UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

QUALITY OF WATER AND TIME OF TRAVEL IN LITTLE COPIAH CREEK NEAR CRYSTAL SPRINGS, MISSISSIPPI

by Stephen J. Kalkhoff

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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)	0.02832	cubic meter per second (m^3/s)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

Throughout this report water temperatures are reported in degrees Celsius. Temperatures may be converted to the Celsius or Farenheit equivalent with the following formula:

$$°C = 5/9\ (°F-32) \text{ or } °F = 9/5\ (°C) + 32$$

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada, formerly called "Mean Sea Level." NGVD of 1929 is referred to as sea level in this report.

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ABSTRACT

An intensive quality of water study was conducted on Little Copiah Creek in the vicinity of Crystal Springs, Mississippi, from August 19 to August 21, 1980.

The quality of water in Little Copiah Creek improved 7 miles downstream of a source of wastewater inflow. The mean total nitrogen concentration decreased from 17 to 1.1 milligrams per liter and the mean total phosphorus concentrations decreased from 5.8 to 0.39 milligrams per liter. The maximum five-day biochemical oxygen demand decreased from 14 to 1.4 mg/L while the dissolved-oxygen concentration increased from 2.0 to 6.9 milligrams per liter. The maximum fecal coliform and fecal streptococcus densities at the upstream sampling site were 2,200 and 6,700 colonies per 100 milliter, respectively, and were observed to decrease downstream to 160 and 1,500 colonies per 100 milliliters. The mean stream temperatures decreased downstream only slightly from 26.5 to 25.0°Celsius and the pH of the water ranged from 7.2 to 7.4 units upstream and 6.5 to 7.0 units at the downstream site. The average rate of dye travel through the upstream 2.3 mile reach was 0.08 miles per hour during the study.

INTRODUCTION

Freshwater is one of the major resources of the state of Mississippi. In order to efficiently utilize and conserve this resource, the Mississippi Department of Natural Resources, Bureau of Pollution Control, is developing a statewide waste-treatment management program. In order to develop this management program, the U.S. Geological Survey in cooperation with the Bureau of Pollution Control is providing water quality data necessary for determining the waste assimilation capacity of various freshwater and tidal streams in the state.

The water quality and time of travel data in this report are the result of a short-term intensive study in Little Copiah Creek near Crystal Springs from August 19 to August 21, 1980. Chemical, physical, bacteriological, and discharge data were collected at three sites (sites 2, 4, and 5). Two sites (sites 1 and 3) were used only for the time of travel study. Time of travel data also were collected at site 4.

DESCRIPTION OF THE AREA

Location

The general location of the study area is in the north-central part of Copiah County near the town of Cyrstal Springs in the south-central part of Mississippi. A map showing the study area and sampling sites is shown in figure 1.

Geology and Topography

Several geological units are exposed in the study area. The upland areas are occupied by the Citronelle Formation of Pliocene age. Gravels of chert and quartz, fine-to-coarse-grained sand, and clay lenses make up this formation. Terrace deposits derived from materials of the Citronelle Formation border the lowlands. The lowlands adjacent to Little Copiah Creek are composed of alluvium consisting of discontinuous beds of clay, silt, sand, and gravel (Bicker and others, 1969, p. 36).

The topography of the study area is one of lowlands separated by ridges. Little Copiah Creek flows through a lowland which is from 0.2 to 0.5 miles wide and ranges from 320 ft above sea level near site 5 to 400 feet above sea level at site 2. The crests of the surrounding ridges are from 50 to 100 feet higher than the adjacent lowlands. The ridges are over 400 feet above sea level. The ridges and lowlands are generally wooded although some areas are used for agricultural purposes.

Climate

The study area has a humid subtropical climate which is influenced by the continental land mass to the north and the Gulf of Mexico to the south. The summers are long and humid, and the winters are normally short and mild. The average annual temperature at Crystal Springs is 64°F with an average August temperature of 80°F. Rainfall normally averages 54 inches per year.

The study was conducted during a period of seasonally high day time air temperature. The average high temperature during this period was 97°F with an average minimum temperature of 73°F. The NOAA (National Oceanic and Atmospheric Administration) weather station in Crystal Springs reported the following maximum and minimum temperatures.

Date	Temperature Maximum	Temperature Minimum
August 19	95	72
August 20	97	72
August 21	99	74

Rainfall did not occur during the study period. However, 0.57 inches was reported on August 18.

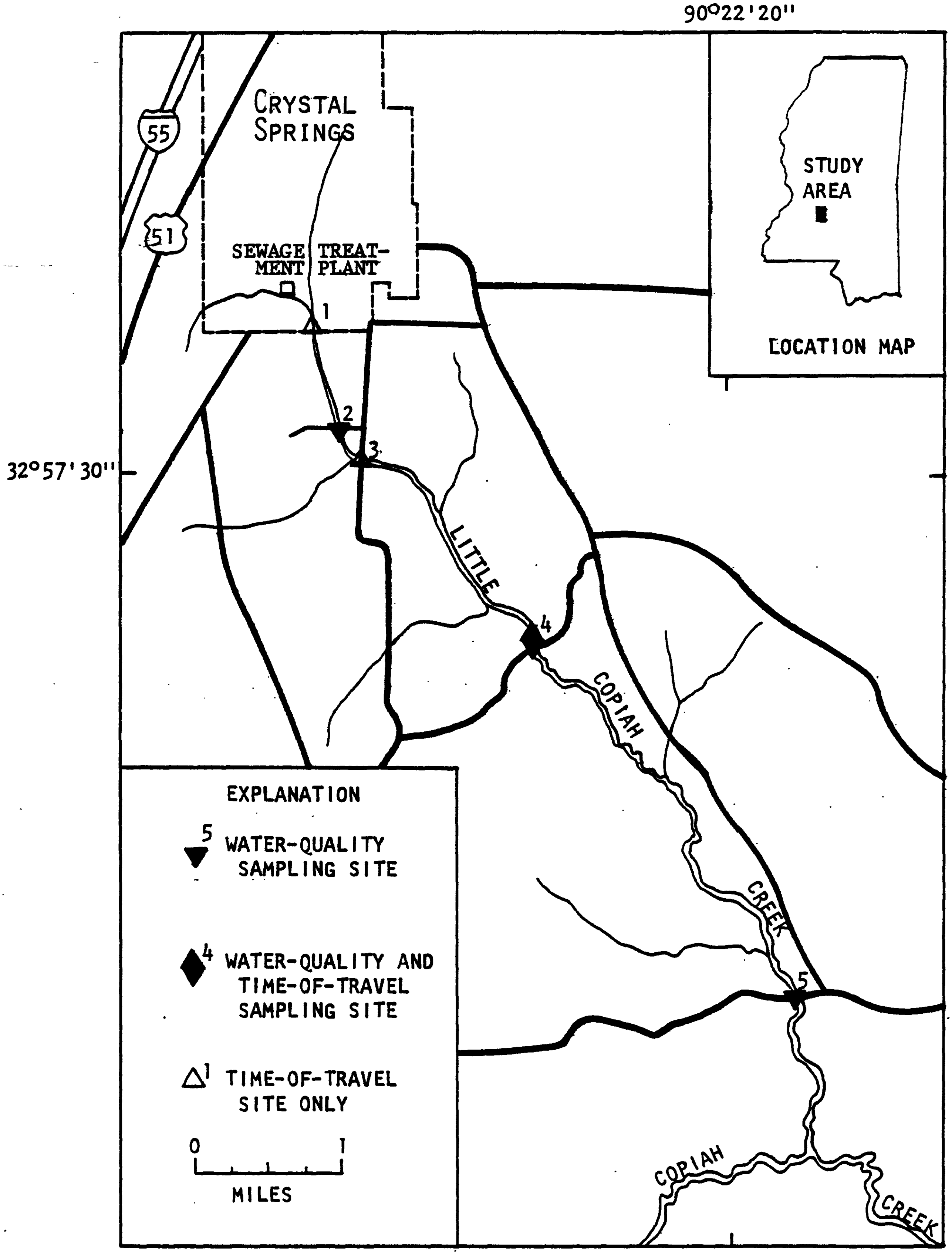

FIGURE 1.--STUDY AREA, WATER-QUALITY, AND TIME-OF-TRAVEL SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

Cultural Features

The Bureau of the Census, preliminary 1980 population count of Crystal Springs is 4,899, a 9 percent increase from 1970. Copiah County had a population of 24,479 (U.S. Bureau of the Census, 1971) in 1970, a decrease of 2,302 or 8.5 percent from 1960.

Crystal Springs economy is based primarily on a number of industries located in or near the city. Clothing, power transformers, furniture, and washed and processed gravel are some of the products produced. Agricultural and service businesses are also important in the economy of the area.

STREAM CHARACTERISTICS

Drainage

Little Copiah Creek originates in Crystal Springs and flows southeast joining Copiah Creek approximately 6 miles southeast of Crystal Springs. Little Copiah Creek drains a total of 16.9 mi^2. The drainage area of the stream is 3.7 mi^2 at site 2, 7.9 mi^2 at site 4, and 14.4 mi^2 at site 5. Several small unnamed streams join Little Copiah Creek in the study area.

Channel Morphology and Stream Gradient

The channel of Little Copiah Creek ranges from 30 to 70 ft in width at the sampling sites. Generally high (10 ft) steep banks are found along this section of the creek. At the time of the study, the stream reach from the sewage treatment plant (site 1) to site 4 consisted of a series of small shallow pools joined by a short section of riffles. The depth of water in these pools was approximately 0.5 to 1.0 ft and the riffle areas were generally less than 0.5 ft. A uniform flow with no riffles or pools was observed at site 5. The channel cross-sections at the sampling sites are shown in figure 2.

The altitude of Little Copiah Creek ranges from 425 feet above sea level at site 1 to approximately 315 feet above sea level at site 5. The altitude is approximately 390, 385, and 355 feet above sea level at sites 2, 3, and 4, respectively. The streambed of Little Copiah Creek falls approximately 35 feet per mile from site 1 to site 2: 17 feet per mile from site 2 to site 3: 15 feet per mile from site 3 to site 4: and 11 feet per mile from site 4 to site 5. The average fall for the entire study reach is 16 feet per mile.

Discharge

The streamflow at the three sampling sites remained fairly constant throughout the study. Streamflow in Little Copiah Creek originated at Crystal Springs sewage treatment plant. The Mississippi Department of Natural Resources, Bureau of Pollution Control (1979, p 30) reports the average discharge from the sewage treatment plant to be 0.88 ft /s. Due to a number of factors, variations in amount of water being treated, evaporation, and groundwater inflow, streamflow may not equal the

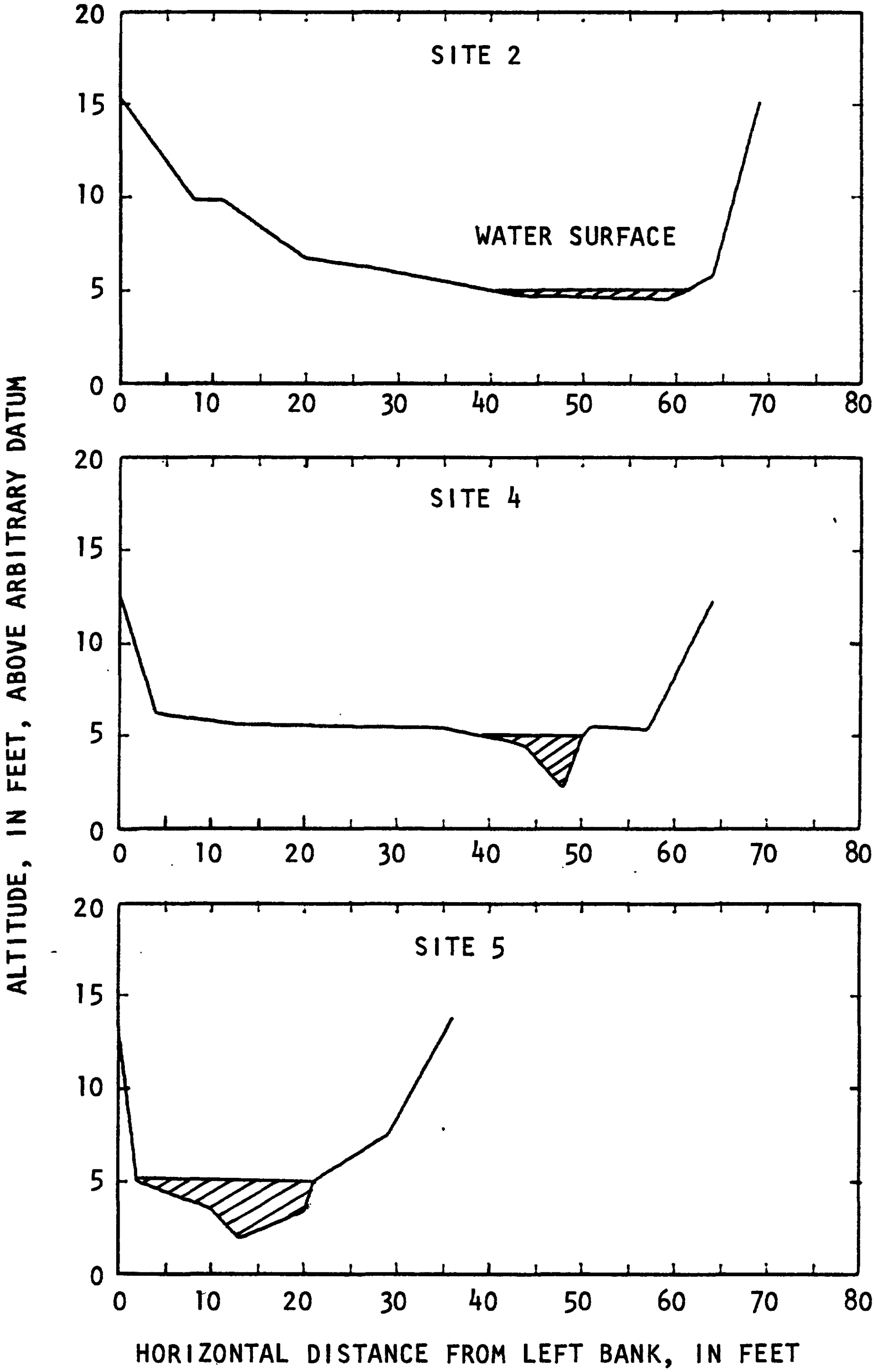

FIGURE 2.--CHANNEL CROSS SECTIONS AT SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

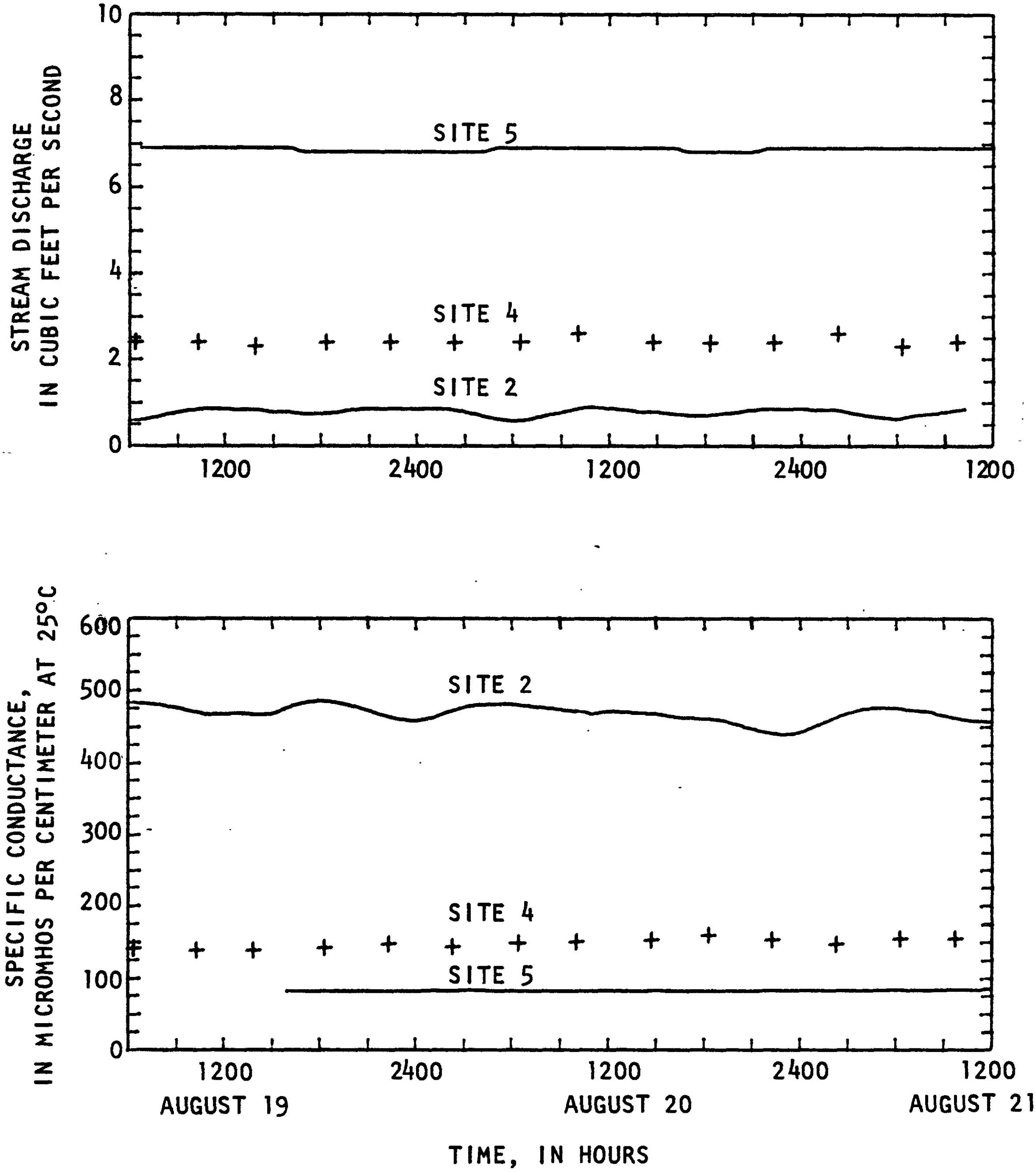

FIGURE 3.--STREAM DISCHARGE AND SPECIFIC CONDUCTANCE AT SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

average discharge from the sewage treatment plan. However, variations in treated water discharge will be reflected in the streamflow at site 2. Streamflow at site 2 was greatest during the day and early evening and lowest slightly after midnight. The average stream discharge was 0.8 ft^3/s at site 2 during the study. Streamflow increased an average of 1.6 ft^3/s between sites 2 and 4. Some inflow water may have entered Little Copiah Creek from discharges by gravel-washing operations located east of Crystal Springs downstream of site 3. The average discharge at site 5 was 6.9 ft^3/s. A large part of the increased streamflow downstream of site 2 was probably from springs common at the base of the Citronelle Formation. Streamflow at the sampling sites is shown in figure 3.

The streamflow in Little Copiah Creek was equal to or slightly greater than the 7-day Q_{10} (minimum 7-day low flow with a 10-year recurrence interval) during the study. Taking the sewage treatment discharge into account, the streamflow at sites 2 and 4 were at the 7-day Q_{10} level. Site 5 had a streamflow which was slightly greater than the 7-day Q_{10} (Tharpe, 1975, p. 18).

TIME OF TRAVEL

Time of travel refers to the rate that dissolved substances move downstream while mixing vertically and laterally within the stream itself. A substance added to a stream will disperse first in the vertical direction. Lateral mixing is completed later depending upon the width of the stream and its velocity. Longitudinal dispersion continues until the added substance leaves the stream reach (Kilpatrick and others, 1970, p. 1).

Rhodamine WT dye was used as the tracer dye because it behaves in the same manner as water particles. Thus, the rate of movement of the dye in Little Copiah Creek will be similar to the movement of solutes in the water.

Rhodamine WT dye was injected at site 1 located about 500 feet downstream of Crystal Springs' Sewage Treatment Plant outfall at 1250 hours on August 19, 1980. The peak concentration of dye was measured approximately 20 hours later 1.3 miles downstream at site 3. An additional 20 hours were required for the peak concentration of dye to travel 2.0 miles to site 4. The rate of travel was approximately 0.06 miles per hour from site 1 to site 3 and 0.10 miles per hour from site 3 to site 4. The average rate of travel through the 3.3 mile reach from site 1 to site 4 was approximately 0.08 miles per hour or 0.12 feet per second.

WATER-QUALITY CHARACTERISTICS

Water-Quality Data Collection and Analysis

The determination of the water quality in this report is based on chemical, physical, and bacteriological analysis of samples collected on Little Copiah Creek. Water quality data were collected at three sampling sites located along Little Copiah Creek. Site 2 was located on a county road slightly over one mile downstream of Crystal Springs sewage treatment plant. Site 4 was downstream another 2.3 miles, and site 5 was situated on a county road 6.9 miles downstream of site 1 (figure 1). Field measurements were made at 4-hour intervals. Nutrient samples were collected at eight-hour intervals. Biochemical oxygen demand and bacteria samples were taken on August 19 and on August 20. A comprehensive water and bottom-material sample was collected at site 5 at 1400 hours on August 20. Continuous monitors for water temperature, specific conductance, and dissolved oxygen were operated at sites 2 and 5.

The 5-day biochemical oxygen demand (BOD_5) and fecal bacteria count were determined in the U.S. Geological Survey Mobile Laboratory temporarily located in Crystal Springs. Samples for the other water quality parameters were analyzed by the U.S. Geological Survey National Water Quality Laboratory in Atlanta, Georgia. The results of field determinations, hourly discharge, and continuous monitor values are given in table 1. The results of laboratory analysis are given in table 2.

General Composition

The results of a comprehensive chemical analysis of a sample of water and bottom material collected at site 5 at 1400 hours on August 20, 1980, are listed in table 2. The water was very soft (11 mg/L) and low in color (8 units). Total mercury concentration in the water sample was 0.1 ug/L (micrograms per liter) which exceeded the U.S. Environmental Protection Agency's (1976, p. 98) recommended limit of 0.05 micrograms per liter for freshwater aquatic life and wildlife. Several other metals were present in detectable amounts but did not exceed recommended limits. The herbicide 2,4-D, (0.02 ug/L) was present in the stream at the time of sampling. Iron (1.2 milligrams per kilogram) and manganese (0.13 milligrams per kilogram) were present in the bottom material. The insecticide DDE (0.3 microgram per kilogram) was the only pesticide in the bottom material that was above detectable limits.

Specific Conductance

Specific conductance is the ability of water to conduct an electrical current and it is related to the amount of ionized substances dissolved in the water. Distilled water has a very low conductance, less than one umho/cm (micromho per centimeter) at 25.0°C. Surface waters in Mississippi have a wide range of conductivity, from less than 50 umhos/cm in freshwater streams to greater than 20,000 umho/cm in saline estuaries along the Gulf Coast. Increased specific conductance is due to greater concentrations of dissolved solids.

The specific conductance in the water of Little Copiah Creek decreased in a downstream direction through the study area (figure 3). At site 2 the mean specific conductance was 469 umhos/cm. The mean specific conductance decreased to 148 umhos/cm at site 4 and 82 umhos/cm at site 5 (figure 4A). The higher specific conductance at site 2 was due to the high dissolved solids content of the waste effluent from Crystal Springs Sewage Treatment Plant. Farther downstream the dissolved solids were diluted with ground water that according to Newcome and others has a lower dissolved-solids content (1972, p. 39). Generally the specific conductance at the individual sites did not change significantly during the study (figure 3).

Water Temperature

Water temperature is an important consideration when the waste assimilation capacity of a stream is being determined. The solubility of gases, rates of chemical reactions, and biological activity are affected by changing water temperatures. For example, the solubility of oxygen decreases with increasing water temperature, the rate in which dissolved oxygen is consumed by aquatic organisms increases with increasing temperature. Also, the mortality rate of fecal bacteria is greater at higher stream temperatures.

The water temperature of Little Copiah Creek was fairly high throughout the study. Stream temperature followed a diurnal pattern reaching a maximum value in the afternoon then decreasing to a minimum in the early morning. The mean temperature was 26.5°C at site 2 decreasing to 25.5°C at site 4 and 25.0°C at site 5. This decrease in stream temperature was probably due to the inflow of cooler ground-water.

The water temperature at the sampling sites on Little Copiah Creek is shown in figure 5.

pH - Hydrogen Ion Activity

The pH of water is a measure of the hydrogen ion activity in water. Pure water at 25°C has a pH of 7.0 units. Water with pH values less than 7.0 units are acidic. Water with a pH greater than 7.0 units is basic. The pH of most streams in Mississippi not influenced by pollution generally is between 6.5 and 8.5 units.

The pH of water in Little Copiah Creek decreased downstream through the study reach. The pH ranged from 7.2 to 7.4 units at site 2. Ranges were found to be 6.5 to 6.9 at site 4 and 6.5 to 7.0 units at site 5 (figure 4C). The pH of the water at the downstream sites on Little Copiah Creek was lowered by inflow of the slightly acidic water (pH of 5.0 to 6.0 units) of the Citronelle Formation (Newcome and others, 1972, p. 39).

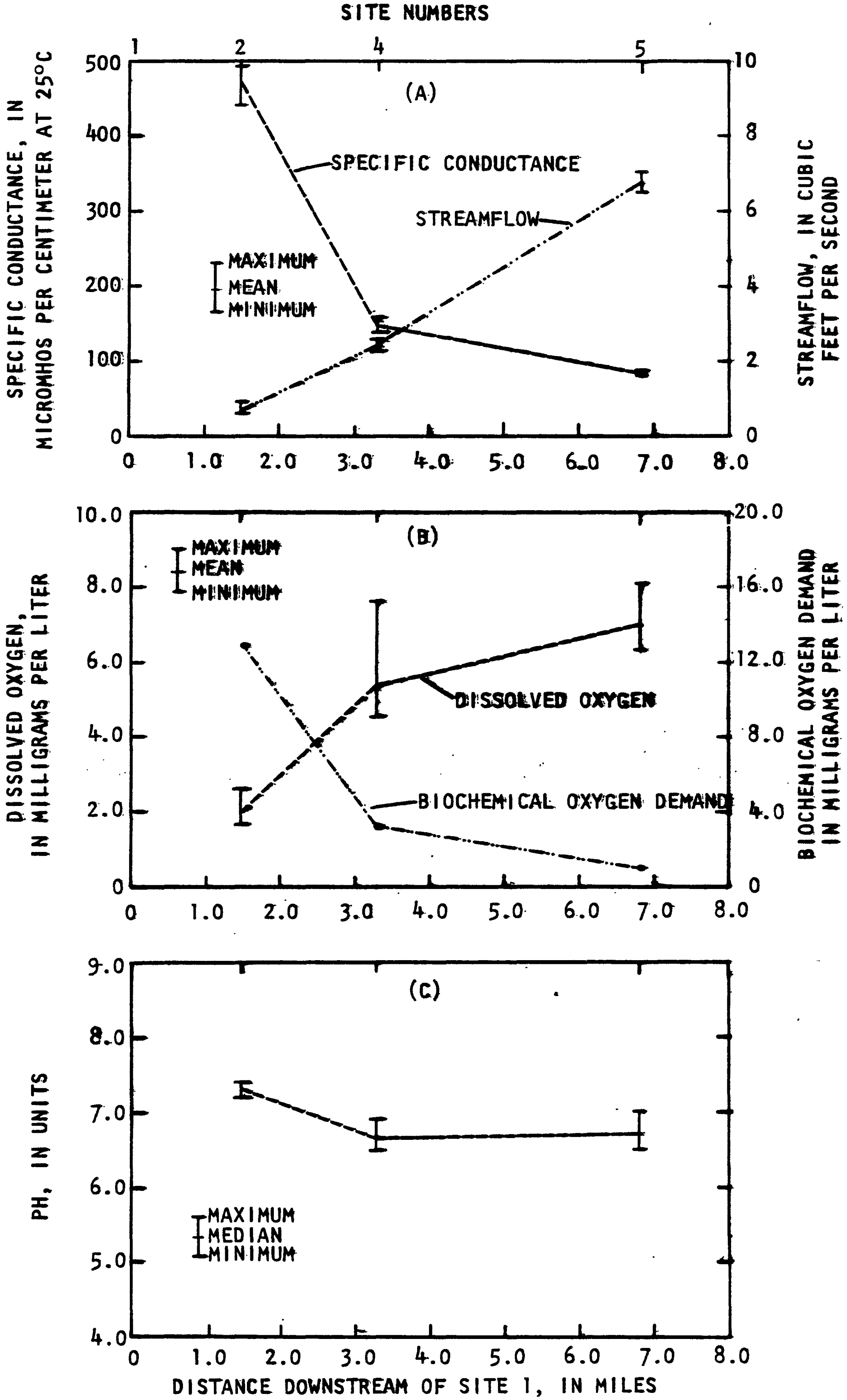

FIGURE 4.--RANGES AND MEAN SPECIFIC CONDUCTANCE, STREAMFLOW, DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND AND RANGES AND MEDIAN PH AT THE SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

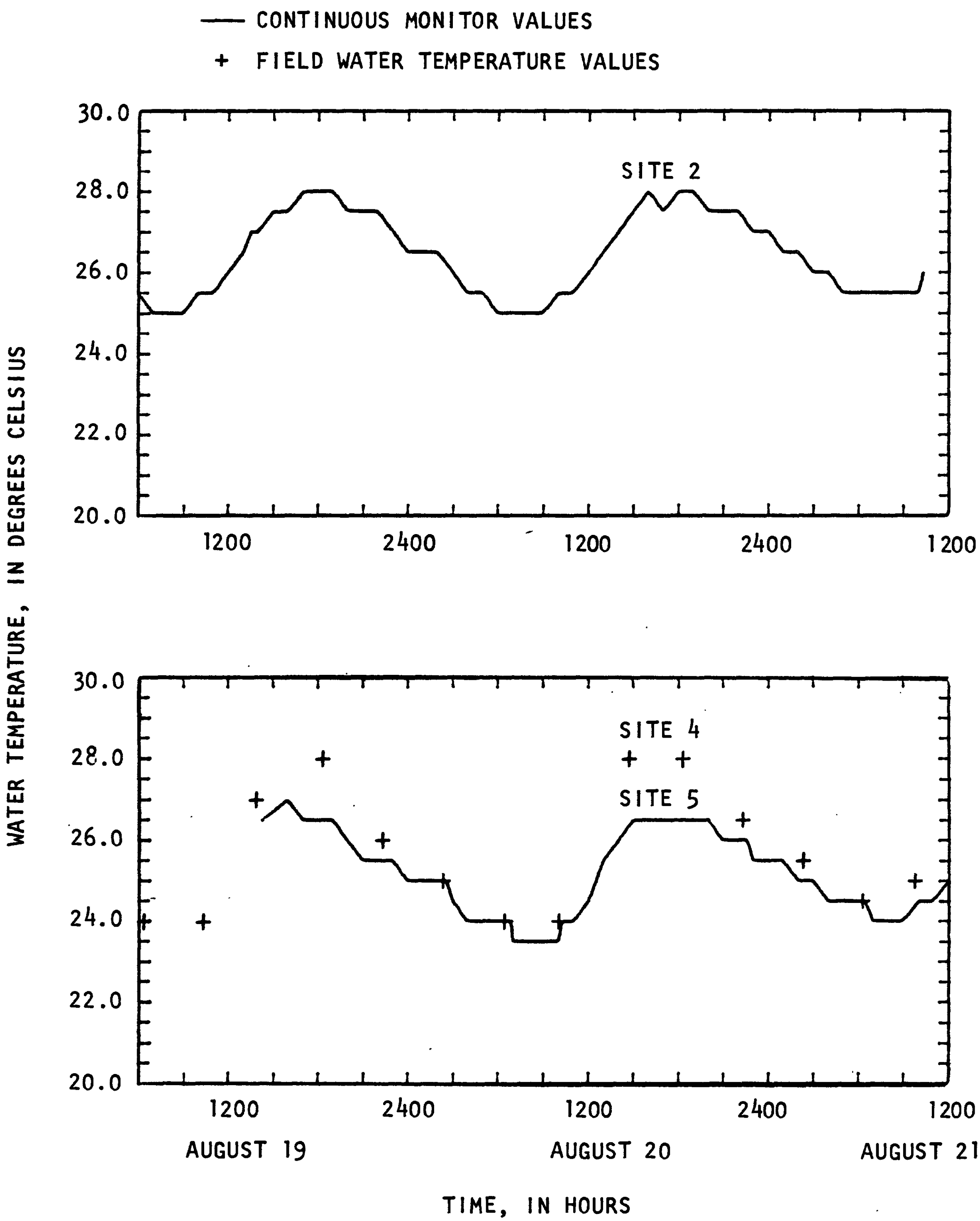

FIGURE 5.--WATER TEMPERATURE AT SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

Dissolved Oxygen

Dissolved oxygen is an essential element in many of the chemical and biological processes in a stream. Oxygen is required to support the aerobic organisms present in the aquatic environment. Streams may have organic or inorganic oxygen-consuming reactions that reduce the level of dissolved oxygen to levels that are unfavorable for some aquatic organisms. Photosynthetic activity of large populations of algae may cause an increase in dissolved-oxygen concentrations during the daylight hours and respiration can cause decrease in dissolved-oxygen content during night-time hours. Thus, the dissolved-oxygen content is an indication of the status of the water with respect to the balance between oxygen-consuming and oxygen-producing processes at the moment of sampling (Hem, 1970).

The dissolved-oxygen concentration in Little Copiah Creek increased downstream. Maximum daily dissolved-oxygen concentrations at site 2 remained below 2.6 mg/L and below the 5.0 mg/L limit recommended for fish and wildlife (Mississippi Department of Natural Resources, Bureau of Pollution Control, 1977, p. 18). The mean concentration was 2.0 mg/L at site 2. A reduction in the oxygen demand at the downstream sites resulted in an increase in dissolved-oxygen concentrations. The mean dissolved-oxygen concentration increased to 5.3 mg/L at site 4 and 6.9 mg/L at site 5 (figure 4B).

The dissolved-oxygen concentrations varied in a diurnal pattern throughout the study reaching a maximum during the afternoon and decreasing to a minimum during the night. The production of oxygen by algae was greater than the biological processes consuming oxygen; therefore, dissolved oxygen concentrations increased during the day. At night oxygen consumption was greater than oxygen production due to cessation of photosynthetic activity by algae resulting in dissolved oxygen concentrations decreasing at night. Figure 6 shows the dissolved-oxygen concentrations at the water-quality sampling sites on Little Copiah Creek.

Biochemical Oxygen Demand

Five-day biochemical oxygen demand (BOD_5) is a measure of the amount of oxygen needed to oxidize organic matter in the stream. The BOD_5 method is commonly used to estimate the organic load of the stream. Normally, unpolluted streams carry a residual organic load creating a BOD_5 of 0.5 to 1.0 mg/L. During high runoff, this load may increase the BOD_5 to 1.0 to 2.0 mg/L or higher (Velz, 1970, p. 39). Industrial and municipal effluents usually increase the BOD_5 load.

The BOD_5 in Little Copiah Creek decreased significantly from site 2 to site 5 (fig. 4B). The maximum BOD_5 value was reduced from 14 mg/L at site 2 to 3.8 mg/L at site 4 and 1.4 mg/L at site 5.

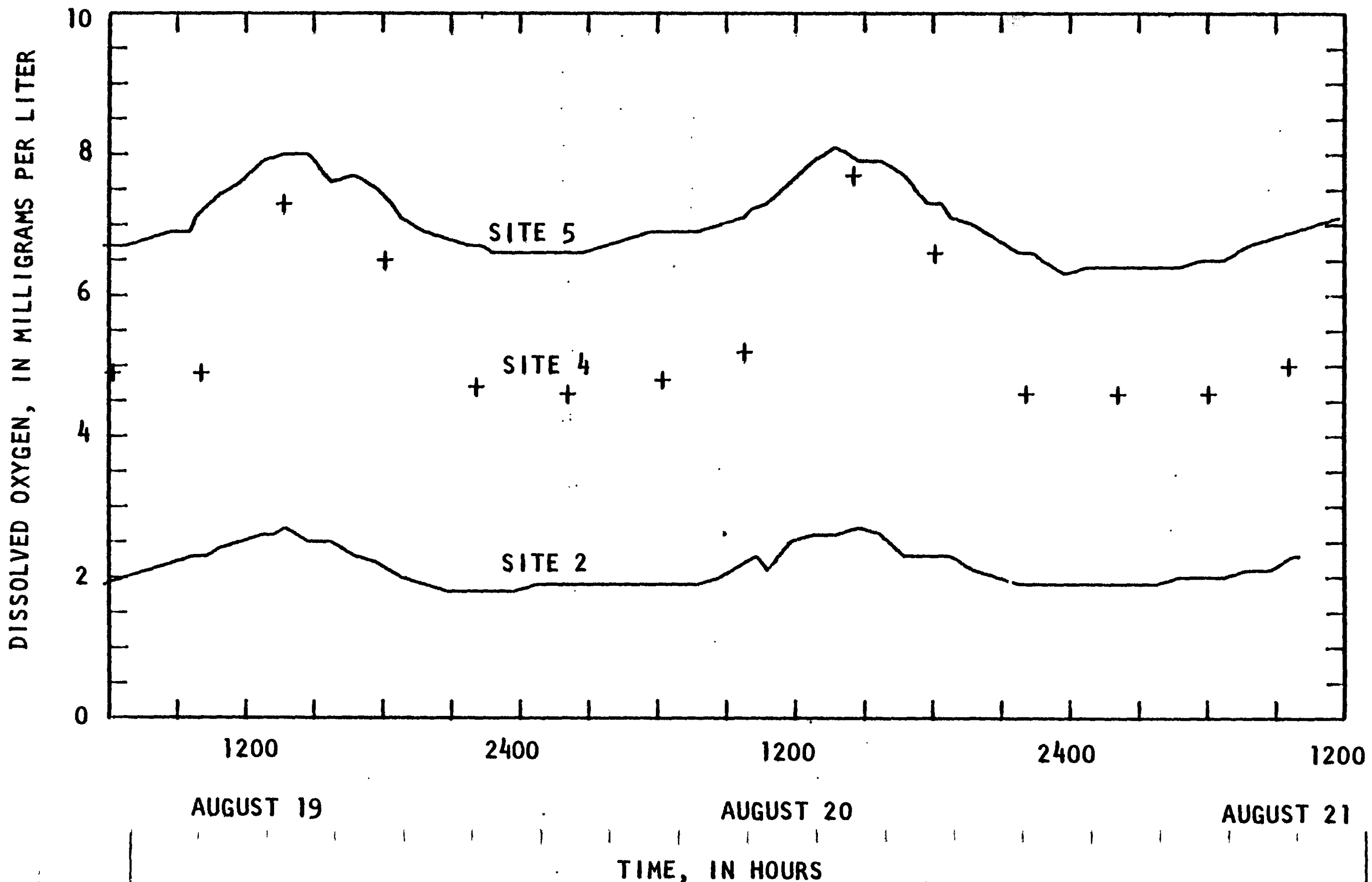

FIGURE 6.--DISSOLVED OXYGEN CONCENTRATIONS AT SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

Nitrogen Compounds

Nitrogen is one of the major nutrients which affects the quality of freshwater. The total nitrogen concentration is commonly reported as the sum of three species of nitrogen: ammonia nitrogen, nitrate-plus-nitrite nitrogen, and organic nitrogen. The mean total nitrogen concentration of Little Copiah Creek was 17 mg/L at site 2 decreasing downstream to 1.1 mg/L at site 5 (table 2).

A significant reduction in the mean concentrations of all types of nitrogen compounds, with the exception of nitrite plus nitrate, occurred downstream from site 2 on Little Copiah Creek. Mean ammonia nitrogen concentrations decreased from 13 mg/L at site 2 to 0.04 mg/L at site 5. Mean organic nitrogen concentrations decreased from 3.3 mg/L at site 2 to 0.28 mg/L at site 5 (figure 7). However, the mean nitrite-plus-nitrate concentration increased from site 2 (0.56 mg/L) to site 4 (2.4 mg/L) and then decreased at site 5 (0.82 mg/L). This increase was probably due to the process of nitrification (conversion of ammonia to nitrite and nitrate by bacteria).

The oxidation of ammonia by bacteria to nitrite and nitrate reduced the ammonia nitrogen load from 56 lb/d (pounds per day) at site 2 to 1.4 lb/d at site 5. At the same time the average nitrite-plus-nitrate nitrogen load increased from 2.4 lb/d at site 2 to approximately 30 lb/d at sites 4 and 5. The average organic nitrogen load decreased from 14 lb/d at site 2 to 5.0 lb/d at site 4 and then increased to 10 lb/d at site 5. Thus the total nitrogen load on the average decreased from 72 lb/d at site 2 to approximately 40 lb/d at sites 4 and 5. The average load of the nitrogen compounds was computed using the mean discharge and average concentration through the study period. The average load of the nitrogen compounds during the study are listed below:

Average nitrogen load, in pounds per day

Site	Ammonia Nitrogen	Nitrate-plus-nitrite nitrogen	Organic nitrogen	Total nitrogen
2	56	2.4	14	72
4	4.8	31	5.0	41
5	1.4	30	10	41

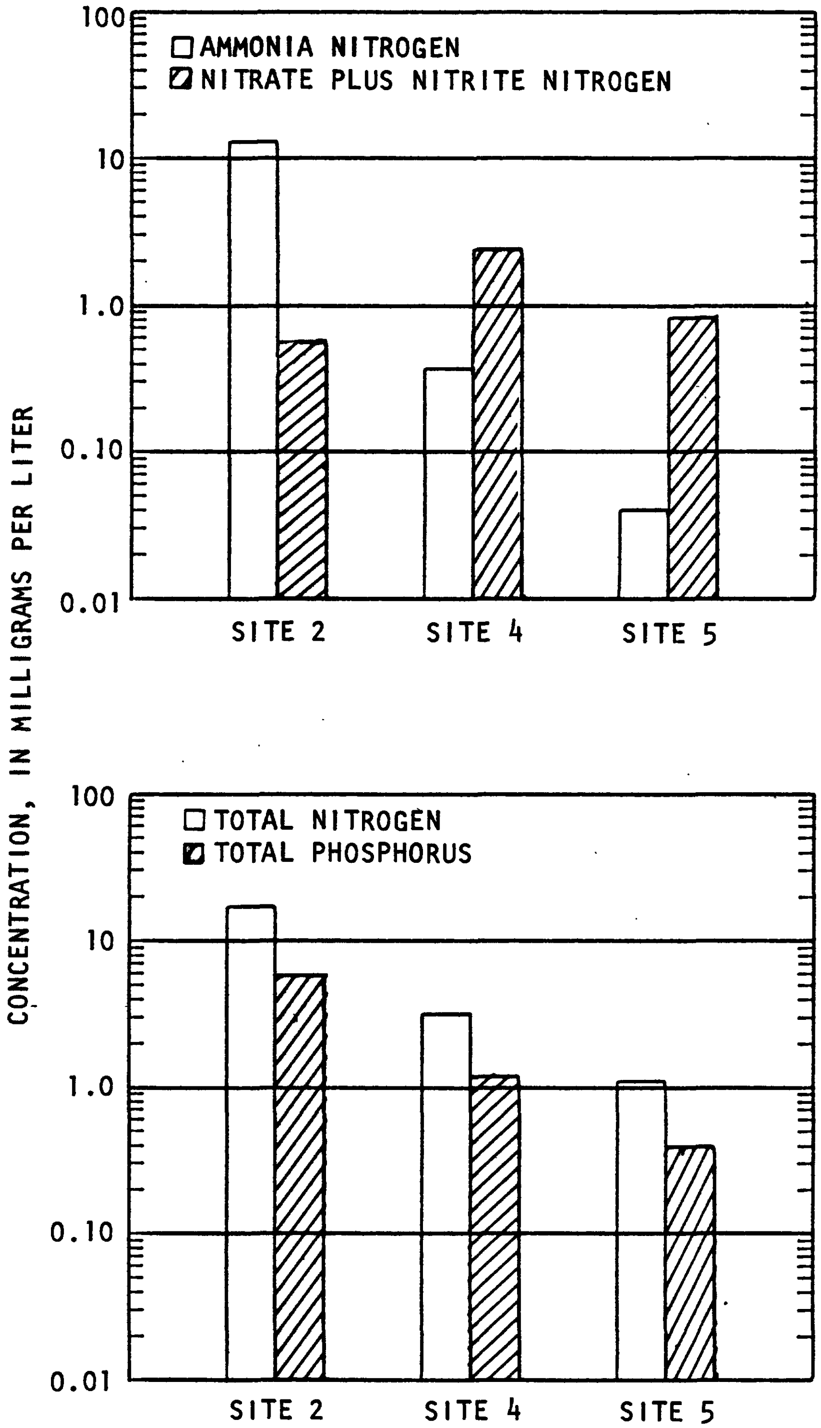

FIGURE 7.--MEAN AMMONIA, NITRATE PLUS NITRITE, AND TOTAL NITROGEN AND PHOSPHORUS CONCENTRATIONS AT THE SAMPLING SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980.

Phosphorus

Phosphorus is the least abundant of the major nutrients and is the nutrient which may limit biological productivity. Phosphorus is commonly reported as total phosphorus and orthophosphate. Total phosphorus concentrations decreased significantly downstream through the study area. The mean total phosphorus concentration decreased from 5.8 mg/L at site 2 to 0.39 mg/L at site 5 and the mean orthophosphate concentration decreased from 5.7 mg/L at site 2 to 0.27 mg/L at site 5 (figure 7). The average phosphorus load was also greater at site 2 (25 lb/d each of total and orthophosphate) than site 5 (14 lb/d of total phosphorus and less than 10 lb/d of orthophosphate). The orthophosphate load decreased downstream due to sedimentation and assimilation by algae. The organic phosphorus load decreased due to bacterial action. The concentrations of total phosphorus and orthophosphate are given in table 2.

Bacteria

The bacteria of the fecal coliform and fecal streptococcal groups, found in large numbers in the enteric wastes of warmblooded animals, including humans, are rarely present in soils and plants in large numbers. Thus these bacteria can be used as indicators of presence of human wastes in streams.

The fecal bacteria densities decreased downstream in Little Copiah Creek. The maximum fecal coliform densities were 2,200 col/100 mL (colonies per 100 milliliters) at site 2, 560 col/100 mL at site 4, and 160 col/100 mL at site 5. The maximum fecal streptococcal densities were 6,700 col/100 mL at site 2, 2,100 col/100 mL at site 4, and 1500 col/100 mL at site 5. Adverse environmental conditions (warm water, competitive life, and sedimentation) contributed to the decline in fecal bacteria densities.

SUMMARY

The study was conducted durng a generally low flow period from August 19-21, 1980 near Crystal Springs, Mississippi. The streamflow at site 2 was primarily Crystal Springs' Sewage Treatment Plant inflow. The streamflow was equal to the 7-day Q_{10} level at site 4 and slightly greater than the 7-day Q_{10} at site 5.

A reduction in nutrient concentrations (total nitrogen and phosphorus), specific conductance, five-day biochemical oxygen demand, and fecal bacteria densities along with an increase downstream in dissolved-oxygen and nitrate plus nitrite concentrations occurred downstream of site 2. This indicates that the water quality of Little Copiah Creek was generally improved downstream from site 2. To a large extent, the improvement of Little Copiah Creek was due to dilution by ground-water inflow and a natural process of nitrification. Total nitrogen concentrations decreased from 17 mg/L at site 2 to 1.1 mg/L at site 5. Mean ammonia nitrogen concentrations were 13 mg/L at site 2 and 0.04 mg/L at site 5. Mean nitrate-plus-nitrite concentration increased from site 2 (0.56 mg/L) to site 5 (2.4 mg/L). Organic nitrogen concentrations decreased; 3.3 mg/L at site 2 to 0.28 mg/L at site 5.

The mean total phosphorus concentration was 5.8 mg/L at site 2 and 0.39 at site 5. The mean specific conductance was 469 umhos/cm at site 2, 148 umhos/cm at site 4, and 82 umhos/cm at site 5. The maximum five-day biochemical oxygen demand value was reduced from 14 mg/L at site 2 to 1.4 mg/L at site 5. Maximum fecal coliform densities were 2,200 col/100 mL at site 2, 560 col/100 mL at site 4, and 160 col/100 mL at site 5. Maximum fecal streptococcal densities were 6,700 col/100 mL at site 2 and 1,500 col/100 mL at site 5. Mean dissolved-oxygen concentrations at site 2 was 2.0 mg/L, less than the 5.0 mg/L limit recommended for diversified warm water biota. Mean dissolved-oxygen concentrations was 5.3 mg/L at site 4 and 6.9 mg/L at site 5.

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HYDROLOGIC DATA

TABLE 1.--RESULTS OF FIELD DETERMINATIONS, HOURLY DISCHARGE, AND CONTINUOUS MONITOR VALUES AT T_E SITES ON LITTLE COPIAH CREEK, AUGUST 19-21, 1980

02487877 - LITTLE COPIAH CREEK AT SITE 2 - LAT 31°57'43", LONG 90°20'59"

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	OXYGEN, DIS-SOLVED (MG/L)
AUG						
19...	0600	.57	483	7.3	25.5	1.8
19...	0700	.61	482	--	25.0	1.8
19...	0800	.70	480	--	25.0	1.9
19...	0900	.78	476	--	25.0	2.1
19...	1000	.84	471	--	25.5	2.2
19...	1040	.86	469	7.3	25.5	2.2
19...	1100	.86	467	--	25.5	2.3
19...	1200	.86	468	--	26.0	2.4
19...	1300	.84	469	--	26.5	2.5
19...	1330	.84	468	7.4	27.0	2.5
19...	1400	.84	467	--	27.0	2.6
19...	1500	.78	468	--	27.5	2.4
19...	1600	.78	476	--	27.5	2.4
19...	1700	.74	483	--	28.0	2.2
19...	1800	.74	486	7.4	28.0	2.1
19...	1900	.78	484	--	28.0	1.9
19...	2000	.84	479	--	25.0	1.9
19...	2100	.86	473	--	27.5	1.7
19...	2200	.86	461	7.3	27.5	1.7
19...	2300	.86	460	--	27.0	1.7
19...	2400	.86	458	--	26.5	1.7
20...	0100	.86	462	--	26.5	1.8
20...	0200	.86	470	7.2	26.5	1.8
20...	0300	.78	477	--	26.0	1.8
20...	0400	.70	480	--	25.5	1.8
20...	0500	.61	481	--	25.5	1.8
20...	0600	.57	481	--	25.0	1.8
20...	0610	.57	480	7.2	25.0	1.8
20...	0700	.61	479	--	25.0	1.8
20...	0800	.70	476	--	25.0	1.8
20...	0900	.78	474	--	25.0	1.9
20...	1000	.86	471	--	25.5	2.1
20...	1040	.90	470	7.3	25.5	2.2
20...	1100	.90	468	--	25.5	2.0
20...	1200	.86	471	--	26.0	2.4
20...	1300	.84	470	--	26.5	2.5
20...	1400	.78	469	--	27.0	2.5
20...	1500	.78	468	7.3	27.5	2.6
20...	1600	.74	464	--	28.0	2.5

TABLE 1.--CONTINUED

02487877 - LITTLE COPIAH CREEK AT SITE 2 - LAT 31°57'43", LONG 90°20'59"

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	OXYGEN, DIS-SOLVED (MG/L)
AUG						
20...	1700	.70	462	--	27.5	2.2
20...	1800	.70	461	7.3	28.0	2.2
20...	1900	.74	460	--	28.0	2.1
20...	2000	.78	454	--	27.5	2.0
20...	2100	.84	447	--	27.5	1.9
20...	2200	.86	441	7.3	27.5	1.8
20...	2300	.86	439	--	27.0	1.8
20...	2400	.86	442	--	27.0	1.8
21...	0100	.84	451	--	26.5	1.8
21...	0200	.84	461	7.3	26.5	1.8
21...	0300	.78	469	--	26.0	1.8
21...	0400	.70	475	--	26.0	1.8
21...	0500	.66	475	--	25.5	1.9
21...	0600	.61	476	7.2	25.5	1.9
21...	0700	.70	473	--	25.5	1.9
21...	0800	.74	471	--	25.5	2.0
21...	0900	.78	466	--	25.5	2.0
21...	1000	.84	461	--	25.5	2.2
21...	1015	.86	460	7.2	26.0	2.2
21...	1100	.86	458	--	26.0	2.1
21...	1200	.86	457	--	26.0	2.2
21...	1300	.86	456	--	26.5	2.4
21...	1400	.86	456	--	27.0	2.6

TABLE 1.--CONTINUED

02487880 - LITTLE COPIAH CREEK AT SITE 4 - LAT 31°56'33", LONG 90°19'39"

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	OXYGEN, DIS-SOLVED (MG/L)
AUG						
19...	0625	2.4	142	6.7	24.0	4.8
19...	1020	2.4	139	6.7	24.0	4.8
19...	1355	2.3	139	6.9	27.0	7.2
19...	1820	2.4	143	6.9	28.0	6.4
19...	2220	2.4	148	6.7	26.0	4.6
20...	0220	2.4	144	6.5	25.0	4.5
20...	0625	2.4	149	6.5	24.0	4.7
20...	1000	2.6	151	6.7	24.0	5.1
20...	1445	2.4	153	6.9	28.0	7.6
20...	1820	2.4	159	6.9	28.0	6.5
20...	2220	2.4	154	6.7	26.5	4.5
21...	0220	2.6	148	6.6	25.5	4.5
21...	0615	2.3	155	6.6	24.5	4.5
21...	0945	2.4	155	6.8	25.0	4.9

TABLE 1.--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	OXYGEN, DIS-SOLVED (MG/L)
AUG						
19...	0645	6.9	80	6.8	24.0	7.2
19...	0700	6.9	--	--	--	6.6
19...	0800	6.9	82	--	23.5	6.7
19...	0900	6.9	82	--	26.5	6.8
19...	0950	6.9	77	7.0	24.0	6.8
19...	1000	6.9	--	--	--	7.0
19...	1100	6.9	--	--	--	7.3
19...	1200	6.9	--	--	--	7.5
19...	1300	6.9	--	--	--	7.8
19...	1400	6.9	--	--	--	7.9
19...	1415	6.9	75	6.6	26.5	7.9
19...	1500	6.9	--	--	--	7.9
19...	1600	6.9	82	--	27.0	7.5
19...	1700	6.8	82	--	26.5	7.6
19...	1800	6.8	82	--	26.5	7.4
19...	1840	6.8	82	6.8	26.5	7.1
19...	1900	6.8	82	--	26.5	7.0
19...	2000	6.8	82	--	26.0	6.8
19...	2100	6.8	82	--	25.5	6.7
19...	2200	6.8	82	--	25.5	6.6
19...	2240	6.8	82	6.6	26.0	6.7
19...	2300	6.8	82	--	25.5	6.5
19...	2400	6.8	82	--	25.0	6.5
20...	0100	6.8	83	--	25.0	6.5
20...	0200	6.8	82	--	25.0	6.5
20...	0240	6.8	83	6.6	25.0	6.6
20...	0300	6.8	84	--	24.5	6.5
20...	0400	6.8	83	--	24.0	6.6
20...	0500	6.9	82	--	24.0	6.7
20...	0600	6.9	82	--	24.0	6.8
20...	0655	6.9	82	6.5	24.0	7.0
20...	0700	6.9	82	--	23.5	6.8
20...	0800	6.9	82	--	23.5	6.8
20...	0900	6.9	82	--	23.5	6.9
20...	1000	6.9	82	--	23.5	7.0
20...	1015	6.9	82	6.8	24.0	7.5
20...	1100	6.9	82	--	24.0	7.2
20...	1200	6.9	83	--	24.5	7.5
20...	1300	6.9	82	--	25.5	7.8

TABLE 1.--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	OXYGEN, DIS-SOLVED (MG/L)
AUG						
20...	1400	6.9	78	6.8	26.0	8.0
20...	1500	6.9	83	--	26.5	7.8
20...	1600	6.9	82	--	26.5	7.8
20...	1700	6.8	82	--	26.5	7.6
20...	1800	6.8	82	--	26.5	7.2
20...	1840	6.8	82	6.9	27.0	7.2
20...	1900	6.8	82	--	26.5	7.0
20...	2000	6.8	82	--	26.5	6.9
20...	2100	6.8	82	--	26.0	6.7
20...	2200	6.9	83	--	26.0	6.5
20...	2240	6.9	83	6.6	26.5	6.7
20...	2300	6.9	83	--	25.5	6.4
20...	2400	6.9	83	--	25.5	6.2
21...	0100	6.9	83	--	25.5	6.3
21...	0200	6.9	83	--	25.0	6.3
21...	0240	6.9	83	6.7	25.5	6.6
21...	0300	6.9	83	--	25.0	6.3
21...	0400	6.9	83	--	24.5	6.3
21...	0500	6.9	83	--	24.5	6.3
21...	0600	6.9	84	--	24.5	6.4
21...	0625	6.9	84	6.5	24.5	6.8
21...	0700	6.9	83	--	24.0	6.4
21...	0800	6.9	83	--	24.0	6.6
21...	0900	6.9	84	--	24.0	6.7
21...	1000	6.9	84	6.9	24.5	6.8
21...	1100	6.9	84	--	24.5	6.9
21...	1200	6.9	85	--	25.0	7.0

TABLE 2.--RESULTS OF LABORATORY ANALYSIS OF WATER AND BOTTOM MATERIAL SAMPLES AT SITES ON LITTLE COPIAH CREEK AUGUST 19-21, 1980

02487877 - LITTLE COPIAH CREEK AT SITE 2 - LAT 31°57'43", LONG 90°20'59"

DATE	TIME	OXYGEN DEMAND, CHEM-ICAL (HIGH LEVEL) (MG/L)	OXYGEN DEMAND, BIOCHEM UNINHIB 5 DAY (MG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./100 ML)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML)	NITRO-GEN, NITRATE TOTAL (MG/L AS N)	NITRO-GEN, NITRITE TOTAL (MG/L AS N)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N)
AUG								
19...	1330	--	14	2200	6700	.21	.310	.52
19...	2200	--	--	--	--	.37	.250	.62
20...	0610	50	12	600	4600	.25	.200	.45
20...	1500	--	--	--	--	.25	.330	.58
20...	2200	--	--	--	--	.42	.240	.66
21...	0600	--	--	--	--	.33	.200	.53

DATE	NITRO-GEN, AMMONIA TOTAL (MG/L AS N)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS NO3)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, ORTHOPH OSPHATE TOTAL (MG/L AS P)
AUG							
19...	14.000	3.0	17	18	78	6.200	6.200
19...	12.000	3.0	15	16	69	6.600	6.600
20...	14.000	3.0	17	17	77	6.400	5.900
20...	12.000	4.0	16	17	73	5.300	5.300
20...	11.000	1.0	12	13	56	5.600	5.600
21...	14.000	6.0	20	21	91	4.800	4.800

TABLE 2--CONTINUED

02487880 - LITTLE COPIAH CREEK AT SITE 4, LAT 31°56'33", LONG 90°19'39"

DATE	TIME	OXYGEN DEMAND, CHEM-ICAL (HIGH LEVEL) (MG/L)	OXYGEN DEMAND, BIOCHEM UNINHIB 5 DAY (MG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML)	NITRO-GEN, NITRATE TOTAL (MG/L AS N)	NITRO-GEN, NITRITE TOTAL (MG/L AS N)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N)
AUG								
19...	1355	--	2.1	560	580	2.1	.120	2.2
19...	2220	--	--	--	--	2.3	.070	2.4
20...	0625	--	3.8	410	2100	2.4	.110	2.5
20...	1445	--	--	--	--	2.2	.160	2.4

DATE	NITRO-GEN, AMMONIA TOTAL (MG/L AS N)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS NO3)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, ORTHOPH OSPHATE TOTAL (MG/L AS P)
AUG							
19...	.300	.38	.68	2.9	13	1.200	1.100
19...	.280	.50	.78	3.2	14	1.200	1.100
20...	.410	.35	.76	3.3	14	1.000	1.000
20...	.480	.34	.82	3.2	14	1.300	1.300

TABLE 2--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	TIME	OXYGEN DEMAND, CHEM-ICAL (HIGH LEVEL) (MG/L)	OXYGEN DEMAND, BIOCHEM UNINHIB 5 DAY (MG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML)	NITRO-GEN, NITRATE TOTAL (MG/L AS N)	NITRO-GEN, NITRITE TOTAL (MG/L AS N)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N)
AUG								
19...	1415	6	1.4	K160	250	.81	.010	.82
19...	2240	--	--	--	--	.81	.000	.81
20...	0655	9	1.4	100	1500	.81	.000	.81
20...	1400	--	--	--	--	.77	.000	.77
20...	2240	--	--	--	--	.80	.010	.81
21...	0625	--	--	--	--	.89	.010	.90

DATE	NITRO-GEN, AMMONIA TOTAL (MG/L AS N)	NITRO-GEN, ORGANIC TOTAL (MG/L AS N)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS N)	NITRO-GEN, TOTAL (MG/L AS NO3)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, ORTHOPH OSPHATE TOTAL (MG/L AS P)
AUG							
19...	.040	.21	.25	1.1	4.7	.380	.250
19...	.020	.48	.50	1.3	5.8	.300	.250
20...	.080	.23	.31	1.1	5.0	.750	.320
20...	.040	.29	.33	1.1	4.9	.270	.250
20...	.030	.28	.31	1.1	5.0	.330	.280
21...	.030	.20	.23	1.1	5.0	.320	.270

TABLE 2--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	TIME	COLOR (PLATINUM COBALT UNITS)	TURBIDITY (NTU)	HARDNESS (MG/L AS CACO3)	HARDNESS, NONCARBONATE (MG/L CACO3)	CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)
AUG								
20...	1400	8	2.4	11	0	2.5	1.2	9.4

DATE	SODIUM ADSORPTION RATIO	ALKALINITY (MG/L AS CACO3)	SULFATE DISSOLVED (MG/L AS SO4)	CHLORIDE, DISSOLVED (MG/L AS CL)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)
AUG							
20...	1.2	15	3.6	12	.1	15	57

DATE	SOLIDS, DISSOLVED (TONS PER AC-FT)	SOLIDS, DISSOLVED (TONS PER DAY)	ARSENIC TOTAL (UG/L AS AS)	ARSENIC TOTAL IN BOTTOM MATERIAL (UG/G AS AS)	CADMIUM TOTAL RECOVERABLE (UG/L AS CD)	CADMIUM RECOV. FM BOTTOM MATERIAL (UG/G AS CD)	CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR)	CHROMIUM, RECOV. FM BOTTOM MATERIAL (UG/G)
AUG								
20...	.08	1.08	1	0	0	<10	9	<10

TABLE 2--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	COBALT, TOTAL RECOV-ERABLE (UG/L AS CO)	COBALT, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS CO)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE)	IRON, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS FE)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB)	LEAD, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS PB)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN)	MANGA-NESE, RECOV. FM BOT-TOM MA-TERIAL (UG/G)
AUG 20...	0	<10	600	1200	5	<10	150	130

DATE	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG)	MERCURY RECOV. FM BOT-TOM MA-TERIAL (UG/G AS HG)	NICKEL, TOTAL RECOV-ERABLE (UG/L AS NI)	NICKEL, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS NI)	SELE-NIUM, TOTAL (UG/L AS SE)	SELE-NIUM, TOTAL IN BOT-TOM MA-TERIAL (UG/G)	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN)	ZINC, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS ZN)
AUG 20...	.1	.00	6	10	0	0	10	3

DATE	PCB TOTAL (UG/L)	PCB, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	ALDRIN, TOTAL (UG/L)	ALDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	CHLOR-DANE, TOTAL (UG/L)	CHLOR-DANE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDD, TOTAL (UG/L)
AUG 20...	.00	0	.00	.0	.0	0	.00

TABLE 2--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	DDD, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	DDE, TOTAL (UG/L)	DDE, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	DDT, TOTAL (UG/L)	DDT, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	DI- AZINON, TOTAL (UG/L)	DI- ELDRIN TOTAL (UG/L)	DI- ELDRIN, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)
AUG								
20...	.0	.00	.3	.00	.0	.00	.00	.0

DATE	ENDO- SULFAN, TOTAL (UG/L)	ENDRIN, TOTAL (UG/L)	ENDRIN, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	ETHION, TOTAL (UG/L)	HEPTA- CHLOR, TOTAL (UG/L)	HEPTA- CHLOR, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	HEPTA- CHLOR EPOXIDE TOTAL (UG/L)	HEPTA- CHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)
AUG								
20...	.00	.00	.0	.00	.00	.0	.00	.0

TABLE 2--CONTINUED

02487892 - LITTLE COPIAH CREEK AT SITE 5, LAT 31°54'37", LONG 90°17'43"

DATE	LINDANE TOTAL (UG/L)	LINDANE TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	MALA-THION, TOTAL (UG/L)	METH-OXY-CHLOR, TOTAL (UG/L)	METHYL PARA-THION, TOTAL (UG/L)	DDT, TOTAL (UG/L)	MIREX, TOTAL (UG/L)	PARA-THION, TOTAL (UG/L)
AUG 20...	.00	.0	.00	.00	.00	.00	.00	.00

DATE	PER-THANE TOTAL (UG/L)	TOX-APHENE, TOTAL (UG/L)	TOXA-PHENE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	TOTAL TRI-THION (UG/L)	2,4-D, TOTAL (UG/L)	2,4,5-T TOTAL (UG/L)	SILVEX, TOTAL (UG/L)
AUG 20...	.00	0	0	.00	.02	.00	.00