UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

WATER-QUALITY INVESTIGATION OF THE CANEY CREEK WATERSHED, NORTHEAST ARKANSAS

Open-File Report 79-1064

Prepared in cooperation with the

U.S. Department of Agriculture, Soil Conservation Service

Little Rock, Arkansas

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ABSTRACT

The results of a 1-year study, in 1977-78, of surface-water quality in the Caney Creek watershed are presented to document conditions before implementation of Soil Conservation Service programs. Analyses of samples collected at two sites shows that water in Caney Creek and Caney Creek Ditch is of good quality with no serious water-quality problems.

INTRODUCTION

The National Environmental Policy Act, the Federal Water Pollution Control Act Amendments of 1972, and the Water Resources Council's "Principles and Standards of Planning Water and Related Land Resources" require documentation of various water-resources parameters before, during, and after implementation of land- and water-improvement projects. This report documents the results of a 1-year study, October 1977 to September 1978, of various water-quality parameters in the Caney Creek watershed, a part of the Upper Tri-County Watershed project area, prior to the beginning of planned land- and water-improvement measures by the Soil Conservation Service. This report was prepared by the U.S. Geological Survey, in cooperation with the Soil Conservation Service, for use in the assessment of the project's impact on the watershed.

After a reconnaissance of the project area, a team of Soil Conservation Service and Geological Survey representatives selected the sampling sites shown in figure 1. After considering the available water-resources data for Caney Creek, the team selected the water-quality parameters to be studied and the frequency of the sampling to be done in the area. All field sampling and laboratory procedures conform to standard Survey methods.

CANEY CREEK WATERSHED

Location

The Caney Creek watershed is in northeast Arkansas between lat 35°52' N. and 35°58' N. and long 91°13' W. and 91°26' W. (fig. 1). Most of the watershed is in Lawrence and Sharp Counties except for a small area in Independence County. The watershed is about 10 miles long and 2¼ miles wide and covers an area of 22.7 square miles.

Topography and Drainage

The Caney Creek watershed, elongated east and west (fig. 1), extends from the hilly Ozark Plateau in its upper reaches to the Coastal Plain in its lower reaches. Consequently, the topography consists of moderately sloped hills in the western two-thirds of the watershed and moderately sloped to almost flat fields in the eastern one-third. Ground-surface altitudes above the National Geodetic Vertical Datum of 1929 (NGVD) range from 600 feet on the western edge of the watershed to 225 feet at the mouth of Caney Creek. Channel slope averages 42 feet per mile from the watershed divide to sampling site 1 and 8.8 feet per mile between sampling sites 1 and 2. The most downstream one-fourth of the main channel has been replaced by a straight ditch that runs east into the Strawberry River (fig. 1).

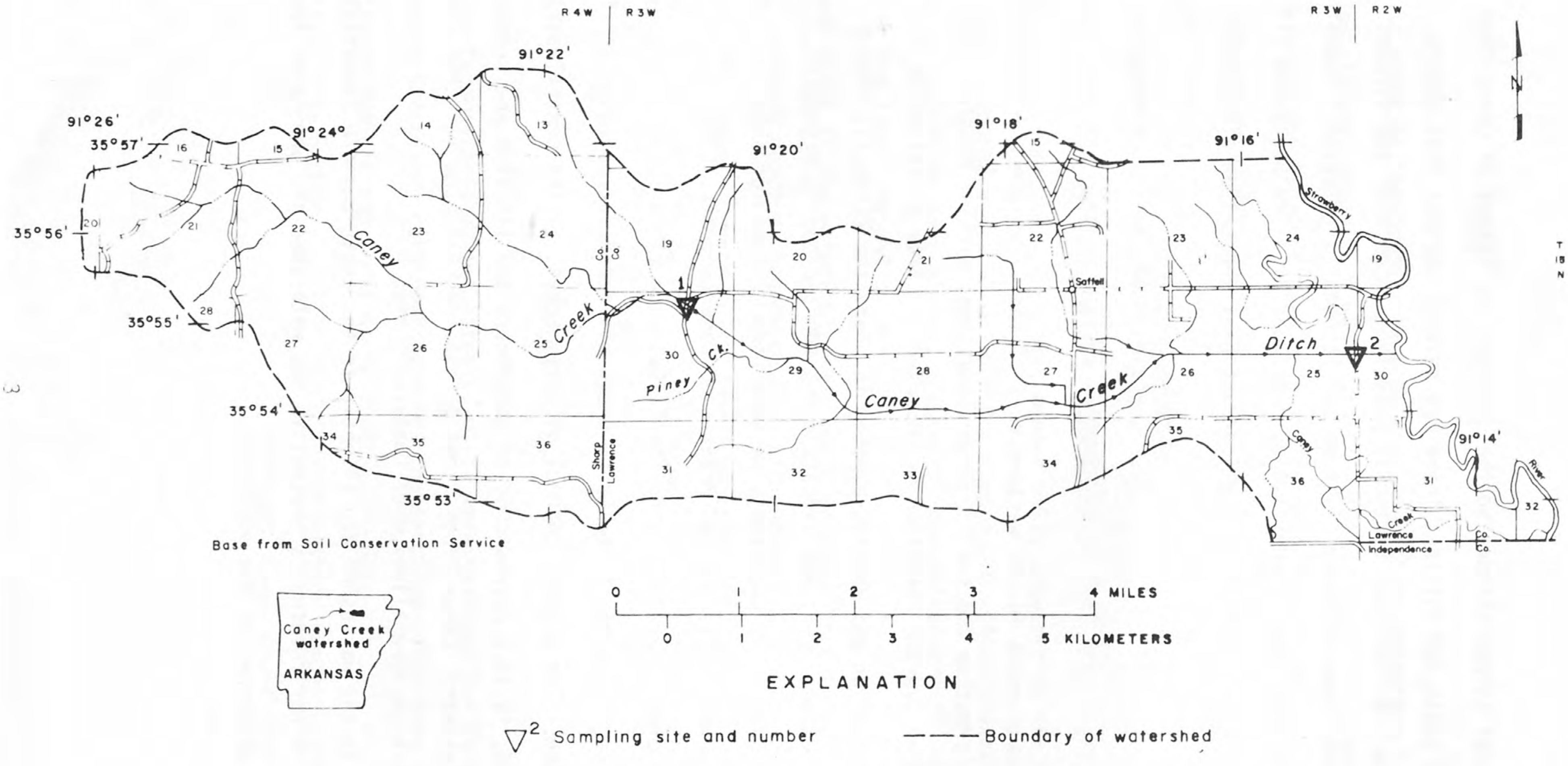

Figure 1.—Sampling sites in Caney Creek watershed.

The natural stream channel in the upstream two-thirds of Caney Creek contains many pools and riffles; there are several springs that assure perennial flow. A fine sand bottom is prevalent in much of the stream. The stream banks have a canopy of trees and abundant vegetation. Downstream, in the ditched part, the channel slope is gradual with few pools and riffles. There also is a canopy of trees and abundant bank vegetation along most of this downstream section.

Geology

The exposed rocks in the western part of the Caney Creek watershed are the Everton Formation and the St. Peter Sandstone, both of Middle Ordovician age. The older Everton Formation is composed of three divisions having erratic distribution and varying greatly in character (Croneis, 1930 p. 23). The top and bottom layers are limestone and the top bed is magnesian. A sandstone layer is between the limestone beds. Disconformably overlying the Everton Formation is the St. Peter Sandstone (Croneis, 1930, p. 27). The Everton Formation rests on the Powell Dolomite of Early Ordovician age.

In the central part of the Caney Creek watershed are outcrops of Cretaceous age. The present channel of Caney Creek, in the central part of the watershed, is in a narrow zone of Quaternary age alluvium and terrace deposits. Eastward, Caney Creek flows across the Fall Line into the Coastal Plain and through more alluvium of Quaternary age.

Strata in the watershed dip slightly to the south but are essentially flat lying. Minor folding is present in the watershed and one major fault borders the watershed to the southwest.

Ground Water

Ground water in the eastern part of the Caney Creek watershed is obtained mostly from alluvial deposits. Wells with the largest yields are screened in coarse gravel at the base of these deposits between 80 and 130 feet deep. There are no serious ground-water-supply problems in this area (Lamonds, Hines, and Plebuch, 1969, p. 32).

In the western part of the watershed, both the St. Peter Sandstone and the Everton Formation contain shallow wells 20 to 50 feet deep. Small yields of 5-10 gallons per minute are common, deeper wells penetrating the Powell Dolomite have produced up to 50 gallons per minute. Solution channels that have developed along bedding planes, fractures, and joints are the major source of water in the limestone and dolomite.

Ground water in the watershed, indicative of water from limestone and dolomite, contains calcium, magnesium, and bicarbonate as the predominant cations and anion. This water is hard to very hard (greater than 120 mg/L as calcium carbonate) and may need to be softened for some domestic and industrial purposes (Lamonds, 1972).

SAMPLING SITES

Two surface-water sampling sites (fig. 1) were selected for this study. For computer storage and retrieval purposes the sampling sites were assigned Survey station numbers and names as follows:

Sampling site number	Survey station number and name
1	07074340 Caney Creek near Saffell, Ark.
2	07074345 Caney Creek Ditch near Saffell, Ark.

Sampling site 1 was at a bridge on a county road 3.1 miles west of Saffell and 1.0 miles upstream from Piney Creek. This site was picked to represent drainage from the hilly upstream part of the watershed.

Sampling site 2 was at a bridge on a county road 2.25 miles east of Saffell and 0.3 mile upstream from the Strawberry River. This site represents drainage from the entire watershed.

WATER-QUALITY PARAMETERS SAMPLED

When sampled, each site was inspected and graded for severity of oil and grease, gas bubbles, floating sludge, atmospheric odor, dead fish, floating debris, and turbidity. Severity was graded on a scale of 0 (none) to 4 (extreme). Field determinations were also made of water temperature, pH, specific conductance, dissolved oxygen, and hardness.

Water samples were collected during each visit and laboratory analyses were made for several constituents and properties, most of which are listed and explained in table 1. Results of all analyses are shown in tables 2 and 3. Frequency of analysis for the different constituents varied; some were analyzed six times during the year and some were analyzed quarterly.

INTERPRETATION OF RESULTS

Analysis of data collected at the sampling sites in the Caney Creek watershed indicates that the water is good quality with no serious water-quality problems. All parameters sampled were within the range of concentrations expected for a rural watershed which is underlain predominantly by limestone and dolomite. The predominant ions are calcium, magnesium, and bicarbonate; the water is hard to very hard and similar to ground water in the area. Most of the samples were

Table 1.—*Source and significance of dissolved-mineral constituents and properties of water*

Constituent or property	Source or cause	Significance
Iron (Fe)	Dissolved from practically all rocks and soils. May also be dissolved from iron pipes, pumps, and other equipment. More than about 2 mg/L of soluble iron in surface water generally indicates acid wastes from mine drainage or other sources.	Iron is objectionable in public-water supplies because of its effect on taste, staining of plumbing fixtures, spotting of laundered clothes, and accumulation of deposits in distribution systems. On exposure to air, iron in ground water oxidizes to reddish-brown sediment. National secondary drinking-water regulations (1977) proposed by the U.S. Environmental Protection Agency (EPA) recommend that iron should not exceed 0.3 mg/L. Water-quality criteria (Natl. Acad. Sci., Natl. Acad. Eng., 1973) for irrigation recommend a maximum concentration of 5 mg/L for continuous use on all soils, and a maximum concentration of 20 mg/L on neutral to alkaline soils for a 20-year period.
Calcium (Ca) and magnesium (Mg)	Dissolved from practically all soils and rocks, especially from limestone, dolomite, and gypsum. Calcium and magnesium are present in large quantities in some brines. Magnesium is present in large quantities in seawater.	Cause most of the hardness and scale-forming properties of water; soap consuming. (See "Hardness as $CaCO_3$" below.) Water that is low in calcium and magnesium is desirable in electroplating, tanning, dyeing, and in textile manufacturing.
Sodium (Na) and potassium (K)	Dissolved from practically all rocks and soils. Also present in oil-field brines, seawater, industrial brines, and sewage.	Large amounts, in combination with chloride, give a salty taste to water. High sodium concentration commonly limits use of water for irrigation. Sodium salts may cause foaming in steam boilers.

Table 1.—*Source and significance of dissolved-mineral constituents and properties of water*—Continued

Constituent or property	Source or cause	Significance
Manganese (Mn)	Dissolved from some rocks and soils. Not so common as iron. Large quantities are commonly associated with high iron concentration or acid waters.	Same objectionable features as iron. Causes dark-brown or black stain. National secondary drinking-water regulations proposed by the EPA (1977) recommend that manganese should not exceed 0.05 mg/L. Water-quality criteria for irrigation (Natl. Acad. Sci., Natl. Acad. Eng., 1973) recommend a maximum concentration of 0.20 mg/L for continued use on all soils and 10 mg/L for use up to 20 years on neutral and alkaline fine-textured soils.
Silica (SiO_2)	Dissolved from practically all rocks and soils; concentrations are commonly less than 30 mg/L. High concentrations, as much as 100 mg/L, generally occur in highly alkaline waters.	Forms hard scale in pipes and boilers. Carried over in steam of high-pressure boilers to form deposits on blades of turbines. Inhibits deterioration of zeolite-type water softeners.
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Commonly present in some industrial wastes.	High concentrations have a laxative effect on some people and, in combination with other ions, give a bitter taste to water. Sulfate in water containing calcium forms a hard scale in steam boilers. National secondary drinking-water regulations proposed by the EPA (1977) recommend that sulfate concentration should not exceed 250 mg/L.

Table 1.—*Source and significance of dissolved-mineral constituents and properties of water*—Continued

Constituent or property	Source or cause	Significance
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and in high concentrations in oil-field brines, seawater, and industrial brines.	High concentrations increase the corrosiveness of water and, in combination with sodium, give a salty taste. National secondary drinking-water regulations proposed by the EPA (1977), recommend that the chloride concentration should not exceed 250 mg/L.
Nitrate (NO_3)	Decaying organic matter, sewage, fertilizer, and nitrates in soil.	Concentration much greater than the local average may suggest pollution. National interim primary drinking-water regulations proposed by the EPA (1977) specify a maximum contaminate level of 10 mg/L of nitrate as N. Nitrate encourages growth of algae and other organisms which produce undesirable tastes and odors.
Phosphate (PO_4)	Dissolved from rocks containing apatite, leached from soils. Present in some fertilizers, detergents, and organic wastes.	Concentrations present in natural waters are not toxic to man, animals, or fish. Phosphate stimulates growth of algae, which may cause objectionable odors.
Residue (dissolved solids)	Chiefly mineral constituents dissolved from rocks and soils. Includes any dissolved organic matter.	National secondary drinking-water regulations proposed by the EPA (1977) recommend that total dissolved-solids concentration should not exceed 500 mg/L. Water having a dissolved-solids concentration of more than 1,000 mg/L is unsuitable for many purposes.

Table 1.—*Source and significance of dissolved-mineral constituents and properties of water*—Continued

Constituent or property	Source or cause	Significance
Hardness as $CaCO_3$	In most waters, nearly all the hardness is caused by calcium and magnesium. Metallic cations other than alkali metals also cause hardness.	Hard water consumes soap before lather will form; deposits soap curd on bathtubs, and forms scale in boilers, water heaters, and pipes.
Hydrogen ion concentration (pH)	Acids, acid-generating salts, and free carbon dioxide decrease pH. Carbonates, bicarbonates, hydroxides, phosphates, silicates, and borates increase pH.	The pH of water is a measure of the activity of hydrogen ions. A pH of 7.0 indicates a neutral solution, a pH greater than 7.0 indicates alkalinity, a pH less than 7.0 indicates acidity. Corrosiveness of water generally increases with decreasing pH.
Temperature	Affected by exposure to sunlight or wind, especially in shallow ponds and ditches.	Affects the usefulness of water for many purposes. Generally, warm water increases biochemical processes. Most industrial users desire cold water.
Specific conductance (μmho/cm at 25°C)	Mineral content of water.	Indicates degree of mineralization. Specific conductance is a measure of the capacity of the water to conduct an electric current. Varies with concentration and degree of ionization of the constituents and with temperature. Nearly all irrigation waters that have been used successfully for a considerable time have conductivity values less than 2,250 μmho/cm.
Dissolved oxygen (O_2)	The main source of oxygen in water exposed to air is the atmosphere, although some oxygen is contributed as a by-product of photosynthesis.	Important as a measure of the "health" of a stream. Low dissolved-oxygen concentration usually indicates the presence of decaying organic material. Low dissolved-oxygen concentration limits biological activity.

Table 2.—*Discharge and water-quality data for Caney Creek, near Saffell, Ark. (site 1)*

DATE	OIL-GREASE (SEVERITY) (01300)	GAS BUBBLES (SEVERITY) (01310)	SLUDGE, FLOATING (SEVERITY) (01315)	ODOR, ATMOSPHERIC (SEVERITY) (01330)	FISH, DEAD (SEVERITY) (01340)	DEBRIS, FLOATING (SEVERITY) (01345)	TURBIDITY (SEVERITY) (01350)	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	SPECIFIC CONDUCTANCE (MICROMHOS) (00095)	PH (UNITS) (00400)
MAR , 1978										
09...	0	0	0	0	0	0	0	22	232	7.1
MAY										
10...	0	0	0	0	0	0	0	17	338	7.9
JUN										
14...	0	0	0	0	0	0	0	3.2	364	8.0
JUL										
19...	0	0	0	1	0	0	0	3.4	357	7.9
SEP										
20...	0	0	0	0	0	1	0	2.5	382	7.5
OCT										
06...	0	0	0	0	0	--	0	2.0	357	7.7

DATE	TEMPERATURE (DEG C) (00010)	TURBIDITY (NTU) (00076)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L) (00310)	HARDNESS (MG/L AS CACO3) (00900)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)
MAR , 1978										
09...	6.0	--	12.2	101	1.2	130	28	14	.6	1
MAY										
10...	14.0	4.0	9.3	93	.8	--	--	--	--	--
JUN										
14...	19.0	.40	7.9	88	.4	210	46	24	1.6	2
JUL										
19...	22.0	10	7.9	93	.4	--	--	--	--	--
SEP										
20...	22.0	1.3	6.7	79	3.2	200	46	21	1.9	2
OCT										
06...	14.0	--	9.0	90	.4	210	47	23	1.7	2

Table 2.—*Discharge and water-quality data for Caney Creek, near Saffell, Ark. (site 1)*—Continued

DATE	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, RESIDUE AT 105 DEG. C, DIS-SOLVED (MG/L) (00515)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)
MAR , 1978									
09...	.0	.8	6.9	1.7	6.4	128	91	.17	7.71
MAY									
10...	--	--	--	--	--	127	151	.17	5.83
JUN									
14...	.0	.6	6.9	2.6	6.3	180	186	.24	1.56
JUL									
19...	--	--	--	--	--	188	15	.26	1.73
SEP									
20...	.1	1.1	4.5	3.4	10	200	206	.27	1.35
OCT									
06...	.1	1.0	3.4	2.7	9.4	196	208	.27	1.06

DATE	SOLIDS, RESIDUE AT 105 DEG. C, SUS-PENDED (MG/L) (00530)	SOLIDS, RESIDUE AT 105 DEG. C, TOTAL (MG/L) (00500)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO-GEN, TOTAL (MG/L AS N) (00600)	NITRO-GEN, TOTAL (MG/L AS NO3) (71887)	PHOS-PHORUS, TOTAL (MG/L AS P) (00665)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE) (01045)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN) (01055)
MAR , 1978									
09...	34	125	.14	.07	.21	.93	.02	490	50
MAY									
10...	8	159	.10	.13	.23	1.0	.01	--	--
JUN									
14...	9	195	.17	.09	.26	1.2	.00	150	80
JUL									
19...	188	203	.24	.51	.75	3.3	.04	--	--
SEP									
20...	4	210	.20	.51	.71	3.1	.01	200	100
OCT									
06...	0	208	.15	.41	.56	2.5	.02	160	70

Table 3.—*Discharge and water-quality data for Caney Creek Ditch, near Saffell, Ark. (site 2)*

DATE	OIL-GREASE (SEVER-ITY) (01300)	GAS BUBBLES (SEVER-ITY) (01310)	SLUDGE, FLOAT-ING (SEVER-ITY) (01315)	ODOR, ATMOS-PHERIC (SEVER-ITY) (01330)	FISH, DEAD (SEVER-ITY) (01340)	DEBRIS, FLOAT-ING (SEVER-ITY) (01345)	TUR-BID-ITY (SEVER-ITY) (01350)	STREAM-FLOW, INSTAN-TANEOUS (CFS) (00061)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS) (00095)	PH (UNITS) (00400)
MAR , 1978										
09...	0	0	0	0	0	1	3	75	125	6.9
MAY										
10...	0	0	0	0	0	2	3	21	232	7.9
JUN										
14...	0	0	0	0	0	0	0	4.4	370	7.7
JUL										
19...	0	0	0	0	0	0	2	6.8	385	7.2
SEP										
20...	0	0	1	0	0	0	1	3.7	384	7.6
OCT										
06...	0	0	0	0	0	1	1	3.1	362	8.0

DATE	TEMPER-ATURE (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	OXYGEN DEMAND, BIO-CHEM-ICAL, 5 DAY (MG/L) (00310)	HARD-NESS (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)
MAR , 1978										
09...	4.5	--	11.2	89	2.3	59	13	6.4	1.3	4
MAY										
10...	17.0	35	8.7	92	1.4	--	--	--	--	--
JUN										
14...	20.0	5.5	7.8	89	1.0	220	47	25	1.8	2
JUL										
19...	23.5	1.1	8.0	96	.9	--	--	--	--	--
SEP										
20...	23.0	9.0	7.1	84	3.6	210	48	21	1.9	2
OCT										
06...	13.5	--	8.8	87	.6	210	48	22	1.8	2

Table 3.—*Discharge and water-quality data for Caney Creek Ditch, near Saffell, Ark. (site 2)*—Continued

DATE	SODIUM AD- SORP- TION RATIO (00931)	POTAS- SIUM, DIS- SOLVED (MG/L AS K) (00935)	SULFATE DIS- SOLVED (MG/L AS SO4) (00945)	CHLO- RIDE, DIS- SOLVED (MG/L AS CL) (00940)	SILICA, DIS- SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS- SOLVED (MG/L) (70300)	SOLIDS, RESIDUE AT 105 DEG. C, DIS- SOLVED (MG/L) (00515)	SOLIDS, DIS- SOLVED (TONS PER AC-FT) (70303)	SOLIDS, DIS- SOLVED (TONS PER DAY) (70302)
MAR , 1978									
09...	.1	1.8	10	2.4	5.1	81	39	.11	16.5
MAY									
10...	--	--	--	--	--	114	133	.16	6.46
JUN									
14...	.1	.7	5.4	3.1	5.4	191	186	.26	2.27
JUL									
19...	--	--	--	--	--	198	169	.27	3.64
SEP									
20...	.1	1.0	4.4	3.0	9.9	206	212	.28	2.06
OCT									
06...	.1	1.0	4.2	3.0	9.0	192	228	.26	1.61

DATE	SOLIDS, RESIDUE AT 105 DEG. C, SUS- PENDED (MG/L) (00530)	SOLIDS, RESIDUE AT 105 DEG. C, TOTAL (MG/L) (00500)	NITRO- GEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITRO- GEN,AM- MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITRO- GEN, TOTAL (MG/L AS N) (00600)	NITRO- GEN, TOTAL (MG/L AS NO3) (71887)	PHOS- PHORUS, TOTAL (MG/L AS P) (00665)	IRON, TOTAL RECOV- ERABLE (UG/L AS FE) (01045)	MANGA- NESE, TOTAL RECOV- ERABLE (UG/L AS MN) (01055)
MAR , 1978									
09...	64	103	.38	.07	.45	2.0	.12	2800	100
MAY									
10...	65	198	.15	.37	.52	2.3	.07	--	--
JUN									
14...	35	221	.13	.19	.32	1.4	.00	410	80
JUL									
19...	40	209	.19	.27	.46	2.0	.01	--	--
SEP									
20...	24	236	.17	.45	.62	2.7	.03	350	80
OCT									
06...	8	230	.10	.32	.42	1.9	.02	450	40

collected during periods of relatively low discharge; therefore, concentrations of dissolved constituents contributed by ground water tend to be higher than during high-flow periods.

The decrease in specific conductance from 232 to 125 micromhos and the decrease in dissolved solids between sites 1 and 2 on March 9, 1978, were due to dilution caused by rainfall that increased streamflow from 22 to 75 cubic feet per second. Dissolved-oxygen concentration in the stream ranged from 79 to 101 percent of saturation, indicating an adequate supply of oxygen for fish and other biota. The increase in biochemical oxygen demand of the March and September samples from both sites, the increase in total nitrogen concentration of the September samples from both sites, and the increase in phosphorus concentration of the March sample at site 2 probably resulted from cattle waste. There are no municipal- or industrial-waste sources in the watershed. The high suspended solids concentration on July 19, 1978, at site 1 probably resulted from cattle wading in the stream.

The iron concentration of 2,800 micrograms per liter found at site 2 on March 9, 1978, probably resulted from rainfall and runoff from freshly exposed topsoil. The lower than usual pH of 6.9 and the higher than usual sulfate concentration of 10 milligrams per liter may indicate the exposure to weathering of iron sulfides.

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