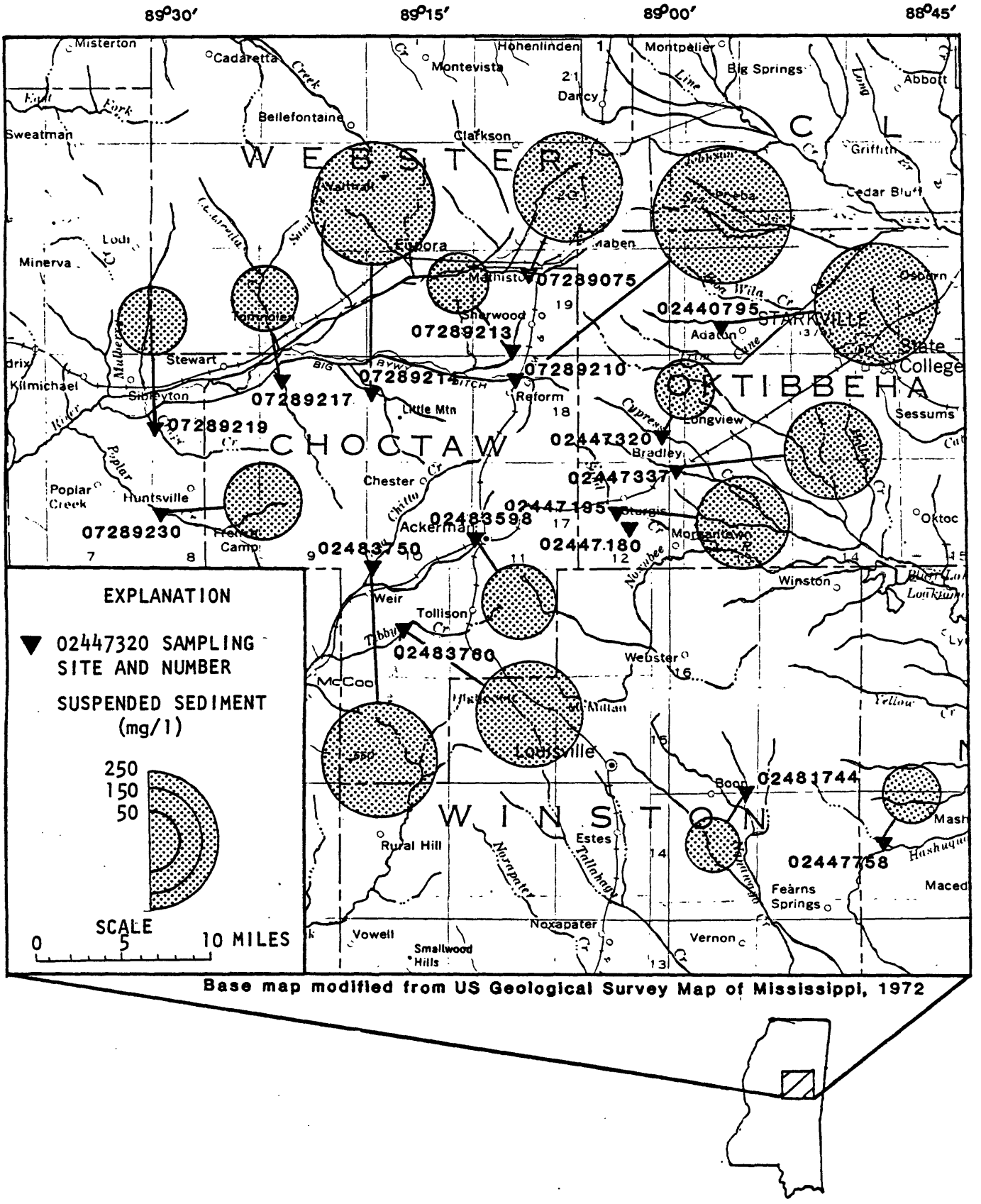

FIGURE 5.--SUSPENDED SEDIMENT CONCENTRATIONS OF STREAMS AT SAMPLING SITES, JULY 27-30, 1982.

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APPENDIX

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

Cubic foot 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 calcium and magnesium) and is expressed as equivalent calcium carbonate ($CaCO_3$).

Micrograms per gram (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.

Microgram per liter (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) is a unit for 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 also is 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 colaoid.

Specific conductance is a measure of the ability of water to conduct an electrical current and is expressed in micromhos (umhos) per centimeter at 25°C. 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 about 65 percent of the specific conductance (in micromhos). This relation is not constant from stream to stream and may even vary in the same source with changes in the composition of the water.

Tons per acre-foot indicates the dry mass of dissolved solids in 1 acre-foot of water. It is computed by multiplying the concentration in milligrams per liter by 0.00136.

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 a measure of light scatter of a beam of light passed through a sample of water.