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GEOLOGICAL SURVEY

POTENTIAL IMPACTS OF A PROPOSED RESERVOIR ON HYDROLOGIC AND WATER-QUALITY CONDITIONS IN LITTLE RUSH CREEK WATERSHED, FAIRFIELD COUNTY, OHIO

by Janet Hren and Rick L. Jones

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Conversion Factors

Factors for converting inch-pound units to the International System (SI) of units are given below:

To convert from	To	Multiply by
inch (in)	millimeter (mm)	25.4
foot (ft)	meter (m)	0.3048
mile (mi)	kilometer (km)	1.609
$foot^2$ (ft^2)	$meter^2$ (m^2)	0.0929
$mile^2$ (mi^2)	$kilometer^2$ (km^2)	2.590
acre	$hectometer^2$ (hm^2)	0.4047
$foot^2$ per second (ft^3/s)	$meter^2$ per second (m^3/s)	0.02832
acre-foot (acre-ft)	$hectometer^3$ (hm^3)	0.001233
ton (short)	metric ton (t)	0.9072
micromho per centimeter (umho/cm)	microsiemens per centimeter (uS/cm)	1.000
degree Fahrenheit (°F)	degree Celsius (°C)	Temp°C=(tem°F -32)/1.8

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ABSTRACT

Water-quality and discharge measurements were made at three sites on Indian Run and one site on Little Rush Creek between February and December, 1979. Indian Run was observed above and below the U.S. Soil Conservation Service Reservoir, VI-D. Little Rush Creek was observed 1.1 miles downstream from the proposed U.S. Soil Conservation Reservoir, VI-A, site. Data from the Indian Run sites were used to predict the potential water-quality conditions in and downstream from the proposed Little Rush Creek Reservoir.

Temperatures measured in Indian Run at the reservoir outflow were as much as 4°C greater than those at the inflow. Dissolved-oxygen saturation ranged from 62 to 110 percent in the inflow and from 57 to 120 percent in the outflow. Indian Run and Little Push Creek are characterized by moderately hard to very hard calcium bicarbonate water. The concentration of dieldrin in water samples from both Little Rush Creek and the outflow from the reservoir on Indian Run was 0.01 micrograms per liter, and in reservoir-surface samples it was 0.02 micrograms per liter. Chlordane concentration in a bottom material sample from the reservoir was 26 micrograms per kilogram. Catfish taken from the reservoir contained 190 micrograms per kilogram chlordane.

All sites showed a good diversity in benthic invertebrate communities. Blue-green algal blooms occurred in the reservoir, indicating nutrient-enriched conditions.

Because of similarities in land use and watershed characteristics, water in the proposed reservoir VI-A is expected to be similar in quality to that of reservoir VI-D. The new reservoir will not significantly affect downstream water quality.

INTRODUCTION

The U.S. Soil Conservation Service has proposed construction of a dam on Little Rush Creek near Oakthorpe, Ohio, to create a 302-acre multipurpose reservoir. The proposed reservoir (VI-A) is part of an ongoing program of watershed protection in Fairfield, Hocking, and Perry Counties (fig. 1). The purpose of this study, made in cooperation with the U.S. Soil Conservation Service, is to provide physiographic, land-use, water-quality, and streamflow data to assess potential reservoir water quality and downstream effects of the proposed impoundment.

Samples were collected from February through December 1979 from a nearby reservoir (VI-D), its inflow and outflow, and from Little Rush Creek near the proposed dam site (fig. 1). This comparative sampling program was used because the respective sites are in the same area and have similar climates, watershed characteristics, stratification patterns, and biologic communities.

WATERSHED DESCRIPTION

Land Use

The Indian Run and Little Rush Creek watersheds compose the northern drainage area of the Hocking River watershed and include parts of Fairfield and Perry Counties (fig. 1). The area is 31 miles southeast of Columbus, Ohio.

The major land uses studied were cropland, pasture, and forest. Percentages for each are shown below:

	Indian Run	Little Rush Creek
Cropland	58	53
Pasture	36	35
Forest	3	9
Other	3	3

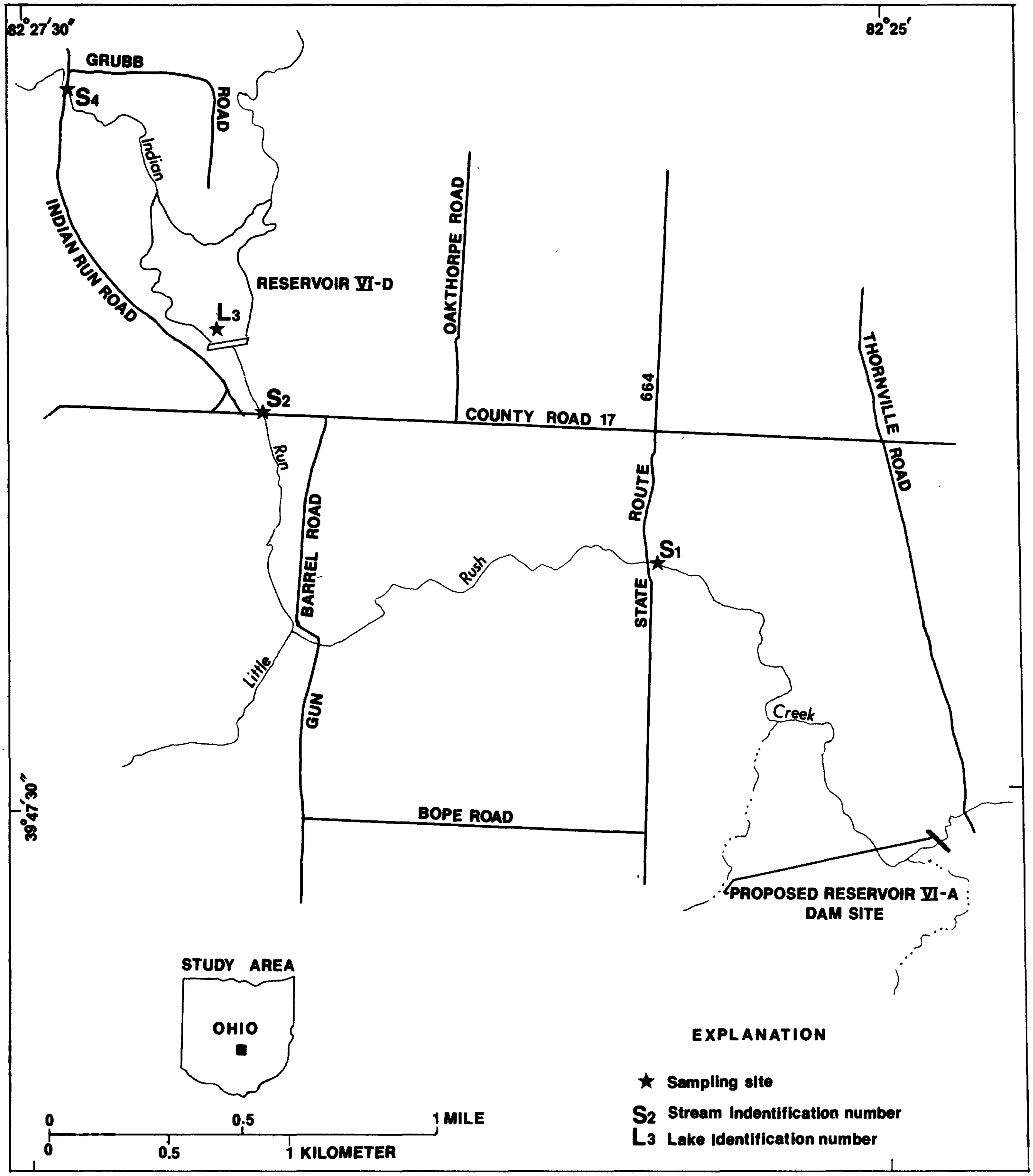


Figure 1.--Site numbers and sampling locations (1979).

The difference in forested acreage between the Indian Run and the Little Rush Creek watersheds (3 percent and 9 percent, respectively) is primarily due to the steeper terrain of the Little Rush Creek watershed, which reduces the amount of tillable acreage. The major cash crop of both watersheds is soybeans. Other crops of importance include corn, wheat, rye, and barley (U.S. Soil Conservation Service, written communication, 1979). Forested areas are primarily hardwoods, which are used in construction and the paper industry. Pasture lands are used mainly for beef and dairy livestock.

Soils

The soils of the Indian Run and Little Rush Creek watersheds were formed during and after late Wisconsin Glaciation. Although there are many similarities in land use in the two watersheds, there are minor differences in the soils.

Indian Run

A large part of the Indian Run watershed is covered by a silty-clay loam or clay loam derived from till. This grayish-brown soil ranges from 8 to 11 inches in thickness and is known as the Cardington-Bennington Association (U.S. Department of Agriculture, 1960). The subsoil is a clay loam ranging from 18 to 24 inches in thickness.

The northwest part of the Indian Run watershed is underlain by lacustrine deposits of silt and clay. In some places this material is covered by 5 to 50 feet of marl and peat (Goldthwait and others, 1961).

Little Rush Creek

The central and northern parts of the Little Rush Creek watershed are covered by soil of the Alexandria-Cardington-Bennington Association, which overlies a relatively high clay subsoil. Alexandria soil is on steep, well-drained slopes.

The gently rolling to steep eastern and southern areas are characterized by moderately well-drained soils overlying sandstone bedrock at depths of 20 to 40 inches. Soils are of the Hanover-Loudonville-Alford Association. The Alford soils are more common on the less sloping, broad ridge tops; whereas, the Hanover and Loudonville soils overlie steeper areas. In areas with a 6 to 18 percent slope, erosion can be severe in periods of rapid runoff, depending on the type of vegetal cover.

The soils in the western part of Little Rush Creek watershed are of the Cardington-Bennington group, the same association as in the Indian Run watershed.

The soils of the two watersheds are generally similar, except that silt and clay predominate in the Indian Run watershed, and sandstone bedrock predominates in the Little Rush Creek watershed.

Climate

The climate is temperate with a mean annual temperature of 50°F. Summers are usually warm and humid, and winters are cold and overcast. Extremes for 1979 were -7°F on February 17 and 90°F on August 7. (National Weather Service, oral communication 1979).

The mean annual precipitation for Lancaster is 36.9 inches. Precipitation totalled 50.3 inches at Lancaster in 1979 (National Weather Service, oral communication 1980).

Description of Sampling Sites and Data Collected

The sampling network in the 7.62 square mile Indian Run watershed contains three sites, S_2, L_3, and S_4 (fig. 1). Site S_2 is just downstream from reservoir VI-D. Site S_4 is on Indian Run, approximately 0.5 miles upstream from reservoir VI-D. Sampling site L_3 is in an area of maximum depth, in the southwest part of reservoir VI-D.

Sampling site S_1, is in the 30.1 square mile Little Rush Creek watershed, 1.1 miles downstream from the proposed reservoir VI-A, and the data are representative of the water that would enter this proposed reservoir.

Chemical and biological data were collected at the three stream sites, S_1, S_2, and S_4, between February 1979 and December 1979. Samples were collected at both low and high flow. A stage recording gage and water-quality monitor were installed by the U.S. Geological Survey at S_1 to measure daily gage height, stream temperature, and specific conductance.

Field measurements of pH, temperature, specific conductance, dissolved oxygen, alkalinity, and bacteria (fecal coliform and fecal streptococci) were made at all the sites. Water samples were collected for selected inorganic and nutrient constituents. Samples were analyzed by the U.S. Geological Survey central laboratory in Georgia. The sampling schedule is presented in table 1 for the three stream sites and the reservoir site. The following is a list of constituents for which the samples were analyzed, but concentrations were below detection limits:

Cyanide	Ethion	Parathion
Beryllium	Toxaphene	Methylparathion
Napthalenes	Heptachlor	Mirex
Lindane	Methoxychlor	Trithion
Endosulfan	Malathion	Methyltrithion

Discharge measurements were made at the stream sites when the water samples were collected. Daily mean discharge for site S_1 is shown in appendix 1. Specific conductance and temperature data for site S_1 are shown in appendix 2 and appendix 3, respectively.

Benthic communities were sampled by artificial substrate (multi-plate type) samplers. The substrate samplers were installed and remained in place for 30 days.

A study to determine possible sources of stream contamination was made in June 1979 for the Indian Run and Little Rush Creek watersheds. Parameters determined were stream temperature, specific conductance, pH, and dissolved oxygen.

The stream temperature of Indian Run, 2.2 miles above site S_4, was 27°C. Temperatures decreased steadily to site S_4, where the water was 17°C. The stream temperatures of tributaries to Indian Run ranged from 18°C to 22°C. The decrease in temperature is the result of several factors. The ground-water inflow (seepage) has a tendency to cool the entire stream. The downstream reaches are harder for the sun to heat because of increased pool depth and increased density of the tree cover.

Table 1.--Sampling schedule for Little Rush Creek and Indian Run (1979)

Explanation: f&c, field and common inorganics, nutrient species, oil, grease, total organic carbon, bacteria, biological oxygen demand, and phytoplankton; p, pesticides (water phase and bottom material); te, trace elements; bo, benthic organisms.

Sample site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
S_1		f&c	f&c		f&c bo	f&c p te	f&c bo	f&c p te	f&c p te	f&c	f&c bo	f&c bo
S_2		f&c	f&c		f&c bo	f&c p te bo	f&c	f&c p te	f&c p te	f&c	f&c bo	f&c bo
L_3			f&c	f&c p te bo		f&c P te bo	f&c bo	f&c bo		f&c bo	bo	f&c
S_4		f&c	f&c		f&c bo	f&c p te bo	f&c	f&c	f&c p te	f&c	f&c bo	f&c bo

The water temperature at reservoir VI-D, site L_3, was 21.5°C at 1 foot below the surface. Stream temperature downstream from the reservoir, at site S_2, was 21°C. Specific conductance ranged from 735 µmho/cm at 25°C at the upper end of the watershed to 475 µmho/cm at site S_2.

Eleven other sites were used to determine mean pH within the watershed. Values ranged from 7.3 to 8.5, with a mean of 8.0. These same sites were used to determine dissolved oxygen saturations. Calculations show saturation in Indian Run near the watershed to be greater than 100 percent. Dissolved oxygen concentrations ranged from 9.1 mg/L to 12.2 mg/L. At site S_4, the concentration was 7.8 mg/L.

The dissolved oxygen saturation at site L_3 was 108 percent (9.2 mg/L). The increase at site L_3 compared with that at site S_4 might be attributed to photosynthesis in the reservoir. Measurements at site S_2 showed saturation to be 93 percent, with a concentration of 8.1 mg/L. The major significance is that while specific conductance and pH are relatively stable as water travels through the reservoir, temperature increases slightly, as does dissolved-oxygen saturation between site S_4 and S_2.

There are no manufacturing plants, sewage-treatment plants, or other major dischargers within the Indian Run watershed. The Ohio Environmental Protection Agency has issued no permits to date, for discharge under the National Pollutant Discharge Elimination System (NPDES), and no other point sources of pollution were detected. However, runoff from agricultural lands (nonpoint sources) contributes increased concentrations of total organic nitrogen and total phosphorus. (See appendixes 4, 5.)

Temperature, specific conductance, pH, and dissolved oxygen were also checked at 19 sites in the Little Rush Creek watershed. The results were similar to those of the Indian Run watershed. Specific conductance ranged from 380 to 680 µmho/cm, and at site S_1 it was 525 µmho/cm. Stream temperature gradually decreased from 23.5°C near the headwaters to 17°C at site S_1. The decrease in temperatures in the downstream reaches was probably caused by the inflow of cooler ground water and the lower incidence of solar radiation due to the tree cover. The pH ranged from 7.3 to 8.3 in the watershed and had no apparent trend.

Dissolved-oxygen saturation in the headwaters of Little Rush Creek and its tributaries was greater than 100 percent but decreased to 86 percent at site S_1. Dissolved oxygen concentrations ranged from 12.6 mg/L near the headwaters to 8.2 mg/L at site S_1. At a site 0.25 mile upstream from the proposed VI-A dam site, stream temperature was 17.5°C and dissolved-oxygen concentration was 8.6 mg/L (92 percent saturation).

The Little Rush Creek watershed, like the Indian Run watershed, has no known point sources of pollution. The increase in concentrations of total organic nitrogen and total phosphorus (appendix 6) is from agricultural runoff.

RESERVOIR SPECIFICATIONS

Reservoir VI-A, planned for flood control and fish and wildlife development, will impound 3,165 acre-feet of water and will have a surface area of 302 acres. It will be a surface-release reservoir with a standard covered top riser, single stage, overflow structure. Reservoir VI-A will have a maximum depth of 36 feet, a mean depth of 10.5 feet and a drainage area of 28.2 square miles. Based on the discharge data in appendix 1 and a volume of 3,165 acre-feet, the water-residence time in reservoir VI-A will be 0.10 year.

The fish and wildlife facilities at reservoir VI-A will include 302 acres of water for fishing and 444 acres of surrounding land for wildlife habitat. Also planned are parking facilities for 30 cars and boat trailers, a boat ramp, and a vault latrine.

Site preparation for the new reservoir will include complete stripping at the dam site and removal of most trees in the main pool area. Grass, brush, and shrubs in the main pool area will be left, as well as trees in some areas of the littoral zone, for fish habitat.

Reservoir VI-D in comparison, is a surface-release reservoir (single-stage, standard covered top riser) with a permanent pool surface area of 43 acres and impounds 410 acre-feet of water. The maximum depth is 26 feet, mean depth is 9.5 feet, and the drainage area is 7.6 square miles. The water-residence time for reservoir VI-D is 0.05 year.

Reservoir VI-D was built as a single-purpose flood-control structure; however, it is open to the public for fishing.

DISCHARGE DATA

Daily mean discharge was computed from the gage-height record collected at site S_1 (appendix 1). Only miscellaneous discharge measurements were made at sites S_2 and S_4. Physical restrictions at both S_2 and S_4 prohibited the measurement of high discharges. However, crest-stage gages were installed to record peak-gage heights at sites S_2 and S_4.

Discharge measurements were made monthly at S_1 from December 1978 to December 1979. A continuous record was obtained from February 1979 to January 1980.

The peak discharge for site S was 1,300 ft³/s on September 14, 1979. The mean daily discharge for that day was 1,080 ft³/s. The lowest recorded daily mean discharge was 4.8 ft³/s on July 23, 1979. The mean discharge for the period of continuous record is 50 ft³/s.

The discharge for site S_4, above the reservoir, ranged from an estimated 480 ft³/s to a measured low of 1.8 ft³/s. Discharge below the reservoir, at site S_2, ranged from 335 ft³/s (estimated) to 2.8 ft³/s.

Data collected at the two sites on Indian Run (S_4, and S_2) show little change in the flow downstream from the reservoir during average or low flow.

WATER-QUALITY DATA

Dissolved Oxygen, Temperature, and pH

Dissolved Oxygen

In reservoirs the pattern of dissolved-oxygen distribution can be extremely variable horizontally, vertically, and seasonally. Each reservoir is unique in the quality of inflow, morphology, stratification patterns, and drawdown and discharge characteristics (Wetzel, 1975).

Sources of dissolved oxygen to a body of water include atmospheric reaeration, photosynthetic production and the incoming flows. Dissolved oxygen may be lost from a lake or reservoir by plant and animal respiration, bacterial respiration in decomposition of organic matter, and chemical oxidation of dissolved organic matter. In new reservoirs, oxygen depletion from the hypolimnion may be enhanced due to the decay of newly flooded vegetal material, soils and debris, etc., (Baxter, 1977).

There were no appreciable differences in dissolved-oxygen concentrations between the outflow (site S_2) and the inflow (site S_4). Monthly variations in dissolved-oxygen concentrations of Indian Run at sites S_4 and S_2 are shown in figure 2. The dissolved-oxygen concentrations at site S_4 ranged from 7.7 mg/L in June to 14.2 mg/L in December (appendix 4). At site S_2, the concentrations ranged from 6.8 mg/L in November to 15.2 mg/L in December (appendix 5). At site S_1, concentrations ranged from 7.6 mg/L in November to 15.4 mg/L in December (appendix 6).

At site L_3, dissolved-oxygen concentrations ranged from 6.6 mg/L in October to 12.8 mg/L in December, 2 feet below the surface and from 0.8 mg/L in August to 13.2 mg/L in December at 18 feet (appendix 7). Dissolved-oxygen data from site L_3 indicate that stratification of reservoir VI-D began in April and continued into October.

Diurnal variations of dissolved oxygen, temperature, pH, and specific conductance were measured at site L_3 on March 28 and 29, 1979 (appendixes 9 and 10). Measurements at site L_3 were taken every 1.5 hours at 2 and 18 feet below the surface. Although a complete top to bottom profile was not taken, measurements at 2 and 18 feet indicated slight differences in dissolved oxygen and temperature. Diurnal variation of dissolved oxygen at 2 feet ranged from 9.0 to 14.4 mg/L, and that at 18 feet ranged from 9.8 to 13.4 mg/L.

Another 24-hour profile was made at site L_3 on October 10-11 (appendixes 9 and 10) when a top to bottom profile of dissolved oxygen, temperature, and specific conductance was taken (fig. 3). Measurements were made at 1-foot intervals from the surface to the bottom in the reservoir and just below the water surface at the stream sites. Fig. 3 shows that the reservoir was thermally mixed and dissolved-oxygen stratification was beginning to break up.

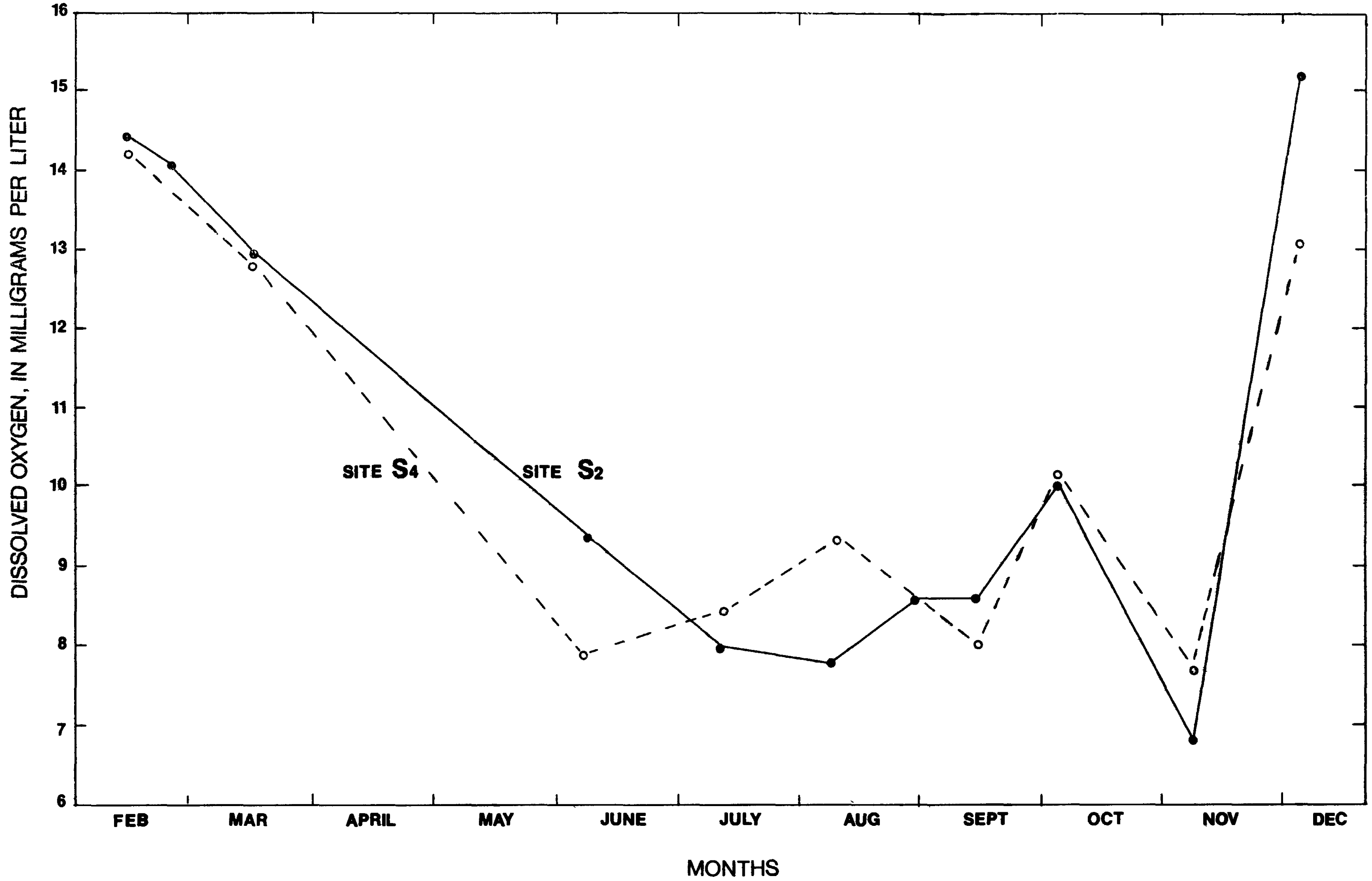
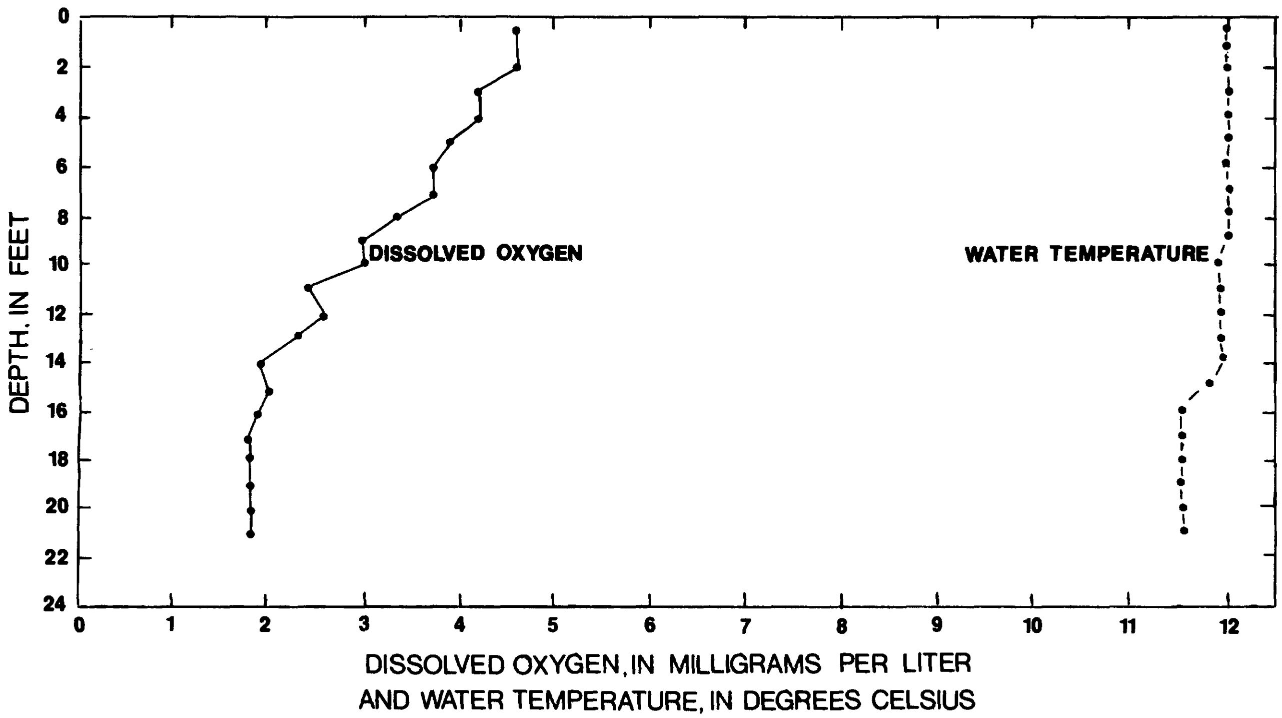


Figure 2.--Monthly variation in dissolved oxygen of Indian Run at sites S_2 and S_4, 1979 (values based on individual samples).



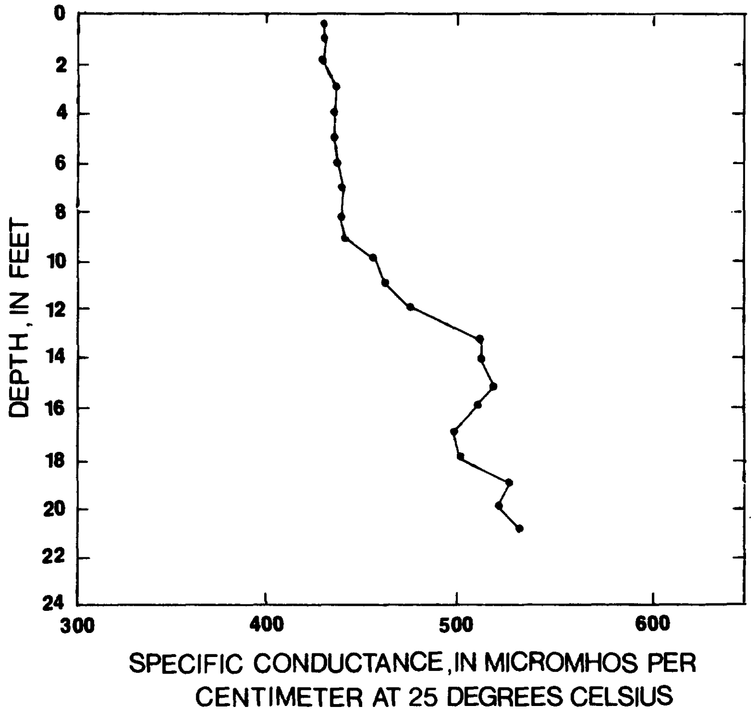


Figure 3.--Data profiles for Reservoir VI-D (site L_3) on October 10, 1979.

Dissolved-oxygen concentrations in reservoir VI-D at 18 feet in June, July, and August (appendix 7) were very low (0.8 to 3.2 mg/L), indicating possible anoxic conditions in the deeper water. Loss of oxygen from the hypolimnion during summer stratification results in a clinograde oxygen distribution (decrease of oxygen in the hypolimnion) typical of most small productive lakes (Hutchinson, 1957). Other Ohio lakes also exhibit similar patterns of stratification and oxygen depletion in the hypolimnion in summer (Tobin and Youger, 1977; 1979). The proposed reservoir VI-A is also expected to have a clinograde oxygen distribution pattern and depletion of dissolved oxygen in the hypolimnion during the summer. This depletion of oxygen may be enhanced during the first few years due to decomposition of vegetal material. Concentrations of dissolved oxygen downstream from reservoir VI-A should be higher or similar to those upstream from the reservoir as it will also have a surface release.

Temperature

Reservoir VI-D did not significantly increase the temperature of the outflow water over that of the inflow. The maximum observed increase in temperature between site S_4 and site S_2 was 4.5°C (fig. 4). None of the measured values exceeded Ohio standards for water temperature for the Hocking River basin (Ohio EPA, 1978).

The temperature of the outflow from the proposed reservoir will probably be somewhat higher than that of the inflow. The longer water residence time of reservoir VI-A will tend to cause a greater increase in temperature than that measured in reservoir VI-D.

pH

The pH of the outflow of reservoir VI-D was generally higher than that of the inflow. This increase is probably due to photosynthetic activity in the reservoir, which reduces the CO_2 content of the water and increases pH. The pH at site S_4 ranged from 6.7 to 8.2 (appendix 4). At site S_2, pH ranged from 6.9 to 8.6 (appendix 5). The lowest values at both sites were recorded during storm runoff. Monthly variation in pH between the two sites is shown in figure 5.

In reservoir VI-D, the pH at 2 feet ranged from 6.8 to 8.8 and that at 18 feet from 6.9 to 8.6 (appendix 7). Diurnal variation of pH in the reservoir in March and October is shown in appendixes 9 and 10.

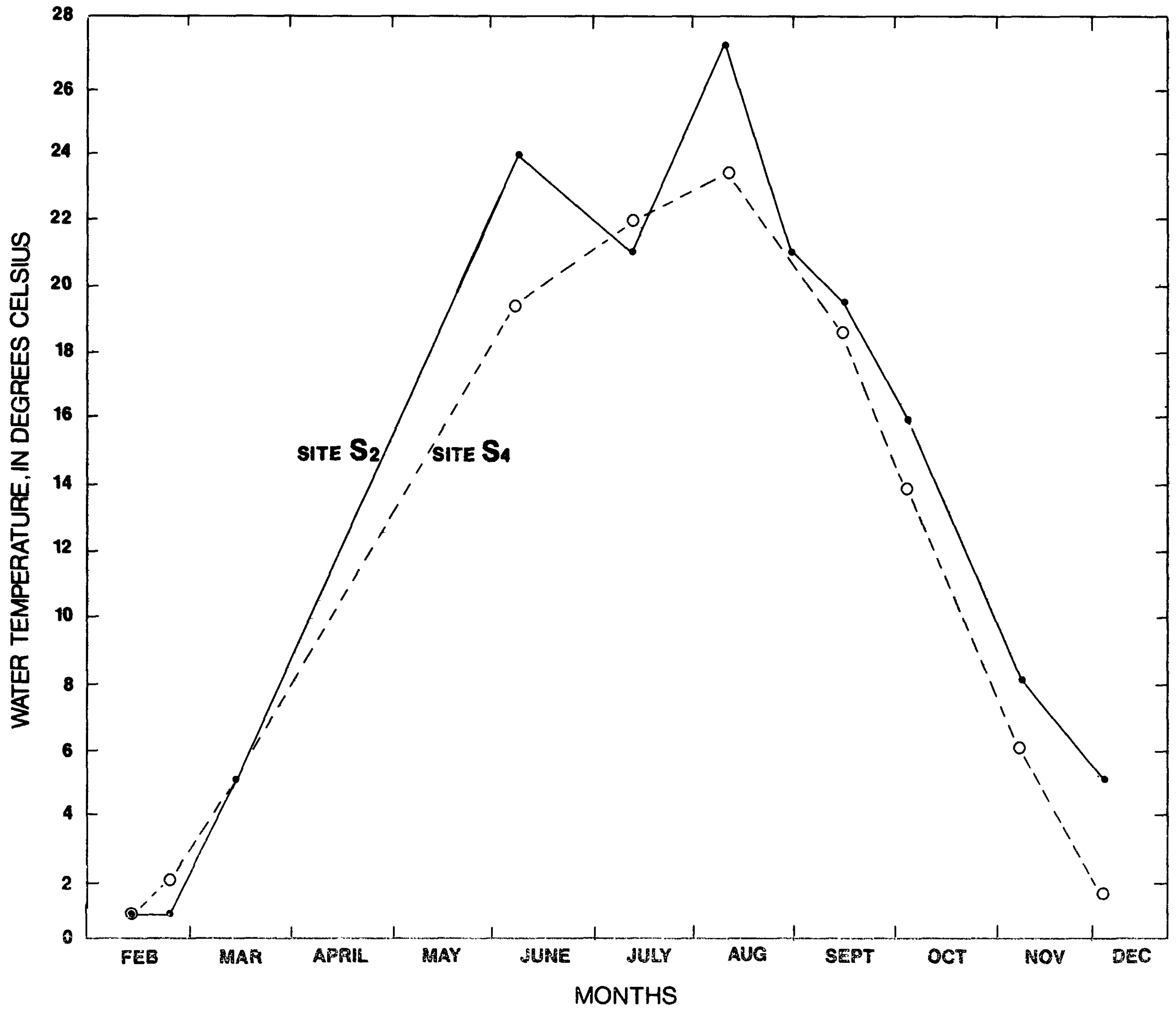


Figure 4. --Monthly variations in water temperature of Indian Run at sites S_2 and S_4, 1979 (values are based on individual samples).

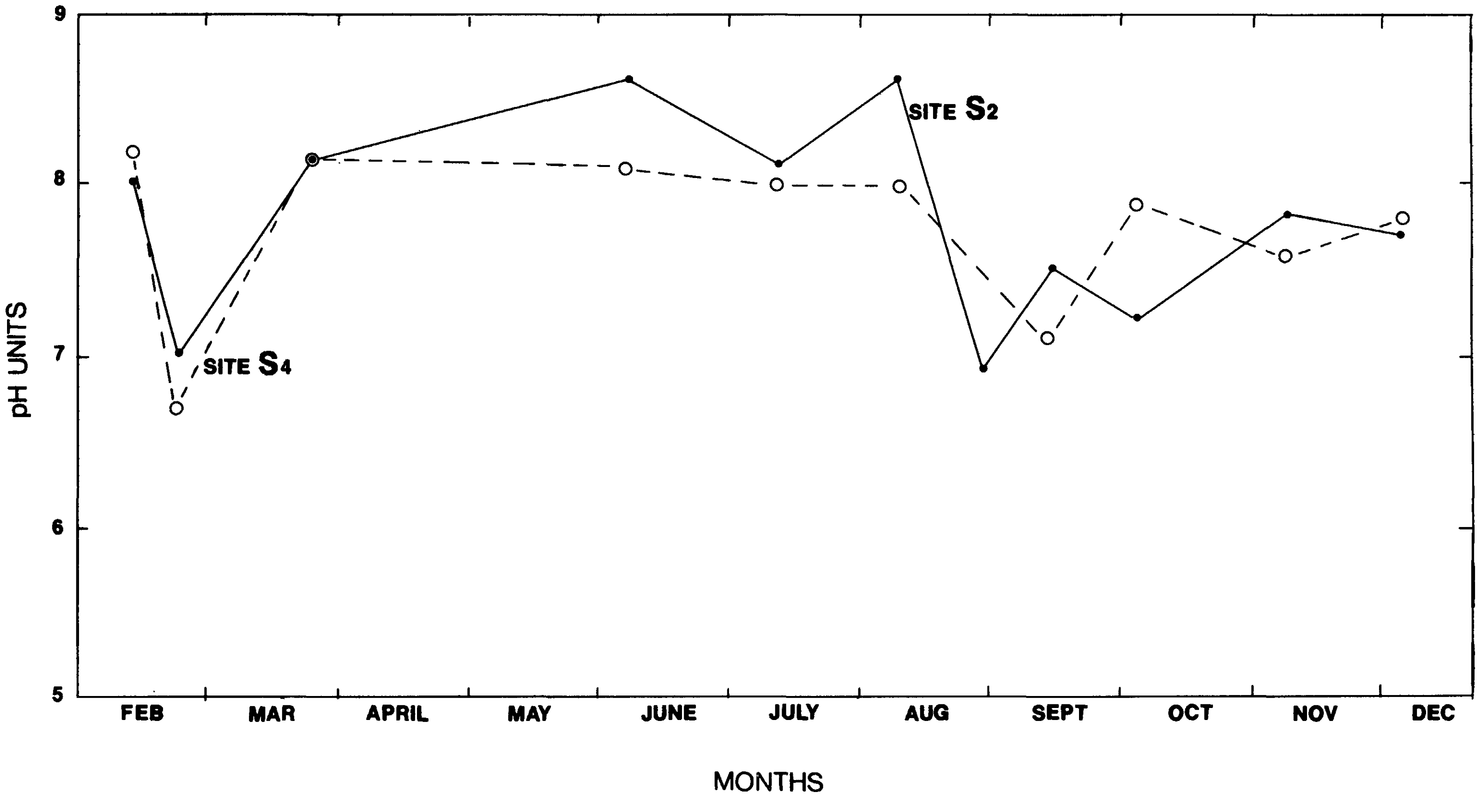


Figure 5.--Monthly variation of pH of Indian Run at sites S_2 and S_4, 1979.

At site S_1, the pH was comparable to that at S_4, ranging from 6.6 to 8.1 (appendix 6). Lowest values at site S_1 were recorded during runoff. The proposed reservoir VI-A will probably slightly increase pH downstream due to the increased photosynthesis.

Nutrients

Two nutrients required for aquatic plant growth and reproduction are nitrogen and phosphorus. They are generally considered to be the major nutrients that can limit or control primary productivity in aquatic systems.

Forms of phosphorus and nitrogen that can be utilized by aquatic plants are the soluble orthophosphate and inorganic nitrogen (NO_2 + NO_3) fractions (Rast and Lee, 1978). Critical concentrations of inorganic phosphorus and inorganic nitrogen required for phytoplankton growth are 0.01 mg/L and 0.3 mg/L, respectively (Sawyer, 1947). Above these levels, nuisance algal blooms can occur. Bloom conditions exist when the number of algae per liter exceed half a million (Fruh, 1967). There are other compounds and elements that can also limit or enhance algal production.

Phosphorus and nitrogen data are presented in appendixes 4, 5, 6, 7, 8. Orthophosphate concentrations at site S_4 ranged from less than the detection limit (0.01 mg/L) to 0.11 mg/L. Eighty-eight percent of the samples collected at site S_4 had concentrations of orthophosphate of 0.01 mg/L or higher. The concentration of inorganic nitrogen at S_4 ranged from 1.37 to 6.65 mg/L. Nitrogen occurred chiefly as nitrate. Increased concentrations of both nitrogen and phosphorus during storms were most likely from agricultural sources.

At site S_2 orthophosphate concentrations ranged from less than the detection limit (0.01 mg/L) to 0.11 mg/L. Seventy-three percent of the samples contained concentrations of 0.01 mg/L or higher. Inorganic nitrogen concentrations at S_2 ranged from 1.03 to 4.7 mg/L, less than that in the inflow.

At site S_1, orthophosphate concentrations ranged from less than the detection limit (0.01 mg/L) to 0.12 mg/L. Eighty-two percent of the samples contained concentrations of 0.01 mg/L or more. Inorganic nitrogen concentrations ranged from 0.33 mg/L to 5.0 mg/L. Values were less than those at S_4, but were still well above the critical concentrations required for algal blooms.

In reservoir VI-D (site L_3), the concentration of orthophosphate 2 feet below the surface ranged from 0.00 mg/L to 0.09 mg/L. On several occasions during the summer, the concentration was below the limit of detectability (0.01 mg/L), indicating that available phosphorus was probably tied up in algal biomass. Inorganic nitrogen concentrations at 2 feet ranged from 1.9 to 5.2 mg/L.

In reservoir VI-D, the concentration of phosphorus may control the severity of algal blooms. The available phosphorus is above the critical concentration described by Sawyer (1947); however, because of the high concentrations of inorganic nitrogen, more severe blooms may occur if additional phosphorus is introduced into the system. Severe blooms are also possible in the proposed reservoir because of the high concentrations of available phosphorus and nitrogen at site S_1.

Major Constituents

The major cations in most inland surface waters are calcium, magnesium, sodium, and potassium. The major anions are bicarbonate, carbonate, sulfate, and chloride. The concentration of these constituents in surface waters is related to the composition of rock material in the drainage basin (Wetzel, 1975).

The inflow (site S_4) to reservoir VI-D was characterized by moderately hard calcium bicarbonate sulfate water during high flows and hard to very hard calcium bicarbonate water during low flows (17-71 mg/L calcium, 56-250 mg/L bicarbonate, 21-49 mg/L sulfate). See criteria used to classify water from Tobin and Youger, (1977).

Data from site L_3 indicate that water in reservoir VI-D is of the hard to very hard calcium bicarbonate type (41-62 mg/L calcium, 120-250 mg/L bicarbonate).

Both sites S_2 and S_1 were characterized during high flows by moderately hard calcium bicarbonate water and by hard to very hard calcium bicarbonate water during low flows (28-69 mg/L calcium, 84-220 mg/L bicarbonate at S_2; 17-67 mg/L calcium, 48-240 mg/L bicarbonate at S_1).

Water in the planned reservoir VI-A is expected to be similar to that in reservoir VI-D in hardness and concentration of major constituents.

Specific conductance, a measure of water's capacity to conduct an electrical current, ranged from 180 to 710 μmho/cm at S_4 (appendix 4). In reservoir VI-D, conductance ranged from 370 to 690 umho/cm at 2 feet, and from 405 to 620 μmho/cm at 18 feet (appendix 7). At site S_2, conductance ranged from 210 to 650 μmho/cm (appendix 6).

At sites S_4, L_3, and S_2, specific conductance was measured only during routine sampling and in general was highest during low flows and lowest during high flows. At site S_1 a U.S. Geological Survey monitor recorded daily values for specific conductance. Values at S_1 ranged from less than 100 μmho/cm to greater than 1,000 μmho/cm. The higher values were recorded in January and February and probably were due to road-salt runoff from a bridge directly upstream from the monitor intake.

Trace Elements and Pesticides

Trace Elements

All monthly samples from all sites were analyzed for iron and manganese. Stream sites S_1 and S_2 were sampled three times, S_4 twice, and the reservoir, site L_3, twice for additional trace elements (appendixes 4, 5, 6, 7).

Water samples collected at site S_4 in February, July, and September exceeded Ohio EPA (1978) water-quality standards for iron for a warmwater habitat (1,700-7,000 μg/L). The June sample exceeded the water quality standards for lead (60 μg/L). At S_2, iron exceeded the Ohio EPA (1978) water-quality standard limits on several occasions (1,200-4,700 μg/L). High levels of cadmium and lead were measured in the June sample (17 μg/L and 200 μg/L, respectively). In reservoir VI-D (site L_3) concentrations of iron, lead, and zinc in both surface and bottom waters were in violation of Ohio EPA (1978) water-quality standards. High concentrations of manganese occurred in the bottom waters in June, July, August, and October. These high levels were probably due to the release of manganese from the sediments under reducing conditions.

In water samples collected at site S_1, concentrations of iron (1,700-1,600 µg/L), lead (100 µg/L), copper (17 µg/L), and zinc (70 µg/L) exceeded Ohio EPA (1978) water-quality standards. High levels of copper and zinc were measured in samples collected in September during a major storm.

No known point sources exist in the watersheds that could be contributing trace elements to the streams. It is possible that the trace elements occur naturally in the surrounding soils and are carried into the streams with stormwater runoff.

Exceedence of the water-quality standards for trace elements could affect the reservoirs ability to support reproducing populations of desirable fish species and benthos. This will depend on the frequency and severity of the violations.

Pesticides

Samples for pesticide analysis, both water phase and bottom material, were collected from the stream sites in June, August, and September (appendixes 4, 5, 6). Samples from the reservoir were collected in April and June (appendix 7). The April, August, and September samples were taken during storm runoff. The June sample was collected during base flow.

The water samples collected in September from S_1, S_2, and S_4 contained levels of dieldrin in excess of Ohio EPA (1978) water-quality standards. The surface-water sample taken from reservoir VI-D in April also exceeded the standard for dieldrin. The bottom material sample taken from the reservoir in April contained 26 µg/kg chlordane. Although U.S. Environmental Protection Agency has not established criteria for concentrations of pesticides in sediment, this level does exceed the U.S. Geological Survey alert system limit (20 µg/kg) for chlordane. Under this system, concentrations exceeding the limit are flagged and verified by reanalyzing the sample.

In July, two bullhead catfish (*Ictalurus* sp.) were taken from reservoir VI-D and analyzed for tissue concentrations of pesticides (table 2). The concentration of chlordane in the fish was nearly twice the recommended level for accumulation in aquatic organisms (National Academy of Sciences and National Academy of Engineering, 1973).

Table 2.--Pesticide residues in catfish taken from reservoir VI-D on July 26, 1979

(Analysis of whole-fish sample by U.S. Geological Survey central laboratory in Georgia.)

Pesticide	Amount in microgram per kilogram
Technical chlordane	190
DDE	38
PDD	3.3
PCB	30
Dieldrin	82
Endrin	1.5

The source of these pesticides in the two watersheds is probably runoff from cropland. Reservoir VI-D was formed by flooding land previously used for agriculture. The site proposed for reservoir VI-A is currently used for agriculture. Dieldrin, chlordane, and perhaps other pesticides may be detected in the proposed reservoir. Pesticide concentrations in reservoir VI-A may be similar to those in reservoir VI-D.

Suspended Sediment

Suspended sediment samples were collected at sites S_1, S_2, and S_4 from March 1979 to December 1979. Table 3 shows the date of collection, concentration, and corresponding discharge. The equal-transit rate method, described by Guy and Norman (1970), was used in the collection of all the samples.

Analysis of suspended sediment samples taken at S_4 showed a maximum concentration of 608 mg/L at a discharge of 63 ft³/s. During base flow, concentrations were less than 10 mg/L.

Appreciable differences in sediment concentrations were observed at S_2. The highest concentration measured at S_2 was 222 mg/L with a discharge of 42 ft³/s. The minimum concentration measured was 4 mg/L at a discharge of 12.6 ft³/s.

Table 3.--Suspended sediment collection at sites S_1, S_2, S_4, 1979

Date	Site S_1			Site S_2			Site S_4		
	Time	Discharge (ft^3/s)	Concentration (mg/L)	Time	Discharge (ft^3/s)	Concentration (mg/L)	Time	Discharge (ft^3/s)	Concentration (mg/L)
Mar. 14, 1979	1530	26	10	1400	6.4	20	1100	3.6	5
Apr. 2, 1979	1010	325	1,230	1240	47.5	23	1125	63.2	608
Apr. 11, 1979	1245	51	20	--	--	--	1315	14.5	14
June 6, 1979	--	--	--	--	--	--	1115	3	18
June 7, 1979	1000	16.5	34	1300	3.4	8	--	--	--
July 11, 1979	--	--	--	1315	2.8	10	0930	2.1	54
Aug. 8, 1979	1145	6.7	12	1330	3.6	8	--	--	--
Aug. 9, 1979	--	--	--	--	--	--	1230	1.8	10
Aug. 20, 1979	2230	180	867	2240	42	222	2305	87	491
Aug. 21, 1979	0015	385	773	0000	49	104	1215	34.9	64
Aug. 21, 1979	1645	196	180	1230	53.1	32	1500	29.8	50
Aug. 29, 1979	1400	390	338	1545	68	65	--	--	--
Sept. 14, 1979	1130	1,300	542	1530	65	108	1400	148	278
Oct. 3, 1979	--	--	--	1300	12.6	4	0930	4.6	5
Oct. 4, 1979	1130	38	7	--	--	--	--	--	--
Nov. 7, 1979	1030	12	9	--	--	--	--	--	--
Nov. 8, 1979	--	--	--	1100	3.2	8	0900	1.8	12
Dec. 4, 1979	1530	23	8	1100	5.1	10	0930	2.7	22

A suspended sediment concentration of 1,230 mg/L was measured on April 2, 1979, at site S_1 at a discharge of 325 ft^3/s. Base flow conditions had minimum concentrations of less than 10 mg/L.

Suspended-sediment load was computed by the flow-duration-sediment-transport-curve method (Miller, 1951) at each site. Yearly load for S_1 was 26,265 tons. Site S_4 had an annual loading of 1,825 tons, whereas S_2, below reservoir VI-D, had only 350 tons.

Trap efficiency for suspended sediment of reservoir VI-D is 81 percent. This percentage is the difference between the annual suspended loads for S_4 and S_2. The trap efficiency in reservoir VI-A is expected to equal or exceed that of VI-D, as the proposed reservoir will be deeper, have a longer water residence time, and, like VI-D, have a surface-release outflow.

BIOLOGIC DATA

Benthic Organisms

Benthic organisms are associated with the substrate of a stream or lake. Because of their slight mobility and relatively long life span, they are often used as indicators of water-quality conditions. The benthic community of an unstressed, clean water system normally consists of a large number of different organisms with few individuals of each type present. Aquatic systems stressed or degraded by contamination are characterized by benthic communities of a few different types with large numbers of each.

The quantitative expression of the distribution of organisms among taxa is called a diversity index. The Shannon-Weaver function was used to calculate mean diversity (d) for this study (Shannon and Weaver, 1949).

Diversity index values of clean water systems are usually between 3 and 4, whereas those of highly polluted waters are less than 1. Values between 3 and 1 indicate slight to moderate levels of degradation (Wilhm, 1970).

Sample counts and diversity indices for sites S_1, S_2, L_3, and S_4 are presented in appendixes 13, 14, 15, and 16, respectively. The tables list the identifications to the family level, whereas the diversity indices are based on the number of different genera.

The median diversity index values for the sampling sites are:

S_1 = 3.07
S_2 = 2.30
L_3 = 2.70
S_4 = 2.25

These values indicate a clean water system at site S_1 and possibly slight to moderate degradation at sites S_2, L_3, and S_4. The values also indicate no difference in diversity of organisms upstream and downstream from reservoir VI-D.

Formation of a reservoir on a stream generally tends to increase the number of organisms immediately below the reservoir due to the increase in food supply (phytoplankton) and the decrease in annual fluctuations in water levels (Hynes, 1970; Baxter, 1977). This increase in number of organisms is the only effect expected on the benthic community after reservoir VI-A is constructed.

Phytoplankton

The phytoplankton are the plant organisms suspended or free-floating in a body of water. Large populations may develop in reservoirs or lakes, but in flowing waters the numbers are usually low. The diversity index of a phytoplankton community is of slight value because the organisms move with the current and are short-lived and very seasonal.

The occurrence of algal blooms, especially the blue-green algae which are typical of nutrient-enriched conditions, are more important than the diversity index concept in looking at the quality of a reservoir.

The large numbers of blue-green and green algae in reservoir VI-D reflect the availability of the plant nutrients, phosphorous, and nitrogen. The phytoplankton data are presented in appendixes 17, 18, 19, 20. Other factors such as increased temperature, availability of other required nutrients, zooplankton grazing, etc., can also affect algal production.

The proposed reservoir VI-A may also support blooms of algae due to the similarities in concentrations of phosphorous and nitrogen at sites S_4 and S_1, and in land-use practices in the watershed. Concentrations of mineral nutrients in reservoir VI-A may be higher during the first few years after formation due to leaching from newly flooded soils and decomposition of vegetal material.

Bacteria

Water samples are analyzed for bacteria as an indication of contamination. Two bacteria commonly tested for are fecal coliforms and fecal streptococci. The ratio of fecal coliform to fecal streptococci is used as an indication of the source of these bacteria. Ratios greater than 4.0 indicate wastes of predominately human origin, whereas ratios less than 1.0 indicate wastes of animals, particularly livestock and poultry (Millipore Corp. 1973).

Fecal coliform and fecal streptococci data for sampling sites S_1, S_2, L_3, and S_4 are presented in appendixes 4, 5, 6, 7. The average fecal coliform to fecal streptococci ratios at sites S_1, S_2, L_3, and S_4 were 0.98, 0.98, 1.14, and 0.78, respectively. These values indicate wastes of predominately animal origin. The numbers of bacteria were highest and the ratios lowest during runoff. This is expected due to the predominance of pasture and farm land in the watersheds.

The number of bacteria in water samples from sites L_3 and S_2 were lower than those from S_4. None of the fecal coliform counts from the reservoir (L_3) exceeded Ohio EPA (1978) water-quality standards of 5,000 colonies per 100 mL for secondary contact recreation waters.

The number of bacteria in samples from site S_1 were generally lower than those from S_4. On one occasion, in water collected during a major storm, the fecal coliform counts did exceed Ohio EPA (1978) water-quality standards for secondary contact recreation waters. However, the probable sources of contamination, houses and farms nearby, will be inundated by the new reservoir and thus eliminated.

SUMMARY AND CONCLUSIONS

Water-quality and discharge characteristics were measured at three sites in the Indian Run watershed: Reservoir VI-D (site L_3), Indian Run above the reservoir (site S_4), and Indian Run below the reservoir (site S_2). Little Rush Creek was sampled near the site of a proposed reservoir (site S_1). Data were collected over an 11-month period, from February through December 1979. Data from the Indian Run sites were used to project potential water quality in and below the proposed reservoir on Little Rush Creek. Watershed characteristics and land use in the Indian Run and Little Rush Creek basins are similar. No point sources of pollution occur in either basin.

The discharge of Indian Run below the reservoir was not affected by the reservoir during average and low flows. At site S_4, the discharge ranged from 480 to 1.8 ft^3/s and at site S_2 from 335 to 2.8 ft^3/s. Formation of a reservoir on a stream tends to decrease annual variation in water levels downstream from the reservoir.

Water temperature and dissolved-oxygen levels below the reservoir were not significantly different than those of the reservoir inflow. Water temperature below the reservoir increased by a maximum of 4°C above that of the inflow. Dissolved-oxygen concentrations ranged from 7.7 to 14.2 mg/L above the reservoir and from 6.8 to 15.2 mg/L below the reservoir. Dissolved-oxygen concentrations above and below the reservoir were all well above the lower limit set by the Ohio EPA for supporting a balanced aquatic community (5.0 mg/L). During the summer, dissolved oxygen in reservoir VI-D decreased with depth (clinograde). Concentrations approached zero near the bottom of the reservoir, which is considered typical of similar lakes in Ohio. The proposed reservoir would probably have similar effects on downstream water temperatures and dissolved-oxygen concentrations because the outflow structure is designed to be like that of reservoir VI-D. The proposed reservoir is also expected to have a clinograde oxygen-distribution pattern during the summer stratification period. Runoff from the agricultural lands provide a recurrent source of nitrogen and phosphorous. The concentrations of these nutrients were sufficient to support blue-green algal blooms of more than 200,000 cells/mL. The nutrient-enriched conditions at site S_1 indicate that algal blooms could exist in the proposed reservoir.

Both Indian Run and Little Rush Creek are characterized by moderately hard to very hard, calcium bicarbonate water.

Several trace elements were measured, on one or more occasions, and found to be in excess of Ohio EPA (1978) water-quality standards. These elements were lead (all sites), cadmium (S_2), copper (S_1), and zinc (S_1, L_3). No sources of these metals are known in either watershed. It is not known whether these elements will be a problem in the proposed reservoir.

Water samples and bottom material from all sites and fish from reservoir VI-D were analyzed for pesticides. Concentrations of dieldrin in the sampled waters exceeded Ohio EPA (1978) water-quality standards at sites S_1, S_2, S_4, and L_3 (surface sample). A bottom material sample taken from reservoir VI-D contained 26 µg/kg chlordane, which exceeds the U.S. Geological Survey alert system limit of 20 µg/kg. The fish samples contained 190 µg/kg chlordane. The recommended limit is 100 µg/kg. The source of these pesticides is most likely runoff from agricultural land. Reservoir VI-D was formed by flooding land previously used for agriculture. Dieldrin and chlordane may also be found in the proposed reservoir.

Benthic communities were sampled at all sites. Diversity indices and numbers of organisms were generally high and indicate clean water systems with perhaps some slight to moderate degradation at sites S_2, S_4, and L_3. Diversity indices and numbers and types of organisms at site S_1, indicate that the proposed reservoir should support a healthy benthic community.

Ratios of fecal coliform to fecal streptococcus at sites S_1, S_2, L_3, and S_4 were 0.98, 0.98, 1.14, and 0.78, respectively. These values indicate wastes of predominately animal origin. None of the bacteria counts from reservoir VI-D exceeded Ohio EPA (1978) water-quality standards of 5,000 colonies per 100 mL of sample for secondary contact recreation waters. Bacterial contamination is not expected to be a problem in the proposed reservoir.

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APPENDIXES

Appendix 1.--Mean daily discharge of Little Rush Creek, site S_1

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1					27	231	121	22	55	18	28	58
2					25	182	292	21	36	12	56	46
3					24	169	83	38	23	9.2	36	41
4					23	132	172	45	18	9.3	27	37
5					22	78	77	48	15	9.1	24	34
6					21	60	46	30	15	8.8	20	32
7					20	52	51	24	15	8.2	8.8	30
8					20	43	188	21	202	8.2	6.7	29
9					19	41	120	18	60	8.6	16	28
10					19	34	100	24	35	19	57	27
11					18	31	75	15	24	11	357	26
12					18	28	71	24	18	7.0	110	26
13					17	26	91	32	15	6.3	42	48
14					17	25	316	19	12	6.2	25	1080
15					16	22	94	16	11	6.0	20	270
16					16	22	63	12	9.2	6.0	16	76
17					16	23	50	11	8.6	5.9	13	50
18					16	24	41	10	7.9	5.6	20	42
19					17	22	36	10	7.1	5.4	22	36
20					50	20	31	9.2	6.4	5.3	42	34
21					162	18	27	9.7	207	5.2	352	60
22					313	19	26	8.4	175	5.0	87	78
23					641	39	25	10	36	4.8	68	49
24					619	26	25	20	23	7.0	48	36
25					729	21	24	20	18	64	36	30
26					488	20	24	80	14	31	75	28
27					145	20	27	117	12	90	228	27
28					169	18	25	67	10	97	132	320
29					---	19	23	35	9.2	276	500	115
30					---	17	22	23	21	71	200	72
31					---	23	---	27	---	32	78	---
TOTAL					3687	1505	2366	866.3	1118.4	858.1	2750.5	2865
MEAN					132	48.5	78.9	27.9	37.3	27.7	88.7	95.5
MAX					729	231	316	117	207	276	500	1080
MIN					16	17	22	8.4	6.4	4.8	6.7	26

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	60	14	30	29								
2	48	30	26	29								
3	39	20	22	29								
4	36	16	22	28								
5	48	14	22	28								
6	36	12	22	28								
7	32	13	24	29								
8	28	12	20	27								
9	38	25	18	21								
10	43	85	18	12								
11	28	41	17	---								
12	51	37	17	---								
13	41	22	85	---								
14	32	19	54	---								
15	28	18	32	---								
16	26	22	28	---								
17	27	19	21	---								
18	27	18	23	---								
19	24	17	19	---								
20	23	15	18	---								
21	21	14	16	---								
22	20	16	17	---								
23	19	22	19	---								
24	18	74	63	---								
25	18	51	69	---								
26	17	219	70	---								
27	16	67	42	---								
28	18	56	31	---								
29	17	44	29	---								
30	15	34	29	---								
31	14	---	29	---								
TOTAL	908	1066	952	---								
MEAN	29.3	35.5	30.7	---								
MAX	60	219	85	---								
MIN	14	12	16	---								

Appendix 2.--Specific conductance of Little Rush Creek, site S_1

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG. C), WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979

DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
1							---	---	446	394	221	191
2							---	---	437	407	228	185
3							---	---	434	390	250	185
4							375	342	440	382	225	189
5							399	376	489	358	234	177
6							422	395	503	439	277	210
7							421	416	494	431	240	209
8							423	415	460	349	275	216
9							448	424	---	---	309	397
10							461	440	---	---	604	304
11							487	409	---	---	469	398
12							---	---	---	---	404	376
13							---	---	---	---	374	334
14							---	---	---	---	407	323
15							---	---	---	---	403	394
16							---	---	---	---	411	397
17							---	---	---	---	415	401
18							---	---	---	---	414	400
19							---	---	---	---	408	396
20							---	---	232	209	409	397
21							295	223	403	208	407	396
22							364	284	302	202	407	396
23							401	366	319	122	411	400
24							404	172	208	124	414	379
25							332	192	251	97	415	379
26							382	334	190	95	395	390
27							396	383	236	189	402	376
28							398	391	239	209	402	392
29							408	400	---	---	427	398
30							420	402	---	---	409	383
31							419	390	---	---	405	394
MONTH							487	172	503	95	604	177

DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
	APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
1	406	365	323	315	---	---	---	---	408	360	516	436
2	354	241	325	317	---	---	---	---	404	315	457	448
3	352	280	331	240	---	---	---	---	384	338	464	456
4	366	231	269	252	---	---	---	---	415	384	470	443
5	344	243	292	264	---	---	---	---	429	414	444	433
6	377	345	302	277	---	---	---	---	437	427	438	436
7	395	377	300	275	522	489	---	---	432	426	441	438
8	395	383	294	273	517	494	---	---	437	430	442	439
9	386	241	278	260	---	---	---	---	439	426	444	441
10	359	267	263	236	---	---	---	---	442	136	447	443
11	392	333	---	---	---	---	---	---	241	150	453	446
12	363	343	---	---	---	---	---	---	---	---	457	449
13	374	220	---	---	---	---	---	---	---	---	457	320
14	306	168	---	---	485	379	---	---	---	---	326	110
15	351	307	---	---	511	420	---	---	---	---	368	199
16	372	350	---	---	456	371	---	---	---	---	412	369
17	391	372	---	---	480	459	---	---	---	---	442	413
18	405	385	---	---	499	465	518	495	---	---	454	442
19	442	365	---	---	501	474	518	512	---	---	465	454
20	397	312	---	---	---	---	518	511	---	---	471	461
21	416	307	---	---	---	---	518	492	332	168	473	342
22	431	279	---	---	---	---	495	490	498	336	394	322
23	345	217	---	---	---	---	500	378	421	411	428	395
24	320	202	---	---	---	---	445	316	450	424	456	429
25	404	287	---	---	---	---	384	271	487	443	469	456
26	---	---	---	---	---	---	340	280	429	193	478	470
27	449	363	---	---	---	---	370	158	408	153	482	477
28	418	303	---	---	---	---	317	156	184	123	479	170
29	326	316	---	---	---	---	317	140	123	122	362	229
30	326	319	---	---	---	---	403	319	407	339	410	363
31	---	---	---	---	---	---	441	399	532	407	---	---
MONTH	449	168	331	236	522	371	518	140	532	122	516	110
YEAR	604	95										

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR

Appendix 2.--Specific conductance of Little Rush Creek, site S_1--Continued

SPECIFIC CONDUCTANCE (MICROMHOS/CM AT 25 DEG. C), WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
1	432	411	490	472	453	446	462	441				
2	440	430	486	460	453	450	462	447				
3	520	425	472	462	461	453	452	446				
4	450	436	477	471	468	461	453	437				
5	436	429	483	475	468	462	456	435				
6	453	436	488	482	466	460	454	438				
7	459	452	489	488	462	448	453	442				
8	465	458	492	487	460	452	476	444				
9	463	445	493	441	465	457	469	453				
10	445	440	439	387	468	463	507	468				
11	457	445	442	398	471	463	---	---				
12	457	427	461	443	474	469	---	---				
13	439	418	469	462	469	358	---	---				
14	457	440	472	468	426	361	---	---				
15	468	458	475	471	449	427	---	---				
16	470	466	475	462	454	447	---	---				
17	470	466	472	463	465	453	---	---				
18	472	465	473	466	479	467	---	---				
19	479	469	473	465	480	470	---	---				
20	482	475	476	466	472	460	---	---				
21	485	479	484	467	469	464	---	---				
22	489	482	523	484	469	464	---	---				
23	491	485	558	475	467	444	---	---				
24	491	487	596	404	442	370	---	---				
25	492	488	439	410	397	371	---	---				
26	490	484	430	283	412	357	---	---				
27	487	480	426	372	431	405	---	---				
28	486	481	434	422	434	428	---	---				
29	487	476	434	422	451	434	---	---				
30	487	478	446	434	455	434	---	---				
31	489	482	---	---	457	437	---	---				
MONTH	520	411	596	283	480	357	507	435				

Appendix 3.--Temperature (°C) of Little Rush Creek, site S_1

TEMPERATURE, WATER (DEG. C), WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979

DAY	MAX OCTOBER	MIN OCTOBER	MAX NOVEMBER	MIN NOVEMBER	MAX DECEMBER	MIN DECEMBER	MAX JANUARY	MIN JANUARY	MAX FEBRUARY	MIN FEBRUARY	MAX MARCH	MIN MARCH
1							---	---	.0	.0	3.5	2.0
2							---	---	.5	.0	4.5	2.5
3							.0	.0	.5	.0	7.5	2.5
4							.5	.0	1.0	.0	9.0	6.0
5							.5	.0	.0	.0	9.0	6.0
6							.5	.0	.0	.0	7.0	5.5
7							.0	.0	.0	.0	7.0	4.5
8							.0	.0	.0	.0	8.5	5.5
9							.0	.0	.0	.0	7.0	5.5
10							.0	.0	.0	.0	7.5	5.0
11							.5	.0	.0	.0	5.0	2.5
12							.0	.0	.0	.0	5.0	1.5
13							.5	.0	.0	.0	6.0	2.5
14							.0	.0	.0	.0	6.5	5.5
15							.0	.0	.0	.0	4.0	1.5
16							.0	.0	.0	.0	5.0	.5
17							.0	.0	.5	.0	7.0	2.0
18							.0	.0	.0	.0	10.0	5.5
19							.0	.0	.0	.0	11.0	8.0
20							.0	.0	.5	.0	12.5	9.5
21							.0	.0	.0	.0	14.0	10.0
22							.5	.0	.0	.0	13.5	9.5
23							1.0	.0	.5	.0	12.5	11.5
24							1.5	.0	1.5	.0	11.5	8.5
25							.0	.0	1.5	.0	8.0	5.5
26							.0	.0	1.0	.0	5.5	3.5
27							1.5	.0	3.0	.5	7.0	3.0
28							1.5	.5	4.0	1.0	8.0	3.5
29							1.0	.0	---	---	11.0	7.5
30							1.0	.0	---	---	13.5	10.0
31							.5	.0	---	---	13.5	12.5
MONTH							1.5	.0	4.0	.0	14.0	.5

DAY	MAX APRIL	MIN APRIL	MAX MAY	MIN MAY	MAX JUNE	MIN JUNE	MAX JULY	MIN JULY	MAX AUGUST	MIN AUGUST	MAX SEPTEMBER	MIN SEPTEMBER
1	12.5	9.5	16.5	10.5	---	---	---	---	24.0	20.0	21.5	19.5
2	11.5	9.0	18.0	11.0	---	---	---	---	23.5	20.5	21.5	20.0
3	11.0	8.5	15.5	14.5	---	---	---	---	22.5	20.0	21.5	20.5
4	8.5	8.5	14.5	11.0	---	---	---	---	23.5	20.0	22.0	20.0
5	8.0	6.5	13.5	9.0	---	---	---	---	23.5	20.0	21.5	20.5
6	7.5	5.5	16.5	11.0	---	---	---	---	24.0	20.0	22.5	20.5
7	7.0	4.0	19.5	14.0	22.0	19.5	---	---	24.0	20.0	21.5	19.5
8	8.5	5.5	22.0	17.0	19.5	17.0	---	---	23.5	20.0	19.5	17.0
9	9.0	5.0	23.5	18.5	---	---	---	---	25.0	21.5	17.5	15.0
10	8.0	4.0	23.5	20.0	---	---	---	---	25.0	20.5	18.0	15.0
11	8.0	7.5	21.5	20.0	---	---	---	---	22.0	20.0	18.5	16.0
12	12.5	8.0	---	---	17.0	16.0	---	---	---	---	19.5	16.5
13	13.5	11.0	---	---	19.0	15.5	---	---	---	---	19.5	18.0
14	12.5	9.0	---	---	20.0	19.0	---	---	---	---	19.5	18.0
15	12.0	8.0	---	---	23.0	20.0	---	---	---	---	18.0	16.0
16	8.0	7.0	---	---	20.0	15.5	---	---	---	---	16.0	15.0
17	10.5	7.0	---	---	19.0	14.0	---	---	---	---	17.0	14.5
18	13.0	8.0	---	---	19.0	16.0	23.0	21.0	---	---	17.0	15.0
19	14.0	9.0	---	---	19.0	14.5	22.0	18.0	---	---	17.0	15.5
20	15.5	10.0	---	---	---	---	22.5	18.5	---	---	16.0	14.5
21	15.5	11.5	---	---	---	---	22.5	20.0	20.0	19.5	16.0	15.5
22	15.5	14.0	---	---	---	---	23.5	20.5	19.5	19.0	16.0	14.5
23	15.5	13.5	---	---	---	---	24.0	21.0	20.0	19.5	15.0	13.5
24	16.5	13.5	---	---	---	---	22.5	21.0	20.0	19.0	15.5	13.0
25	19.5	15.5	---	---	---	---	21.5	20.5	20.0	18.5	16.0	13.5
26	18.0	15.5	---	---	---	---	23.0	21.0	20.0	18.5	16.5	14.5
27	15.5	13.0	---	---	---	---	22.5	21.5	20.5	19.5	16.0	15.0
28	13.0	11.0	---	---	---	---	22.5	20.0	20.5	20.0	17.0	16.0
29	13.0	10.5	---	---	---	---	21.5	20.0	20.0	20.0	17.0	16.5
30	15.0	10.5	---	---	---	---	22.0	20.0	20.5	19.5	17.0	16.0
31	---	---	---	---	---	---	23.0	20.0	21.0	19.5	---	---
MONTH	19.5	4.0	23.5	9.0	23.0	14.0	24.0	18.0	25.0	18.5	22.5	13.0
YEAR	25.0											

NOTE: NUMBER OF MISSING DAYS OF RECORD EXCEEDED 20% OF YEAR.

Appendix 3.--Temperature (°C) of Little Rush Creek, site S_1--Continued

TEMPERATURE, WATER (DEG. C), WATER YEAR OCTOBER 1979 TO SEPTEMBER 1980

DAY	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
1	17.0	15.5	13.0	11.5	3.0	2.0	1.5	1.5				
2	16.5	15.5	11.5	10.0	2.5	1.0	1.5	1.0				
3	15.5	14.5	10.0	8.0	1.5	.0	2.0	1.5				
4	14.5	13.5	8.5	6.5	2.5	1.0	1.5	.5				
5	13.5	12.5	8.5	5.0	4.0	1.5	.5	.0				
6	12.5	11.5	7.0	6.0	4.5	3.5	1.0	.0				
7	12.0	11.0	7.0	6.5	5.0	3.5	1.5	.0				
8	11.5	10.0	6.0	5.0	4.5	2.5	.0	.0				
9	11.5	11.0	8.0	6.0	3.0	2.0	.5	.0				
10	11.0	10.0	9.0	8.0	3.0	1.5	.0	.0				
11	10.0	9.0	8.0	6.0	5.5	2.5	---	---				
12	11.0	9.5	6.5	4.5	7.0	5.5	---	---				
13	11.0	9.5	6.5	5.0	6.5	4.5	---	---				
14	9.5	8.0	6.5	5.0	4.5	2.5	---	---				
15	9.0	7.5	5.0	4.5	2.5	1.0	---	---				
16	11.0	9.0	6.0	4.5	3.0	2.0	---	---				
17	12.5	11.0	6.5	4.0	2.0	.0	---	---				
18	14.0	12.0	7.5	4.5	.5	.0	---	---				
19	14.5	12.5	7.5	5.0	1.5	.0	---	---				
20	16.5	14.0	9.5	7.0	1.0	.0	---	---				
21	17.5	15.0	10.0	7.0	2.0	.0	---	---				
22	18.0	15.5	10.5	9.0	4.0	1.5	---	---				
23	16.5	12.0	11.5	10.5	6.5	4.0	---	---				
24	12.0	9.0	11.0	8.0	8.0	6.5	---	---				
25	9.0	8.0	10.0	8.0	8.0	5.0	---	---				
26	8.5	6.5	11.0	9.0	5.0	4.0	---	---				
27	8.5	5.5	9.0	8.0	4.5	3.0	---	---				
28	11.0	7.5	8.0	6.0	3.0	2.5	---	---				
29	11.0	8.0	6.0	3.0	2.5	2.0	---	---				
30	11.5	8.0	3.0	2.5	2.0	1.5	---	---				
31	13.0	9.5	---	---	2.0	1.5	---	---				
MONTH	18.0	5.5	13.0	2.5	8.0	.0	2.0	.0				

Appendix 4.--Physical, chemical, and bacteria data for Indian Run at site S_4, 1979

WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C)	TEMPERATURE, AIR (DEG C)	TURBIDITY (JTU)	TURBIDITY (NTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN, DISSOLVED (PERCENT SATURATION)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2)
FEB , 1979											
13...	1430	1.0	-5.0	--	--	14.2	100	2.0	550	8.2	2.3
24...	1030	2.0	6.0	--	--	--	--	3.1	240	6.7	20
MAR											
14...	1100	5.0	4.5	10	--	12.8	100	.0	485	8.2	2.0
JUN											
06...	1115	19.5	--	--	5.0	7.9	85	.6	535	8.1	2.8
JUL											
11...	1315	22.0	--	--	40	8.5	96	.7	590	8.0	2.7
AUG											
09...	1230	23.5	--	--	3.0	9.4	110	.9	570	8.0	3.7
SEP											
14...	1400	18.5	--	--	80	8.0	85	2.7	180	7.1	7.1
OCT											
03...	0930	14.0	13.5	--	10	10.2	98	.5	515	7.9	4.5
NOV											
08...	0915	6.0	5.5	--	2.0	7.7	62	.8	590	7.6	10
DEC											
04...	0930	2.5	4.0	--	1.0	13.2	96	.4	710	7.8	5.3

DATE	ALKALINITY FIELD (MG/L AS CACO3)	BICARBONATE FET-FLD (MG/L AS HCO3)	CARBONATE FET-FLD (MG/L AS CO3)	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)	SODIUM ADSORPTION RATIO	PERCENT SODIUM	SODIUM+POTASSIUM DISSOLVED (MG/L AS NA)
FEB , 1979											
13...	184	224	0	250	69	65	22	8.6	.2	7	--
24...	52	64	0	95	42	26	7.3	5.7	.3	11	--
MAR											
14...	161	196	0	230	74	61	20	10	.3	8	--
JUN											
06...	180	220	0	270	89	70	23	8.1	.2	6	--
JUL											
11...	139	170	0	220	77	57	18	9.1	.3	8	--
AUG											
09...	189	230	0	250	65	67	21	14	.4	11	16
SEP											
14...	46	56	0	63	18	17	5.1	2.6	.1	8	6.7
OCT											
03...	181	221	0	240	59	65	20	8.3	.2	7	10
NOV											
08...	205	250	0	270	67	71	23	10	.3	11	11
DEC											
04...	172	210	0	270	97	70	23	9.0	.2	10	10

DATE	POTASSIUM, DISSOLVED (MG/L AS K)	CHLORIDE, DISSOLVED (MG/L AS CL)	SULFATE DISSOLVED (MG/L AS SO4)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 105 DEG. C, SUSPENDED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L)	SOLIDS, DISSOLVED (TONS PER DAY)	SOLIDS, DISSOLVED (TONS PER AC-FT)	OIL AND GREASE, TOTAL RECOV. GRAVIMETRIC (MG/L)	NITROGEN, TOTAL (MG/L AS N)
FEB , 1979											
13...	1.5	24	49	7.2	2	318	288	2.1	.43	0	4.7
24...	2.9	18	24	4.5	144	152	120	26.1	.21	0	5.4
MAR											
14...	1.8	27	49	5.6	--	298	271	2.9	.41	0	4.9
JUN											
06...	1.8	26	48	6.6	16	305	292	2.5	.41	2	7.2
JUL											
11...	2.3	18	46	7.0	--	278	241	1.6	.38	1	3.0
AUG											
09...	2.3	36	37	7.4	--	356	298	1.7	.48	0	2.3
SEP											
14...	4.1	8.0	21	4.4	237	113	90	45.2	.15	2	2.6
OCT											
03...	2.1	21	42	9.5	--	287	277	3.5	.39	1	3.7
NOV											
08...	1.4	24	43	5.8	--	330	301	1.5	.45	0	2.7
DEC											
04...	1.4	22	45	8.0	--	318	282	2.3	.43	0	3.8

DATE	NITROGEN, ORGANIC TOTAL (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, NITRITE TOTAL (MG/L AS N)	NITROGEN, NITRATE TOTAL (MG/L AS N)	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS NH4)	NITROGEN, TOTAL (MG/L AS NO3)	PHOSPHATE, TOTAL (MG/L AS PO4)	PHOSPHORUS, TOTAL (MG/L AS P)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P)
FEB , 1979											
13...	.47	.080	.020	4.1	.55	4.1	--	21	--	.010	.010
24...	1.0	.160	.020	4.2	1.20	4.2	--	24	--	.190	.070
MAR											
14...	.34	.020	.020	4.5	.36	4.5	--	22	--	.030	.010
JUN											
06...	.51	.050	.100	6.5	.56	6.6	.06	32	.09	.030	<.010
JUL											
11...	.58	.060	.020	2.4	.64	2.4	.07	13	.12	.070	.040
AUG											
09...	.37	.020	.020	1.9	.39	1.9	.02	10	.03	.030	.010
SEP											
14...	1.3	.050	.020	1.3	1.30	1.3	.06	12	.34	.250	.110
OCT											
03...	.32	.050	.030	3.3	.37	3.3	.06	16	.06	.040	.020
NOV											
08...	.27	.000	.020	2.4	.27	2.4	.00	12	.00	.010	.000
DEC											
04...	.38	.090	.010	3.3	.47	3.3	.11	17	.03	.020	.010

Appendix 4.--Physical, chemical, and bacteria data for Indian Run at site S_4, 1979.--Continued

WATER QUALITY DATA

DATE	PHOS-PHORUS TOTAL (MG/L AS PO4)	CARBON, ORGANIC TOTAL (MG/L AS C)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG)	ARSENIC TOTAL (UG/L AS AS)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN)	NICKEL, TOTAL RECOV-ERABLE (UG/L AS NI)
FEB , 1979											
13...	--	6.8	--	--	--	--	--	220	--	140	--
24...	--	5.5	--	--	--	--	--	4500	--	130	--
MAR											
14...	--	3.4	--	--	--	--	--	300	--	60	--
JUN											
06...	.09	6.5	<.5	1	6	20	4	610	60	50	20
JUL											
11...	.21	5.4	--	--	--	--	--	1700	--	70	--
AUG											
09...	.09	5.6	--	--	--	--	--	320	--	40	--
SEP											
14...	.77	9.3	<.5	5	ND	20	11	7000	8	170	10
OCT											
03...	.12	5.2	--	--	--	--	--	770	--	60	--
NOV											
08...	.03	4.2	--	--	--	--	--	180	--	40	--
DEC											
04...	.06	2.3	--	--	--	--	--	190	--	90	--

DATE	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN)	ALDRIN, TOTAL (UG/L)	ALDRIN, DIS-SOLVED (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)	CHLOR-DANE, DIS-SOLVED (UG/L)	DDD, TOTAL (UG/L)	DDD, DIS-SOLVED (UG/L)	DDD, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDE, TOTAL (UG/L)
FEB , 1979											
13...	--	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--	--
MAR											
14...	--	--	--	--	--	--	--	--	--	--	--
JUN											
06...	<20	--	.00	.0	--	1.0	.00	--	.00	.2	--
JUL											
11...	--	--	--	--	--	--	--	--	--	--	--
AUG											
09...	--	--	--	--	--	--	--	--	--	--	--
SEP											
14...	30	.00	--	.0	.00	8.0	--	.00	--	.5	.00
OCT											
03...	--	--	--	--	--	--	--	--	--	--	--
NOV											
08...	--	--	--	--	--	--	--	--	--	--	--
DEC											
04...	--	--	--	--	--	--	--	--	--	--	--

DATE	DDE, DIS-SOLVED (UG/L)	DDE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDT, TOTAL (UG/L)	DDT, DIS-SOLVED (UG/L)	DDT, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DI-ELDRIN TOTAL (UG/L)	DI-ELDRIN DIS-SOLVED (UG/L)	DI-ELDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, DIS-SOLVED (UG/L)
FEB , 1979										
13...	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--
MAR										
14...	--	--	--	--	--	--	--	--	--	--
JUN										
06...	.00	.2	--	.00	.0	--	.00	.0	--	.00
JUL										
11...	--	--	--	--	--	--	--	--	--	--
AUG										
09...	--	--	--	--	--	--	--	--	--	--
SEP										
14...	--	.4	.00	--	1.4	.01	--	4.1	.00	--
OCT										
03...	--	--	--	--	--	--	--	--	--	--
NOV										
08...	--	--	--	--	--	--	--	--	--	--
DEC										
04...	--	--	--	--	--	--	--	--	--	--

DATE	ENDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L)	HEPTA-CHLOR EPOXIDE DIS-SOLVED (UG/L)	HEPTA-CHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	PCB, TOTAL (UG/L)	PCB, DIS-SOLVED (UG/L)	DI-AZINON, TOTAL (UG/L)	DI-AZINON, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DI-AZINON, DIS-SOLVED (UG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./100 ML)
FEB , 1979										
13...	--	--	--	--	--	--	--	--	--	37
24...	--	--	--	--	--	--	--	--	--	400
MAR										
14...	--	--	--	--	--	--	--	--	--	320
JUN										
06...	.0	--	.00	.0	--	.0	--	.0	.00	960
JUL										
11...	--	--	--	--	--	--	--	--	--	550
AUG										
09...	--	--	--	--	--	--	--	--	--	800
SEP										
14...	.0	.01	--	.7	.00	--	.00	.0	--	27000
OCT										
03...	--	--	--	--	--	--	--	--	--	1900
NOV										
08...	--	--	--	--	--	--	--	--	--	160
DEC										
04...	--	--	--	--	--	--	--	--	--	160

Appendix 5.--Physical, chemical, and bacteria data for Indian Run at site S_2, 1979

WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C)	TEMPERATURE, AIR (DEG C)	TURBIDITY (JTU)	TURBIDITY (NTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN, DISSOLVED (PERCENT SATURATION)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2)
FEB , 1979											
13...	1115	1.0	-6.0	--	--	14.4	100	2.3	440	8.0	2.9
24...	1230	1.0	6.5	--	--	14.2	100	2.7	260	7.0	13
MAR											
14...	1400	5.0	5.0	25	--	13.0	100	.1	390	8.2	1.5
JUN											
07...	1300	24.0	--	--	4.0	9.4	110	.6	503	8.6	.7
JUL											
11...	1100	23.0	--	--	4.0	8.0	92	.6	547	8.1	2.8
AUG											
08...	1330	27.5	--	--	2.0	7.8	98	3.1	375	8.6	.6
29...	1530	21.0	--	--	60	8.6	96	.5	260	6.9	19
SEP											
14...	1530	19.5	--	--	60	8.6	92	2.4	210	7.5	5.1
OCT											
03...	1300	16.0	16.5	--	10	10.1	100	.6	360	7.2	14
NOV											
08...	1100	8.0	5.5	--	3.0	6.8	57	.3	470	7.8	5.3
DEC											
04...	1100	5.0	4.0	--	5.0	15.2	120	1.1	650	7.7	6.1

DATE	ALKALINITY FIELD (MG/L AS CACO3)	BICARBONATE FET-FLD (MG/L AS HCO3)	CARBONATE FET-FLD (MG/L AS CO3)	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)	SODIUM ADSORPTION RATIO	PERCENT SODIUM	SODIUM+POTASSIUM DISSOLVED (MG/L AS NA)
FEB , 1979											
13...	151	184	0	220	68	58	18	9.2	.3	8	--
24...	69	84	0	100	35	28	8.3	7.0	.3	12	--
MAR											
14...	125	152	0	180	54	47	15	7.6	.2	8	--
JUN											
07...	142	157	8	220	80	56	20	8.4	.2	8	--
JUL											
11...	180	220	0	260	78	69	21	11	.3	8	13
AUG											
08...	122	120	14	160	34	41	13	6.1	.2	8	9.4
29...	75	92	0	110	36	31	8.3	4.0	.2	7	7.3
SEP											
14...	82	100	0	110	26	29	8.6	3.7	.2	7	7.7
OCT											
03...	112	136	0	150	38	42	12	5.1	.2	7	9.0
NOV											
08...	172	210	0	210	42	56	18	8.1	.2	11	11
DEC											
04...	156	190	0	200	41	54	15	5.4	.2	8	8.5

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	SULFATE DIS-SOLVED (MG/L AS SO4)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 105 DEG. C, SUS-PENDED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, DIS-SOLVED (TONS PER DAY)	SOLIDS, DIS-SOLVED (TONS PER AC-FT)	OIL AND GREASE, TOTAL RECOV. GRAVI-METRIC (MG/L)	NITRO-GEN, TOTAL (MG/L AS N)
FEB , 1979											
13...	2.2	25	47	6.6	4	287	257	2.8	.39	0	4.7
24...	2.5	17	26	4.4	104	160	135	45.1	.22	0	4.2
MAR											
14...	2.2	20	40	5.9	--	214	213	3.7	.29	0	3.8
JUN											
07...	2.3	23	46	2.5	12	277	244	2.5	.38	2	5.3
JUL											
11...	1.9	27	53	7.9	--	326	299	2.5	.44	0	5.1
AUG											
08...	3.3	14	33	5.4	--	213	189	2.0	.29	0	2.6
29...	3.3	8.9	19	4.6	9	136	124	25.1	.19	1	2.2
SEP											
14...	4.0	11	18	3.8	93	163	127	--	.22	0	1.9
OCT											
03...	3.9	13	28	7.0	--	191	178	6.7	.26	0	2.9
NOV											
08...	2.4	18	39	4.2	--	288	249	2.4	.39	0	1.9
DEC											
04...	3.1	19	40	4.8	--	275	235	3.7	.37	0	3.1

DATE	NITRO-GEN, ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N)	NITRO-GEN, NITRITE TOTAL (MG/L AS N)	NITRO-GEN, NITRATE TOTAL (MG/L AS N)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N)	NITRO-GEN, NO2+NO3 TOTAL (MG/L AS N)	NITRO-GEN, AMMONIA TOTAL (MG/L AS NH4)	NITRO-GEN, TOTAL (MG/L AS NO3)	PHOS-PHATE, TOTAL (MG/L AS PO4)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, ORTHO, TOTAL (MG/L AS P)
FEB , 1979											
13...	.74	.090	.020	3.9	.83	3.9	--	21	--	.030	.020
24...	.82	.180	.020	3.2	1.00	3.2	--	19	--	.140	.060
MAR											
14...	.33	.130	.030	3.3	.46	3.3	--	17	--	.050	.020
JUN											
07...	.54	.060	.080	4.6	.60	4.7	.07	23	.06	.020	<.010
JUL											
11...	.51	.080	.050	4.5	.59	4.5	.10	23	.12	.040	.040
AUG											
08...	.83	.130	.030	1.6	.96	1.6	.16	11	.00	.040	<.010
29...	.40	.280	<.010	1.5	.68	1.5	.34	9.7	.34	.140	.110
SEP											
14...	.86	.100	.040	.89	.96	.93	.12	8.4	.12	.130	.040
OCT											
03...	.50	.220	.060	2.1	.72	2.2	.27	13	.09	.070	.030
NOV											
08...	.30	.050	.030	1.5	.35	1.5	.06	8.2	.00	.020	.000
DEC											
04...	.70	.090	.040	2.3	.79	2.3	.11	14	.09	.040	.030

Appendix 5.--Physical, chemical, and bacteria data for Indian Run at site S_2, 1979.--Continued

WATER QUALITY DATA

DATE	PHOSPHORUS TOTAL (MG/L AS PO4)	CARBON, ORGANIC TOTAL (MG/L AS C)	MERCURY TOTAL RECOVERABLE (UG/L AS HG)	ARSENIC TOTAL (UG/L AS AS)	CADMIUM TOTAL RECOVERABLE (UG/L AS CD)	CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR)	COPPER, TOTAL RECOVERABLE (UG/L AS CU)	IRON, TOTAL RECOVERABLE (UG/L AS FE)	LEAD, TOTAL RECOVERABLE (UG/L AS PB)	MANGANESE, TOTAL RECOVERABLE (UG/L AS MN)	NICKEL, TOTAL RECOVERABLE (UG/L AS NI)
FEB , 1979											
13...	--	2.9	--	--	--	--	--	250	--	90	--
24...	--	4.9	--	--	--	--	--	4700	--	150	--
MAR											
14...	--	5.9	--	--	--	--	--	1200	--	120	--
JUN											
07...	.06	6.5	<.5	1	17	20	4	350	200	70	19
JUL											
11...	.12	4.8	--	--	--	--	--	470	--	50	--
AUG											
08...	.12	6.3	--	--	--	--	--	230	--	90	--
29...	.43	11	<.5	2	ND	<20	8	3200	ND	90	10
SEP											
14...	.40	8.8	<.5	3	ND	20	8	4300	3	160	7
OCT											
03...	.21	8.9	--	--	--	--	--	530	--	120	--
NOV											
08...	.06	5.6	--	--	--	--	--	180	--	40	--
DEC											
04...	.12	4.4	--	--	--	--	--	360	--	70	--

DATE	ZINC, TOTAL RECOVERABLE (UG/L AS ZN)	ALDRIN, TOTAL (UG/L)	ALDRIN, DISSOLVED (UG/L)	ALDRIN, TOTAL IN BOTTOM MATERIAL (UG/KG)	CHLORDANE, TOTAL (UG/L)	CHLORDANE, TOTAL IN BOTTOM MATERIAL (UG/KG)	CHLORDANE, DISSOLVED (UG/L)	DDD, TOTAL (UG/L)	DDD, DISSOLVED (UG/L)	DDD, TOTAL IN BOTTOM MATERIAL (UG/KG)	DDE, TOTAL (UG/L)
FEB , 1979											
13...	--	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--	--
MAR											
14...	--	--	--	--	--	--	--	--	--	--	--
JUN											
07...	20	--	.00	.0	--	5.0	.00	--	.00	.0	--
JUL											
11...	--	--	--	--	--	--	--	--	--	--	--
AUG											
08...	--	--	--	--	--	--	--	--	--	--	--
29...	20	--	.00	.0	--	.0	.00	--	.00	.0	--
SEP											
14...	20	.00	--	.0	.00	2.0	--	.00	--	.2	.00
OCT											
03...	--	--	--	--	--	--	--	--	--	--	--
NOV											
08...	--	--	--	--	--	--	--	--	--	--	--
DEC											
04...	--	--	--	--	--	--	--	--	--	--	--

DATE	DDE, DIS-SOLVED (UG/L)	DDE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDT, TOTAL (UG/L)	DDT, DIS-SOLVED (UG/L)	DDT, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DI-ELDRIN TOTAL (UG/L)	DI-ELDRIN DIS-SOLVED (UG/L)	DI-ELDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, DIS-SOLVED (UG/L)
FEB , 1979										
13...	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--
MAR										
14...	--	--	--	--	--	--	--	--	--	--
JUN										
07...	.00	.0	--	.00	.0	--	.00	5.7	--	.00
JUL										
11...	--	--	--	--	--	--	--	--	--	--
AUG										
08...	--	--	--	--	--	--	--	--	--	--
29...	.00	.0	--	.00	.0	--	.01	.8	--	.00
SEP										
14...	--	.2	.00	--	.3	.01	--	.0	.00	--
OCT										
03...	--	--	--	--	--	--	--	--	--	--
NOV										
08...	--	--	--	--	--	--	--	--	--	--
DEC										
04...	--	--	--	--	--	--	--	--	--	--

DATE	ENDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L)	HEPTA-CHLOR EPOXIDE DIS-SOLVED (UG/L)	HEPTA-CHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	PCB, TOTAL (UG/L)	PCB, DIS-SOLVED (UG/L)	DI-AZINON, TOTAL (UG/L)	DI-AZINON, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DI-AZINON, DIS-SOLVED (UG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./100 ML)
FEB , 1979										
13...	--	--	--	--	--	--	--	--	--	K10
24...	--	--	--	--	--	--	--	--	--	310
MAR										
14...	--	--	--	--	--	--	--	--	--	100
JUN										
07...	.0	--	.00	2.4	--	.0	--	.0	.00	560
JUL										
11...	--	--	--	--	--	--	--	--	--	66
AUG										
08...	--	--	--	--	--	--	--	--	--	K24
29...	.0	--	.01	.0	--	.0	--	.0	.00	--
SEP										
14...	.0	.00	--	.0	.00	--	.00	.0	--	10000
OCT										
03...	--	--	--	--	--	--	--	--	--	100
NOV										
08...	--	--	--	--	--	--	--	--	--	K12
DEC										
04...	--	--	--	--	--	--	--	--	--	140

Appendix 6.--Physical, chemical, and bacteria data for Little Rush Creek at site S_1, 1979

WATER QUALITY DATA

DATE	TIME	TEMPERATURE (DEG C)	TEMPERATURE, AIR (DEG C)	TURBIDITY (NTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN, DISSOLVED (PERCENT SATURATION)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2)	ALKALINITY FIELD (MG/L AS CACO3)
FEB , 1979											
14...	1145	.5	-7.0	--	13.2	92	2.0	500	8.1	2.6	167
24...	1415	1.5	7.5	--	--	--	1.6	217	6.6	26	52
MAR											
14...	1530	6.0	6.0	10	12.0	96	.1	360	8.3	1.5	153
JUN											
07...	1000	20.5	--	6.0	8.6	94	.4	540	7.6	8.8	180
JUL											
11...	0930	19.5	21.5	2.0	7.8	84	2.4	425	8.0	3.4	172
AUG											
08...	1145	24.5	--	4.0	8.4	100	.3	462	7.9	4.6	189
29...	1300	20.5	--	125	8.5	93	2.7	240	6.9	20	82
SEP											
14...	1130	18.5	--	170	8.2	87	3.8	160	6.6	19	39
OCT											
04...	1130	14.0	13.5	10	8.6	83	1.4	465	7.4	12	161
NOV											
07...	1030	6.5	--	1.0	7.6	62	.2	550	7.8	6.1	197
DEC											
04...	1230	2.0	6.5	1.0	15.4	110	.3	585	7.6	8.8	180

DATE	BICARBONATE FET-FLD (MG/L AS HCO3)	CARBONATE FET-FLD (MG/L AS CO3)	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)	SODIUM ADSORPTION RATIO	PERCENT SODIUM	SODIUM+POTASSIUM DISSOLVED (MG/L AS NA)	POTASSIUM, DISSOLVED (MG/L AS K)
FEB , 1979											
14...	204	0	230	65	60	20	8.1	.2	7	--	1.4
24...	64	0	88	36	24	6.9	4.1	.2	9	--	2.8
MAR											
14...	180	3	220	65	56	19	7.7	.2	7	--	1.5
JUN											
07...	220	0	260	77	67	22	8.1	.2	6	--	1.7
JUL											
11...	210	0	190	16	49	16	7.3	.2	8	--	2.9
AUG											
08...	230	0	240	49	62	20	8.8	.2	7	11	2.4
29...	100	0	130	51	37	9.9	4.1	.2	6	8.2	4.1
SEP											
14...	48	0	62	22	17	4.7	2.1	.1	6	7.6	5.5
OCT											
04...	196	0	220	59	58	18	8.6	.3	8	11	2.3
NOV											
07...	240	0	250	57	67	21	8.7	.2	10	10	1.6
DEC											
04...	220	0	230	50	60	20	9.7	.3	12	11	1.5

DATE	CHLORIDE, DISSOLVED (MG/L AS CL)	SULFATE DISSOLVED (MG/L AS SO4)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 105 DEG. C, SUSPENDED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L)	SOLIDS, DISSOLVED (TONS PER DAY)	SOLIDS, DISSOLVED (TONS PER AC-FT)	OIL AND GREASE, TOTAL RECOV. GRAVIMETRIC (MG/L)	NITROGEN, TOTAL (MG/L AS N)	NITROGEN, ORGANIC TOTAL (MG/L AS N)
FEB , 1979											
14...	17	51	7.8	0	289	266	13.3	.39	0	3.9	.35
24...	11	24	5.3	622	158	110	201	.21	0	4.9	1.2
MAR											
14...	18	48	6.0	--	255	248	17.9	.35	0	4.3	.70
JUN											
07...	20	48	7.2	23	304	282	14.0	.41	2	5.5	.50
JUL											
11...	17	36	3.3	--	238	235	7.0	.32	0	5.4	.89
AUG											
08...	18	40	8.1	--	308	273	5.7	.42	0	1.9	.22
29...	7.2	20	7.8	8	144	139	152	.20	2	2.9	.76
SEP											
14...	6.0	13	5.0	421	100	77	321	.14	0	2.8	1.7
OCT											
04...	17	41	11	--	267	252	27.5	.36	0	.83	.50
NOV											
07...	18	45	5.1	--	307	285	9.9	.42	0	2.2	.23
DEC											
04...	17	45	8.3	--	296	270	18.4	.40	0	3.2	.19

DATE	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, NITRITE TOTAL (MG/L AS N)	NITROGEN, NITRATE TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS NH4)	NITROGEN, TOTAL (MG/L AS NO3)	PHOSPHATE, TOTAL (MG/L AS PO4)	PHOSPHORUS, TOTAL (MG/L AS P)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P)	PHOSPHORUS TOTAL (MG/L AS PO4)
FEB , 1979											
14...	.010	.010	3.5	.36	3.5	--	17	--	.010	.010	--
24...	.160	.030	3.5	1.40	3.5	--	22	--	.330	.060	--
MAR											
14...	<.010	.010	3.6	.70	3.6	--	19	--	.020	<.010	--
JUN											
07...	.040	.060	4.9	.54	5.0	.05	25	.12	.040	.010	.12
JUL											
11...	.090	.180	4.2	.98	4.4	.11	24	.09	.030	.030	.09
AUG											
08...	.010	<.010	1.7	.23	1.7	.01	8.5	.03	.040	.010	.12
29...	.070	<.010	2.1	.83	2.1	.08	13	.37	.220	.120	.67
SEP											
14...	.050	.030	1.1	1.70	1.1	.06	12	.37	.310	.120	.95
OCT											
04...	.040	.010	.28	.54	.29	.05	3.7	.06	.030	.020	.09
NOV											
07...	.010	.010	2.0	.24	2.0	.01	9.9	.03	.010	.010	.03
DEC											
04...	.100	.000	2.9	.29	2.9	.12	14	.00	.010	.000	.03

Appendix 6.--Physical, chemical, and bacteria data for Little Rush Creek at site S_1, 1979.--Continued

WATER QUALITY DATA

DATE	CARBON, ORGANIC TOTAL (MG/L AS C)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG)	ARSENIC TOTAL (UG/L AS AS)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN)	NICKEL, TOTAL RECOV-ERABLE (UG/L AS NI)	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN)
FEB , 1979											
14...	2.6	--	--	--	--	--	150	--	70	--	--
24...	13	--	--	--	--	--	16000	--	450	--	--
MAR											
14...	2.8	--	--	--	--	--	410	--	40	--	--
JUN											
07...	2.8	<.5	1	9	20	6	800	<200	50	18	20
JUL											
11...	9.0	--	--	--	--	--	250	--	60	--	--
AUG											
08...	4.4	--	--	--	--	--	360	--	30	--	--
29...	12	<.5	5	2	20	<20	8900	6	290	16	30
SEP											
14...	13	<.5	5	<2	20	17	13000	11	370	17	70
OCT											
04...	1.7	--	--	--	--	--	1700	--	30	--	--
NOV											
07...	3.8	--	--	--	--	--	150	--	10	--	--
DEC											
04...	2.1	--	--	--	--	--	200	--	80	--	--

DATE	ALDRIN, TOTAL (UG/L)	ALDRIN, DIS-SOLVED (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)	CHLOR-DANE, DIS-SOLVED (UG/L)	DDD, TOTAL (UG/L)	DDD, DIS-SOLVED (UG/L)	DDD, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDE, TOTAL (UG/L)
FEB , 1979										
14...	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--
MAR										
14...	--	--	--	--	--	--	--	--	--	--
JUN										
07...	--	.00	1.3	--	6.0	.00	--	.00	.0	--
JUL										
11...	--	--	--	--	--	--	--	--	--	--
AUG										
08...	--	--	--	--	--	--	--	--	--	--
29...	--	.00	.0	--	.0	.00	--	.00	.0	--
SEP										
14...	.00	--	.0	.00	.0	--	.00	--	.0	.00
OCT										
04...	--	--	--	--	--	--	--	--	--	--
NOV										
07...	--	--	--	--	--	--	--	--	--	--
DEC										
04...	--	--	--	--	--	--	--	--	--	--

DATE	DDE, DIS- SOLVED (UG/L)	DDE, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	DDT, TOTAL (UG/L)	DDT, DIS- SOLVED (UG/L)	DDT, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	DI- ELDRIN TOTAL (UG/L)	DI- ELDRIN DIS- SOLVED (UG/L)	DI- ELDRIN, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, DIS- SOLVED (UG/L)
FEB , 1979										
14...	--	--	--	--	--	--	--	--	--	--
24...	--	--	--	--	--	--	--	--	--	--
MAR										
14...	--	--	--	--	--	--	--	--	--	--
JUN										
07...	.00	.2	--	.00	.0	--	.00	7.7	--	.00
JUL										
11...	--	--	--	--	--	--	--	--	--	--
AUG										
08...	--	--	--	--	--	--	--	--	--	--
29...	.00	.0	--	.00	.0	--	.01	.0	--	.00
SEP										
14...	--	.0	.00	--	.0	.01	--	.2	.00	--
OCT										
04...	--	--	--	--	--	--	--	--	--	--
NOV										
07...	--	--	--	--	--	--	--	--	--	--
DEC										
04...	--	--	--	--	--	--	--	--	--	--

DATE	ENDRIN, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	HEPTA- CHLOR EPOXIDE TOTAL (UG/L)	HEPTA- CHLOR EPOXIDE DIS- SOLVED (UG/L)	HEPTA- CHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	PCB, TOTAL (UG/L)	PCB, DIS- SOLVED (UG/L)	DI- AZINON, TOTAL (UG/L)	DI- AZINON, TOTAL IN BOT- TOM MA- TERIAL (UG/KG)	DI- AZINON, DIS- SOLVED (UG/L)	COLI- FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML)
FEB , 1979										
14...	--	--	--	--	--	--	--	--	--	240
24...	--	--	--	--	--	--	--	--	--	590
MAR										
14...	--	--	--	--	--	--	--	--	--	30
JUN										
07...	.0	--	.00	.7	--	.0	--	.0	.00	74
JUL										
11...	--	--	--	--	--	--	--	--	--	1200
AUG										
08...	--	--	--	--	--	--	--	--	--	140
29...	.0	--	.00	.0	--	.0	.00	.0	.00	--
SEP										
14...	.0	.00	--	.0	.00	--	.00	.0	--	86000
OCT										
04...	--	--	--	--	--	--	--	--	--	630
NOV										
07...	--	--	--	--	--	--	--	--	--	78
DEC										
04...	--	--	--	--	--	--	--	--	--	40

Appendix 7.--Physical, chemical, and bacteria data for reservoir VI-D at site L_3, 1979

WATER QUALITY DATA

DATE	TIME	SAMPLING DEPTH (FT)	TEMPERATURE (DEG C)	TEMPERATURE, AIR (DEG C)	TURBIDITY (JTU)	TURBIDITY (NTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN, DISSOLVED (PERCENT SATURATION)	OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	SPECIFIC CONDUCTANCE (UMHOS)	PH (UNITS)
MAR , 1979											
13...	1100	2.0	4.5	--	25	--	10.0	77	.5	390	7.6
13...	1130	18	4.5	--	25	--	10.0	77	.7	405	7.7
APR											
24...	1230	2.0	16.5	22.0	--	15	9.2	94	1.4	405	8.6
24...	1300	18	9.5	23.0	--	20	7.5	83	.4	475	8.6
JUN											
05...	1145	2.0	24.0	--	--	4.0	8.9	100	1.4	402	8.2
05...	1215	18	9.0	--	--	4.0	3.2	27	1.3	550	7.1
JUL											
12...	1145	2.0	24.0	--	--	3.0	10.0	120	.5	405	8.5
12...	1155	18	12.0	--	--	5.0	2.4	20	2.6	520	6.9
AUG											
07...	1045	2.0	26.5	--	--	2.0	10.4	130	5.1	370	8.8
07...	1115	18	13.0	--	--	2.0	.8	8	2.2	560	7.1
OCT											
05...	1130	2.0	15.5	12.0	--	10	6.6	66	.8	375	6.8
05...	1200	18	14.0	12.0	--	5.0	2.8	27	1.6	493	6.9
DEC											
05...	1000	2.0	3.5	--	--	5.0	12.8	96	1.4	446	8.2
05...	1015	18	3.5	--	--	5.0	13.2	99	.5	497	7.2

DATE	CARBON DIOXIDE DISSOLVED (MG/L AS CO2)	ALKALINITY FIELD (MG/L AS CACO3)	BICARBONATE FET-FLD (MG/L AS HCO3)	CARBONATE FET-FLD (MG/L AS CO3)	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)	SODIUM ADSORPTION RATIO	PERCENT SODIUM
MAR , 1979											
13...	5.6	115	140	0	170	55	45	14	7.6	.3	9
13...	4.5	115	140	0	170	53	44	14	7.7	.3	9
APR											
24...	.7	136	150	8	200	59	52	16	7.6	.2	8
24...	.7	153	170	8	190	37	50	16	7.4	.2	8
JUN											
05...	1.6	131	160	0	210	77	52	19	8.9	.3	8
05...	25	164	200	0	220	55	58	18	9.0	.3	8
JUL											
12...	.7	117	130	6	180	58	47	14	6.4	.2	7
12...	44	180	220	0	220	43	60	18	8.8	.3	8
AUG											
07...	.4	135	120	22	160	21	41	13	6.0	.2	8
07...	32	205	250	0	220	19	60	18	8.3	.2	7
OCT											
05...	37	118	144	0	160	42	43	12	4.5	.2	6
05...	41	167	204	--	210	43	57	16	7.4	.2	7
DEC											
05...	1.9	160	192	0	210	52	56	17	7.4	.2	10
05...	21	170	208	0	240	69	62	20	9.0	.3	11

DATE	SODIUM+ POTASSIUM DISSOLVED (MG/L AS NA)	POTASSIUM, DISSOLVED (MG/L AS K)	CHLORIDE, DISSOLVED (MG/L AS CL)	SULFATE DISSOLVED (MG/L AS SO4)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 105 DEG. C, SUSPENDED (MG/L)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L)	SOLIDS, DISSOLVED (TONS PER AC-FT)	OIL AND GREASE, TOTAL RECOV. GRAVIMETRIC (MG/L)	NITROGEN, TOTAL (MG/L AS N)
MAR , 1979											
13...	--	2.3	19	37	6.0	--	206	200	.28	1	3.7
13...	--	2.3	20	39	6.0	--	214	202	.29	0	3.8
APR											
24...	--	2.4	22	46	3.2	12	256	231	.35	0	3.9
24...	--	2.9	23	46	5.0	2	254	242	.35	0	4.2
JUN											
05...	--	2.3	22	45	2.2	7	258	230	.35	2	5.9
05...	--	2.6	24	44	5.1	17	284	259	.39	2	4.3
JUL											
12...	--	2.9	18	37	3.0	--	246	198	.33	0	5.4
12...	--	2.7	22	39	5.8	--	284	265	.39	0	3.6
AUG											
07...	9.3	3.3	14	32	5.6	--	252	196	.34	4	3.4
07...	11	3.0	20	33	6.2	--	334	272	.45	0	3.0
OCT											
05...	8.3	3.8	13	29	6.9	--	196	183	.27	0	2.7
05...	11	3.3	18	28	8.0	--	259	238	.35	0	2.9
DEC											
05...	11	3.2	20	40	6.0	--	265	244	.36	0	2.9
05...	11	2.4	21	43	7.2	--	297	267	.40	0	3.3

DATE	NITROGEN, ORGANIC TOTAL (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, NITRITE TOTAL (MG/L AS N)	NITROGEN, NITRATE TOTAL (MG/L AS N)	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS NH4)	NITROGEN, TOTAL (MG/L AS NO3)	PHOSPHATE, TOTAL (MG/L AS PO4)	PHOSPHORUS, TOTAL (MG/L AS P)	PHOSPHORUS, ORTHO, TOTAL (MG/L AS P)
MAR , 1979											
13...	.25	.150	.030	3.3	.40	3.3	--	16	--	.060	.020
13...	.30	.150	.030	3.3	.45	3.3	--	17	--	.060	.020
APR											
24...	.61	.020	.030	3.3	.63	3.3	.02	17	.12	.040	<.010
24...	.44	.200	.050	3.6	.64	3.6	.24	19	.12	.040	.020
JUN											
05...	.64	.060	.080	5.1	.70	5.2	.07	26	.06	.020	<.010
05...	.78	.620	.150	2.8	1.40	2.9	.75	19	.12	.040	<.010
JUL											
12...	.88	.120	.250	4.2	1.00	4.4	.15	24	.06	.030	.020
12...	.70	1.40	.220	1.3	2.10	1.5	1.7	16	.09	.040	.030
AUG											
07...	1.5	.150	.080	1.7	1.60	1.8	.18	15	.00	.070	<.010
07...	1.0	1.50	.030	.45	2.50	.48	1.8	13	.00	.050	<.010
OCT											
05...	.67	.310	.050	1.7	.98	1.7	.38	12	.06	.060	.020
05...	.60	1.90	.040	.38	2.50	.42	2.3	13	.03	.090	.010
DEC											
05...	.55	.170	.030	2.2	.72	2.2	.21	13	.28	.050	.090
05...	.30	.190	.020	2.8	.49	2.8	.23	15	.06	.030	.020

Appendix 7.--Physical, chemical, and bacteria data for reservoir VI-D at site L_3, 1979.--Continued

WATER QUALITY DATA

DATE	PHOS-PHORUS TOTAL (MG/L AS PO4)	CARBON, ORGANIC TOTAL (MG/L AS C)	MERCURY TOTAL RECOV-ERABLE (UG/L AS HG)	ARSENIC TOTAL (UG/L AS AS)	CADMIUM TOTAL RECOV-ERABLE (UG/L AS CD)	CHRO-MIUM, TOTAL RECOV-ERABLE (UG/L AS CR)	COPPER, TOTAL RECOV-ERABLE (UG/L AS CU)	IRON, TOTAL RECOV-ERABLE (UG/L AS FE)	LEAD, TOTAL RECOV-ERABLE (UG/L AS PB)	MANGA-NESE, TOTAL RECOV-ERABLE (UG/L AS MN)	NICKEL, TOTAL RECOV-ERABLE (UG/L AS NI)
MAR , 1979											
13...	--	4.4	--	--	--	--	--	1100	--	120	--
13...	--	4.4	--	--	--	--	--	1100	--	130	--
APR											
24...	.12	6.1	<.5	2	2	<20	2	440	26	30	16
24...	.12	3.2	<.5	1	6	<20	2	500	60	50	17
JUN											
05...	.06	5.7	<.5	<1	6	40	5	280	69	90	15
05...	.12	5.0	<.5	1	2	30	3	360	14	550	11
JUL											
12...	.09	8.6	--	--	--	--	--	120	--	40	--
12...	.12	5.3	--	--	--	--	--	940	--	1400	--
AUG											
07...	.21	11	--	--	--	--	--	140	--	50	--
07...	.15	7.2	--	--	--	--	--	320	--	2800	--
OCT											
05...	.18	6.2	--	--	--	--	--	540	--	230	--
05...	.28	5.3	--	--	--	--	--	450	--	4400	--
DEC											
05...	.15	10	--	--	--	--	--	300	--	70	--
05...	.09	4.3	--	--	--	--	--	370	--	120	--

DATE	ZINC, TOTAL RECOV-ERABLE (UG/L AS ZN)	ALDRIN, TOTAL (UG/L)	ALDRIN, DIS-SOLVED (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)	CHLOR-DANE, DIS-SOLVED (UG/L)	DDD, TOTAL (UG/L)	DDD, DIS-SOLVED (UG/L)	DDD, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDE, TOTAL (UG/L)
MAR , 1979											
13...	--	--	--	--	--	--	--	--	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--
APR											
24...	160	.00	.00	--	.00	--	.00	.00	.00	--	.00
24...	220	--	--	.0	--	26	--	--	--	.0	--
JUN											
05...	20	--	--	--	--	--	--	--	--	--	--
05...	30	--	.00	.0	--	7.0	.00	--	.00	2.1	--
JUL											
12...	--	--	--	--	--	--	--	--	--	--	--
12...	--	--	--	--	--	--	--	--	--	--	--
AUG											
07...	--	--	--	--	--	--	--	--	--	--	--
07...	--	--	--	--	--	--	--	--	--	--	--
OCT											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--
DEC											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--

DATE	DDE, DIS-SOLVED (UG/L)	DDE, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DDT, TOTAL (UG/L)	DDT, DIS-SOLVED (UG/L)	DDT, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DI-ELDRIN TOTAL (UG/L)	DI-ELDRIN DIS-SOLVED (UG/L)	DI-ELDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	ENDRIN, TOTAL (UG/L)	ENDRIN, DIS-SOLVED (UG/L)	ENDRIN, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)
MAR , 1979											
13...	--	--	--	--	--	--	--	--	--	--	--
13...	--	--	--	--	--	--	--	--	--	--	--
APR											
24...	.00	--	.00	.00	--	.02	.01	--	.00	.00	--
24...	--	.0	--	--	.0	--	--	.0	--	--	.5
JUN											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	.00	.0	--	.00	2.1	--	.00	.0	--	.00	.0
JUL											
12...	--	--	--	--	--	--	--	--	--	--	--
12...	--	--	--	--	--	--	--	--	--	--	--
AUG											
07...	--	--	--	--	--	--	--	--	--	--	--
07...	--	--	--	--	--	--	--	--	--	--	--
OCT											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--
DEC											
05...	--	--	--	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--	--	--	--

DATE	HEPTA-CHLOR EPOXIDE TOTAL (UG/L)	HEPTA-CHLOR EPOXIDE DIS-SOLVED (UG/L)	HEPTA-CHLOR EPOXIDE TOT. IN BOTTOM MATL. (UG/KG)	PCB, TOTAL (UG/L)	PCB, DIS-SOLVED (UG/L)	PCB, SUS-PENDED TOTAL (UG/L)	DI-AZINON, TOTAL (UG/L)	DI-AZINON, TOTAL IN BOT-TOM MA-TERIAL (UG/KG)	DI-AZINON, DIS-SOLVED (UG/L)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML)
MAR , 1979										
13...	--	--	--	--	--	--	--	--	--	12
13...	--	--	--	--	--	--	--	--	--	12
APR										
24...	.00	.00	--	.00	.0	.0	.00	--	.00	40
24...	--	--	.0	--	--	--	--	.0	--	12
JUN										
05...	--	--	--	--	--	--	--	--	--	K20
05...	--	.00	.0	--	.0	--	--	.0	.02	200
JUL										
12...	--	--	--	--	--	--	--	--	--	K25
12...	--	--	--	--	--	--	--	--	--	320
AUG										
07...	--	--	--	--	--	--	--	--	--	34
07...	--	--	--	--	--	--	--	--	--	220
OCT										
05...	--	--	--	--	--	--	--	--	--	K33
05...	--	--	--	--	--	--	--	--	--	K37
DEC										
05...	--	--	--	--	--	--	--	--	--	140
05...	--	--	--	--	--	--	--	--	--	180

Appendix 8.--Twenty-four hour profile data for site S_4, Indian Run above reservoir VI-D

Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)	Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)
		March 28-29, 1979					October 10-11, 1979		
1223	8.25	580	8.34	13.2	1335	11.0	490	7.70	--
1326	9.75	570	8.35	12.4	1445	11.0	490	7.80	--
1424	11.0	560	8.41	12.4	1555	11.5	495	8.00	10.2
1520	11.0	565	7.25	11.6	1750	11.5	500	7.65	9.4
1631	11.0	570	8.30	11.0	1850	11.0	490	7.60	9.3
1750	11.0	545	8.39	10.8	2015	10.5	485	7.45	9.5
1945	10.5	569	8.20	9.0	2215	9.8	525	7.70	9.8
2115	10.5	570	8.10	8.9	2400	9.8	520	7.60	10.2
2245	10.5	570	7.80	10.4	0215	9.5	515	7.50	10.4
0030	10.0	578	7.85	9.5	0400	9.5	510	7.60	10.8
0150	10.0	560	7.80	8.8	0630	9.5	510	7.50	10.2
0330	10.0	575	7.65	9.2	0800	9.5	510	7.60	10.2
0450	10.0	590	7.60	8.2	0940	9.0	500	7.40	9.2
0631	10.0	590	7.80	9.4	1200	10.0	490	7.90	10.0
0730	10.5	590	7.60	9.6	1315	10.5	790	7.90	8.6
0900	11.0	575	7.90	10.0					
1025	12.0	570	8.20	12.0					
1137	13.0	565	8.30	13.0					

Appendix 9.--Twenty-four hour profile data for site L_3, at 2 feet, reservoir VI-D

Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)	Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)
		March 28-29, 1979					October 10-11, 1979		
1156	7.0	400	7.95	14.4	1303	12.5	355	7.10	--
1304	7.0	410	7.82	12.2	1426	12.5	410	7.50	6.0
1425	7.0	422	8.05	11.8	1615	12.5	430	7.50	7.4
1520	7.1	427	7.99	12.2	1730	12.5	430	7.25	7.8
1635	7.1	430	7.75	--	1850	12.5	405	7.30	7.6
1800	7.2	439	7.80	11.8	2010	11.5	430	7.20	9.0
1920	7.2	430	7.75	10.8	2210	12.0	405	7.30	6.4
2050	7.3	428	7.82	12.6	2400	11.5	410	7.40	6.9
2245	7.0	430	7.92	12.2	0200	11.5	410	7.40	8.0
0020	7.0	425	7.85	12.4	0400	11.5	415	7.45	7.5
0145	7.0	428	7.95	12.4	0615	11.5	415	7.50	6.7
0320	7.5	428	7.80	12.4	0800	11.5	440	7.30	6.5
0450	7.5	430	7.85	12.6	0950	12.0	450	7.30	5.6
0630	7.5	430	7.80	12.4	1130	12.0	430	7.30	3.4
0730	7.0	430	7.85	12.2	1250	12.0	420	7.60	4.6
0900	6.5	420	7.80	12.2					
1030	7.5	430	7.80	12.4					
1145	8.0	400	8.00	12.2					

Appendix 10.--Twenty-four hour profile data for site L_3, at 18 feet, reservoir VI-D

Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)	Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)
March 28-29, 1979					October 10-11, 1979				
1156	6.5	435	8.01	13.4	1307	12.0	525	7.40	--
1304	6.0	440	7.90	11.7	1436	12.0	520	7.45	--
1425	6.5	440	7.95	12.6	1610	12.0	520	7.60	3.3
1520	6.1	444	7.79	13.2	1736	12.0	520	7.20	3.8
1635	6.1	442	7.89	11.4	1854	12.0	470	7.30	4.4
1800	6.0	440	7.81	11.2	2010	12.0	520	7.10	4.0
1920	6.1	439	7.92	12.0	2210	12.0	500	7.40	1.6
2053	6.2	431	7.95	11.4	0005	12.0	500	7.40	--
2245	6.5	430	7.91	10.6	0205	12.0	500	7.45	1.9
0020	6.5	430	7.85	11.0	0405	12.0	500	7.50	1.8
0145	6.0	440	7.70	10.0	0620	12.0	500	7.45	1.8
0320	6.0	440	7.85	10.6	0805	11.5	515	7.40	1.6
0450	6.0	450	7.80	10.4	0955	11.5	525	7.80	1.6
0635	6.0	440	7.80	9.8	1120	11.5	495	7.35	1.7
0730	6.0	440	7.50	10.2	1255	11.5	510	7.70	1.8
0900	6.0	435	7.80	10.5					
1030	6.3	440	7.80	10.4					
1145	6.5	430	7.75	10.8					

Appendix 11.--Twenty-four hour profile data for site S_2, Indian Run below reservoir VI-D

Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)	Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)
March 28-29, 1979					October 10-11, 1979				
1215	8.75	465	8.29	12.6	1330	12.5	380	7.60	--
1321	9.5	460	8.21	13.6	1440	12.5	370	7.55	--
1433	9.25	465	8.21	13.4	1606	12.5	450	7.70	9.3
1526	8.75	430	7.56	12.0	1745	12.0	370	7.55	9.1
1642	8.0	480	8.10	12.4	1915	12.0	370	7.30	8.7
1756	8.0	475	8.10	12.0	2020	11.5	370	7.30	9.1
1955	7.5	480	8.15	12.8	2225	10.3	397	7.71	9.8
2120	8.2	480	7.90	11.4	0025	10.5	460	7.60	10.2
2250	8.1	485	7.85	11.4	0220	10.5	440	7.55	10.4
0040	8.0	470	7.80	11.2	0430	11.5	380	7.55	11.4
0200	8.0	480	7.80	11.1	0645	11.5	380	7.50	9.7
0340	8.5	485	7.70	12.2	0815	11.5	380	7.50	9.4
0505	8.0	480	7.80	11.2	1040	12.0	360	7.50	7.5
0640	8.75	460	7.90	11.6	1140	12.0	370	7.65	7.7
0738	8.5	485	7.70	10.8	1310	12.0	390	7.80	7.8
0906	8.75	470	8.00	12.4					
1031	9.0	465	8.10	12.4					
1141	9.5	480	8.20	13.2					

Appendix 12.--Twenty-four hour profile data for site S_1, Little Rush Creek near Rushville, Ohio

Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)	Time	Temperature (°C)	Specific conductance (micromhos)	pH (units)	Dissolved oxygen (mg/L)
		March 28-29, 1979					October 10-11, 1979		
1155	6.75	465	8.21	14.8	1315	11.5	430	7.70	--
1310	8.00	480	8.18	13.2	1430	11.5	450	7.70	--
1439	8.5	480	8.20	13.8	1615	10.5	440	7.80	9.5
1534	8.5	480	8.20	13.6	1735	10.5	430	7.60	10.2
1653	8.0	480	8.20	14.2	1905	10.0	430	7.25	9.1
1809	8.0	480	8.17	13.2	2030	9.75	420	7.40	9.4
2000	8.0	480	7.90	11.4	2240	9.5	464	7.75	11.2
2130	7.6	490	8.10	12.6	0015	9.5	450	7.60	11.4
2305	7.8	485	7.91	12.4	0230	9.5	440	7.60	9.8
0050	7.5	490	7.90	12.6	0415	9.5	450	7.70	11.4
0215	7.9	490	7.90	11.6	0635	9.5	450	7.60	11.2
0355	8.0	500	8.00	11.6	0820	9.0	450	7.75	10.2
0510	8.5	495	8.05	11.6	1035	9.0	450	7.50	10.2
0650	8.5	495	8.10	12.4	1150	10.0	430	7.80	12.5
0742	8.5	500	7.80	11.0	1300	9.5	450	7.90	10.4
0911	9.0	520	8.10	12.4					
1036	10.0	520	8.00	13.1					
1148	10.5	520	8.30	13.2					

Appendix 13.--Benthic organism data for Little Rush Creek at site S_1, 1979

Organism (common name)	Sample count			
	Date samplers were removed			
	May 3	July 11	Nov. 7	Dec. 4
Annelida				
Oligochaeta (aquatic earthworm)	4	--	--	--
Arthropoda				
Insecta				
Coleoptera (beetles)				
Elmidae (riffle beetles)	--	1	--	--
Diptera				
Ceratopogonidae (biting midge)	2	--	--	--
Chironomidae (midges)	263	119	7	272
Ephemeroptera (mayflies)				
Baetidae	3	--	--	12
Heptageniidae	--	53		4
Leptophlediidae	1	--	--	--
Odonata (dragonflies)				
Agriidae	1	--	--	--
Plecoptera (stoneflies)				
Nemouridae	--	--	--	4
Trichoptera (caddisflies)				
Hydropsychidae	1	--	--	--
Polycentropodidae	--	3	--	--
Mollusca				
Gastropoda (snails)				
Ancylidae (fresh-water limpet)	--	7	--	--
Lymnaeidae	--	--	1	--
Nematoda (nematodes)	2	--	--	--
Total count	277	183	8	292
Diversity index (genera)	3.2	3.4	1.06	2.94
Total biomass (wet weight, g/m^2)	0.7	2.1	--	0.74

Appendix 14.--Benthic organism data for Indian Run at site S_2, 1979

Organism (common name)	Sample count			
	Date samplers were removed			
	May 3	June 7	Nov. 8	Dec. 4
Annelida				
Oligochaeta (aquatic earthworms)	15	295	24	--
Arthropoda				
Crustacea				
Talitridae (scuds)	6	33	10	--
Astacidae (crayfish)	--	1	--	--
Insecta				
Diptera				
Chironomidae (midges)	85	235	106	--
Ephemeroptera (mayflies)				
Caenidae	12	17	--	--
Heptageniidae	2	2	--	--
Cnidaria				
Hydrozoa	1	479	300	1,680
Mollusca				
Bivalvia (bivalves)				
Sphaeriidae (fingernail clams)	--	1	--	--
Gastropoda (snails)				
Physidae (pond snails)	--	7	--	--
Planorbidae (orb snails)	--	6	--	--
Nematoda (nematodes)	2	--	--	--
Platyhelminthes (flat worms)				
Turbellaria	--	--	1	--
Total count	123	1,076	441	1,680
Diversity index (genera)	3.8	2.6	2.0	0.0
Total biomass (wet weight, g/m^2)	1.7	--	0.9	--

Appendix 15.--Benthic organism data for resrvoir VI-D at site L_3, 1979

Organism (common name)	Sample count				
	Date samplers were removed				
	Apr. 29	June 12	Aug. 7	Oct. 5	Nov. 7
Annelida					
Hirudinae (leeches)					
Glossiphoniidae	--	1	19	1	--
Oligochaeta (aquatic earthworm)	40	--	--	6	--
Arthropoda					
Crustacea					
Amphipoda (scuds)	53	13	149	20	5
Insecta					
Diptera					
Ceratopogonidae (biting midge)	12	--	--	--	--
Chironomidae (midges)	428	120	214	219	27
Ephemeroptera (mayflies)					
Baetidae	--	--	9	--	--
Caenidae	101	14	19	9	3
Ephemerellidae	--	--	12	--	--
Leptophlebiidae	--	--	11	--	--
Megaloptera (alderflies)	--	--	1	--	--
Odonata (dragonflies)					
Coenagrionidae	10	8	1	--	11
Corduliida	--	--	3	--	--
Trichoptera (caddisflies)					
Hydroptilidae	4	--	--	--	--
Leptoceridae	1	--	--	--	--
Phryganeidae	1	--	--	--	--
Cnidaria					
Hydrozoa	14	--	--	--	--
Mollusca					
Gastropoda (snails)					
Ancylidae (fresh-water limpet)	--	1	--	--	--
Lymnaeidae (pond snails)	--	--	41	--	--
Pysidae	1	--	--	--	--
Planorbidae	2	19	22	31	--
Platyhelminthes (flatworms)					
Turbellaria	3	--	33	27	--
Total count	670	176	534	313	46
Diversity index (genera)	2.4	3.8	4.0	2.5	2.7
Total biomass (wet weight, g/m^2)	8.2	1.5	7.3	0.3	0.1

Appendix 16.--Benthic invertebrate data for Indian Run at site S_4, 1979

Organism (common name)	Sample count			
	Date samplers were removed			
	May 3	June 6	Nov. 8	Dec. 4
Annelida				
Oligochaeta (aquatic earthworms)	--	1	--	--
Arthropoda				
Crustacea				
Amphipoda (scuds)	1	--	--	--
Decapoda	--	1	--	--
Insecta				
Coleoptera (beetles)				
Elmidae (riffle beetles)	1	4	--	8
Diptera				
Ceratopogonidae (biting midge)	--	4	--	--
Chironomidae (midges)	41	577	1,370	1,712
Ephidiae	2	--	--	--
Ephemeroptera (mayflies)				
Baetidae	--	--	4	--
Heptageniidae	3	14	4	--
Odonata (dragonflies)	--	--	--	4
Trichoptera (caddisflies)				
Hydropsychidae	--	2	--	4
Cnidaria				
Hydrozoa	--	1	--	--
Mollusca				
Gastropoda (snails)				
Physidae (pond snails)	--	12	--	--
Total count	48	616	1,378	1,728
Diversity index (genera)	2.4	2.1	1.5	3.2
Total biomass (wet weight, g/m^2)	0.2	0.9	0.9	--

Appendix 17.--Phytoplankton data for Little Rush Creek at site S_1, 1979

Organism (common name)	Sample counts (cells/milliliter)							
	Date							
	Feb. 14	Feb. 24	Mar. 14	June 6	Aug. 29	Sept. 14	Oct. 4	Nov. 7
Chlorophyta								
Chlorophyceae (green algae)								
Ankistrodesmus	--	--	--	--	5	320	13	--
Chlamydomonas	--	--	--	230	--	--	13	--
Chrysophyta								
Bacillariophyceae (diatoms)								
Cocconeis	--	--	--	--	5	--	--	--
Cyclotella	--	60	20	--	--	--	--	13
Cymbella	--	--	--	--	--	5	--	--
Navicula	10	--	--	120	50	10	26	64
Nitzschia	--	30	--	39	25	20	--	26
Surirella	5	--	--	--	35	--	--	--
Synedra	--	--	--	--	20	--	--	--
Cyanophyta								
Mxyophyceae (blue-green algae)								
Oscillatoria	50	--	--	--	--	--	--	--
Euglenophyta (euglenoids)								
Euglena	--	--	--	--	--	--	26	--
Trachelomonas	5	30	--	--	5	--	--	--
Pyrrophyta (fire algae)								
Ceratium	--	--	--	--	5	--	--	--
Total count (cells/ml)	70	120	20	389	150	355	78	103
Diversity index (genera)	1.3	1.5	0.0	1.3	2.5	0.6	1.9	1.3

Appendix 18.--Phytoplankton data for Indian Run at site S_2, 1979

Organism (common name)	Sample counts (cells/milliliter)									
	Date									
	Feb. 13	Feb. 24	Mar. 14	July 11	Aug. 3	Aug. 29	Sept. 14	Oct. 3	Nov. 8	Dec. 4
Chlorophyta										
Chlorophyceae (green algae)										
Ankistrodesmus	--	--	--	--	--	--	190	--	--	--
Chlamydomonas	--	--	15	--	1,100	--	--	--	--	--
Closteriopsis	--	--	--	--	--	--	--	--	26	--
Coelastrum	--	--	--	--	2,700	--	9,200	2,200	--	--
Crucigenia	--	--	--	--	2,500	--	--	--	--	--
Oocystis	--	--	--	84	--	--	--	--	--	--
Scenedesmus	--	--	15	--	620	--	110	--	--	--
Schroederia	--	--	--	--	--	--	--	--	13	--
Sphaerocystis	--	--	--	--	160	--	--	--	--	--
Volvox	--	--	--	--	--	--	43,000	--	--	--
Chrysophyta										
Bacillariophyceae (diatoms)										
Cyclotella	--	120	140	--	--	--	620	120	13	--
Diatoma	71	--	15	--	--	--	--	--	--	--
Fragillaria	5	91	--	--	--	--	--	--	--	--
Gomphonema	71	--	46	--	--	--	9	--	26	--
Melosira	--	30	--	--	--	5,900	66	--	--	--
Navicula	50	--	15	84	--	10	38	--	13	55
Nitzschia	25	30	--	--	--	--	--	--	--	--
Surirella	30	--	15	--	--	--	--	--	--	--
Synedra	5	--	--	--	--	--	9	--	--	--
Cryptophyta (cryptomonads)										
Chroomonas	--	--	--	--	39	--	--	--	--	--
Chryptomonas	5	--	--	--	78	--	--	--	--	--
Cyanophyta										
Myxophyceae (blue-green algae)										
Anabaena	--	--	--	200,000	--	--	--	--	--	--
Anacystis	--	--	--	--	1,900	--	--	--	--	--
Oscillatoria	250	--	--	--	9,300	--	--	--	--	--
Euglenophyta (euglenoids)										
Trachelomonas	35	30	18	--	--	--	--	39	--	14
Euglena	--	--	15	--	--	--	--	--	--	--
Pyrrophyta (fire algae)										
Gymnodinium	--	--	--	--	--	10	--	--	--	--
Ceratium	--	--	--	--	--	10	--	--	--	--
Total count (cells/ml)	547	301	294	200,168	18,397	5,930	53,242	2,359	91	69
Diversity index (genera)	2.4	2.0	2.5	0.0	2.1	0.1	0.8	0.4	2.2	0.7

Appendix 19.--Phytoplankton data for reservoir VI-D at site L_3, 1979

Organism (common name)	Sample counts (cells/milliliter)					
	Date					
	Mar. 13	June 5	July 12	Aug. 7	Oct. 5	Dec. 5
Chlorophyta						
Chlorophyceae (green algae)						
Ankistrodesmus	--	--	--	32	--	--
Chlamydomonas	--	230	--	--	--	--
Coelastrum	--	--	--	15,000	1,400	--
Crucigenia	--	--	--	3,500	--	--
Oocystis	--	350	--	190	--	--
Phacotus	--	--	--	79	--	--
Scenedesmus	--	--	--	95	--	--
Schroederia	--	39	--	16	190	--
Spirogyra	--	--	--	190	--	--
Chrysophyta						
Bacillariophyceae (diatoms)						
Cyclotella	15	--	--	--	260	27
Melosira	--	--	--	130	--	--
Navicula	15	120	--	--	--	14
Nitzschia	--	39	--	--	--	27
Surirella	--	--	--	--	--	14
Chrysophyceae (yellow-brown algae)						
Mallomonas	--	--	--	--	--	41
Cryptophyta						
Cryptomonas	--	39	--	--	--	--
Cyanophyta						
Myxophyceae (blue-green algae)						
Anabaena	--	--	250,000	--	--	--
Anacystis	--	--	--	440	64	--
Aphanizomenon	--	--	--	2,400	--	--
Oscillatoria	--	--	--	--	1,300	--
Euglenophyta (euglenoids)						
Trachelomonas	61	540	--	48	--	14
Pyrrophyta (fire algae)						
Ceratium	--	--	130	--	--	--
Peridinium	--	--	--	270	--	--
Total count (cells/ml)	91	1,357	250,130	22,390	3,214	137
Diversity index (genera)	1.3	2.2	0.0	1.6	1.7	2.4

Appendix 20.--Phytoplankton data for Indian Run at site S_4, 1979

Organism (common name)	Sample counts (cells/milliliter)									
	Date									
	Feb. 13	Feb. 24	Mar. 14	June 6	July 11	Aug. 9	Sept. 14	Oct. 3	Nov. 11	Dec. 4
Chlorophyta										
Chlorophyceae (green algae)										
Ankistrodesmus	--	30	--	--	--	--	--	--	--	--
Chlamydomonas	--	--	--	--	--	--	27	--	--	--
Closterium	--	--	--	--	--	--	370	--	--	--
Coelastrum	--	--	--	--	--	--	380	--	750	--
Crucigenia	--	--	--	150	--	--	--	--	--	--
Oocystis	--	--	--	--	--	--	--	--	--	14
Scenedesmus	--	--	--	--	--	100	--	--	--	--
Chrysophyta										
Bacillariophyceae (diatoms)										
Achnantnes	--	--	--	--	--	--	14	--	--	--
Cyclotella	5	--	20	--	--	--	--	--	51	--
Gomphonemia	25	--	--	--	--	--	--	--	--	--
Fragillaria	--	--	20	--	--	--	--	--	--	--
Navicula	15	30	20	39	190	51	55	13	26	--
Nitzschia	5	--	20	--	--	--	82	26	39	--
Rhoicosphenia	--	--	20	39	--	--	--	--	--	--
Surirella	56	30	61	--	--	--	--	--	--	--
Synedra	--	--	--	--	--	27	--	--	64	--
Chrysophyceae (yellow-brown algae)										
Synura	10	--	--	--	--	--	--	--	--	--
Cryptophyta										
Cryptomonas	5	--	--	--	--	--	--	--	26	--
Cyanophyta										
Myxophxceae (blue-green algae)										
Anacystis	--	--	--	--	--	--	96	--	--	--
Oscillatoria	--	--	--	--	--	--	690	--	--	--
Euglenophyta (euglenoids)	--	61	--	--	--	--	--	--	--	--
Euglena	--	--	260	--	--	--	--	--	--	--
Trachelomonas	10	--	40	--	--	--	14	--	--	--
Total count (cells/ml)	131	151	461	228	190	178	1,728	39	956	14
Diversity index (genera)	2.5	1.9	2.1	1.3	0.0	0.9	2.4	0.9	1.2	0.0

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