QUALITY OF WATER AND BOTTOM MATERIAL OF STREAMS THAT DRAIN POTENTIAL LIGNITE MINING AREAS IN THE OUTCROP AREA OF THE WILCOX GROUP IN MISSISSIPPI

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CONVERSION FACTORS

For readers who may prefer to use the metric (International System) of units rather than the inch-pound units used herein, the conversion factors are listed below:

Multiply inch-pound unit	by	To obtain metric unit
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square foot (ft^2)	0.09290	square meter
square mile (mi^2)	2.590	square kilometer
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]
degree Fahrenheit (°F)	°C = 5/9 x (°F-32)	degree Celsius (°C)

ABBREVIATIONS

mg/L	milligram per liter
µg/g	microgram per gram
µg/L	microgram per liter
µm	micrometer
µS/cm	microsiemens per centimeter at 25 °C

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ABSTRACT

A hydrologic investigation to determine the quality of water and bottom material of streams that drain potential lignite mining areas in the outcrop area of the Wilcox Group in Mississippi was conducted annually during low streamflow in July or August from 1980 to 1985. The Wilcox Group crops out in a 15- to 40-mile-wide band from Lauderdale County in east-central Mississippi to Benton County in north-central Mississippi. The base flow of small streams is sustained by ground-water discharge. The water in the streams is slightly acidic to neutral, dissolved-oxygen concentrations are greater than 5.0 milligrams per liter, concentrations of bicarbonate generally are less than 30 milligrams per liter, and concentrations of other major ions are less than 10 milligrams per liter. Dissolved-solids concentrations generally are less than 100 milligrams per liter. Dissolved-solids concentrations generally decrease with increasing discharge. Suspended-sediment concentrations generally are less than 50 milligrams per liter and increase slightly with discharge. Both suspended sediment and bed material are important in the transport of iron and other metals in streams. Iron and manganese are the most prevalent metals in the bottom material. Concentrations of arsenic, cadmium, chromium, cobalt, copper, lead, selenium, and zinc in bottom material generally are less than 10 micrograms per gram. Mercury concentrations in bottom material are less than 0.05 microgram per gram.

INTRODUCTION

With the advent of the energy crisis in the 1970's and early 1980's, a search for alternative domestic energy supplies was begun. Geothermal and solar energy, oil shale, coal, and lignite were several alternative energy sources considered. Of these, only solar energy and lignite deposits are readily available in Mississippi. Technology for the large scale commercial use of solar energy has yet to be developed. Technology for the utilization of lignite deposits in Mississippi is presently available and the development for this resource only awaits suitable economic conditions.

Potentially mineable deposits of lignite occur in the outcrop area of the Wilcox Group. Lignite deposits in Mississippi have been listed by Brown (1907) and Williamson (1976), and were described in reports on the geology and mineral resources of Calhoun (Parks, 1961, p. 63), Choctaw (Vestal, 1943, p. 74-86), Marshall (Vestal, 1954, p. 26-66), Yalobusha (Turner, 1952, p. 11), Lauderdale (Foster, 1940, p. 94), and Lafayette (Attaya, 1951, p. 18) Counties. Areas that contain lignite beds 2.5 feet or more thick and less than 250 feet deep in the outcrop of the Wilcox Group were mapped by Meissner and others (1982, plate 9).

With present technology, lignite mining can be economically feasible with the removal of up to 150 feet of overburden; however, the removal of overburden and the mining of lignite may adversely affect the streamflow and water quality in nearby streams. Puente and Newton (1979) reported that low flows of streams were higher in mined than in unmined areas and water in streams that drained mined areas was often highly mineralized and contained high concentrations of dissolved and total iron, aluminum, and manganese. The pH also generally was lower in mined than in unmined areas. Peters (1981, p. 18) reported an 18-fold increase in sodium concentration for mined areas and a 14-fold increase in sulfate concentration over background levels.

Purpose and Scope

In order to assess the effect of strip mining of lignite in Mississippi, there is a need for background data on quality of water and bottom material in streams that drain potential mining areas. This report presents the results of the chemical analyses of samples and describes the relations between various physical and chemical characteristics of the water and bottom materials in these streams. Relations between these constituents may be expected to change with the onset of mining activities and thus may be used to assess the effect of mining activities on stream water quality.

Stream discharge measurements were made and water samples were collected at 87 sites in the northeastern quarter of Mississippi in or near the outcrop area of the Wilcox Group (fig. 1). Samples were collected from Lauderdale County in east-central Mississippi to Benton County in north-central Mississippi. Fifteen samples were collected yearly during a low-flow period in July or August from 1980 to 1985. Three types of samples (water, suspended sediment, and bottom material) were collected at each site. Water samples were analyzed for all major ions and several metals (iron, manganese, and aluminum). Suspended-sediment concentrations were determined from sediment samples. Bottom-material samples were analyzed for trace metals commonly found in lignite.

Results of the analyses of water, sediment, and bottom material samples have been published in yearly open-file data reports (Arthur, 1981 and 1982, Kalkhoff 1983, 1984, 1985, and 1986). The results along with field measurements are permanently stored in the U.S. Geological Survey WATSTORE water-quality file and are listed in the hydrologic data section in the back of this report (tables 1-5).

Topography and Land Use

The outcrop area of the Wilcox Group is characterized by rugged topography along the eastern edge and by gently rolling hills and moderately wide floodplains elsewhere. The hilly areas that form the majority of the area are wooded. Much of the relatively flat stream valleys and terraces are used for row crops (cotton, soybeans) and pasture.

Numerous small communities and towns (less than 10,000 population) are scattered

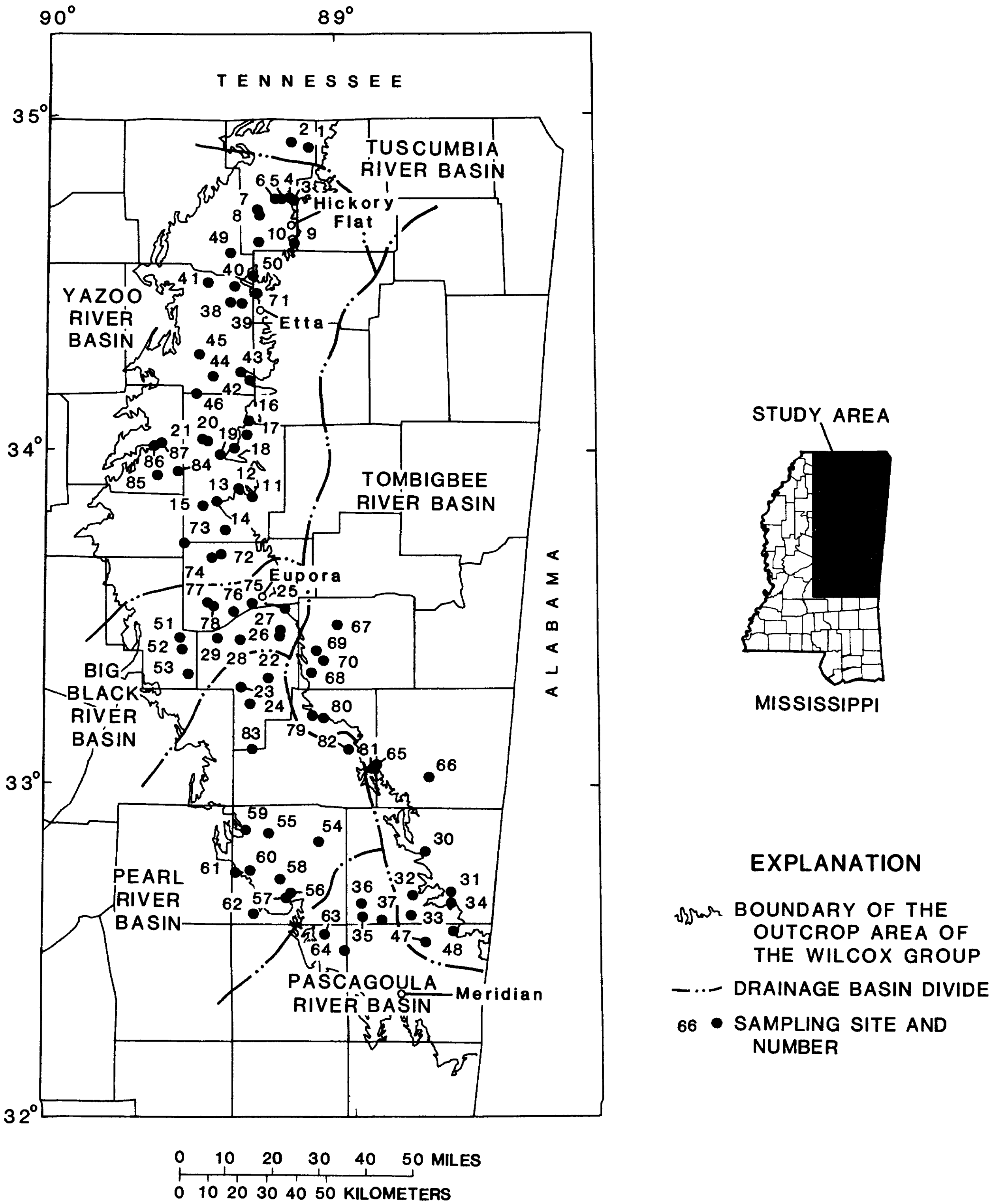

Figure 1.--*Location of the study area, drainage basins, and sampling sites.*

across the area. The upstream parts of Grenada, Enid, and Sardis Lakes are in or near the western edge of the outcrop of the Wilcox Group.

Geology

A detailed description of the stratigraphy and the depositional environment in the Wilcox Group is given by Williamson (1976, p. 17-24) and is briefly summarized here. The Wilcox Group is composed predominantly of non-marine interbedded varyingly carbonaceous clay, silt and sand, and beds of lignite. Wilcox clays are various shades of gray with occassional green and blue shades. Silts generally are white to light gray and are present in thin layers. Sands vary from white to yellow, are predominantly fine to medium grained, and, in places, include lignite fragments. During periods of low flow, ground water discharged from the Wilcox Group and, in places, from the uppermost beds of the Midway Group (Naheola Formation) sustains streamflow. Westward, streams drain only the Wilcox beds and farther west the overlying Meridian Sand Member of the Tallahatta Formation.

Climate

The climate in the study area is moist and subtropical (Sanders, 1959, p. 216). The mean maximum temperature ranges from 54-60 °F in January to 92 °F in July, and the mean minimum temperature ranges from 34 to 40 °F in January to 70 °F in July. Maximum daily temperatures exceed 90 °F from June to September. Mean annual precipitation (National Oceanic and Atmospheric Administration, 1984) ranges from 53 inches at Meridian in the southern part of the study area to more than 55 inches in the central and northern part of the study at Eupora and Hickory Flat. Mean monthly precipitation is greatest in the winter and early spring (fig. 2) when rainfall comes from large frontal systems. Increased rainfall in July is due to the development of localized thunderstorms. The driest months are in late summer and early fall.

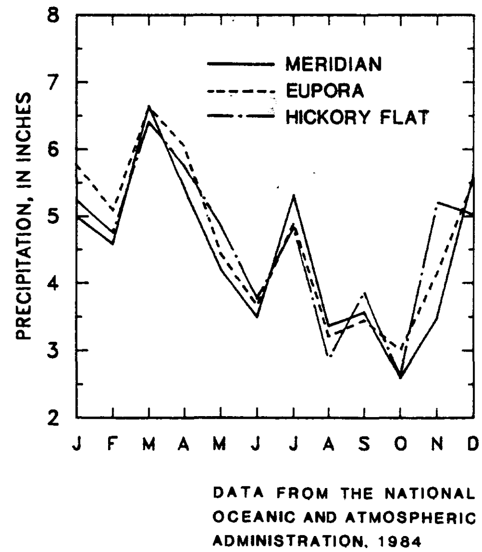

Figure 2.--*Mean monthly precipitation at three sites in the study area, 1948-84.*

Hydrology

The Wilcox Group is drained by many small streams which are in six major drainage basins (fig. 1). Streamflow in small streams in the Wilcox outcrop area originates primarily from two sources, surface runoff from precipitation and ground-water inflow (fig. 3). Figure 4 shows precipitation and the corresponding discharge in Cypress Creek near Etta, Miss. Although the data are from 1940, the precipitation was close to the long-term (86-year) average and thus the pattern of discharge is representative of that in a small stream (28.5-mi^2 drainage area) draining the Wilcox Group. Discharge was greatest during the winter and early spring when the precipitation was the greatest. Discharge was the least during late summer from August through October. Streamflow orginates primarily from ground-water inflow during this period.

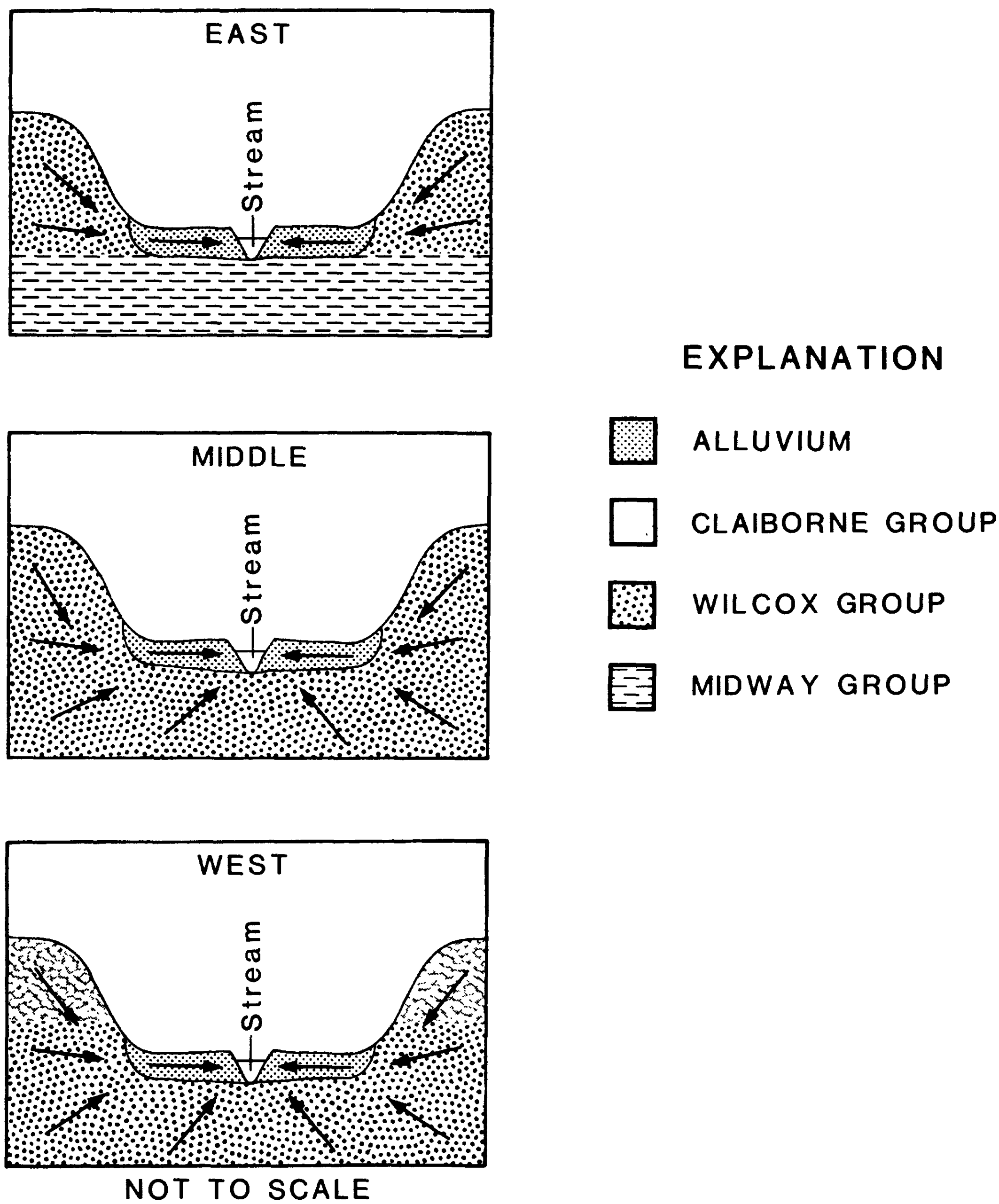

Figure 3.--*Generalized geologic section across a stream that drains the east, middle, and west parts of the outcrop area of the Wilcox Group.*

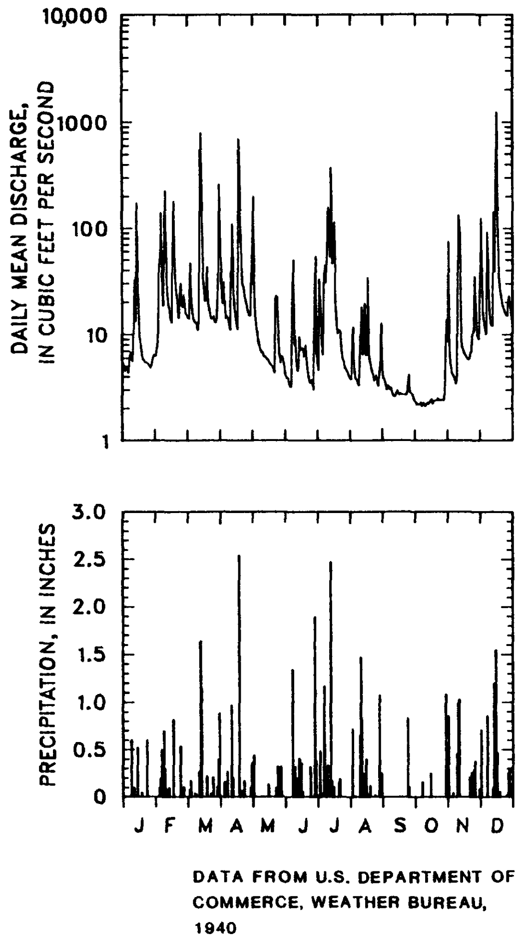

Figure 4.--*Daily mean discharge in Cypress Creek near Etta (site 38) and daily precipitation at University, Mississippi, 1940.*

Tharpe (1975, p. 19) mapped the annual minimum 7-day average flow with a 10-year recurrence interval for streams in the study area. He reported that the minimum discharge per unit drainage area (Q/A) generally was less than 0.01 $(ft^3/s)/mi^2$ (cubic foot per second per square mile) of drainage area. Flow was greater in the extreme northern part and along the more rugged eastern edge of the Wilcox outcrop area where the Q/A ranged from 0.01 to 0.3 $(ft^3/s)/mi^2$. Thus, Q/A values greater than approximately 0.3 found during the low-flow period during August through October indicate that streamflow originates partially from precipitation runoff.

During this investigation, Q/A values calculated from measured discharges ranged from 0.004 to 1.58 $(ft^3/s)/mi^2$. The median value was 0.13 $(ft^3/s)/mi^2$. The interquartile range was 0.05 to 0.28 $(ft^3/s)/mi^2$. This indicates that most samples were collected during a low-flow period when streamflow originates from ground-water inflow.

Methods

Streamflow measurements were made at time of sample collection by methods described by Buchanan and Somers (1969, p. 38-40). Water temperatures and dissolved oxygen were measured in the stream. The pH and specific conductance were measured immediately after sample collection. Water samples were dipped from well-mixed sections of the shallow, narrow streams.

Water samples collected for the analysis of dissolved ions were filtered through a 0.45 µm membrane filter into polyethylene bottles. Water samples collected for analysis of cationic constituents were preserved by acidifying with nitric acid to a pH less than 2.0. Mercuric chloride tablets were added to unfiltered samples for nitrogen analysis. Water samples were stored in ice chests and shipped to the Survey's central lab in Doraville, Georgia. Analyses of water samples were by the methods described by Fishman and Friedman (1985) and listed in table 6 at the back of this report.

Because water depth was shallow at most sites, sediment samples generally were collected by dipping a sample from the stream. Sediment samples were analyzed at the U.S. Geological Survey sediment lab in Baton Rouge, Louisiana.

Bottom material samples were scooped from a representative section of the stream channel and generally were collected in a ponded or slow moving part of the stream. Bottom material samples were analyzed in the U.S. Geological Survey lab in Doraville, Georgia. Analysis of bottom material samples were by methods described by Fishman and Friedman (1985).

Bicarbonate concentrations were not determined analytically, but were calculated by subtracting the sum of the equivalents of chloride and sulfate from the total equivalents of cations and then converting the difference (assumed to be equivalents of bicarbonate) to concentration of bicarbonate. Because nitrate concentrations generally were negligible, they were ignored in the calculation of the bicarbonate concentration. Suspended iron and manganese concentrations were calculated by subtracting the dissolved concentration from the total concentration.

QUALITY OF WATER

Natural factors as well as human activities affect stream water quality. During low-flow periods when most or all of the streamflow originates from ground-water inflow, the stream water quality will have similar characteristics to the water in the outcropping aquifers. Water quality of the Wilcox aquifer in its outcrop will, in turn, be determined by geochemical reactions taking place between aquifer materials and precipitation. High concentrations of ions may occur during the summer drought periods when evaporation is greatest. During periods of high streamflow most of the flow originates from overland runoff, and the quality of the water is very similar to that of rainwater, unless the overland runoff has picked up contaminants from the land surface. Climatic conditions such as precipitation and temperature will indirectly influence water quality during both low- and high-flow periods. Land-use practices in the study area will influence the type of materials flowing into streams and thus have an effect on stream water quality. Changing land use practices (such as lignite mining) may alter the chemical character of water in streams.

Summaries of the water quality, suspended sediment, and bed material data collected during this investigation are presented in this report in terms of median values and interquartile range and not the more familiar terms of mean values and standard deviations. Means and standard deviations accurately describe the distribution of the data when the data are normally distributed. The nonparametric statistical terms median and interquartile range were used because they are based on rank and do not rely on the presence of normally distributed data.

The nonparametric equivalent of the mean, the median, is less influenced by extreme values and provides a better measure of central tendency than the mean when the population has a few extremely large or small values. The median is the value, when all data are ranked from smallest to largest values, above or below which lie an equal number of observations (Lapin, 1973, p. 46).

The nonparametric measure of dispersion is the interquartile range. The interquartile range is defined as the range of the middle 50 percent of the observation values (Lapin, 1973, p. 54), when the observation values are ranked from smallest to largest.

Chemical Quality

The water quality of streams that drain the outcrop of the Wilcox Group is statistically summarized in table 7 at the back of this report and is illustrated in figure 5. The data indicate that during low-flow periods water in small streams is typically a calcium, magnesium, sodium bicarbonate type that has a slightly acidic to neutral pH, and has low dissolved-solids concentrations (less than 100 mg/L). Major cation concentrations generally are less than 10 mg/L. Concentrations of two anions, sulfate and chloride, generally are less than 10 mg/L. Bicarbonate is the predominate anion and usually is present in concentrations between 10 and 30 mg/L.

Concentrations of other dissolved constituents generally are low. Dissolved aluminum concentrations are at or below detection limits (100 μg/L) and dissolved iron and manganese concentrations generally are less than 600 and 400 μg/L, respectively. The turbidity generally is less than 20 NTU (nephelometric turbidity units).

There is little areal variation in the water quality of streams that drain the Wilcox Group. The pH is similar throughout the outcrop area and generally is within the range from 6.6 to 7.0. Dissolved-solids concentrations are variable and no pattern or trend is apparent in the outcrop area. Concentrations of sulfate (an ion commonly indicative of coal mining activity) ranged

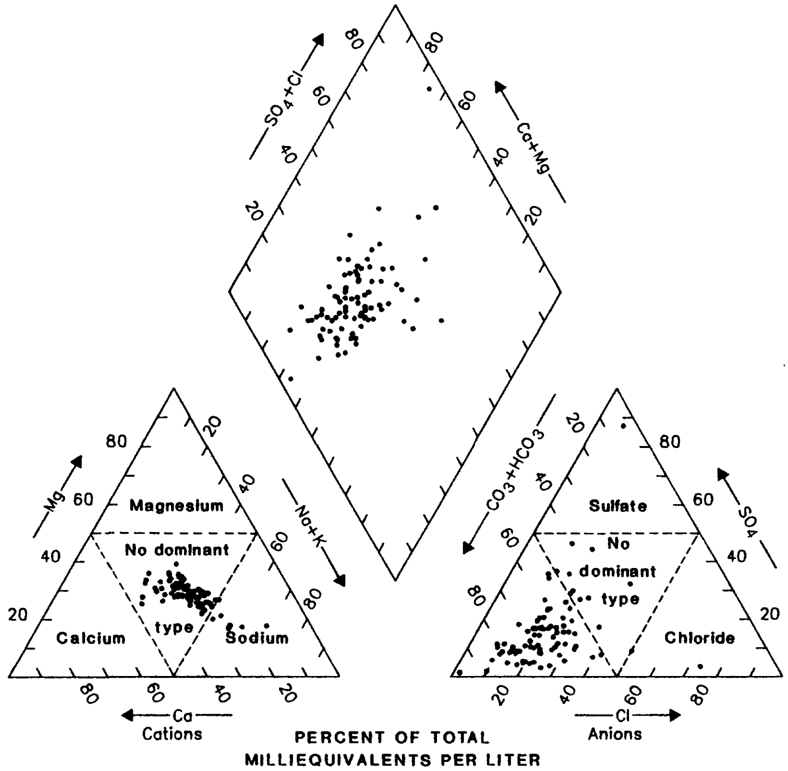

Figure 5.--*Classification of major water types in streams in the study area.*

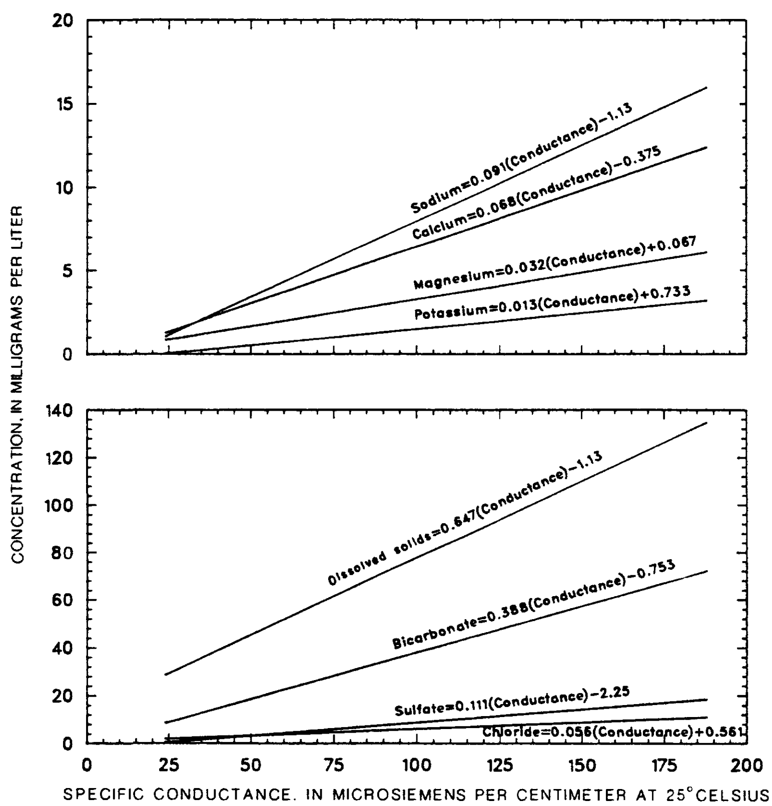

Figure 6.--*Relations between specific conductance and major constituents and dissolved-solids concentrations during low-flow periods at sites on streams that drain the outcrop area of the Wilcox Group, 1980-85.*

from 1.9 to 5.0 mg/L, with no pattern evident.

Several sites sampled during this investigation had water quality that was not typical of streams draining the outcrop area. Water in Lick Creek (site 67) in Oktibbeha County had significantly higher concentrations (table 2) of the major dissolved ions than water in nearby streams. The cause of increased mineralization could not be determined. Several streams that drained small communities also had slightly increased dissolved-solids concentrations.

The linear relations between conductance and concentrations of individual ions and dissolved solids is shown in figure 6. The correlation coefficient ranged from 0.65 for sulfate to 0.94 for both calcium and dissolved solids. These linear relations are valid for streams that drain the Wilcox Group that are unaffected by lignite mining activities and have specific conductance values ranging from 25 to approximately 190 µS/cm.

Analysis of water-quality data indicate a negative correlation between dissolved-oxygen concentrations and total organic carbon concentrations. A plot of the two constituents (fig. 7) shows a general trend of descreasing dissolved-oxygen concentration with increasing total organic-carbon concentration. An increased organic carbon load in streams from mining activities would thus decrease dissolved-oxygen concentrations and would ultimately have a negative effect on aquatic life.

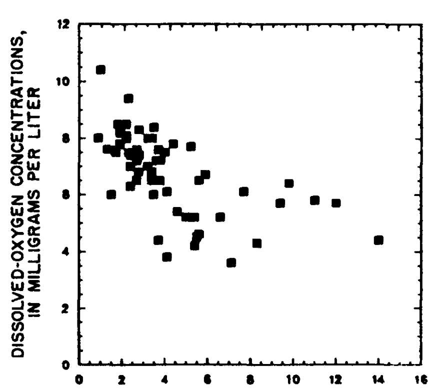

Figure 7.--*Relation between total organic carbon and dissolved-oxygen concentrations during low-flow periods at sites on streams that drain the outcrop area of the Wilcox Group, 1980-85.*

A negative correlation was also found between stream discharge and dissolved-solids concentration. Because the drainage areas upstream of the sampling sites varied widely, direct comparisons of the dissolved-solids concentrations between streams may be misleading. The drainage area can be accounted for by calculating a new variable, Q/A, which is the discharge per unit area in cubic feet per second per square mile. Dissolved-solids concentrations tended to decrease with increasing Q/A (fig. 8). Dilution of ground-water discharge by overland flow may account for the decreasing concentrations. If mining activity was present in a basin, overland flow may dissolve minerals exposed on the land surface, increasing the dissolved-solids concentrations overland. Thus in mined basins, dissolved-solids concentrations may increase with increasing Q/A.

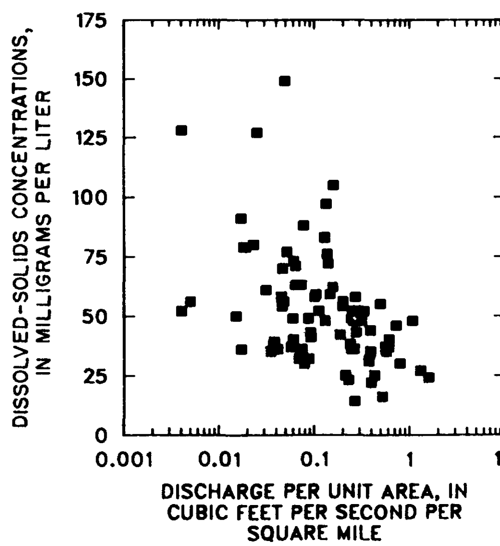

Figure 8.--*Relation between dissolved-solids concentrations and unit discharge of streams that drain the outcrop area of the Wilcox Group, 1980-85.*

Suspended Sediment

Removal of materials overlying lignite deposits and the subsequent erosion of spoil banks may cause increased sediment concentrations in streams that drain mined areas. Increased sediment concentrations may have several detrimental effects on the hydrology and water quality of the streams. High sediment concentrations can be esthetically unattractive. Deposition of sediments may reduce the flow capacity of stream channels and reservoir storage capacity. Sediments of deposition may cause serious ecological changes by alteration of species composition and population density of the biological community (Guy, 1970, p. E4). High concentrations of suspended sediment in surface-water supplies will increase water treatment costs for municipal and industrial supplies and may facilitate the transport of metals generally found in lignite deposits.

In streams that drain the outcrop area of the Wilcox Group, suspended-sediment concentrations generally were less than 50 mg/L (table 4). The variation in concentration is attributed to variations in stream discharge and corresponding variations in stream velocities and land use practices. Figure 9 illustrates the effect of precipitation on sediment concentrations in unmined basins. In 1982 when a significantly greater amount of precipitation (2.44 in.) fell in the week preceding the sampling, the median sediment concentration was significantly greater (92 mg/L) than in the years 1980-81 and 1983-85 (15-32 mg/L).

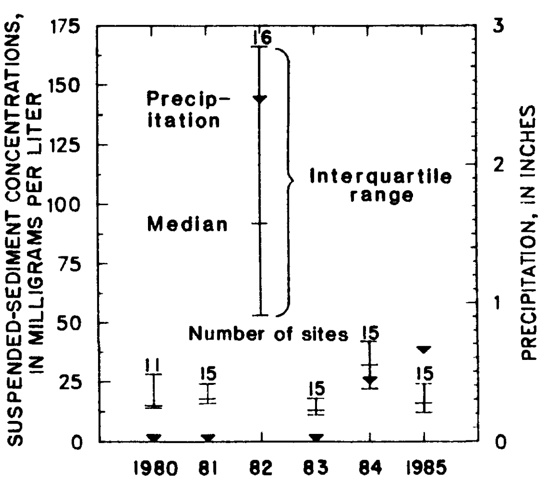

Figure 9.--*Median and interquartile range of suspended-sediment concentrations for sites on streams sampled annually, 1980-85, and precipitation in the week preceding the sampling.*

Correlations between suspended-sediment concentrations and stream discharge per unit drainage area (Q/A) are shown in figure 10. This figure shows a slight trend of increasing sediment concentrations with Q/A. Sediment concentrations increase as the predominant source of streamflow changes from ground-water inflow to overland flow, indicating that overland flow has washed sediment into the stream.

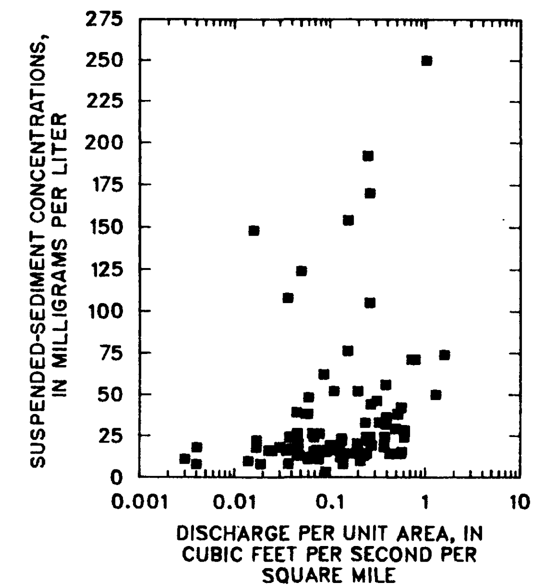

Figure 10.--*Relation between suspended-sediment concentrations and unit discharge of streams that drain the outcrop area of the Wilcox Group, 1980-85.*

Total iron concentrations, color, and turbidity were also correlated with sediment concentrations and had coefficients of 0.68, 0.57, and 0.76, respectively (fig. 11). Physical and chemical constituents (turbidity values and total iron concentrations) associated with sediment generally increased with increasing sediment concentrations. Values for color varied between 1 and 100 units in samples with less than 50 mg/L suspended-sediment concentrations. For suspended-sediment concentrations greater than 50 mg/L there was a general trend of increasing color with increasing sediment concentrations.

Peters (1981, p. 18) reported that suspended material is important in the transport of metals in a small stream in Indiana. This was found to be the case in

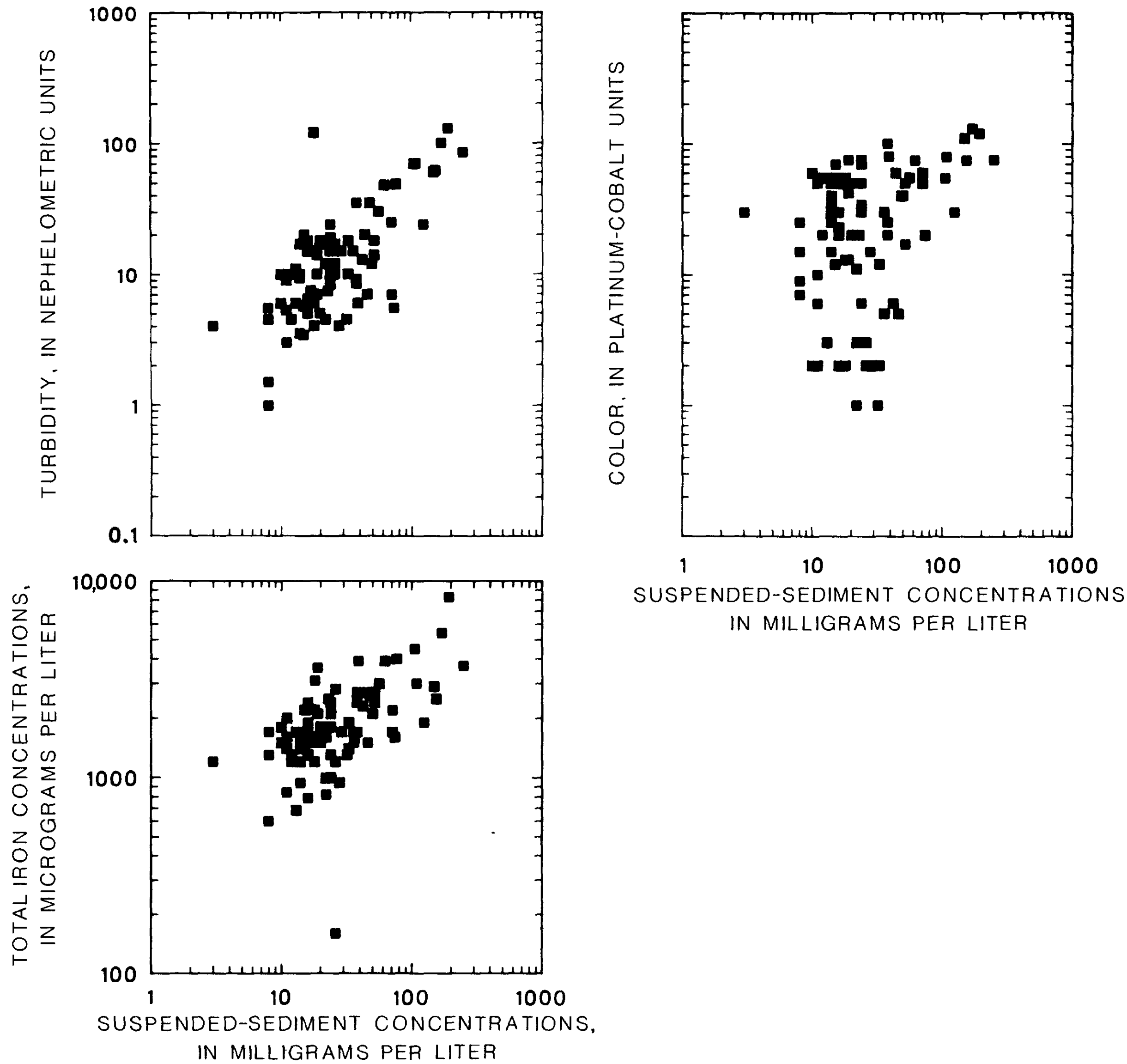

Figure 11.--*Relations between turbidity, total iron concentrations and color and suspended-sediment concentrations in streams that drain the outcrop area of the Wilcox Group, 1980-85.*

streams draining the Wilcox outcrop also. Suspended-iron concentrations were greater than dissolved-iron concentrations at 80 of 84 sites. This was not the case however, for manganese. Suspended manganese concentrations were greater than dissolved manganese at only 4 of 84 sites.

QUALITY OF BOTTOM MATERIAL

Bottom material is important when considering the water quality of a stream. Clays, silts, sands, and organic material that comprise the bottom material may serve as sources or sinks for trace metals. Depending on stream velocities, bottom material may be transported to downstream locations and some metals associated with the bottom materials may dissolve back into solution, altering stream water quality.

Trace metal concentrations in stream bottom samples collected in this investigation are given in table 8 at the back of this report. Arsenic and cadmium were not detected. Cobalt, lead, and selenium were detected in less than 10 samples. Chromium and zinc were detected in the majority of the samples but generally were present in concentrations less than 10 μg/g. Mercury was detected in slightly less than half the samples but concentrations generally were less than 0.05 μg/g. Iron and manganese were the most prevalent metals present in the bottom material. The median iron and manganese concentrations were 1,600 and 270 μg/g, respectively.

SUMMARY AND CONCLUSIONS

A study to define background quality of water and bottom materials in streams in potential lignite mining areas that drain outcrop areas of the Wilcox Group was conducted during low-streamflow periods in July or August. From 1980 to 1985, 15 sites were sampled each summer. The discharge per unit area generally was less than 0.3 $(ft^3/s)/mi^2$ indicating streamflow originated primarily from ground-water inflow during the study sampling period.

Water in small streams in the study area during low-flow periods typically is a calcium, magnesium, sodium bicarbonate type having a slightly acidic to neutral (6.6 to 7.0) pH, dissolved-oxygen concentrations greater than 5.0 mg/L, and dissolved-solids concentrations less than 100 mg/L. Major cation concentrations generally are less than 10 mg/L. Of the major anions, bicarbonate is the only ion generally present in concentrations greater than 10 mg/L. No significant areal variations in pH, sulfate, and dissolved solids were found.

Concentrations of the major ions and dissolved solids can be estimated from the linear relations between the individual ion and the specific conductance. These linear equations are valid for streams that drain Wilcox outcrops unaffected by lignite mining activities and have specific conductance values in the range from 25 to about 190 μS/cm. Dissolved-solids concentrations generally decrease with increasing discharge per unit drainage area.

Suspended-sediment concentrations generally were less than 50 mg/L. Variations were due primarily to variations in rainfall in the week preceding the sampling and to variations in the amount of overland runoff in the streamflow. Suspended-sediment concentrations increased slightly with increasing discharge per unit drainage area. Total iron, color, and turbidity values increased with increasing suspended-sediment concentrations. Suspended-iron concentrations were greater than dissolved iron concentrations at 80 of 84 sites.

Iron and manganese were the most prevalent metals present in the bottom material. The median iron and manganese concentrations were 1,600 and 270 μg/g, respectively. Concentrations of metals at most sites in the bottom material in streams draining the Wilcox outcrop were less than 10 μg/g. Mercury concentrations in bottom material were less than 0.05 μg/g.

This study documents the water quality of small streams during periods of low streamflow, when the quality may be severely alterted by mining activities. Additional data are needed to document background water quality of streams at higher flow when overland flow is a major contributor to streamflow. Additional data are also needed in unmined areas to understand the relation between the water quality in the shallow Miocene aquifer and the streams.

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HYDROLOGIC DATA

Table 1.--*Location and drainage area of surface-water sampling sites*

Map number	Site identi-fication number	Station name	Location Lat.	Location Long.	Drainage area (mi^2)
		Benton County			
1	07030361	Wolf River on Cnty road nr Brody	345434	0890253	5.82
2	07030364	Grogg Creek near Canaan	345532	0890641	14.85
3	07269400	Shelby Creek near Gravestown	344505	0890609	18.98
4	07269650	Curtis Creek near Ashland	344535	0890702	5.80
5	07269700	Yellow Rabbit Creek near Ashland	344521	0890848	16.25
6	07269790	Rhoden Creek near Pine Grove	344522	0891013	7.73
7	07269815	Snow Creek near Pine Grove	344323	0891406	48.40
8	07269850	Chilli Creek near Pine Grove	344225	0891341	18.86
9	07269878	Oaklimeter Creek near Hickory Flat	343722	0890559	11.15
10	07269879	Pechahalee Creek near Hickory Flat	343738	0891351	6.92
		Calhoun County			
11	07281975	Duncan Creek nr Derma	335140	0891508	8.45
12	07281991	Huffman Creek nr Calhoun City	335310	0891806	8.36
13	07282015	Big Creek nr Big Creek	335051	0892250	15.56
14	07282198	Shutispear Creek NE of Slate Springs	334540	0892100	6.52
15	07282210	Savannah Creek at Big Creek	335005	0892550	8.07
16	07282898	McGill Creek nr Sarepta	340518	0891554	8.68
17	07282904	Savannah Creek nr Bruce	340250	0891620	7.02
18	07282980	Cowpen Canal nr Bruce	340024	0891904	22.88
19	07283010	Yoda Creek at Bruce	335915	0892208	11.00
20	07283200	Brushy Creek nr Bruce	340140	0892452	20.28
21	07283208	Persimmon Creek nr Bruce	340202	0892601	18.48
		Choctaw County			
22	02483598	Yockanookany River NW of Ackerman	331858	0891130	7.80
23	02483750	Besa Chitto Creek nr Weir	331719	0891725	18.30
24	02483760	Tibby Creek nr McCool	331420	0891534	30.20
25	07289075	Pigeon Roost Creek at Mathiston	333128	0890755	17.20
26	07289210	Big Bywy Ditch nr Mathiston	332628	0890906	21.60
27	07289213	Blytha Creek nr Reform	332736	0890856	4.09
28	07289214	Middle Bywy Creek nr Tomnolen	332551	0891739	30.70
29	07289217	McCurtain Creek nr Stewart	332607	0892234	41.30

Table 1.--*Location and drainage area of surface-water sampling sites*--Continued

Map number	Site identification number	Station name	Location Lat.	Location Long.	Drainage area (mi^2)
		Kemper County			
30	02467091	Sucarnoochee Creek Below Dekalb	324741	0883743	76.20
31	02467240	Pawticfaw Creek nr Blackwater	323950	0884031	34.66
32	02467290	Pawticfaw Creek West of Porterville	324026	0883212	92.70
33	02467310	Blackwater Creek nr Klondike	323618	0884052	11.37
34	02467390	Blackwater Creek nr Oak Grove	323827	0883210	45.00
35	02475800	Tallachula Creek nr Damascus	323828	0885129	12.00
36	02475802	Okatibbee Creek nr Klondike	323606	0885113	32.20
37	02475850	Chickasawhay Creek nr Klondike	323528	0884705	26.10
		Lafayette County			
38	07268500	Cypress Creek nr Etta	342630	0891725	28.50
39	07268510	Puskus Creek nr Etta	342642	0891957	19.28
40	07268750	Wolf Creek near Etta	342938	0891903	7.14
41	07270500	Bagley Creek near Abbeville	343018	0892453	9.96
42	07273660	Coon Creek nr Toccopola	341232	0891546	7.89
43	07273690	Muckaloon Creek nr Tula	341402	0891739	5.99
44	07273850	Potlockney Creek nr Tula	341316	0892341	20.44
45	07273950	Pumpkin Creek nr Denmark	341718	0892642	15.63
46	07274237	Otouckalofa Creek at Paris	341010	0892724	20.77
		Lauderdale County			
47	02467430	Ponta Creek nr Lizelia	323128	0883743	22.90
48	02467459	Big Reed Creek nr Tamola	323325	0883145	17.30
		Marshall County			
49	07270000	Potts Creek nr Potts Camp	343540	0892000	8.26
50	07270200	Mills Creek near Cornersville	343130	0891501	20.24
		Montgomery County			
51	07289160	Wolf Creek at Sibleyton	332616	0893043	41.28
52	07289219	Crape Creek nr Kilmichael	332406	0893014	18.60
53	07289230	Poplar Creek nr French Camp	331941	0892853	43.70

Table 1.--*Location and drainage area of surface-water sampling sites*--Continued

Map number	Site identi-fication number	Station name	Location Lat.	Location Long.	Drainage area (mi^2)
		Neshoba County			
54	02481865	Spring Creek nr Bond	324939	0890041	2.81
55	02481892	Jofuska Creek nr Arlington	325108	0891129	18.91
56	02481911	Coonshuck Canal nr House	324022	0890639	17.30
57	02481920	Fulton Canal at McDonald	323927	0890741	23.28
58	02481930	Lonsilocher Canal nr Philadelphia	324249	0890859	16.69
59	02481967	Lukfapa Creek nr Arlington	325142	0891622	16.52
60	02481986	Beasha Creek nr Laurel Hill	324424	0891524	21.61
61	02481995	Luneluah Creek at Laurel Hill	324400	0891835	14.68
62	02482715	Sipsey Creek nr Dixon	323640	0891442	17.96
		Newton County			
63	02475209	Tallashua Creek Above Little Rock	323258	0885925	44.20
64	02475580	Tallahatta Creek nr Little Rock	323003	0885506	20.40
		Noxubee County			
65	02447758	Blackwater Creek nr Fearns Springs	330322	0884806	10.40
66	02448190	Running Water Creek nr Shuqualak	330105	0883650	38.30
		Oktibbeha County			
67	02440795	Lick Creek nr Adaton	332835	0885637	
68	02447195	Sand Creek nr Sturgis	331958	0890214	43.60
69	02447320	Big Creek nr Sturgis	332353	0890109	8.27
70	02447337	Cypress Creek nr Bradley	332210	0885937	9.89
		Union County			
71	07268200	Fice Creek at Etta	342820	0891410	9.09

Table 1.--*Location and drainage area of surface-water sampling sites*--Continued

Map number	Site identi- fication number	Station name	Location Lat.	Location Long.	Drainage area (mi^2)
		Webster County			
72	07282240	Sabougla Creek nr Slate Springs	334120	0892149	35.52
73	07282250	Pryor Creek nr Cadaretta	334042	0892353	14.83
74	07282320	Horse Pen Creek nr Cadaretta	334320	0892952	8.31
75	07289090	Little Black Creek at Eupora	333225	0891505	25.08
76	07289110	Salt Creek nr Eupora	333055	0891905	6.90
77	07289112	Calabrella Creek nr Tomnolen	333235	0892445	15.01
78	07289120	Sand Creek nr Tomnolen	333154	0892325	13.30
		Winston County			
79	02447085	Little Noxubee River nr Webster	331215	0890205	23.75
80	02447090	Mill Creek nr Louisville	331151	0885940	24.57
81	02447755	Moody Creek nr Fern Springs	330241	0884902	17.94
82	02481744	Nanih Waiya Creek nr Boon	330613	0885412	11.00
83	02482292	Lobutcha Creek nr Rural Hill	330616	0891502	42.21
		Yalobusha County			
84	07283465	Unnamed Creek nr Benwood	335615	0893120	6.95
85	07283478	York Creek nr Coffeeville	335535	0893548	12.42
86	07283720	Turkey Creek nr Velma	340049	0893628	41.93
87	07283725	Hurricane Creek nr Velma	340121	0893455	7.30

Table 2.-- *Physical characteristics of water in streams that drain potential lignite mining areas in Mississippi*

[ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter; °C, degrees Celsius; mg/L, milligrams per liter; NTU, nephelometric turbidity units; dash indicates missing data]

Map number	Date of collection	Time (hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (units)	Temperature (°C)	Oxygen, dissolved (mg/L)	Color (units)	Turbidity (NTU)
				Benton County					
1	08/15/85	1300	2.17	38	6.8	25.5	6.5	55	6
2	08/15/85	1445	4.08	60	6.4	29.0	6.0	75	10
3	08/15/85	1630	7.17	30	6.7	27.0	6.8	75	15
4	08/20/85	1330	2.48	30	6.1	24.0	--	30	4
5	08/20/85	1605	12.7	29	6.4	25.0	--	50	7
6	08/21/85	0905	10.0	28	6.4	23.0	--	40	12
7	08/21/85	1225	76.3	31	6.6	27.0	--	20	6
8	08/15/85	0955	3.71	67	7.1	25.5	7.5	20	5
9	08/21/85	1540	1.44	61	6.7	31.0	--	55	10
10	08/15/85	0815	.26	50	6.8	25.0	7.0	25	6
				Calhoun County					
11	08/28/83	1010	.41	188	7.3	25.5	8.1	3	11
12	08/28/83	1220	.03	156	7.2	31.0	6.8	2	3
13	08/27/83	1530	.30	115	8.1	35.5	9.1	9	1
14	08/27/83	1215	3.20	77	6.9	25.5	5.6	2	15
15	08/28/83	1400	.63	45	7.3	31.5	8.3	2	12
16	08/15/84	1015	2.70	58	--	23.0	6.0	5	7
17	08/14/84	1650	.48	60	--	28.5	7.4	12	6
18	08/14/84	1400	3.10	100	--	31.0	9.4	11	17
19	08/29/83	0915	1.40	118	7.3	27.0	6.5	13	7
20	08/29/83	1145	2.80	105	7.8	31.0	8.8	7	2
21	08/14/84	1038	.32	160	--	26.0	8.0	3	5
				Choctaw County					
22	07/27/82	1215	5.60	34	6.7	24.5	5.8	60	25
23	07/27/82	0730	4.80	48	6.2	22.5	5.7	130	100
24	07/27/82	0945	.50	32	6.8	23.5	5.2	110	60
25	07/29/82	1245	2.70	130	7.1	25.5	4.3	75	62
26	07/29/82	0815	23.0	41	6.5	23.5	6.5	75	85
27	07/29/82	1110	.81	54	7.2	24.5	5.2	50	14
28	07/29/82	1445	7.70	42	7.0	27.0	6.4	120	130
29	07/29/82	1645	16.0	35	6.5	25.5	6.1	55	30
				Kemper County					
30	08/25/80	1600	46.0	26	6.8	26.0	7.8	30	8
31	08/27/81	1300	8.50	48	6.7	23.5	7.6	40	10
32	08/27/80	0930	56.3	31	6.8	23.0	8.5	15	4

Table 2.-- *Physical characteristics of water in streams that drain potential lignite mining areas in Mississippi*--Continued

Map number	Date of collection	Time (hours)	Streamflow (ft^3/s)	Specific conductance (µS/cm)	pH (units)	Temperature (°C)	Oxygen, dissolved (mg/L)	Color (units)	Turbidity (NTU)
				Kemper County (continued)					
33	08/27/81	1030	0.20	85	6.8	24.5	5.4	50	15
34	08/27/80	1230	25.0	32	6.7	22.0	8.5	15	--
35	08/26/80	1630	.71	45	6.9	25.5	7.8	20	9
36	08/28/80	1200	4.70	44	6.8	23.0	7.6	55	9
37	08/28/80	1000	1.64	75	6.8	23.0	6.5	20	5
				Lafayette County					
38	08/24/84	1100	7.30	53	--	20.5	10.4	1	12
39	08/24/84	0910	7.50	31	--	24.5	7.6	1	5
40	08/14/85	1025	.65	58	6.7	25.0	7.2	30	4
41	08/14/85	1155	1.85	45	6.7	27.0	7.2	35	10
42	08/16/84	1430	2.60	49	--	25.0	7.0	2	10
43	08/16/84	1050	.40	75	--	23.0	8.4	3	17
44	08/17/84	0930	.95	93	--	24.0	4.4	2	10
45	08/13/84	1630	3.70	34	--	25.0	7.0	12	18
46	08/17/84	1340	2.30	49	--	25.0	7.2	17	18
				Lauderdale County					
47	08/27/80	1700	3.05	115	7.0	23.0	7.7	20	7
48	08/27/80	1430	9.85	28	6.0	22.0	8.3	30	3
				Marshall County					
49	08/14/85	1445	.03	78	6.6	29.5	6.6	15	5
50	08/14/85	1545	2.09	69	7.5	32.0	7.2	55	15
				Montgomery County					
51	08/24/83	1745	3.60	44	6.8	27.5	5.8	23	18
52	07/30/82	0945	1.60	48	6.6	26.5	4.6	75	48
53	07/30/82	0745	6.80	58	6.5	25.5	6.1	85	49
				Neshoba County					
54	08/26/81	1000	.16	44	6.6	22.5	3.8	100	35
55	08/26/81	1330	1.30	24	6.6	24.0	7.8	50	19
56	08/25/81	1600	.83	56	7.0	24.5	8.0	50	18
57	08/25/81	1400	1.70	77	7.6	25.5	8.0	20	7
58	08/25/81	1130	.39	100	7.6	24.0	8.2	30	6
59	08/26/81	1600	.67	30	6.7	23.5	7.4	50	8
60	08/25/81	0930	1.00	55	6.9	22.5	7.8	50	17
61	08/24/81	1700	.57	33	7.0	26.0	7.0	70	24
62	08/24/81	1330	.63	38	7.3	24.0	7.5	50	16

Table 2.-- *Physical characteristics of water in streams that drain potential lignite mining areas in Mississippi*--Continued

Map number	Date of col- lec- tion	Time (hours)	Stream- flow (ft^3/s)	Spe- cific con- duct- ance (µS/cm)	pH (units)	Temper- ature (°C)	Oxygen, dis- solved (mg/L)	Color (units)	Tur- bid- ity (NTU)
				Newton County					
63	08/26/80	1100	2.80	51	6.6	25.0	5.7	50	5
64	08/26/80	1300	1.51	45	6.8	24.5	6.3	25	--
				Noxubee County					
65	07/27/82	1500	2.80	62	6.9	28.0	6.7	60	20
66	08/25/80	1200	15.0	28	6.8	25.5	8.1	30	15
				Oktibbeha County					
67	07/28/82	1635	.50	860	7.0	--	6.4	5	2
68	07/28/82	1145	1.60	40	6.8	20.5	5.2	80	70
69	07/28/82	1500	.50	95	6.7	26.0	3.6	40	35
70	07/28/82	1330	.50	94	6.5	25.0	4.2	30	24
				Union County					
71	08/14/85	0820	.84	44	6.5	25.5	6.0	70	20
				Webster County					
72	08/26/83	1145	2.70	121	7.5	27.5	8.0	6	3
73	08/26/83	1400	3.40	34	7.5	24.5	8.3	3	6
74	08/27/83	0920	.21	179	6.8	24.5	3.6	2	5
75	08/26/83	0810	.77	76	7.0	27.5	5.2	13	120
76	08/25/83	0830	.03	92	6.9	25.5	4.9	2	4
77	08/25/83	1540	.90	51	7.0	29.5	--	10	9
78	08/25/83	1200	2.80	42	6.7	25.5	9.2	2	6
				Winston County					
79	08/31/81	1530	2.40	77	6.9	24.0	6.8	42	14
80	08/31/81	1300	6.50	28	6.8	24.0	8.1	34	10
81	08/31/81	1030	9.30	27	6.3	24.0	8.3	25	9
82	07/27/82	1700	.50	48	6.5	26.5	4.4	80	6
83	08/28/81	0930	.63	51	5.8	23.5	4.5	60	10
				Yalobusha County					
84	08/15/84	1400	1.70	31	--	27.5	7.6	6	10
85	08/15/84	1715	4.90	31	--	29.0	7.5	5	--
86	08/23/84	1205	11.0	25	--	23.0	8.0	55	70
87	08/23/84	1515	4.10	36	--	25.5	6.5	6	13

Table 3.--*Concentrations of major dissolved ions in water of streams that drain potential lignite mining areas in Mississippi*
[Constituents in milligrams per liter; dash indicates missing data]

Map number	Date of collection	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Solids, residue at 180°C	Solids, volatile on ignition
				Benton County					
1	08/15/85	2.7	1.3	2.0	0.8	0.7	2.2	31	16
2	08/15/85	3.9	1.8	2.1	.9	.4	1.6	43	14
3	08/15/85	1.9	1.1	1.9	.7	1.5	2.1	32	14
4	08/20/85	2.0	1.1	1.7	.9	.2	.2	25	15
5	08/20/85	1.7	1.0	1.5	.9	2.1	1.7	30	18
6	08/21/85	1.6	.9	1.8	.9	.6	2.0	27	17
7	08/21/85	1.7	.9	1.9	.9	.6	1.8	24	12
8	08/15/85	4.9	2.6	3.6	1.3	4.9	3.5	54	16
9	08/21/85	3.6	1.8	4.4	1.6	4.6	4.6	48	20
10	08/15/85	3.3	2.0	2.9	1.1	3.2	4.1	39	18
				Calhoun County					
11	08/28/83	9.1	4.6	21	1.7	38	13	149	41
12	08/28/83	7.4	3.3	19	2.2	20	15	128	39
13	08/27/83	6.8	3.5	11	2.1	8.0	8.0	79	29
14	08/27/83	5.4	2.6	5.3	2.2	3.0	4.2	55	38
15	08/28/83	--	--	--	--	1.0	4.0	30	27
16	08/15/84	3.4	1.7	4.4	1.2	2.4	2.6	48	8
17	08/14/84	3.1	1.8	5.6	1.2	1.0	15	--	16
18	08/14/84	5.7	3.2	8.3	1.7	7.7	5.5	76	13
19	08/29/83	7.6	3.9	11	2.7	5.0	6.0	83	40
20	08/29/83	7.3	3.7	8.5	1.9	3.0	3.7	72	36
21	08/14/84	11	5.5	12	2.6	18	9.9	91	17
				Choctaw County					
22	07/27/82	1.9	.9	1.7	1.9	4.0	2.2	46	26
23	07/27/82	2.2	.9	3.6	1.7	5.0	3.5	51	28
24	07/27/82	1.7	.8	2.6	.6	1.0	2.9	36	16
25	07/29/82	7.1	2.9	16	4.7	16	12	105	39
26	07/29/82	5.1	2.7	4.8	1.8	4.0	2.7	48	24
27	07/29/82	3.7	1.6	5.9	1.1	3.0	4.0	56	26
28	07/29/82	2.8	1.6	3.6	3.2	5.0	3.0	52	26
29	07/29/82	1.9	1.1	3.5	.8	3.0	2.7	44	20
				Kemper County					
30	08/25/80	1.0	.7	1.9	1.0	.7	3.0	37	19
31	08/27/81	2.4	1.6	3.4	1.8	4.4	2.8	49	14
32	08/27/80	1.3	.9	2.1	1.0	1.4	2.6	40	21
33	08/27/81	4.4	2.8	5.0	2.4	6.8	4.2	79	27
34	08/27/80	1.2	.8	2.2	1.0	2.1	2.2	37	19

Table 3.--*Concentrations of major dissolved ions in water of streams that drain potential lignite mining areas in Mississippi*--Continued

Map number	Date of collection	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Solids, residue at 180°C	Solids, volatile on ignition
				Kemper County--Continued					
35	08/26/80	2.4	1.9	2.1	1.3	1.0	2.8	49	28
36	08/28/80	2.3	1.6	2.1	1.3	1.7	2.9	59	32
37	08/28/80	4.0	2.7	3.9	1.9	2.7	3.7	71	28
				Lafayette County					
38	08/24/84	3.1	1.8	4.3	.9	2.2	2.8	48	12
39	08/24/84	2.0	1.0	2.0	.8	3.2	1.8	35	6
40	08/14/85	3.8	2.2	3.1	1.5	2.7	2.6	43	19
41	08/14/85	2.9	1.7	3.0	1.2	3.6	2.7	42	--
42	08/16/84	3.3	1.6	3.3	1.2	4.1	1.9	52	18
43	08/16/84	4.4	3.0	5.0	1.3	3.9	2.1	--	16
44	08/17/84	8.4	4.6	4.7	2.1	5.2	3.3	70	27
45	08/13/84	2.0	1.2	2.1	1.0	5.4	2.0	38	18
46	08/17/84	2.9	1.9	3.1	1.3	5.3	3.0	52	14
				Lauderdale County					
47	08/27/80	8.4	3.7	5.5	2.7	4.3	4.1	97	41
48	08/27/80	1.1	.7	1.5	.9	3.1	2.7	35	16
				Marshall County					
49	08/14/85	5.2	2.5	4.5	2.0	5.3	6.6	56	17
50	08/14/85	4.9	2.4	4.9	1.7	3.6	4.2	59	21
				Montgomery County					
51	08/24/83	2.5	1.2	3.6	1.1	2.0	3.8	32	22
52	07/30/82	2.9	1.8	2.5	2.1	8.0	2.2	49	24
53	07/30/82	4.1	2.1	4.1	2.1	10	2.7	62	28
				Neshoba County					
54	08/26/81	1.8	1.2	2.3	2.1	.5	3.1	37	15
55	08/26/81	1.1	.7	1.7	.7	1.7	2.6	32	16
56	08/25/81	3.2	1.8	2.6	2.3	4.7	4.0	56	18
57	08/25/81	6.0	2.2	3.0	1.7	6.1	6.2	63	25
58	08/25/81	8.0	2.6	3.7	2.8	7.1	6.4	80	35
59	08/26/81	1.7	1.0	1.6	.7	1.9	2.5	36	18
60	08/25/81	3.8	1.7	2.7	1.7	1.9	4.0	54	20
61	08/24/81	1.7	.9	2.0	.9	.7	3.0	36	14
62	08/24/81	2.6	1.3	2.7	1.2	.7	3.8	35	16

Table 3.--*Concentrations of major dissolved ions in water of streams that drain potential lignite mining areas in Mississippi*--Continued

Map number	Date of collection	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Sulfate (SO_4)	Chloride (Cl)	Solids, residue at 180°C	Solids, volatile on ignition
				Newton County					
63	08/26/80	2.6	1.8	2.5	1.6	1.9	3.9	63	35
64	08/26/80	2.1	1.4	3.0	1.8	1.9	2.8	36	24
				Noxubee County					
65	07/27/82	3.7	2.4	3.0	1.4	7.0	2.9	58	20
66	08/25/80	1.2	.8	1.7	.7	1.0	2.5	35	19
				Oktibbeha County					
67	07/28/82	72	35	45	6.9	360	26	--	88
68	07/28/82	2.0	1.3	2.7	1.7	3.0	2.4	38	17
69	07/28/82	6.4	4.1	4.9	3.0	21	4.5	73	26
70	07/28/82	5.3	3.6	5.9	2.3	15	3.6	77	27
				Union County					
71	08/14/85	2.5	1.3	3.3	1.6	2.3	3.9	41	18
				Webster County					
72	08/26/83	9.5	4.4	9.9	1.7	3.0	6.8	88	33
73	08/26/83	2.0	1.0	3.1	.8	2.0	2.1	23	19
74	08/27/83	15	6.9	11	2.1	7.0	7.1	127	39
75	08/26/83	4.6	2.4	7.3	1.6	2.0	5.3	61	24
76	08/25/83	6.0	3.5	6.5	1.9	2.0	7.0	52	45
77	08/25/83	3.2	1.7	3.9	1.1	4.0	3.7	40	26
78	08/25/83	2.3	1.1	3.3	1.7	2.0	4.5	25	27
				Winston County					
79	08/31/81	4.3	2.5	4.7	2.0	4.7	4.3	58	18
80	08/31/81	0.8	0.4	2.3	.7	.7	2.8	14	14
81	08/31/81	0.5	.4	2.6	.6	.8	3.3	16	12
82	07/27/82	3.3	1.3	2.7	.7	3.0	3.5	58	32
83	08/28/81	2.6	1.6	3.4	1.4	3.2	4.7	50	23
				Yalobusha County					
84	08/15/84	1.5	1.0	2.3	.8	3.4	2.1	36	12
85	08/15/84	1.7	1.0	2.1	.7	1.1	2.2	22	25
86	08/23/84	1.3	.7	2.3	.8	3.5	1.9	36	11
87	08/23/84	1.9	1.1	2.6	1.2	2.6	2.3	36	11

Table 4.--*Nitrogen, organic carbon, suspended sediment, and selected metals in water of streams that drain potential lignite mining areas of Mississippi*
[dash indicates missing data]

Site number	Date of collection	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				
				Benton County						
1	08/15/85	.01	<.10	3.4	18	<100	3,100	230	1,100	1,100
2	08/15/85	.01	<.10	3.5	19	<100	3,600	1,200	4,000	4,000
3	08/15/85	.01	<.10	3.4	24	100	2,400	350	120	130
4	08/20/85	.01	<.10	--	14	100	1,200	690	250	210
5	08/20/85	.01	<.10	--	71	100	2,200	720	50	47
6	08/21/85	.01	<.10	--	50	100	2,100	680	190	89
7	08/21/85	.01	<.10	--	74	100	1,600	500	180	50
8	08/15/85	.01	<.10	4.0	20	<100	1,500	95	90	89
9	08/21/85	.01	<.10	--	12	100	1,300	580	150	160
10	08/15/85	.01	<.10	--	8	100	1,300	410	140	140
				Calhoun County						
11	08/28/83	.01	.10	4.6	13	300	1,700	350	420	310
12	08/28/83	.03	.80	4.4	11	500	840	170	190	120
13	08/27/83	<.01	<.10	--	8	<100	--	42	--	210
14	08/27/83	<.01	.10	--	29	300	1,700	560	280	230
15	08/28/83	<.01	<.10	--	26	--	160	--	140	--
16	08/15/84	--	<.10	1.5	46	<100	1,500	450	100	100
17	08/14/84	--	<.10	2.4	15	100	1,700	370	230	210
18	08/14/84	--	<.10	2.3	22	<100	1,600	210	100	41
19	08/29/83	.01	.10	--	19	400	1,600	320	170	130
20	08/29/83	.01	.10	--	8	500	600	69	120	54
21	08/14/84	--	.10	3.2	22	100	820	65	220	200
				Choctaw County						
22	07/27/82	.02	.20	11.0	71	--	1,700	490	330	300
23	07/27/82	.05	.30	12.0	170	--	5,400	300	450	260
24	07/27/82	.03	.20	5.0	148	--	2,900	470	700	540
25	07/29/82	.11	1.80	8.3	154	--	2,500	360	580	450
26	07/29/82	.04	.10	5.6	250	--	3,700	420	480	270
27	07/29/82	.01	.10	6.6	52	--	2,700	890	500	390
28	07/29/82	.04	.20	9.8	192	--	8,300	290	250	150
29	07/29/82	--	.10	4.1	56	--	3,000	530	150	79
				Kemper County						
30	08/25/80	<.01	.17	1.9	24	--	1,300	90	90	50
31	08/27/81	.01	.04	1.3	14	--	1,400	90	130	130
32	08/27/80	<.01	.12	1.8	28	--	940	120	60	40
33	08/27/81	.01	.05	4.6	18	--	2,200	720	320	320
34	08/27/80	<.01	.09	2.2	14	--	940	120	50	40

Table 4.--*Nitrogen, organic carbon, suspended sediment, and selected metals in water of streams that drain potential lignite mining areas of Mississippi*--Continued

Site number	Date of col-lec-tion	Ni-trite (N)	Ni-trite plus ni-trate (N)	Or-ganic carbon total	Sedi-ment sus-pended	Alum-inum (Al)	Iron, total (Fe)	Iron, dis-solved (Fe)	Manga-nese, total (Mn)	Manga-nese, dis-solved (Mn)
		Milligrams per liter				Micrograms per liter				
				Kemper County--Continued						
35	08/26/80	<0.01	.09	4.4	38	--	1,700	470	150	80
36	08/28/80	<.01	.11	3.7	14	--	1,600	540	90	70
37	08/28/80	<.01	.12	3.8	12	--	1,200	780	110	110
				Lafayette County						
38	08/24/84	<.01	<.10	1.0	22	<100	990	23	140	120
39	08/24/84	.01	<.10	2.7	32	<100	1,300	410	170	130
40	08/14/85	.01	.10	3.8	3	<100	1,200	470	140	140
41	08/14/85	.01	<.10	3.6	14	<100	1,400	510	90	82
42	08/16/84	--	<.10	3.2	33	<100	1,400	47	200	150
43	08/16/84	--	<.10	3.5	26	100	1,200	44	130	110
44	08/17/84	--	.11	3.7	26	100	2,800	170	690	680
45	08/13/84	--	.10	3.2	33	<100	1,900	32	160	130
46	08/17/84	--	<.10	2.7	52	100	2,400	380	280	240
				Lauderdale County						
47	08/27/80	.01	.33	5.2	23	--	2,500	150	150	140
48	08/27/80	<.01	.08	2.8	15	--	1,400	230	100	80
				Marshall County						
49	08/14/85	.01	<.10	3.4	8	100	1,700	610	430	420
50	08/14/85	.01	<.10	--	16	<100	1,700	20	70	67
				Montgomery Coounty						
51	08/24/83	.01	.10	--	16	300	2,400	640	310	270
52	07/30/82	.03	.20	5.6	62	--	3,900	220	500	420
53	07/30/82	.03	.20	7.7	76	--	4,000	550	500	350
				Neshoba County						
54	08/26/81	.02	.27	4.1	38	--	2,700	70	340	290
55	08/26/81	.01	.15	1.9	24	--	2,100	50	120	100
56	08/25/81	.01	.30	2.2	20	--	1,800	100	170	160
57	08/25/81	.01	.41	0.9	16	--	790	310	80	70
58	08/25/81	.01	.31	1.9	16	--	1,300	660	330	330
59	08/26/81	.01	.08	2.8	17	--	1,600	180	150	120
60	08/25/81	.01	.28	1.9	14	--	1,500	430	110	100
61	08/24/81	.01	.12	2.4	24	--	1,800	170	170	150
62	08/24/81	.01	.28	1.7	16	--	1,900	70	180	150

Table 4.--*Nitrogen, organic carbon, suspended sediment, and selected metals in water of streams that drain potential lignite mining areas of Mississippi*--Continued

Site number	Date of collection	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				
			Newton County							
63	08/26/80	<0.01	.21	9.4	11	--	1,600	380	260	260
64	08/26/80	<.01	.14	2.4	14	--	1,400	570	120	120
			Noxubee County							
65	07/27/82	.01	.10	5.9	44	--	2,700	630	360	360
66	08/25/80	.01	.15	2.2	36	--	1,500	70	90	70
			Oktibbeha County							
67	07/28/82	.02	.20	2.5	198	--	90	17	57	57
68	07/28/82	.03	.20	5.4	108	--	3,000	320	160	160
69	07/28/82	.02	.10	7.1	48	--	2,600	890	870	740
70	07/28/82	--	.10	5.4	124	--	1,900	710	380	370
			Union County							
71	08/14/85	.01	<.10	--	15	100	2,200	780	180	180
			Webster County							
72	08/26/83	<.01	<.10	--	11	100	1,400	440	260	230
73	08/26/83	.01	.10	--	13	300	680	140	90	65
74	08/27/83	<.01	<.10	--	16	<100	--	2,400	2,300	2,300
75	08/26/83	.01	<.10	--	18	<100	1,500	330	350	230
76	08/25/83	.01	<.10	--	18	500	1,200	120	1,200	1,200
77	08/25/83	.01	<.10	--	11	100	2,000	520	380	350
78	08/25/83	.01	<.10	--	10	100	1,500	150	440	410
			Winston County							
79	08/31/81	.01	.14	2.8	19	--	2,100	150	250	250
80	08/31/81	.01	.13	3.3	24	--	1,800	90	80	60
81	08/31/81	.02	.23	1.9	38	--	2,400	70	60	40
82	07/27/82	.01	.10	14	39	--	3,900	3,100	1,600	1,600
83	08/28/81	.01	.06	5.5	10	--	1,800	220	520	510
			Yalobusha County							
84	08/15/84	--	<.10	1.5	24	<100	1,000	38	60	42
85	08/15/84	--	<.10	2.3	36	100	1,700	150	100	71
86	08/23/84	.01	<.10	3.4	105	<100	4,500	310	110	38
87	08/23/84	.01	<.10	2.7	42	<100	2,300	260	120	89

Table 5.--*Concentrations of selected metals in bottom material samples from streams that drain potential lignite mining areas in Mississippi*

[Micrograms per gram of bottom material; dash indicates missing data]

Map number	Date of col-lec-tion	Arsenic (As)	Cad-mium (Cd)	Chro-mium (Cr)	Co-balt (Co)	Cop-per (Cu)	Iron (Fe)	Lead (Pb)	Manga-nese (Mn)	Mer-cury (Hg)	Sele-nium (Se)	Zinc (Zn)
Benton County												
1	08/15/85	<1	<1	<1	<10	<1	1,200	<10	1,300	0.03	<1	2
2	08/15/85	<1	<1	4	<10	<1	1,700	<10	240	.04	<1	4
3	08/15/85	<1	<1	<1	<10	<1	1,100	<10	350	.04	<1	2
4	08/20/85	<1	<1	<1	<10	<1	1,100	<10	280	.02	<1	2
5	08/20/85	<1	<1	<1	<10	<1	640	<10	330	.01	<1	3
6	08/21/85	<1	<1	<1	<10	<1	1,200	<10	470	.04	<1	2
7	08/21/85	<1	<1	<1	<10	<1	980	<10	430	.05	<1	3
8	08/15/85	<1	<1	<1	<10	<1	1,400	<10	260	.05	<1	3
9	08/21/85	<1	<1	2	<10	<1	1,100	<10	190	.03	<1	2
10	08/15/85	<1	<1	<1	<10	<1	1,300	20	360	.05	<1	3
Calhoun County												
11	08/28/83	<1	<1	3	<10	<1	910	<10	390	.02	<1	2
12	08/28/83	<1	<1	4	<10	1	4,200	<10	260	.02	<1	4
13	08/27/83	<1	<1	2	<10	1	2,600	<10	310	.01	<1	3
14	08/27/83	<1	<1	2	<10	1	1,000	<10	88	.02	<1	2
15	08/28/83	<1	<1	2	<10	<1	540	<10	78	.01	<1	1
16	08/15/84	<1	<1	<1	<10	<1	460	<10	46	.02	<1	2
17	08/14/84	<1	<1	<1	<10	<1	790	<10	230	<.01	<1	2
18	08/14/84	<1	<1	<1	<10	<1	530	<10	100	<.01	<1	2
19	08/29/83	<1	<1	2	<10	1	2,900	<10	260	.04	<1	4
20	08/29/83	<1	<1	4	<10	3	4,200	<10	620	.03	<1	10
21	08/14/84	<1	<1	<1	<10	<1	590	<10	180	<.01	<1	2
Choctaw County												
22	07/27/82	<1	<1	1	<10	1	1,500	<10	210	<.01	<1	1
23	07/27/82	<1	<1	3	<10	2	4,100	<10	200	<.01	<1	6
24	07/27/82	<1	<1	4	10	3	16,000	10	4,400	<.01	<1	16
25	07/29/82	<1	<1	30	20	5	14,000	30	2,600	<.01	<1	44
26	07/29/82	<1	<1	3	10	1	7,900	10	660	<.01	<1	5
27	07/29/82	<1	<1	2	<10	1	3,800	<10	1,300	<.01	<1	7
28	07/29/82	<1	<1	1	<10	1	2,100	<10	200	<.01	<1	3
29	07/29/82	<1	<1	1	<10	1	2,000	<10	890	<.01	<1	6
Kemper County												
30	08/25/80	<1	<10	<10	<10	<10	3,800	<10	1,200	<.01	<1	7
31	08/27/81	<1	<1	<10	<10	1	1,000	<10	180	<.01	<1	4
32	08/27/80	<1	<10	<10	10	<10	3,400	<10	360	<.01	<1	7
33	08/27/81	<1	<1	<10	10	1	1,700	<10	230	<.01	<1	10
34	08/27/80	<1	<10	<10	<10	<10	720	<10	14	<.01	<1	2

Table 5.--*Concentrations of selected metals in bottom material samples from streams that drain potential lignite mining areas in Mississippi*--Continued

Map number	Date of collection	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Zinc (Zn)
					Kemper County--Continued							
35	08/26/80	<1	<10	<10	<10	<10	1,000	<10	210	<0.01	<1	2
36	08/28/80	<1	<10	<10	<10	<10	1,400	<10	130	<.01	<1	3
37	08/28/80	<1	<10	<10	30	<10	7,900	10	1,500	<.01	<1	6
					Lafayette County							
38	08/24/84	<1	<1	<1	<10	<1	970	<10	350	.15	<1	3
39	08/24/84	<1	<1	1	<10	3	1,500	<10	350	<.01	2	4
40	08/14/85	<1	<1	2	<10	1	2,900	<10	320	.05	<1	4
41	08/14/85	<1	<1	<1	<10	<1	840	<10	550	.02	<1	2
42	08/16/84	<1	<1	3	<10	4	3,400	<10	1,000	<.01	3	7
43	08/16/84	<1	<1	1	<10	2	2,500	<10	360	<.01	--	4
44	08/17/84	<1	<1	2	<10	4	4,000	<10	510	<.01	<1	6
45	08/13/84	<1	<1	1	<10	2	1,900	<10	330	.03	<1	5
46	08/17/84	<1	<1	<1	<10	<1	1,600	<10	340	<.01	<1	5
					Lauderdale County							
47	08/27/80	<1	<10	<10	<10	<10	3,800	<10	130	<.01	<1	9
48	08/27/80	<1	<10	<10	<10	<10	460	<10	11	<.01	<1	1
					Marshall County							
49	08/14/85	<1	<1	2	<10	<1	1,600	<10	220	.02	<1	2
50	08/14/85	<1	<1	5	<10	1	8,400	<10	1,200	.03	<1	8
					Montgomery County							
51	08/24/83	<1	<1	3	<10	1	2,800	<10	300	.04	<1	3
52	07/30/82	<1	<1	3	10	3	3,600	<10	810	<.01	<1	9
53	07/30/82	<1	<1	1	<10	1	1,700	<10	200	<.01	<1	4
					Neshoba County							
54	08/26/81	<1	<1	<10	<10	2	550	<10	51	<.01	<1	3
55	08/26/81	<1	<1	<10	<10	<1	590	<10	110	<.01	<1	4
56	08/25/81	<1	<1	<10	<10	1	700	<10	230	<.01	<1	4
57	08/25/81	<1	<1	<10	10	1	310	<10	230	<.01	<1	3
58	08/25/81	<1	<1	<10	<10	1	390	<10	180	<.01	<1	2
59	08/26/81	<1	<1	<10	<10	<1	340	<10	70	<.01	<1	3
60	08/25/81	<1	<1	<10	<10	<1	200	<10	82	<.01	<1	2
61	08/24/81	<1	<1	<10	<10	<1	230	<10	42	<.01	<1	2
62	08/24/81	<1	<1	<10	<10	<1	440	<10	89	<.01	<1	7

Table 5.--*Concentrations of selected metals in bottom material samples from streams that drain potential lignite mining areas in Mississippi*--Continued

Map number	Date of collection	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Mercury (Hg)	Selenium (Se)	Zinc (Zn)
					Newton County							
63	08/26/80	<1	<10	<10	<10	10	200	<10	18	<0.01	<1	1
64	08/26/80	<1	<10	<10	<10	<10	1,000	<10	130	<.01	<1	3
					Noxubee County							
65	07/27/82	<1	<1	1	<10	1	1,900	<10	110	<.01	<1	4
66	08/25/80	<1	<10	<10	<10	<10	3,500	<10	410	<.01	<1	13
					Oktibbeha County							
67	07/28/82	<1	<1	10	20	12	13,000	30	3,600	<.01	<1	84
68	07/28/82	<1	<1	4	10	5	8,700	10	810	<.01	<1	18
69	07/28/82	<1	<1	3	10	47	6,600	10	26	<.01	<1	20
70	07/28/82	<1	<1	4	<10	1	4,200	<10	120	<.01	<1	9
					Union County							
71	08/14/85	<1	<1	3	<10	3	4,800	<10	1,700	.08	<1	10
					Webster County							
72	08/26/83	<1	<1	1	<10	<1	920	<10	290	.04	<1	2
73	08/26/83	<1	<1	2	<10	1	1,600	<10	370	<.01	<1	3
74	08/27/83	<1	<1	5	<10	2	3,100	<10	200	.02	<1	5
75	08/26/83	<1	<1	3	<10	2	2,000	<10	130	.02	<1	6
76	08/25/83	<1	<1	3	<10	1	2,100	<10	330	.02	<1	4
77	08/25/83	<1	<1	2	<10	1	3,700	<10	370	.04	<1	4
78	08/25/83	<1	<1	10	<10	<1	670	<10	530	.02	<1	2
					Winston County							
79	08/31/81	<1	<1	3	<10	2	2,900	<10	140	<.01	<1	<10
80	08/31/81	<1	<1	5	<10	1	2,300	<10	110	<.01	<1	<10
81	08/31/81	<1	<1	3	<10	2	2,500	<10	290	<.01	<1	10
82	07/27/82	<1	<1	8	30	5	16,000	10	2,200	<.01	<1	33
83	08/28/81	<1	<1	10	<10	1	430	<10	--	<.01	<1	5
					Yalobusha County							
84	08/15/84	<1	<1	<1	<10	<1	440	<10	190	<.01	<1	3
85	08/15/84	<1	<1	<1	<10	<1	390	<10	190	<.01	<1	2
86	08/23/84	<1	<1	<1	<10	<1	690	<10	340	<.01	<1	2
87	08/23/84	<1	<1	2	<10	2	1,700	<10	310	<.01	<1	7

Table 6.--*Sample preparation and chemical analyses procedures*

[AA - Atomic Adsorption, BTM - Bottom material; methods from Fishman and Friedman (1985)]

Sample preparation method	Chemical constituent
Filtration through a 0.45µm membrane	Dissolved calcium, magnesium, sodium, potassium, sulfate, chloride, solids, volatile solids, aluminum, iron, and manganese
Acidification with nitric acid	Dissolved calcium, magnesium, sodium, potassium; total and dissolved aluminum, iron, and manganese
Chill	Organic carbon, nitrite, nitrite plus nitrate, color
Mercuric chloride	Nitrite, nitrite plus nitrate

Chemical constituent	Analytical method
Specific conductance	Field measurement
Dissolved oxygen	Field measurement
pH	Field measurement
Color	Electrometry,visual comparison
Turbidity	Nephelometry
Calcium	AA direct
Magnesium	AA direct
Sodium	AA direct
Potassium	AA direct
Sulfate	Turbidimetry auto
Chloride	Colorimetry, auto
Nitrite+Nitrate	Colorimetry, auto
Nitrite	Colorimetry, auto
Solids	Gravimetry
Volatile solids	Gravimetry
Organic carbon	Wet oxidation
Aluminum, dissolved	AA direct
Iron, dissolved	AA direct
Iron, total	Digestion,AA direct
Manganese, dissolved	AA direct
Manganese, total	Digestion, AA direct
Arsenic BTM	AA auto
Cadmium BTM	Digestion, AA direct
Chromium BTM	Digestion, AA direct
Cobalt BTM	Digestion, AA direct
Copper BTM	Digestion, AA direct
Iron BTM	Digestion, AA direct
Lead BTM	Precipitation,separation,counting
Manganese BTM	Digestion, AA direct
Mercury BTM	AA direct
Zinc BTM	Digestion, AA direct

Table 7.--*Statistical summary of water quality in streams that drain the outcrop area of the Wilcox Group in Mississippi*

[Dissolved constituents in milligrams per liter, except as indicated; mi^2, square miles; ft^3/s, cubic feet per second; $(ft^3/s)/mi^2$, discharge per unit drainage area; µS/cm, microsiemens per centimeter; °C, degrees Celsius; NTU, nephalometric tubidity unit; µg/L, micrograms per liter; *, calculated values]

Constituent	Number of samples	Median	Interquartile range	Minimum	Maximum
Drainage area (mi^2)	87	17.3	8.68-24.6	2.81	92.7
Discharge (ft^3/s)	87	2.17	0.63-4.80	0.03	76.3
QA [($ft^3/s/mi^2$)]	87	0.13	.05-.27	.004	1.58
Conductance (µS/cm)	87	49	34-77	24	860
Temperature (°C)	86	25.0	24.0-27.0	20.5	35.5
pH (units)	72	6.8	6.6-7.0	5.8	8.1
Color (units)	87	30	9-55	1	130
Turbidity (NTU)	84	10	6-18	1	130
Oxygen (O_2)	81	7.0	5.9-8.0	3.6	10.4
Calcium (Ca)	86	3.0	1.9-5.0	0.5	72
Magnesium (Mg)	86	1.7	1.1-2.6	.4	35
Sodium (Na)	86	3.2	2.3-4.9	1.5	45
Potassium (K)	86	1.4	.9-1.9	.6	6.9
*Bicarbonate (HCO_3)	86	17	12-28	3.7	92
Sulfate (SO_4)	87	3.0	1.9-5.0	<.2	360
Chloride (Cl)	87	3.1	2.5-4.2	.2	26
Nitrite (NO_2 as N)	70	.01	<.01-.01	<.01	0.11
Nitrite+Nitrate (NO_2+NO_3 as N)	72	.1	.1-.2	.04	1.8
Solids	84	48	36-60	14	149
Solids, volatile	86	20	16-27	6	83
Organic carbon (total)	66	3.4	2.3-5.3	.9	14
Suspended sediment	87	22	14-42	3	250
Aluminum, diss. (µg/L)	44	<100	<100-<100	<100	500
Iron, dissolved (µg/L)	86	320	120-530	10	3,100
*Iron, suspended (µg/L)	84	1,372	962-1,950	150	8,010
Iron, total (µg/L)	85	1,700	1,350-2,400	90	8,300
Manganese, diss. (µg/L)	86	150	81-302	38	4,000
*Manganese, sus. (µg/L)	84	20	1-50	0	210
Manganese, total (µg/L)	86	170	110-352	50	4,000

Table 8.--*Statistical summary of metals in bottom material from streams that drain the outcrop area of the Wilcox Group in Mississippi*

[Constituents in micrograms per gram]

Constituent	Number of samples	Median	Interquartile range	Minimum	Maximum
Arsenic (As)	87	<1	<1-<1	<1	<1
Cadmium (Cd)	87	<1	<1-<1	<1	<1
Chromium (Cr)	87	3	<1-10	<1	30
Cobalt (Co)	87	<10	<10-<10	<10	30
Copper (Cu)	87	1	<1-3	<1	47
Iron (Fe)	87	1,600	720-3,400	200	16,000
Lead (Pb)	87	<10	<10-10	<10	30
Manganese (Mn)	86	270	137-415	11	4,400
Mercury (Hg)	87	0.01	<0.01-0.02	<0.01	0.15
Zinc (Zn)	87	4	2-7	<1	84
Selenium (Se)	86	<1	<1-<1	<1	3