WATER-QUALITY RECONNAISSANCE AND STREAMFLOW GAIN AND LOSS OF YOCUM CREEK BASIN, CARROLL COUNTY, ARKANSAS

by Robert L. Joseph and W. Reed Green

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
yard (yd)	0.9144	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot per minute (ft/min)	0.3048	meter per minute
foot per mile (ft/mi)	0.1894	meter per kilometer
gallon per minute (gal/min)	0.063008	liter per second

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

$$°F = 1.8\ °C + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

A study of the Yocum Creek Basin conducted between July 27 and August 3, 1993, described the surface- and ground-water quality of the basin and the streamflow gain and loss. Water samples were collected from 12 sites on the mainstem of Yocum Creek and 2 tributaries during periods of low to moderate streamflow (less than 40 cubic feet per second). Water samples were collected from 5 wells and 12 springs located in the basin.

In 14 surface-water samples, nitrite plus nitrate concentrations ranged from 1.3 to 3.8 milligrams per liter as nitrogen. Orthophosphorus concentrations ranged from 0.01 to 0.06 milligrams per liter as phosphorous. Fecal coliform bacteria counts ranged from 9 to 220 colonies per 100 milliliters, with a median of 49 colonies per 100 milliliters. Fecal streptococci bacteria counts ranged from 37 to 1,500 colonies per 100 milliliters with a median of 420 colonies per 100 milliliters. Analyses for selected metals collected near the mouth of Yocum Creek indicate that metals are not present in significant concentrations in surface-water samples.

Diel dissolved oxygen concentrations and temperatures were measured at two sites on the mainstem of the stream. At the upstream site, dissolved oxygen concentrations ranged from 6.2 to 9.9 milligrams per liter and temperatures ranged from 18.5 to 23.0 degrees Celsius. Dissolved oxygen concentrations were higher and temperature values were lower at the upstream site than those at the downstream site.

Five wells were sampled in the basin and dissolved ammonia was present in concentrations ranging from 0.01 to 0.07 milligrams per liter as nitrogen. Dissolved nitrite plus nitrate was present in wells, with concentrations ranging from less than 0.02 to 6.0 milligrams per liter as nitrogen. Volatile organic compound samples were collected at two wells and two springs. Chloroform was the only volatile organic compound found to be above the detection limit. Analysis indicated that 0.2 micrograms per liter of chloroform was present in one spring-water sample.

In springs sampled, nitrite plus nitrate concentrations ranged from 1.4 to 7.0 milligrams per liter as nitrogen. Dissolved ammonia plus organic nitrogen concentrations ranged from less than 0.2 to 0.49 milligrams per liter as nitrogen. Orthophosphorus concentrations ranged from 0.01 to 0.07 milligrams per liter as phosphorus. Fecal coliform bacteria counts ranged from 3 to 200 colonies per 100 milliliters, with a median of 18 colonies per 100 milliliters. Fecal streptococci bacteria counts ranged from 110 to more than 2,000 colonies per 100 milliliters with a median of 350 colonies per 100 milliliters.

Large producing springs located in the mid to upper reaches of the basin contribute most of the flow to Yocum Creek. Streamflow increased an average of 29 percent on the mainstem of the stream. One losing reach was discovered on the mainstem of the stream and two losing reaches on tributaries to the mainstem. Surface flow steadily decreased along these reaches to the point where surface flow was not present, and the streambed became dry. These observations suggest that significant interaction exists between the underlying Springfield aquifer and surface flow in the Yocum Creek Basin.

INTRODUCTION

The purpose of this report is to describe the current water-quality conditions within the Yocum Creek Basin using physical, nutrient, bacteriological, common constituent, selected metal data, and volatile organic compound data collected at various surface- and ground-water sites in the basin, and to identify gaining and losing streamflow reaches of Yocum Creek and its tributaries. This report was prepared by the U.S. Geological Survey (USGS) in cooperation with the Arkansas Soil and Water Conservation Commission.

The authors wish to thank the following land owners Mryl Bradley, Quinton Tipton, Terry Benson, Kreglyn Garrett, Kirby Garrett, and Stephen Strafford for granting permission and assistance in sampling of their wells and springs. Additional thanks is extended to Leon Duncan of the Carroll County Cooperative Extension Service.

DESCRIPTION OF STUDY AREA

Yocum Creek, in northwestern Arkansas, drains an area of 72.8 mi^2 (Sullavan, 1974), and flows northward through Carroll County (fig. 1) in the Springfield Plateau physiographic section (Fenneman, 1938). The Springfield Plateau topography is characterized by gentle to moderate slopes, ranging from 12 to 50 percent. A large part of this section is dissected by streams that form V-shaped valleys. The study area (fig. 2) has a dendritic drainage pattern with land-surface elevations ranging from approximately 915 ft above sea level near Table Rock Lake to 1,850 ft above sea level in the southern portion of the study area. Yocum Creek has a mean gradient of 18 ft/mi and a mean channel width of 72 ft.

Agricultural development over the last 10 years has resulted in numerous changes in land use, which may affect ground- and surface-water quality. The economic base of Carroll County has undergone changes as well; farming has become more diversified with increased chicken broiler and turkey production over the past decade (Fowlkes and others, 1981). Located in the Yocum Creek Basin are 77 chicken broiler houses and 49 turkey houses, which annually produce an estimated 5 million broilers and 1.75 million turkeys, respectively. Approximately 1.25 million laying hens, 17,000 beef cattle, and 900 dairy cattle are in the Yocum Creek Basin (Leon Duncan, Carroll County Cooperative Extension Service, oral commun., 1994).

Mean annual air temperature in the Yocum Creek Basin is 59 °F, with an average of 52.7 in. of precipitation annually (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1992). The normal mean air temperature for the months of May through August (1961-90) is 71 °F, however, in 1993, during this 4-month period the mean air temperature was 74 °F. The normal precipitation during the months of May through August is 17.5 in., however, 18.9 in. of precipitation were recorded during this period in 1993 (Charles McDonald, National Weather Service, written and oral commun., 1993).

The surficial geology in the headwaters of Yocum Creek consists of Batesville Sandstone of Mississippian age. The Batesville is a coarse- to medium-grained, buff-colored, calcareous sandstone (Croneis, 1930). The average thickness of Batesville Sandstone is approximately 25 ft in the study area. The Batesville Sandstone is composed of sandstone, shale, limestone, and minor amounts of coal, which can be locally fractured with bedding planes that usually yield 2 to 5 gal/min to wells, except for larger sandstone formations, which may yield 25 gal/min (Lamonds, 1972).

The largest part of the basin lies on the Boone Formation of Mississippian age. The Boone Formation is normally 300 to 350 ft thick in northern Arkansas and is comprised of limestone, chert, and minor beds of shale and sandstone (Frezon and Glick, 1959). Residual cherty rubble yields 2 to 5 gal/min to wells, however, many large springs and wells tap large solution channels, which may yield more than 25 gal/min to wells. The movement of ground water along fractures and bedding planes in this formation produces an abundant number of caves, solution channels, and sinkholes.

The lower part of Yocum Creek, near Table Rock Lake, lies on the Cotter Dolomite of Ordovician age. The Cotter Dolomite consists of a massive, medium-grained, gray dolomitic rock to a fine-grained earthy, white to buff dolomitic rock (Croneis, 1930). The formation consists largely of dolostone, chert, limestone, and smaller amounts of sandstone and shale. The Cotter Dolomite has been reported to be as thick as 500 ft in Boone County directly east of the study area (Caplan, 1960). Fractures in dolomite and dolomitic limestone usually yield 5 to 10 gal/min to wells. Deeply incised valleys exposed in the Cotter Dolomite commonly produce large springs or seeps.

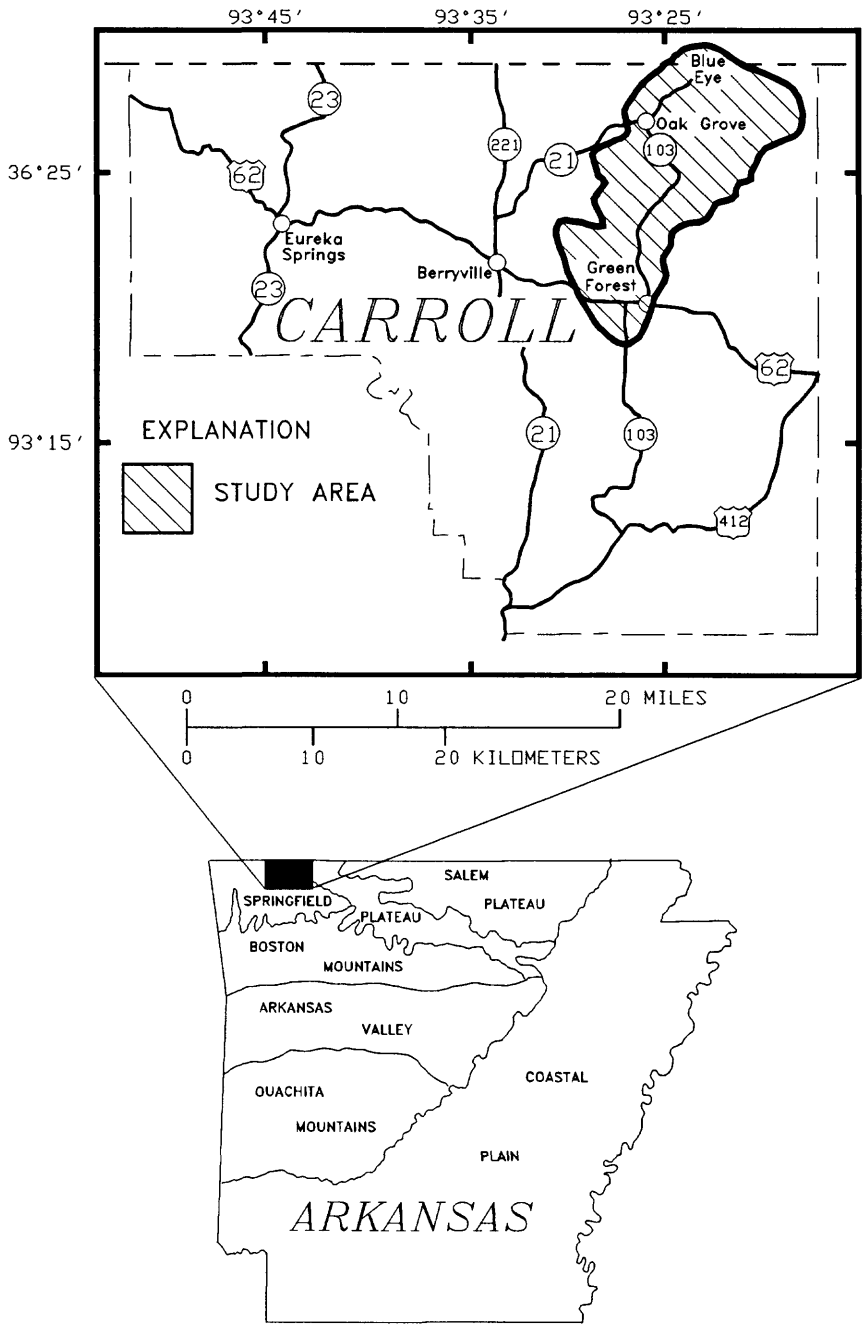

Figure 1.--Location of study area.

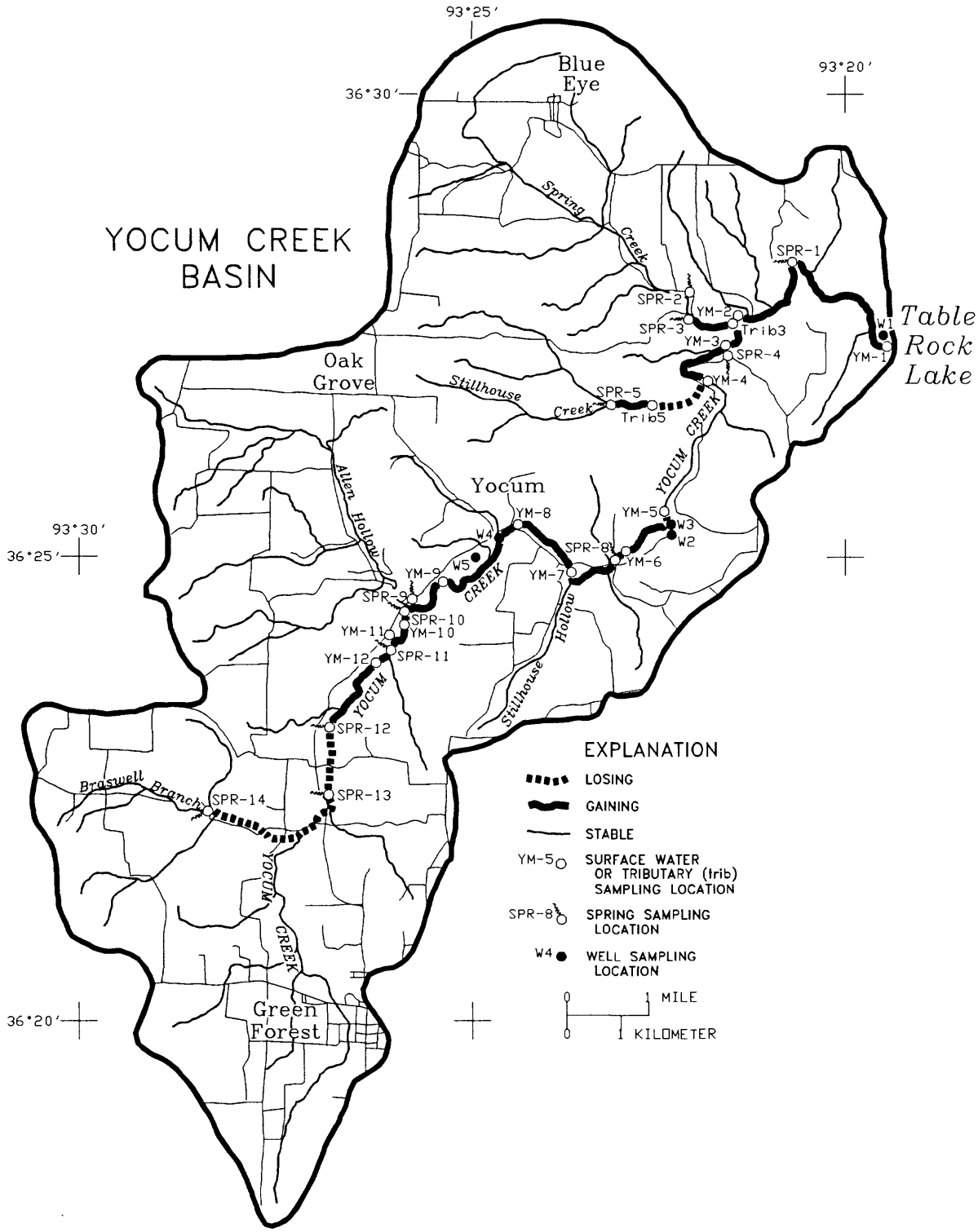

Figure 2.--Location of sampling sites and gaining and losing stream reaches.

DATA COLLECTION METHODOLOGY

Ground- and surface-water samples were collected and stream discharge measurements were made within the Yocum Creek Basin between July 27 and August 3, 1993. The sampling site locations were chosen to provide the best understanding of the current water-quality and streamflow conditions. Water samples were collected by hand dipping sample collection bottles into the centroid of flow in the stream and tributaries to the mainstem. Collection, storage, and preservation of samples followed methods outlined by Ward and Harr (1990). Analyses for fecal coliform and fecal streptococcal bacteria were performed following methods described by Britton and Greeson (1987). Discharge was measured at numerous locations on the mainstem of the stream and at tributary inflow points during low-flow conditions (no storm runoff). Discharge measurements were made with a current meter following methods described by Buchanan and Sommers (1984). Comparisons of successive downstream discharge measurements were used to determine if the stream reaches were gaining or losing. Dissolved oxygen concentrations and temperature data were collected for a 24-hour period on an hourly basis at two sites (YM-3 and YM-8) on the mainstem. Water samples from springs were collected by hand dipping sample collection bottles into the orifice of the spring. Water samples from wells were collected from outside faucets prior to any treatment systems.

SURFACE-WATER QUALITY

Water-quality data were collected at 12 surface-water sites on Yocum Creek and 2 tributaries (table 1) during the study. Specific conductance ranged from 285 to 463 microsiemens per centimeter at 25 degrees Celsius (µS/cm) (table 2). Specific conductance values generally were higher in the headwaters of the basin. Dissolved ammonia concentrations for surface-water sites ranged from 0.01 to 0.03 milligrams per liter (mg/L) as nitrogen. Dissolved nitrite and dissolved ammonia plus organic nitrogen values were just above detection limits (0.01 mg/L). Dissolved nitrite plus nitrate concentrations ranged from 1.3 to 3.8 mg/L as nitrogen. Dissolved orthophosphorus concentrations ranged from 0.01 to 0.06 mg/L as phosphorus in surface-water sites. Total phosphorous concentrations ranged from less than 0.02 to 0.07 mg/L as phosphorus in surface-water sites.

Fecal coliform bacteria counts for surface-water sites ranged from 9 to 220 colonies per 100 milliliter (cols/100 mL) with a median of 49 (cols/100mL). Fecal streptococci bacteria counts for surface-water sites ranged from 37 to 1,500 cols/100 mL with a median of 420 cols/100 mL. Analyses for common constituents and selected metals at one surface-water site (YM-1) indicate that most concentrations were below the detections limits (table 3). Calcium, silica, barium, and strontium were measured in low concentrations.

Table 1.--*Sampling site descriptions of surface-water sites in the Yocum Creek Basin*

[Station number corresponds to national downstream order number assigned by the U.S. Geological Survey]

Site number	Station number	Station name	Latitude	Longitude	Local site identifier
YM-1	07053260	Yocum Creek at Table Rock Lake near Oak Grove, Arkansas	362718	0931922	21N22W28BAD
YM-2	07053253	Yocum Creek upstream from Table Rock Lake near Oak Grove, Arkansas	362737	0932125	21N22W19DCB
YM-3	07053250	Yocum Creek near Oak Grove, Arkansas	362714	0932123	21N22W30ACA
YM-4	07053247	Yocum Creek site 4 near Oak Grove, Arkansas	362652	0932141	21N22W30CAC
YM-5	07053246	Yocum Creek northeast of Yocum, Arkansas	362532	0932217	20N23W01AAC
YM-6	07053245	Yocum Creek east of Yocum, Arkansas	362501	0932244	20N23W01CDA
YM-7	07053243	Yocum Creek southeast of Yocum, Arkansas	362451	0932331	20N23W11ABA
YM-8	07053242	Yocum Creek at Yocum, Arkansas	362518	0932416	20N23W02CBB
YM-9	07053239	Yocum Creek near Yocum, Arkansas	362440	0932513	20N23W10BCA
YM-10	07053236	Yocum Creek site 10 near Green Forest, Arkansas	362423	0932537	20N23W04DAB
YM-11	07053235	Yocum Creek site 11 near Green Forest, Arkansas	362405	0932544	20N23W09DCD
YM-12	07053234	Yocum Creek site 12 near Green Forest, Arkansas	362357	0932553	20N23W16ABB
Trib-3	07053252	Spring Creek near Oak Grove, Arkansas	362734	0932126	21N22W19DCC
Trib-5	07053248	Stillhouse Hollow Creek near Oak Grove, Arkansas	362639	0932206	21N22W30CCC

Table 2.--*Discharge and water-quality data for surface-water sites located in the Yocum Creek Basin*

[Temperature reported to nearest 0.5 degrees Celsius; °C, degrees Celsius; five digit numbers in parentheses are STORET parameter codes used for computer storage of data; mm of Hg, millimeters of mercury; ft^3/s, cubic feet per second; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; WH, whole water; FET, fixed endpoint titration; F, field; <, less than; cols/100 mL, number of colonies per 100 milliliters of sample; K, non-ideal count]

Site ID	Date of sample	Time of sample	Water temperature (°C) (00010)	Air pressure (mm of Hg) (00025)	Discharge, instantaneous (ft^3/s) (00061)	Specific conductance (µS/cm at 25 °C) (00095)	Oxygen, dissolved (mg/L) (00300)	pH, field (standard units) (00400)	Alkalinity, WH, FET, F (mg/L as $CaCO_3$) (00410)
YM-1	7-27-93	1240	24.0	744	40	310	9.1	8.0	136
YM-2	7-27-93	1805	23.5	732	35	308	9.0	8.3	138
YM-3	7-28-93	0830	22.0	736	24	335	7.6	7.8	162
YM-4	7-28-93	1245	25.0	735	20	316	9.6	8.3	142
YM-5	7-28-93	1530	25.0	734	22	463	7.7	7.8	138
YM-6	7-29-93	0850	19.5	737	20	356	8.3	7.5	148
YM-7	7-29-93	1010	20.0	737	15	348	8.7	7.9	156
YM-8	7-29-93	1210	21.0	736	14	339	10.0	8.0	142
YM-9	7-29-93	1540	21.5	733	14	345	9.5	7.9	144
YM-10	8-02-93	1300	19.0	732	12	352	9.0	7.1	160
YM-11	8-02-93	1425	24.0	732	5.0	399	8.8	7.6	154
YM-12	8-02-93	1400	24.5	732	3.5	388	9.2	7.8	154
Trib-3	7-27-93	1740	18.0	732	8.6	285	9.1	8.8	144
Trib-5	7-28-93	1330	19.0	734	2.6	320	8.8	7.4	156
Minimum			18.0		2.6	285	7.6	7.1	136
Maximum			25.0		40	463	10.0	8.8	162
Median			22.0		15	342	9.0	7.8	146

Site ID	Nitrogen ammonia, dissolved (mg/L as N) (00608)	Nitrogen, nitrite dissolved (mg/L as N) (00613)	Nitrogen, ammonia plus organic dissolved (mg/L as N) (00623	Nitrogen, nitrite plus nitrate dissolved (mg/L as N) (00631)	Phosphorus, total (mg/L as P) (00665)	Phosphorus Ortho, dissolved (mg/L as P) (00671)	Coliform fecal, 0.7 micron membrane filter (cols/100 mL) (31625)	Strepto-cocci fecal, KF agar (cols/100 mL) (31673)
YM-1	0.01	0.01	<0.20	1.9	0.03	0.03	K55	K37
YM-2	.03	.01	.39	2.0	.03	.03	200	160
YM-3	.02	.01	<.20	2.3	.05	.03	K42	K320
YM-4	.02	.01	.24	2.4	.07	.04	K45	420
YM-5	.02	.01	<.20	2.5	.07	.04	K27	440
YM-6	.02	.01	.28	2.7	.03	.03	K70	860
YM-7	.02	.01	<.20	2.9	.04	.04	87	780
YM-8	.02	.01	<.20	2.5	.04	.04	K58	1,100
YM-9	.02	.02	<.20	3.8	.04	.04	K42	390
YM-10	.03	<.01	<.20	2.7	.03	.04	K52	520
YM-11	.03	<.01	<.20	3.6	.05	.06	K24	720
YM-12	.03	<.01	<.20	3.1	.05	.06	K12	1,500
Trib-3	.01	.01	<.20	1.8	.02	.02	K220	340
Trib-5	.01	.01	<.20	1.3	<.02	.01	K9	140
Minimum	.01	<.01	<.20	1.3	<.02	.01	K9	K37
Maximum	.03	.02	.39	3.8	.07	.06	K220	1,500
Median	.02	.01	<.20	2.5	.04	.04	49	420

Table 3.--*Water-quality data for selected surface-water sites, wells, and springs located in the Yocum Creek Basin*

[µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; five digit numbers in parentheses are STORET parameter codes used for computer storage of data; mg/L, milligrams per liter; <, less than; µg/L, micrograms per liter; °C, degrees Celsius]

Site ID	Date of sample	Time of sample	Specific conductance (µS/cm at 25 °C) (00095)	pH, lab (00403)	Hardness, total (mg/L as CaO_3) (00900)	Noncarbonate, hardness (mg/L as $CaCO_3$) (00902)	Calcium, dissolved (mg/L as Ca) (00915)	Magnesium, dissolved (mg/L as mg) (00925)	Sodium, dissolved (mg/L as Na) (00930)	Sodium, adsorption rate (ratio) (00931)
YM-1	7-27-93	1240	310	8.2	150	12	55	2.6	3.2	0.1
W1	7-27-93	1700	440	7.9	240	29	50	27	2.8	0
W5	7-29-93	1500	366	7.5	190	33	75	1.4	1.8	0
SPR-3	7-28-93	1040	288	7.4	140	7	52	1.3	3.0	.1
SPR-13	8-02-93	1615	460	7.2	150	0	58	1.8	3.7	.1

Site ID	Sodium percent (percent) (00932)	Potassium, dissolved (mg/L as K) (00935)	Chloride, dissolved (mg/L as Cl) (00940)	Sulfate, dissolved (mg/L as SO_4) (00945)	Fluoride, dissolved (mg/L as F) (00950)	Silica, dissolved (mg/L as SiO_2) (00955)	Arsenic, dissolved (µg/L as As) (01000)	Barium, dissolved (µg/L as Ba) (01005)	Beryllium, dissolved (µg/L as Be) (01010)	Boron, dissolved (µg/L as B) (01020)
YM-1	5	2.2	6.3	3.9	<0.1	11	<1	46	<1	<20
W1	3	4.1	3.2	18	.6	9.3	<1	8	<1	30
W5	2	.82	4.2	3.1	<.1	12	<1	31	<1	<20
SPR-3	5	1.7	5.4	2.0	<.1	11	<1	40	<1	<20
SPR-13	5	1.1	8.8	1.8	<.1	10	<1	37	<1	<20

Site ID	Cadmium, dissolved (µg/L as Cd) (01025)	Chromium, dissolved (µg/L as Cr) (01030)	Cobalt, dissolved (µg/L as Co) (01035)	Copper, dissolved (µg/L as Cu) (01040)	Iron, dissolved (µg/L as Fe) (01046)	Lead, dissolved (µg/L as Pb) (01049)	Manganese, dissolved (µg/L as Mn) (01056)	Molybdenum, dissolved (µg/L as Mo) (01060)	Nickel, dissolved (µg/L as Ni) (01065)
YM-1	<1.0	<5	<3	<10	<3	<10	1.0	<10	<10
W1	<1.0	<5	<3	<10	<3	<10	2.0	<10	<10
W5	2.0	<5	<3	<10	<3	<10	<1.0	<10	<10
SPR-3	<1.0	<5	<3	<10	<3	<10	<1.0	<10	<10
SPR-13	2.0	<5	<3	<10	<3	<10	<1.0	<10	<10

DISSOLVED OXYGEN AND TEMPERATURE MONITORING

Hourly dissolved oxygen and temperature values were collected at two sites (YM-3 and YM-8) on the mainstem of Yocum Creek from August 2 to August 3 (figs. 3 and 4). These data were collected to determine the diel fluctuations in dissolved oxygen concentrations and temperature during changes in air temperature and sunlight intensity.

At the downstream site (YM-3), dissolved oxygen concentrations ranged from 5.7 to 9.3 mg/L with a median of 6.4 mg/L. The minimum dissolved oxygen concentration of 5.7 mg/L was recorded at 0405 hours and the maximum dissolved oxygen concentration value of 9.3 mg/L was recorded at 1605 hours. The minimum stream temperature of 21.5 °C was recorded at 0605 hours, and the maximum stream temperature of 25 °C was recorded at 1605 hours (fig. 4). The median stream temperature at site YM-3 was 22.8 °C.

At the upstream site (YM-8), dissolved oxygen concentrations ranged from 6.2 to 9.9 mg/L with a median of 7.8 mg/L. The minimum dissolved oxygen concentration of 6.2 mg/L was recorded at 0145 hours and the maximum dissolved oxygen concentration of 9.9 mg/L was recorded at 1345 hours. The minimum stream temperature of 18.5 °C was recorded at 0545 hours and the maximum stream temperature of 23.0 °C was recorded at 1645 hours. The median stream temperature at site YM-8 was 20.0 °C.

The stream temperature at the downstream site (YM-3) was about 2 degrees warmer than the upstream site (YM-8), which is located closer to the large producing springs in the mid to upper reaches of the basin. The cooler site, YM-8, normally maintained a higher dissolved oxygen concentration than site YM-3.

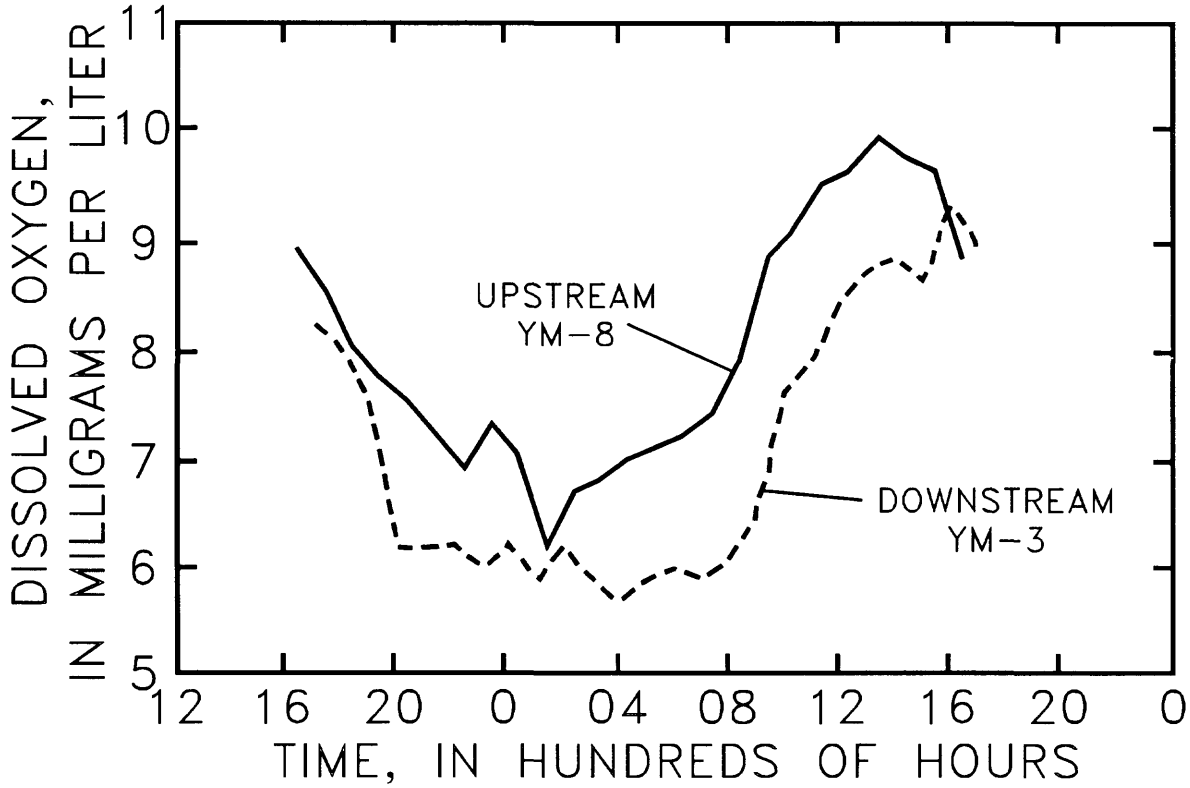

Figure 3.--Comparison of dissolved oxygen concentrations between sites YM-3 and YM-8, August 2-3, 1993.

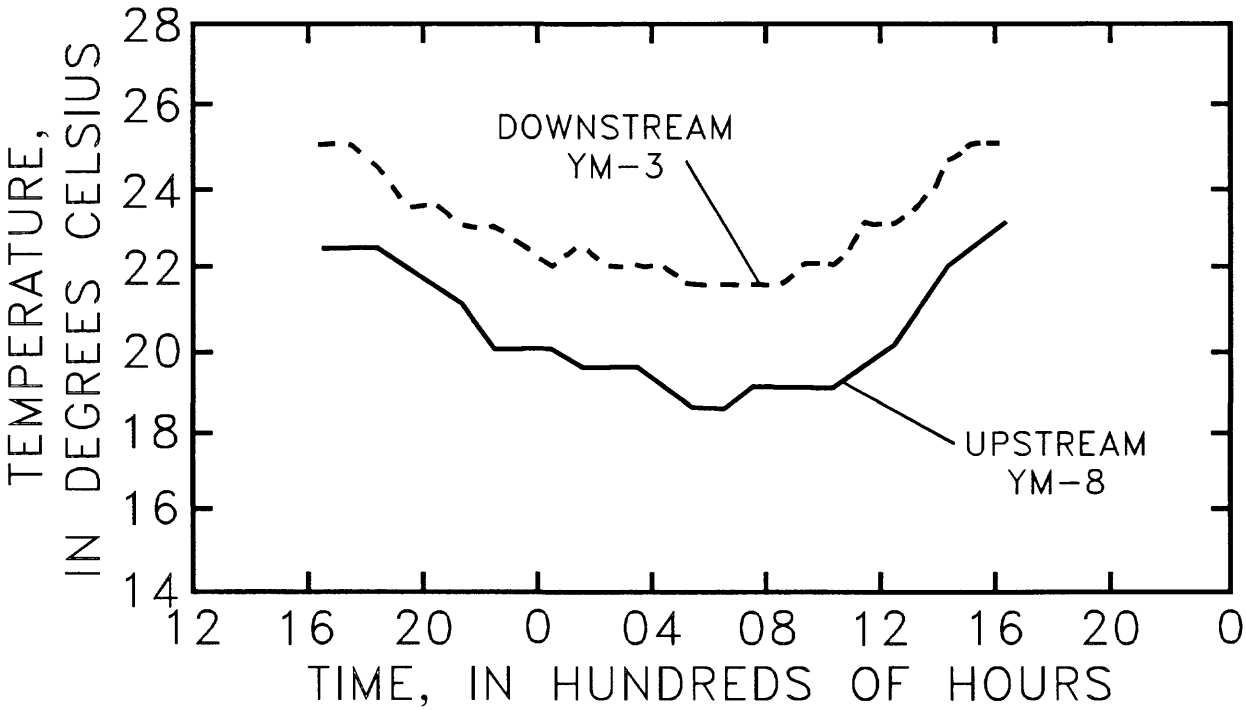

Figure 4.--Comparison of temperatures between sites YM-3 and YM-8, August 2-3, 1993.

GROUND-WATER QUALITY

Water-quality data were collected from five wells in the Yocum Creek Basin (table 4). Three of these wells are considered shallow wells (30 to 68 ft) penetrating the Springfield aquifer and two wells are considered deep (350 and 550 ft) penetrating the Ozark aquifer. Specific conductance values ranged from 361 to 549 µS/cm (table 5). Dissolved ammonia was present in small concentrations in all five wells, and ranged from 0.01 to 0.07 mg/L as nitrogen. Dissolved nitrite plus nitrate ranged from less than 0.02 to 6.0 mg/L. The sample from well W-4 recorded a dissolved nitrite plus nitrate concentration of 6.0 mg/L as nitrogen, which is approaching the U.S. Environmental Protection Agency maximum contaminant level for drinking water of 10 mg/L as nitrogen (U.S. Environmental Protection Agency, 1994). Fecal coliform bacteria counts for wells ranged from less than 3 to 15 cols/100 mL with a median of 3 cols/100 mL. Fecal streptococci bacteria counts ranged from less than 4 to 77 cols/100 mL with a median of 17 cols/100 mL. Analyses for common constituents and selected trace metals in wells W1 and W5 indicate that drinking water standards were not exceeded. Volatile organic compound analyses (table 6) indicate that organic compounds were not present above the detection limit.

In springs discharging from the Springfield aquifer, nitrite plus nitrate concentrations ranged from 1.4 to 7.0 mg/L as nitrogen (table 7). Dissolved ammonia plus organic nitrogen concentrations ranged from less than 0.02 to 0.49 mg/L as nitrogen. Dissolved orthophosphorus concentrations ranged from 0.01 to 0.07 mg/L as phosphorus. Fecal coliform bacteria counts ranged from 3 to 200 cols/100 mL, with a median of 18 cols/100 mL. Fecal streptococci bacteria counts ranged from 110 to more than 2,000 cols/100 mL with a median of 350 cols/100 mL. Analyses for common constituents and selected trace metals in two springs (SPR-3 and SPR-13) indicate that trace metals were present in low concentrations. Volatile organic compound samples were collected at two springs, SPR-3 and SPR-13 (table 8). Chloroform was the only volatile organic compound found to be above the detection limit. Analyses indicated that 0.2 µg/L of chloroform were present in SPR-13.

Table 4.--*Sampling site descriptions of wells and springs in the Yocum Creek Basin*

Site number	Station name	Latitude	Longitude	Local site identifier
W1	Well 1	362724	0931857	21N22W28AAB
W2	Well 2	362518	0932213	20N22W01DAA
W3	Well 3	362521	0932213	20N23W01ADD
W4	Well 4	362510	0932433	20N23W03DAC
W5	Well 5	362502	0932447	20N23W03DCB
SPR-1	Spring 1	362815	0932040	21N22W20BAB
SPR-2	Spring 2	362742	0932204	21N22W19CBB
SPR-3	Spring 3	362735	0932159	21N22W19CCA
SPR-4	Spring 4	362714	0932120	21N22W30ACA
SPR-5	Spring 5	362639	0932247	21N23W25CDD
SPR-8	Spring 8	362501	0932253	20N23W01CDB
SPR-9	Spring 9	362438	0932526	20N23W09ADA
SPR-10	Spring 10	362420	0932543	20N23W09DBD
SPR-11	Spring 11	362403	0932545	20N23W16ABA
SPR-12	Spring 12	362255	0932640	20N23W20ADB
SPR-13	Spring 13	362232	0932646	20N23W20DCA
SPR-14	Spring 14	362210	0932821	20N24W30BBD

Table 5.--*Well depth and water-quality data for wells located in the Yocum Creek Basin*

[Temperature reported to nearest 0.5 degrees Celsius; °C, degrees Celsius; five digit numbers in parentheses are STORET parameter codes used for computer storage of data; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; WH, whole water; FET, fixed endpoint titration; F, field; mg/L, milligrams per liter; <, less than; cols/100 mL, number of colonies per 100 milliliters of sample; K, non-ideal count]

Site ID	Date of sample	Time of sample	Water temper-ature (°C)	Depth of well, total (feet) (00010)	Elevation of land surface datum (feet above sea level) (72000)	Specific conductance (µS/cm at 25 °C) (00095)	pH, field (standard units) (00400)	Alkalinity, WH, FET, F (mg/L as $CaCO_3$) (00410)	Nitrogen ammonia, dissolved (mg/L as N) (00608)
W1	7-27-93	1700	21.0	550	1,000	440	7.6	208	0.02
W2	7-28-93	1610	21.0	40	1,080	549	7.2	156	.01
W3	7-28-93	1620	16.5	350	1,080	361	7.7	174	.07
W4	7-29-93	1130	17.0	30	1,100	375	7.2	196	.02
W5	7-29-93	1500	16.0	68	1,110	366	7.1	160	.01
Minimum			16.0	30	1,000	361	7.1	156	.01
Maximum			21.0	550	1,110	549	7.7	208	.07
Median			17.0	68	1,080	375	7.2	174	.02

Site ID	Nitrogen, nitrite dissolved (mg/L as N) (00613)	Nitrogen, ammonia plus organic dissolved (mg/L as N) (00623)	Nitrogen, nitrite plus nitrate dissolved (mg/L as N) (00631)	Phos-phorus, total (mg/L as P) (00665)	Phos-phorus ortho, dissolved (mg/L as P) (00671)	Coliform fecal, 0.7 micron membrane filter (cols/100 mL) (31625)	Strepto-cocci fecal, KF agar (cols/100 mL) (31673)	Well owner
W1	0.01	<0.2	0.07	<0.02	0.01	<3	K33	M. Bradley
W2	.01	<.2	2.6	.03	.03	K3	K17	Q. Tipton
W3	.01	<.2	<.02	<.02	.01	<3	<4	Q. Tipton
W4	.01	<.2	6.0	.03	.02	K15	K77	T. Benson
W5	.01	<.2	1.0	.02	.01	K3	K17	K. Garrett
Minimum	.01	<.02	<.02	<.02	.01	<3	<4	
Maximum	.01	<.02	6.0	.03	.03	K15	K77	
Median	.01	<.02	1.0	.02	.01	K3	K17	

Table 6.--*Organic compound data for selected wells and springs in the Yocum Creek Basin*

[µg/L, micrograms per liter; five digit number in parentheses are STORET parameter codes used for computer storage of data; <, less than]

Site ID	Date of sample	Time of sample	Dichloro-difluoro-methane (µg/L) (34668)	Vinyl chloride (µg/L) (39175)	Trichloro-fluoro-methane (µg/L) (34488)	1,1-Dichloro-ethene (µg/L) (34501)	Methylene chloride (µg/L) (34423)	Trans-1,2-dichloro-ethane (µg/L) (34546)	1,1-Dichloro-ethane (µg/L) (34496)	Cis 1,2-Dichloroethene (µg/L) (77093)
W1	7-27-93	1700	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
W5	7-29-93	1500	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
SPR-3	7-28-93	1040	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
SPR-13	8-02-93	1615	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2

Site ID	Chloroform (µg/L) (32106)	1,1,1-Tri-chloroethane (µg/L) (34506)	Carbon tetra-chloride (µg/L) (32102)	Benzene (µg/L) (34030)	1,2-Di-chloro-ethane (µg/L) (32103)	Trichloro-ethene (µg/L) (39180)	1,2-Dichloro-propane (µg/L) (34541)	Bromodi-chloro-methane (µg/L) (32101)	Toluene (µg/L) (34010)	Tetrachloro-ethene (µg/L) (34475)
W1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
W5	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
SPR-3	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
SPR-13	.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2

Site ID	Dibromo-chloro-methane (µg/L) (32105)	Chloro-benzene (µg/L) (34301)	Ethyl-benzene (µg/L) (34371)	Dimethyl-benzene (Xylenes-total) (µg/L) (81551)	Styrene (µg/L) (77128)	Bromo-form (µg/L) (32104)	1,3-Dichloro-benzene (meta) (µg/L) (34566)	1,4-Dichloro-benzene (para) (µg/L) (34571)	1,2-Dichloro-benzene (ortho) (µg/L) (34536)	Trichloro-trifluoro-ethane (1,1,2-Cl 1,2,2 F) (µg/L) (77652)
W1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5
W5	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.5
SPR-3	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.5
SPR-13	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.5

Table 7.--*Discharge and water-quality data for springs located in the Yocum Creek Basin*

[Temperature reported to nearest 0.5 degrees Celsius; °C, degrees Celsius; five digit numbers in parentheses are STORET parameter codes used for computer storage of data; mm of Hg, millimeters of mercury; ft^3/s, cubic feet per second; --, no data; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; WH, whole water; FET, fixed endpoint titration; F, field; <, less than; cols/100 mL, number of colonies per 100 milliliters of sample; K, non-ideal count; >, greater than]

Site ID	Date of sample	Time of sample	Water temperature (°C) (00010)	Air pressure (mm of Hg) (00025)	Discharge, instantaneous (ft^3/s) (00061)	Specific conductance (µS/cm at 25 °C) (00095)	Oxygen, dissolved (mg/L) (00300)	pH, field (standard units) (00400)	Alkalinity, WH, FET, F (mg/L as $CaCO_3$) (00410)	Nitrogen ammonia, dissolved (mg/L as N) (00608)
SPR-1	7-27-93	1430	19.0	743	0.22	315	8.2	8.0	138	0.01
SPR-2	7-28-93	1020	17.0	737	.67	298	6.4	7.1	136	.02
SPR-3	7-28-93	1040	16.0	736	6.6	288	6.2	7.0	128	.01
SPR-4	7-28-93	1000	14.0	737	.58	394	8.3	7.4	190	.01
SPR-5	7-28-93	1400	17.5	733	2.3	329	7.5	7.4	140	.01
SPR-8	7-29-93	0910	14.5	737	1.4	410	7.8	7.2	200	.01
SPR-9	7-29-93	1610	14.5	732	.21	369	4.0	6.8	152	.01
SPR-10	8-02-93	1245	14.0	732	5.6	333	6.9	6.8	148	.03
SPR-11	8-02-93	1420	15.0	732	--	436	7.2	7.5	184	.03
SPR-12	7-29-93	1400	20.5	732	1.1	441	9.9	7.6	178	.02
SPR-13	8-02-93	1615	16.0	732	3.7	460	7.1	6.8	184	.03
SPR-14	8-02-93	1550	20.0	732	.51	518	7.1	7.9	256	.04
Minimum			14.0		.21	288	4.0	6.8	128	.01
Maximum			20.5		6.6	518	9.9	8.0	256	.04
Median			15.5		1.1	382	7.2	7.3	165	.02

Site ID	Nitrogen, nitrite dissolved (mg/L as N) (00613)	Nitrogen, ammonia plus organic dissolved (mg/L as N) (00623)	Nitrogen, nitrite plus nitrate, dissolved (mg/L as N) (00631)	Phosphorus, total (mg/L as P) (00665)	Phosphorus ortho, dissolved (mg/L as P) (00671)	Coliform fecal, 0.7 micron membrane filter (cols/ 100 mL) (31625)	Streptococci fecal, KF agar (cols/ 100 mL) (31673)	Name
SPR-1	0.01	<0.20	2.0	0.02	0.02	K12	280	Bear Hollow Spring
SPR-2	.01	.49	1.9	.02	.01	K6	120	--
SPR-3	.01	.20	1.9	.03	.01	K48	700	Spring Creek Spring
SPR-4	.01	.26	2.1	.03	.02	K58	>2,000	Tipton Spring
SPR-5	.01	<.20	1.4	<.02	.01	K12	110	Stillhouse Spring
SPR-8	.01	<.20	2.6	.02	.01	K33	K420	Tipton Spring
SPR-9	.01	<.20	3.6	.03	.03	K200	400	Duncan Spring
SPR-10	<.01	<.20	1.8	.03	.03	K3	160	Anderson Spring
SPR-11	<.01	.20	7.0	.06	.07	K21	240	Garrett Spring
SPR-12	.01	<.20	2.5	.08	.07	80	>2,000	--
SPR-13	<.01	<.20	4.2	.08	.06	K15	170	Newhome Spring
SPR-14	<.01	.24	2.1	.07	.02	K6	980	--
Minimum	<.01	<.20	1.4	<.02	.01	K3	110	--
Maximum	.01	.49	7.0	.08	.07	K200	>2,000	--
Median	.01	<.20	2.1	.03	.02	18	350	--

STREAMFLOW GAIN AND LOSS

Numerous discharge measurements were made in the Yocum Creek Basin to determine the connection between the stream and the underlying Springfield aquifer. Three losing streamflow reaches were identified during the study of the Yocum Creek Basin (fig. 2). The mainstem of Yocum Creek was characterized by one losing reach. A discharge of 3.7 ft^3/s was measured at SPR-13 (Newhome Spring). Surface flow began to decrease approximately 75 yds from the orifice of the spring, and two-tenths of a mile from SPR-13 all surface flow was redirected to subsurface flow. The mainstem of the creekbed was dry for a distance of approximately four-tenths of a mile, where 1.1 ft^3/s of surface flow was measured at SPR-12.

Two losing reaches were located on tributaries feeding Yocum Creek. Trib-5, located on Stillhouse Creek, is four-tenths of a mile from the confluence of Yocum Creek. Surface flow was measured at 2.6 ft^3/s. Surface flow decreased steadily until the creekbed was dry for a distance of two-tenths of a mile from the confluence of Yocum Creek. The other losing tributary was located on Braswell Branch. A discharge of 0.51 ft^3/s was measured at SPR-14. Surface flow disappeared one-tenth of a mile downstream from SPR-14. Surface flow did not reoccur for approximately 1.6 mi at SPR-13.

Large producing springs (SPR-13, SPR-12, and SPR-10) located in the mid to upper reaches of the basin contribute most of the flow to Yocum Creek. Streamflow increased an average of 29 percent in each of the 11 gaining reaches of the mainstem from site YM-12 to YM-1 at the mouth. The largest increase occurred between sites YM-11 and YM-10 where a 140 percent increase in surface flow was measured. These observations suggest that significant interaction exists between the underlying Springfield aquifer and surface flow in the Yocum Creek Basin.

SUMMARY

A study of the Yocum Creek Basin was undertaken between July 27 and August 3, 1993, to describe the current water-quality conditions of the surface and ground water in the basin. Physical, nutrient, bacteriological, common constituent, selected metal, and volatile organic compound data were collected at various sites in the basin. Streamflow measurements were conducted at various locations along the mainstem and at sites on major tributaries to identify gaining and losing reaches of streamflow.

Dissolved nitrite plus nitrate concentrations ranged from 1.3 to 3.8 mg/L as nitrogen in surface-water samples. A ground-water sample (W-4), contained a dissolved nitrite plus nitrate concentration of 6.0 mg/L as nitrogen, which is approaching the U.S. Environmental Protection Agency maximum contaminant level for drinking water of 10 mg/L as nitrogen (U.S. Environmental Protection Agency, 1993). Dissolved nitrite plus nitrate concentrations ranged from 1.4 to 7.0 mg/L as nitrogen in springs sampled.

Fecal coliform bacteria counts for surface-water sites ranged from 9 to 220 cols/100 mL with a median of 49 cols/100 mL. Fecal streptococci bacteria counts for surface-water sites ranged from 37 to 1,500 cols/100 mL with a median of 420 cols/100 mL. Fecal coliform bacteria counts for springs ranged from 3 to 200 cols/100 mL with a median of 18 cols/100 mL. Fecal streptococci bacteria counts for springs ranged from 110 to more than 2,000 cols/100 mL with a median of 350 cols/100 mL.

Analyses for selected metals at one mainstem site, two springs, and two well sites indicate that metals were not present in significant concentrations. Volatile organic compound samples were collected at two wells and two springs. Chloroform was the only volatile organic compound found to be above the detection limit. Analysis indicated that 0.2 µg/L of chloroform were present in SPR-13.

Diel dissolved oxygen concentrations and temperatures were measured at an upstream and downstream site on the mainstem of the stream. At the upstream site (YM-8), dissolved oxygen concentrations ranged from 6.2 to 9.9 mg/L and temperatures ranged from 18.5 to 23.0 °C. Dissolved oxygen concentrations were higher and temperature values were lower at the upstream site than those at the downstream site.

Large producing springs located in the mid to upper reaches of the basin contribute most of the flow to Yocum Creek. Streamflow increased an average of 29 percent on the mainstem of the stream. One losing reach was discovered on the mainstem of the stream and two losing reaches on tributaries to the mainstem. Surface flow steadily decreased along these reaches to the point where surface flow was not present, and the streambed became dry. These observations suggest that significant interaction exists between the underlying Springfield aquifer and surface flow in the Yocum Creek Basin.

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