EFFECTS ON WATER QUALITY DUE TO FLOOD-WATER DETENTION BY BARKER AND ADDICKS RESERVOIRS, HOUSTON, TEXAS

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METRIC CONVERSIONS

Factors for converting inch-pound units to metric (International System) units are given in the following table:

Multiply inch-pound unit	By	To obtain metric units
acre	0.4047	hectare
acre-foot (acre-ft)	1,233.0	cubic meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
degree Fahrenheit (°F)	5/9 (°F-32)	degree Celsius (°C)
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "mean sea level."

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ABSTRACT

The Barker and Addicks Reservoirs, located about 16 miles west of Houston, Texas, provide flood-detention storage for storm runoff. Of interest are the water-quality characteristics in the study area and changes in water quality during detention. Study area sampling sites were selected upstream along Buffalo Bayou for Barker Reservoir and on Bear Creek and Langham Creek for Addicks Reservoir, within the reservoirs, near the reservoir outflows, and below the confluence of each reservoir outflow at the streamflow station Buffalo Bayou near Addicks. Flow data were available at all sites except in the reservoirs. Analyses of samples collected during both low flow and storm runoff show that, in general, the waters of the study area were low in mineralization, but the aesthetics of the water was a problem.

The inorganic constituents, trace metals, and pesticides rarely exceeded maximum contaminant levels recommended by the U.S. Environmental Protection Agency for public supply using 1976 and 1977 criteria for primary and secondary standards. All species of nutrients, except ammonia nitrogen and phosphorus, almost always were below the recommended maximum contaminant levels. Phosphorus almost always exceeded these levels.

Aesthetic problems are evident. Large values of suspended solids, turbidity, and color were common. Small dissolved-oxygen values commonly occurred in the reservoirs. Possible bacterial problems are indicated because coliform-bacteria densities exceeded recommended levels in about 25 percent of the samples.

The effects of the reservoirs on the water-quality characteristics of storm runoff were analyzed using three approaches. The first approach was a comparison of the discharge-weighted average values of nine selected constituents at each streamflow-gaging station during four storms. Reservoir effects on the quality of runoff detained 1 to 4 days in the two reservoirs were inconsistent. However, the reservoirs consistently had an effect on the water quality of runoff that was detained the longest (more than 8 days). Biochemical oxygen demand, suspended solids, turbidity, color, total nitrogen, and total organic carbon discharge-weighted average values were consistently smaller after flowing through the reservoirs. Dissolved solids and total phosphorus values were consistently larger after flowing through the reservoirs.

The second approach was an analysis of the means of the discharge-weighted average values computed for the four hydrologic events using the Student t-test.

Statistical results indicate that reservoir detention significantly reduced suspended solids (the mean decreased from 178 milligrams per liter at the inflows to 105 milligrams per liter at the outflows) and turbidity (the mean decreased from 119 nephelometric turbidity units at the inflows to 66 nephelometric turbidity units at the outflows).

The third approach was a comparison at each site of the mean, maximum, and minimum values computed for seven constituents that did not correlate with discharge. These constituents or properties of water were temperature, pH, dissolved oxygen, dissolved oxygen percent saturation, total-coliform bacteria, fecal-coliform bacteria, and fecal-streptococci bacteria. The only consistent water-quality changes observed were with the three bacteria groups, which were decreased by flood-water detention.

INTRODUCTION

In the late 1940's, the U.S. Army Corps of Engineers built reservoirs on Buffalo Bayou and South Mayde Creek about 16 mi west of Houston, Texas, to provide flood protection for the Houston area (fig. 1). Both dams have controlled release structures which allow the Corps of Engineers to drastically reduce flooding along Buffalo Bayou between the reservoirs and the Houston Ship Channel. The use of these reservoirs as storage basins not only reduces the flood peak along the downstream reach, but also extends the duration of storm runoff. However, the operation of both Barker and Addicks Reservoirs has been seriously constrained due to rapid urbanization of the Houston metropolitan area. Not only has development been almost complete downstream from the reservoir, but development also has encroached into the upper part of the reservoir. This situation causes a constrained range of options for operation of the reservoirs. As a result, detention time usually is at a minimum because the release gates on the dams rarely are closed for more than a day.

The detention time of the runoff is a critical factor in water-quality changes that occur downstream from the reservoirs. Some of these possible changes in water quality may be beneficial; others may be detrimental. Data are needed by the Corps of Engineers to define water quality upstream, within, and downstream from the reservoirs and document the changes in water quality that result from the storage of storm runoff in these detention reservoirs. This study was developed and conducted by the U.S. Geological Survey for the Corps of Engineers.

Description of Study Area

The study area (fig. 1) consists of the drainage basin above the streamflow-gaging station, Buffalo Bayou near Addicks, Texas (08073500). Buffalo Bayou is the major stream that drains the Houston area. The bayou is regulated by the Barker and Addicks flood-detention reservoirs near the western limits of the Houston metropolitan area. From these reservoirs, Buffalo Bayou meanders eastward to the Houston Ship Channel, and is fed by five major tributaries along its course: Whiteoak, Brays, Sims, Hunting, and Greens Bayous. The operating plan for these reservoirs during floods is to temporarily store storm runoff and gradually release the water immediately following the storm. Base flow and runoff from small storms are allowed to pass through the reservoirs unrestricted.

Barker Reservoir is located on Buffalo Bayou about 1.1 mi south of Addicks, 1.2 mi upstream from South Mayde Creek, and 16.8 mi west of downtown Houston (fig. 1). The dam is a rolled-earth structure about 72,900 ft long and 37 ft high. It was completed in February 1946, but actual flood detention began in the spring of 1945. The reservoir has a capacity of 209,000 acre-ft and a surface area of about 16,700 acres at an altitude of 106.0 ft above NGVD of 1929, which is the ground altitude at the ends of the dam. The maximum volume of storage since construction was 39,200 acre-ft at a water-surface altitude of 94.60 ft on May 15, 1968.

Addicks Reservoir is located on South Mayde Creek about 1.2 mi east of Addicks, 1.4 mi upstream from the confluence with Buffalo Bayou, and 15.7 mi

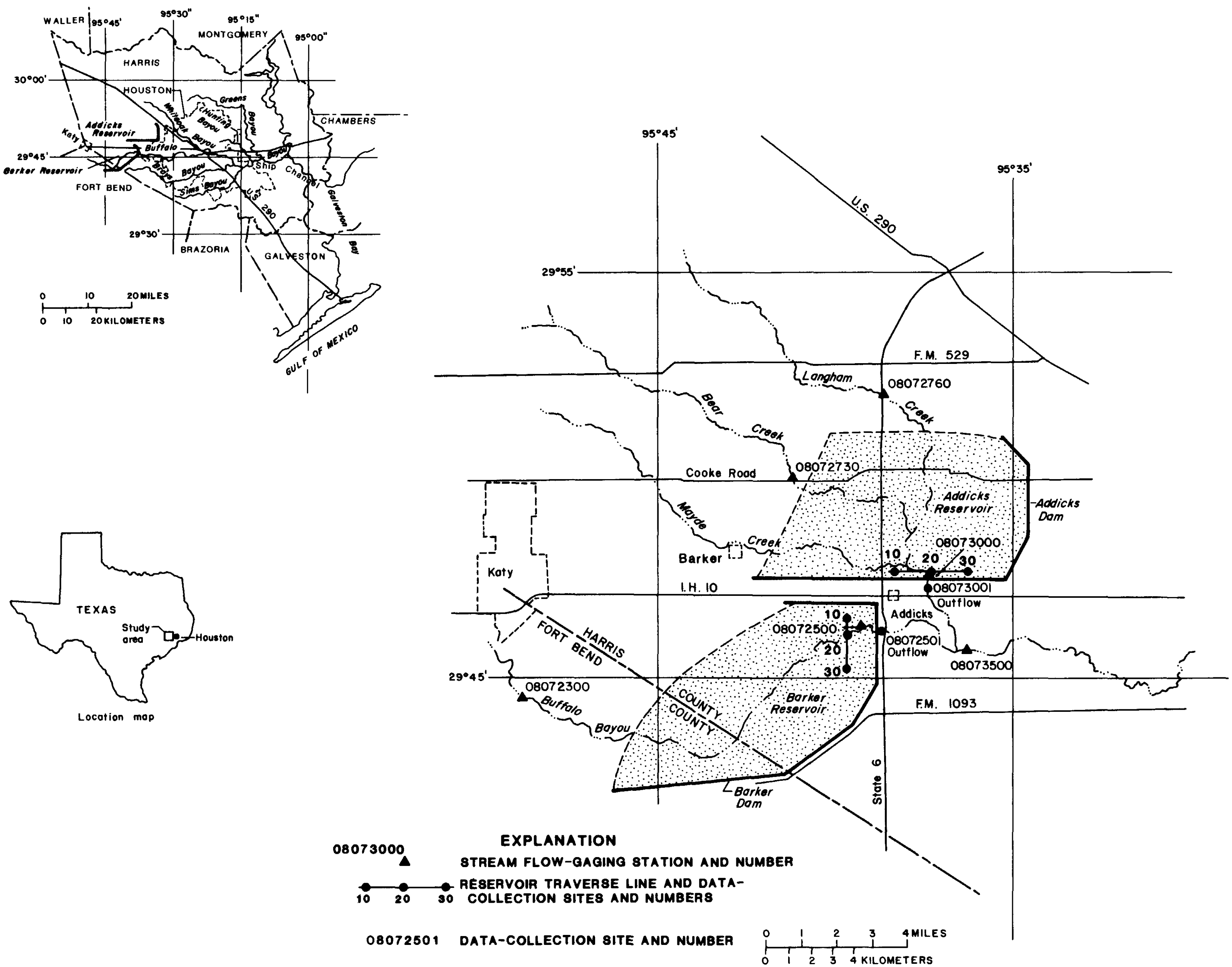

Figure 1.--Location of the study area and data-collection sites.

west of downtown Houston. The dam is a rolled-earth structure about 61,200 ft long and 49 ft high. It was completed in December 1948. The reservoir has a capacity of 212,500 acre-ft and a surface area of about 17,000 acres at an altitude of 112.0 ft above NGVD of 1929, which is the ground altitude at the end of the dam. The maximum volume of storage since construction was 37,460 acre-ft at a water-surface altitude of 100.02 ft.

Historical and descriptive information for the reservoirs has been compiled by Dowell and Breeding (1967) and by Dowell and Petty (1973). Records of reservoir stages and contents and engineering data are published annually in the series of U.S. Geological Survey reports entitled "Water Resources Data for Texas" (1979, 1980, 1982). Engineering data are summarized in table 1.

Purpose and Scope

The principal purposes of this report were (1) to describe the quality of the water upstream, in, and downstream from the reservoirs during the study period and (2) to define and document the effects on water quality due to detention of flood waters by Barker and Addicks Reservoirs for selected rainfall events. The effort to define the effects of flood-water detention were limited to analysis of four storms, of which only one had water detained longer than 5 days.

STUDY APPROACH

Data Collection

The data-collection sites are shown in figure 1. For each reservoir, there is at least one inflow site, a sampling line having three sites within each reservoir, and a site on the downstream side of the outlet structure. Station 08073500 Buffalo Bayou near Addicks, located below the confluence of Buffalo Bayou and South Mayde Creek, also was included. The inflow site for Barker Reservoir is the streamflow-gaging station 08072300 Buffalo Bayou near Katy. Two inflow sites are used for Addicks Reservoir--the streamflow-gaging stations 08072730 Bear Creek near Barker and 08072760 Langham Creek at State Highway 6 near Addicks. Station 08072500 on Barker Reservoir and station 08073000 on Addicks Reservoir measure reservoir stage and contents. The reservoir outflow sites are 08072501 for Barker Reservoir and 08073001 for Addicks Reservoir. Descriptions of these sites are given in table 2.

Data collection for the purpose of characterizing the water-quality variation and defining the effects on water quality due to the detention of flood water began in June 1978 and ended in September 1981. No data were collected from December 1979 to September 1980 because of a shortage of funds.

Data collection was conducted during two flow regimes--storm runoff and dry-weather low flow. Low flow was defined as flow occurring when no appreciable precipitation had occurred in the basin (less than 1.0 in. the previous day and less than 2.0 in. within the last 10 days). Low-flow samples were collected at all inflow stations, at both reservoir outlets, and at the station downstream of the confluence of Buffalo Bayou and South Mayde Creek. The objective was to define the water-quality characteristics along the reaches

Table 1.--Engineering data for Barker and Addicks Reservoirs

Reservoir name	Construction type	Outlet description		Reservoir feature			
				Crest of spillway	Maximum storage since construction completed	Design flood	Ends of dam
Barker Reservoir	Rolled earthfill dam	Five concrete conduits, 9 feet by 7 feet each. Controlled by vertical slide gates.	Surface area (acres):	0	9,900	16,400	16,700
			Storage capacity (acre-feet):	0	39,200	199,000	209,000
Addicks Reservoir	Rolled earthfill dam	Five concrete conduits, 8 feet by 5 feet each. Controlled by vertical slide gates.	Surface area (acres):	0	6,600	16,400	17,000
			Storage capacity (acre-feet)	0	37,460	200,800	212,500

Table 2.--Description of sites used in study

[mi, mile; ft, foot]

Station number or site identification number	Station or site name	Latitude	Longitude	Location	Function	Drainage area (square miles)
			Barker Reservoir system			
08072300	Buffalo Bayou near Katy, Tex.	29°44'35"	095°54'48"	2.5 mi downstream from Willow Fork at Buffalo Bayou and Cane Branch of Buffalo Bayou, 3.1 mi southeast of Katy, upstream from Barker Reservoir.	Inflow sample site	63.3
08072500	Barker Reservoir near Addicks, Tex.	29°46'11"	095°38'49"	45 ft upstream from reservoir outflow works, 1,160 ft upstream from Addicks-Howell County Road, 1.2 mi upstream from South Mayde Creek, 1.1 mi south of Addicks, on Barker Reservoir.	Reservoir stage and contents	128
294617095390501	Barker Reservoir line 10, site 10	29°46'17"	095°39'05"	In Barker Reservoir, 1,000 ft to the north of Baker Reservoir line 10, site 20	Sample point in reservoir	--
294617095390502 (08072500)a/	Barker Reservoir line 10, site 20	29°46'17"	095°39'05"	In Barker Reservoir, 145 ft upstream from reservoir outlet works.	Sample point in reservoir	--
294617095390503	Barker Reservoir line 10, site 30	29°46'17"	095°39'05"	In Barker Reservoir, 1,000 ft to the south of Barker Reservoir line 10, site 20.	Sample point in reservoir	--
294610095385400 (08072501)b/	Barker Reservoir outflow	29°46'10"	095°38'54"	1,100 ft downstream from Barker Reservoir near Addicks, and 1,050 ft downstream from reservoir outlet works.	Outflow sample site	128
			Addicks Reservoir system			
08072730	Bear Creek near Barker, Tex.	29°49'50"	095°41'12"	4.1 mi upstream from mouth of Langham Creek on bank at bridge on Clay Road, upstream from Barker Reservoir, 2.5 mi west of State Highway 6 near Barker, Tex.	Inflow sample site	19.8
08072760	Langham Creek at State Highway 6 near Addicks, Tex.	29°51'55"	095°38'44"	On right bank 100 ft downstream from bridge on State Highway 6, 2.2 mi downstream from Dinners Creek, and 5.6 mi north of Addicks.	Inflow sample site	25.8
08073000	Addicks Reservoir near Addicks, Tex.	29°47'28"	095°37'24"	At Addicks Reservoir on South Mayde Creek, 65 ft upstream from reservoir outlet works, 2,700 ft upstream from U.S. Highway 90, 1.2 mi east of Addicks, and 1.4 mi upstream from mouth.	Reservoir stage and contents	129
294729095372501	Addicks Reservoir line 10, site 10	29°47'29"	095°37'25"	In Addicks Reservoir, 1,000 ft to the west of Addicks Reservoir line 10, site 20.	Sample point in reservoir	--
294729095372502 (08073000)a/	Addicks Reservoir line 10, site 20	29°47'29"	095°37'25"	In Addicks Reservoir, 165 ft upstream from Reservoir outlet works.	Sample point in reservoir.	--
294729095372503	Addicks Reservoir line 10, site 30	29°47'29"	095°37'25"	In Addicks Reservoir, 1,000 ft to the east of Addicks Reservoir line 10, site 20.	Sample point in reservoir	--
294706095372400 (08073001)b/	Addicks Reservoir outflow	29°47'06"	095°37'24"	1,100 ft downstream from Addicks Reservoir near Addicks, and 1,000 ft downstream from reservoir outlet works.	Outflow sample site	129
			Study area outlet			
08073500	Buffalo Bayou near Addicks, Tex.	29°45'42"	095°36'20"	Near right bank at bridge on Dairy-Ashford Road over rectified channel, 1.8 mi downstream from South Mayde Creek, and 2.6 mi southeast of Addicks.	Sample site for combined outflow	293

a/ Water-quality samples for reservoir collected at this site.
b/ Station number used for referencing site.

when the reservoir had no effect. Storm-runoff was sampled at all sites. At the three inflow sites, water samples were collected as soon as possible during the rising stage and continued from high falling stage through low falling stage. Samples within each reservoir were collected with Kemmerer[1/] samplers, starting as soon as possible after storage began. Sampling continued at weekly intervals for 3 consecutive weeks or until the reservoir was emptied. After releases from each reservoir began, water samples were collected from the reservoir outflows and the downstream station at weekly intervals for 3 consecutive weeks or until the reservoir was emptied.

Water-quality data consisted of field measurements and laboratory analyses. Field measurements included water temperature, pH, dissolved oxygen, and specific conductance, which were obtained for all samples. Field measurements also were made at various sampled depths and unsampled sites along the cross section in each reservoir. The laboratory analyses included biochemical oxygen demand (BOD), total-coliform bacteria, fecal-coliform bacteria, fecal-streptococci bacteria, suspended solids, volatile suspended solids, turbidity, color, dissolved solids, major dissolved ions, total nitrogen, total phosphorus, and total organic carbon (TOC). A limited number of samples were analyzed for dissolved trace elements, total pesticides, and polychlorinated biphenyls (PCB). Samples for laboratory analysis were collected at all inflow and outflow sites but only at the central site of the reservoir cross section, located at the innundated stream channel.

Reservoir operating regulations and restrictions often prohibited the Corps of Engineers from detaining storm runoff for the desired sampling intervals. Six storm-runoff events were studied. Table 3 describes these events and summarizes the number of samples collected. Figures 2-7 illustrate the hydrologic response for each of these six events at the sites used in this study and indicate when the water-quality data were collected during each event.

Four of these events were selected for detailed analysis: November 26 - December 13, 1978; February 2-28, 1979; September 17 - October 18, 1979; and May 1-22, 1981. The selection was based on sample coverage during the runoff event, seasonal conditions, and duration of reservoir detention. May 1-22, 1981, the only event in which flood water was stored for more than a week, was selected for a more detailed discussion.

The water-quality data collected for this study are presented in previous reports (U.S. Geological Survey, 1979; 1980; and 1982). These data are listed in Appendices A-F.

Data Analysis

The data analyses were divided into two general categories. The first category describes the quality of the water during the study. The second category uses three approaches to define and document the effects of detention of flood water by the reservoirs on water quality.

1/ Use of a brand name in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

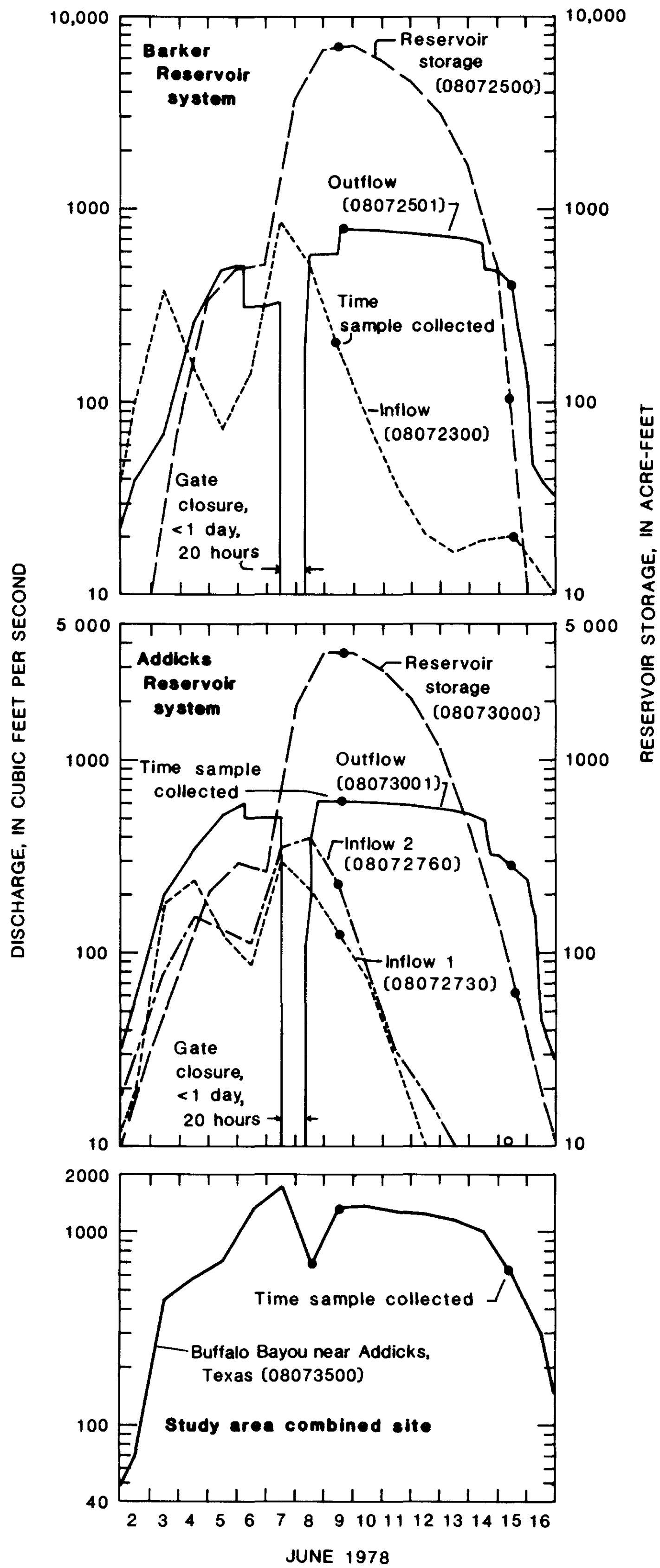

Figure 2.--Hydrographs showing storage, discharge, and the timing of sample collection for June 2-16, 1978.

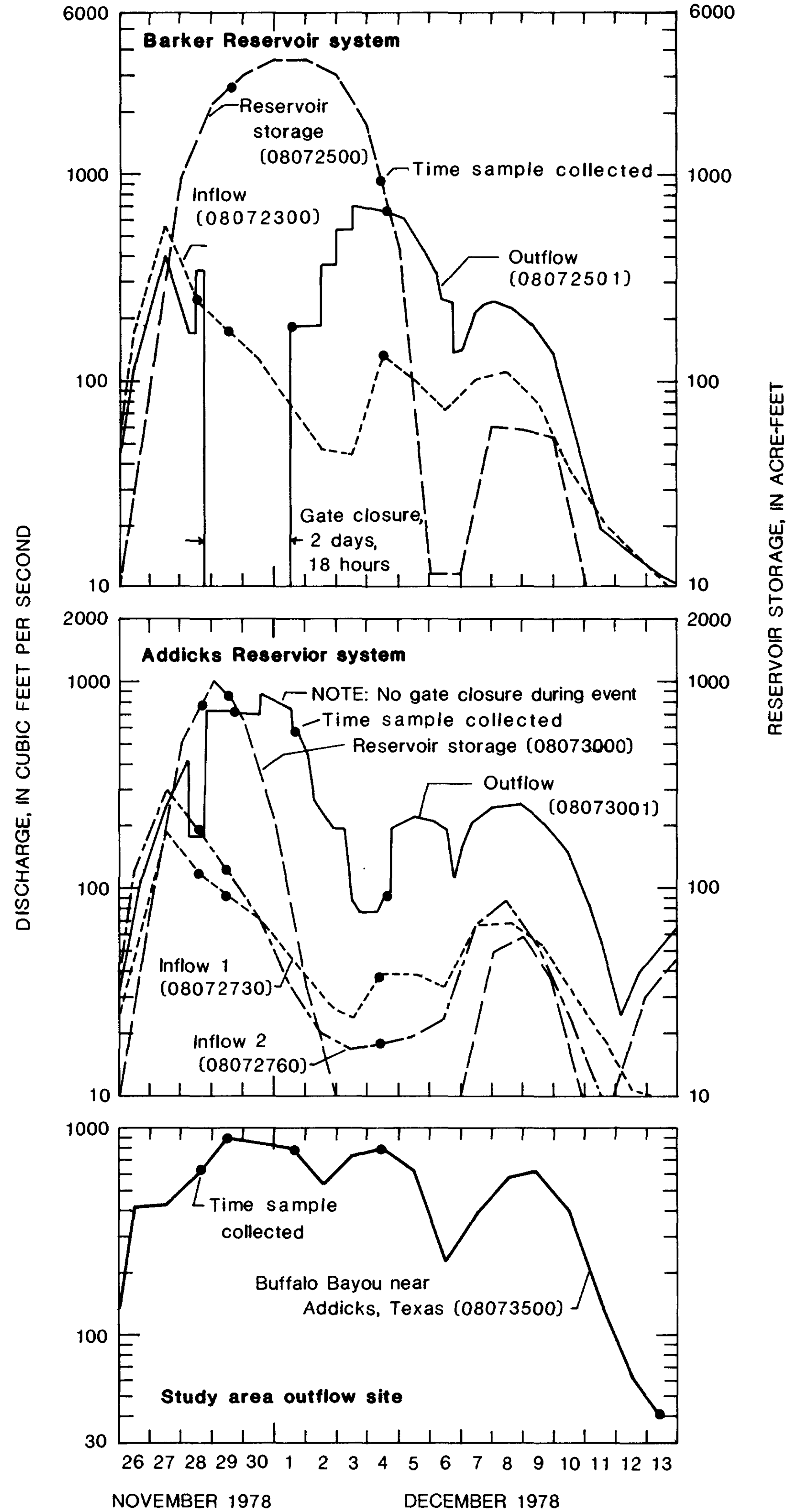

Figure 3.--Hydrographs showing storage, discharge, and the timing of sample collection for November 26 - December 13, 1978.

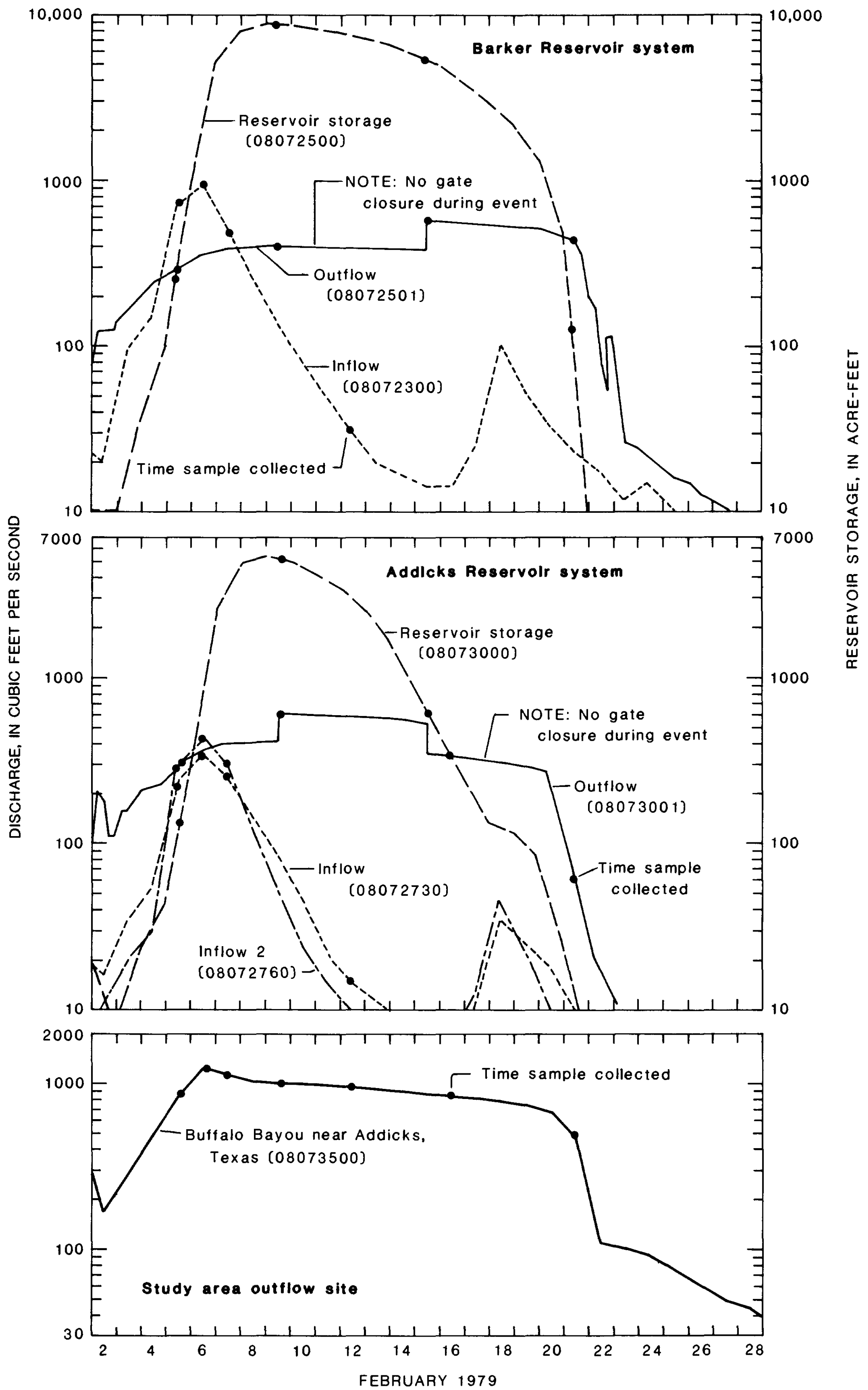

Figure 4.--Hydrograph showing storage, discharge, and the timing of sample collection for February 2-28, 1979.

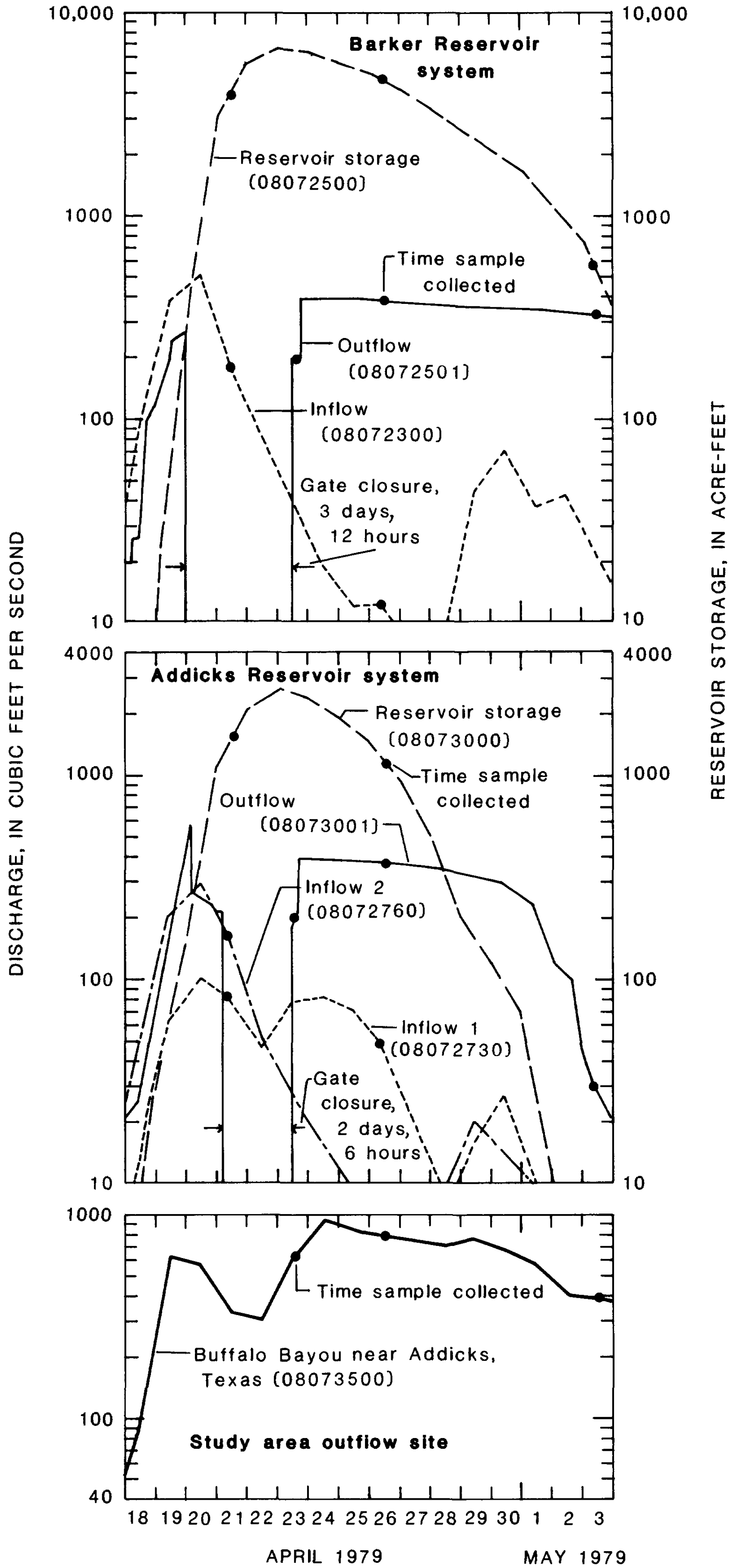

Figure 5.--Hydrographs showing storage, discharge, and the timing of sample collection for April 18 - May 3, 1979.

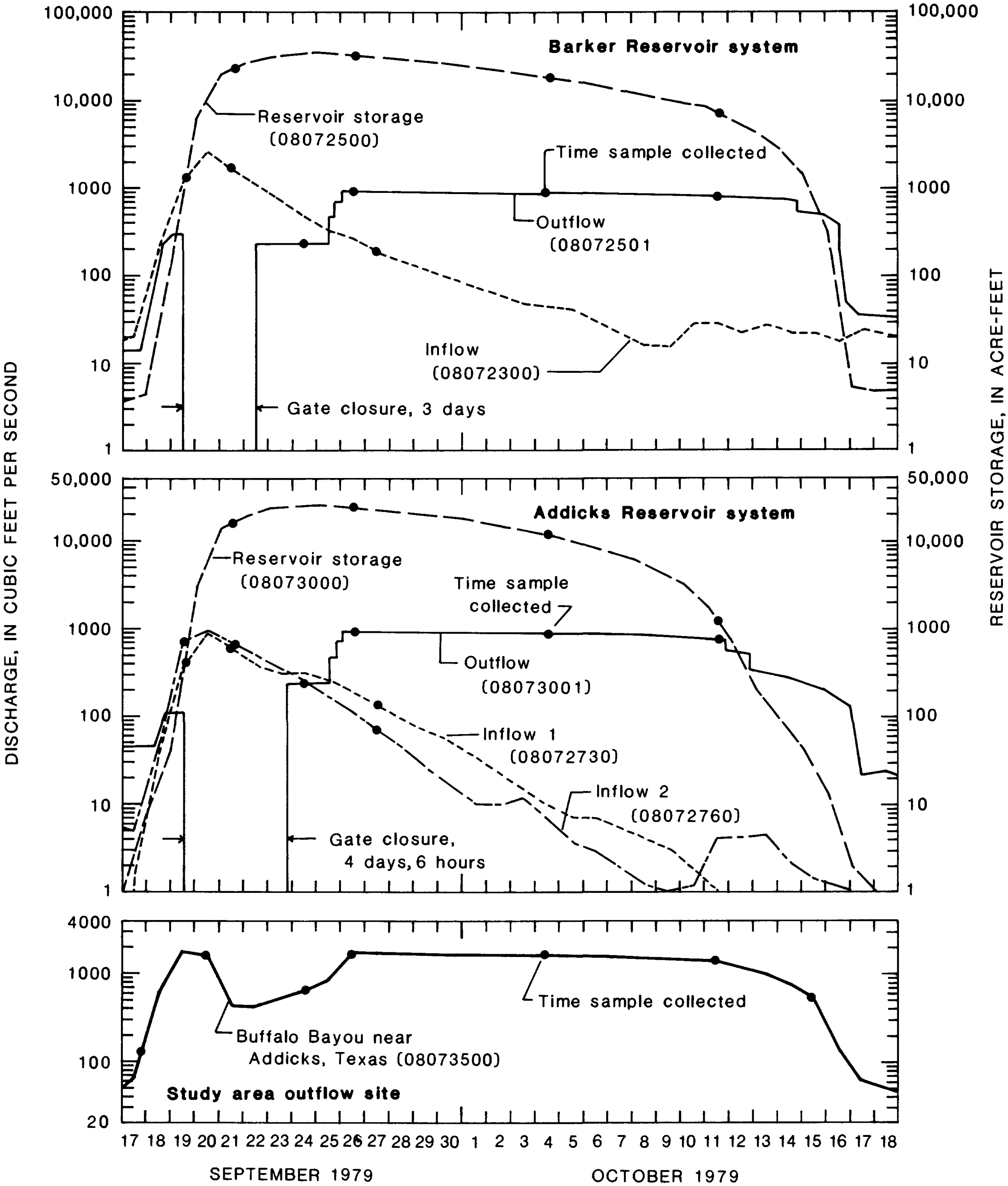

Figure 6.--Hydrographs showing storage, discharge, and the timing of sample collection for September 17 - October 18, 1979.

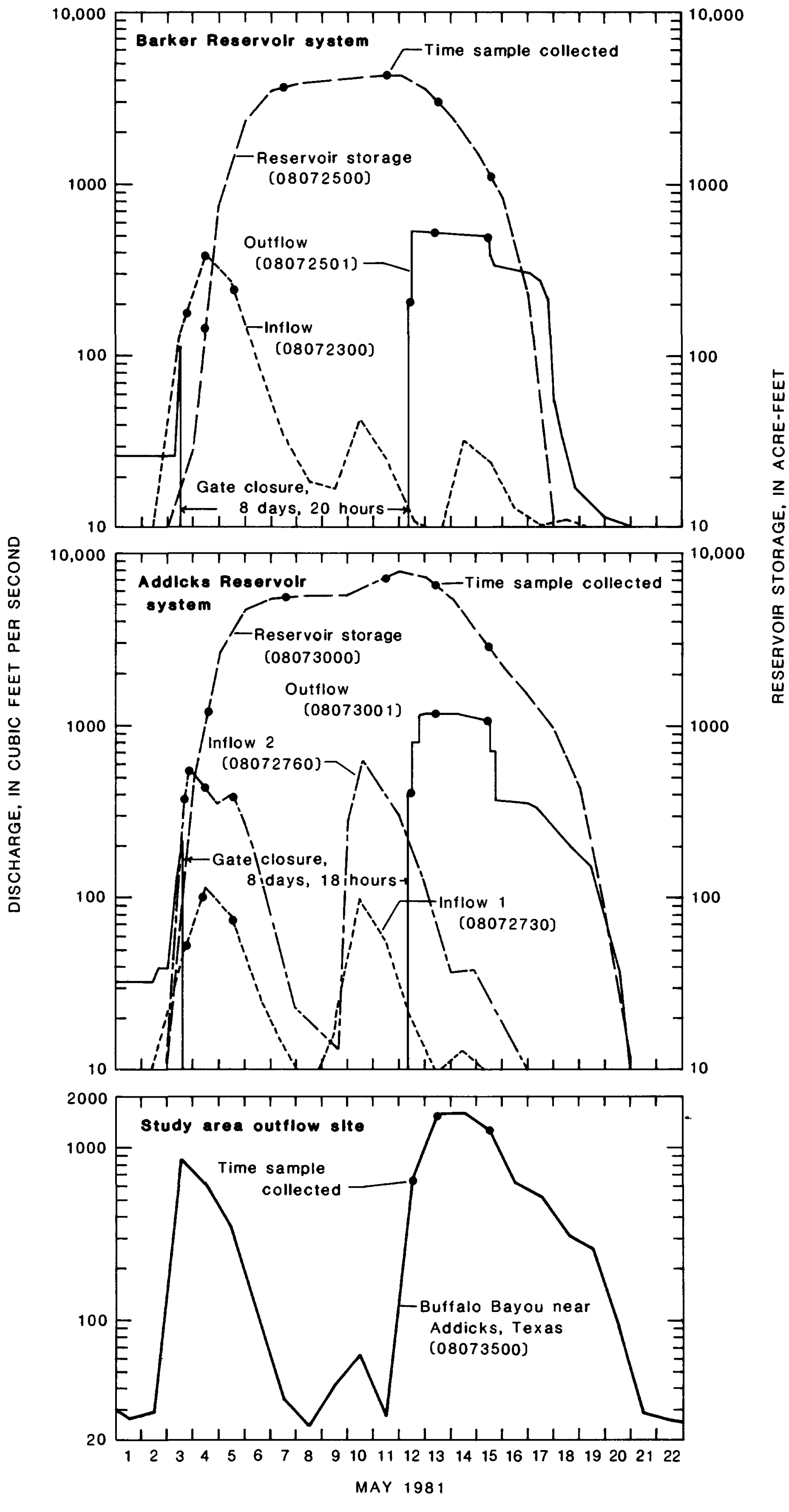

Figure 7.--Hydrographs showing storage, discharge, and the timing of sample collection for May 1-22, 1981.

Table 3.--Description of runoff events sampled during the study

Runoff event: Number	Runoff event: Begin	Runoff event: End	Total precipitation (inches)	Antecedent conditions: 10-day previous precipitation (inches)	Antecedent conditions: 30-day previous precipitation (inches)	Antecedent conditions: Class	Barker Reservoir system: Maximum daily storage (acre-feet)	Barker Reservoir system: Number of days flow detained with no release	Barker: Number of samples available: Inflow (08072300)	Barker: Reservoir (08072500)	Barker: Outflow (08072501)	Addicks Reservoir system: Maximum daily storage (acre-feet)	Addicks Reservoir system: Number of days flow detained with no release	Addicks: Number of samples available: Inflow (08072730)	Addicks: Inflow (08072760)	Addicks: Reservoir (08073000)	Addicks: Outflow (08073001)	Buffalo Bayou near Addicks (08073500) (number of samples available)
1	6- 2-78	6-16-78	5.23	1.14	2.17	Dry	6,890	5/6	2	2	2	3,530	5/6	2	2	2	2	3
2	11-26-78	12-13-78	3.14	1.08	3.19	Dry	3,530	2 3/4	3	2	2	1,010	0	3	3	2	3	5
3	2- 2-79	2-28-79	3.00	1.53	4.83	Wet	8,750	0	4	4	4	5,390	0	4	4	3	4	7
4	4-18-79	5- 3-79	2.58	.00	1.63	Dry	6,480	3 1/2	2	3	3	2,610	2 1/4	2	2	3	3	3
5	9-17-79	10-18-79	9.90	.32	.97	Dry	34,680	3	3	4	4	25,480	4 1/4	3	3	4	4	7
6	5- 1-81	5-22-81	4.22	2.27	2.37	Wet	4,280	8 5/6	3	5	3	7,830	8 3/4	3	4	5	3	3

The quality of water is indicated by statistical summaries of the data and the results are described. The range in values of the various constituents and properties also is compared to recommended water-quality criteria (U.S. Environmental Protection Agency, 1976, 1977a; National Academy of Sciences, National Academy of Engineering, 1973) when applicable. The constituents and properties are arbitrarily grouped into the following six categories:

(1) Field measurements, biochemical oxygen demand (BOD), and bacteria;
(2) Physical and aesthetic properties;
(3) Major inorganic constituents and related properties;
(4) Nutrients and total organic carbon (TOC);
(5) Trace elements; and
(6) Pesticides and polychlorinated biphenyls (PCB).

The first approach in defining and documenting the effects on water quality due to the detention of flood water is an evaluation of the discharge-weighted average values for nine selected constituents or properties--BOD, suspended solids, volatile suspended solids, turbidity, color, dissolved solids, total nitrogen, total phosphorus, and TOC--for each selected storm event (Nov. 26 - Dec. 13, 1978; Feb. 2-28, 1979; Sept. 17 - Oct. 18, 1979; and May 1-22, 1981). The discharge-weighted average values at the inflow and at the outflow sites during each event are compared to define the effect on water quality due to detention of flood water by the reservoirs.

The second approach is an analysis of the mean of the discharge-weighted average values for each selected constituent or property at each type of site (inflow, reservoir, and outflow) during all events. A Student t-test was performed on the mean values to determine whether or not there is a statistically significant difference between the various types of sites. Interpretations are made regarding the effect that the reservoir may have had on those constituents or properties which have significant differences.

The third approach is an analysis of the chemical and biological constituents and properties at each site that were not highly correlated to discharge. A total of seven selected constituents and properties were considered in this approach: water temperature, pH, dissolved oxygen, dissolved oxygen percent saturation, total-coliform bacteria, fecal-coliform bacteria, and fecal-streptococci bacteria. The mean, maximum, and minimum statistics for these selected constituents and properties were determined, and the significance of differences believed to be related to the detention of flood water is discussed.

DESCRIPTION OF WATER QUALITY

A summary of the source and significance of some of the various constituents and properties grouped in the six categories is presented in table 4. The water-quality constituents and properties which are included in each group and their values are discussed in the following sections. Actual values for individual samples are listed in the supplemental-data section by category.

While the water is not intended for, nor is it used as, a public water supply, criteria published by the U.S. Environmental Protection Agency (1976, 1977a) for assessing public water supplies are used for comparison purposes. A summary of the criteria for primary and secondary recommended maximum contaminant levels (allowable or accepted levels) and several pertinent definitions

Table 4.--Source and significance of selected constituents and properties commonly reported in water analyses 1/

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS, microsiemens per centimeter at 25 degrees Celsius]

Constituent or property	Source or cause	Significance
Silica (SiO_2)	Silicon ranks second only to oxygen in abundance in the Earth's crust. Contact of natural water with silica-bearing rocks and soils usually results in a concentration range of about 1 to 30 mg/L, but concentrations as large as 100 mg/L are common in water in some areas.	Although silica in some domestic and industrial water supplies may inhibit corrosion of iron pipes by forming protective coatings, it generally is objectionable in industrial supplies, particularly in boiler feedwater, because it may form hard scale in boilers and pipes or deposit in the tubes of heaters and on steam-turbine blades.
Iron (Fe)	Iron is an abundant and widespread constituent of many rocks and soils. Iron concentrations in natural water are dependent on several chemical equilibria processes including oxidation and reduction; precipitation and solution of hydroxides, carbonates, and sulfides; complex formation especially with organic material; and the metabolism of plants and animals. Dissolved-iron concentrations in oxygenated surface water seldom are as much as 1 mg/L. Some ground water, unoxygenated surface water such as deep water of stratified lakes and reservoirs, and acidic water resulting from discharge of industrial wastes or drainage from mines may contain considerably more iron. Corrosion of iron casings, pumps, and pipes may add iron to water pumped from wells.	Iron is an objectionable constituent in water supplies for domestic use because it may adversely affect the taste of water and beverages and stain laundered clothes and plumbing fixtures. According to the National Secondary Drinking Water Regulations proposed by the U.S. Environmental Protection Agency (1977a), the secondary maximum contamination level of iron for public water systems is 300 µg/L. Iron also is undesirable in some industrial water supplies, particularly in water used in high-pressure boilers and those used for food processing, production of paper and chemicals, and bleaching or dyeing of textiles.
Calcium (Ca)	Calcium is widely distributed in the common minerals of rocks and soils and is the principal cation in natural freshwater, especially water that contacts deposits or soils originating from limestone, dolomite, gypsum, and gypsiferous shale. Calcium concentrations in freshwater usually range from zero to several hundred milligrams per liter. Larger concentrations are not uncommon in water in arid regions, especially in areas where some of the more soluble rock types are present.	Calcium contributes to the total hardness of water. Small concentrations of calcium carbonate combat corrosion of metallic pipes by forming protective coatings. Calcium in domestic water supplies is objectionable because it tends to cause incrustations on cooking utensils and water heaters and increases soap or detergent consumption in water used for washing, bathing, and laundering. Calcium also is undesirable in some industrial water supplies, particularly in water used by electroplating, textile, pulp and paper, and brewing industries and in water used in high-pressure boilers.
Magnesium (Mg)	Magnesium ranks eight among the elements in order of abundance in the Earth's crust and is a common constituent in natural water. Ferromagnesian minerals in igneous rock and magnesium carbonate in carbonate rocks are two of the more important sources of magnesium in natural water. Magnesium concentrations in freshwater usually range from zero to several hundred milligrams per liter; but larger concentrations are not uncommon in water associated with limestone or dolomite.	Magnesium contributes to the total hardness of water. Large concentrations of magnesium are objectionable in domestic water supplies because they can exert a cathartic and diuretic action upon unacclimated users and increase soap or detergent consumption in water used for washing, bathing, and laundering. Magnesium also is undesirable in some industrial supplies, particularly in water used by textile, pulp and paper, and brewing industries and in water used in high-pressure boilers.
Sodium (Na)	Sodium is an abundant and widespread constituent of many soils and rocks and is the principal cation in natural water associated with argillaceous sediments, marine shales, and evaporites and in sea water. Sodium salts are very soluble and once in solution tend to stay in solution. Sodium concentrations in natural water vary from less than 1 mg/L in stream runoff from areas of high rainfall to more than 100,000 mg/L in ground and surface water associated with halite deposits in arid areas. In addition to natural sources of sodium, sewage, industrial effluents, oilfield brines, and deicing salts may contribute sodium to surface and ground water.	Sodium in drinking water may impart a salty taste and may be harmful to persons suffering from cardiac, renal, and circulatory diseases and to women with toxemias of pregnancy. Sodium is objectionable in boiler feedwater because it may cause foaming. Large sodium concentrations are toxic to most plants; and a large ratio of sodium to total cations in irrigation water may decrease the permeability of the soil, increase the pH of the soil solution, and impair drainage.

Table 4.- Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	
Potassium (K)	Although potassium is only slightly less common than sodium in igneous rocks and is more abundant in sedimentary rocks, the concentration of potassium in most natural water is much smaller than the concentration of sodium. Potassium is not as easily liberated from silicate minerals as sodium and is more easily adsorbed by clay minerals and reincorporated into solid weathering products. Concentrations of potassium more than 20 mg/L are unusual in natural freshwater, but much larger concentrations are not uncommon in brines or in water from hot springs.	Large concentrations of potassium in drinking water may impart a salty taste and act as a cathartic, but the range of potassium concentrations in most domestic supplies seldom causes these problems. Potassium is objectionable in boiler feedwaters because it may cause foaming. In irrigation water, potassium and sodium act similarly upon the soil, although potassium generally is considered less harmful than sodium.
Alkalinity	Alkalinity is a measure of the capacity of water to neutralize a strong acid, usually to pH of 4.5, and is expressed in terms of an equivalent concentration of calcium carbonate ($CaCO_3$). Alkalinity in natural water usually is caused by the presence of bicarbonate and carbonate ions and to a lesser extent by hydroxide and minor acid radicals such as borates, phosphates, and silicates. Carbonates and bicarbonates are common to most natural water because of the abundance of carbon dioxide and carbonate minerals in nature. Direct contribution to alkalinity in natural water by hydroxide is rare and usually can be attributed to contamination. The alkalinity of natural water varies widely but rarely exceeds 400 to 500 mg/L as $CaCO_3$.	Alkaline water may have a distinctive unpleasant taste. Alkalinity is detrimental in several industrial processes, especially those involving the production of food and carbonated or acid-fruit beverages. The alkalinity in irrigation water in excess of alkaline earth concentration may increase the pH of the soil solution, leach organic material and decrease permeability of the soil, and impair plant growth.
Sulfate (SO_4)	Sulfur is a minor constituent of the Earth's crust but is widely distributed as metallic sulfides in igneous and sedimentary rocks. Weathering of metallic sulfides such as pyrite by oxygenated water yields sulfate ions to the water. Sulfate is dissolved also from soils and evaporite sediments containing gypsum or anhydrite. The sulfate concentration in natural freshwater may range from zero to several thousand milligrams per liter. Drainage from mines may add sulfate to waters by virtue of pyrite oxidation.	Sulfate in drinking water may impart a bitter taste and act as a laxative on unacclimated users. According to the National Secondary Drinking Water Regulations proposed by the U.S. Environmental Protection Agency (1977a), the secondary maximum contaminant level of sulfate for public water systems is 250 mg/L. Sulfate also is undesirable in some industrial supplies, particularly in water used for the production of concrete, ice, sugar, and carbonated beverages and in water used in high-pressure boilers.
Chloride (Cl)	Chloride is relatively scarce in the Earth's crust but is the predominant anion in sea water, most petroleum-associated brines, and in natural freshwater, particularly water associated with marine shales and evaporites. Chloride salts are very soluble and once in solution tend to stay in solution. Chloride concentrations in natural water vary from less than 1 mg/L in stream runoff from humid areas to more than 100,000 mg/L in ground and surface water associated with evaporites in arid areas. The discharge of human, animal, or industrial wastes and irrigation return flows may add significant quantities of chloride to surface and ground water.	Chloride may impart a salty taste to drinking water and may accelerate the corrosion of metals used in water-supply systems. According to the National Secondary Drinking Water Regulations proposed by the U.S. Environmental Protection Agency (1977a), the secondary maximum contaminant level of chloride for public water systems is 250 mg/L. Chloride also is objectionable in some industrial supplies, particularly those used for brewing and food processing, paper and steel production, and textile processing. Chloride in irrigation water generally is not toxic to most crops but may be injurious to citrus and stone fruits.
Fluoride (F)	Fluoride is a minor constituent of the Earth's crust. The calcium fluoride mineral fluorite is a widespread constituent of resistate sediments and igneous rocks, but its solubility in water is negligible. Fluoride commonly is associated with volcanic gases, and volcanic emanations may be important sources of fluoride in some areas. The	Fluoride in drinking water decreases the incidence of tooth decay when the water is consumed during the period of enamel calcification. Excessive quantities in drinking water consumed by children during the period of enamel calcification may cause a characteristic discoloration (mottling) of the teeth. According to the

Table 4.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Fluoride--Cont.	fluoride concentration in fresh surface water usually is less than 1 mg/L; but larger concentrations are not uncommon in saline water from oil wells, ground water from a wide variety of geologic terranes, and water from areas affected by volcanism.	National Interim Primary Drinking Water Regulations established by the U.S. Environmental Protection Agency (1976), the maximum contaminant level of fluoride in drinking water varies from 1.4 to 2.4 mg/L, depending upon the annual average of the maximum daily air temperature for the area in which the water system is located. Excessive fluoride also is objectionable in water supplies for some industries, particularly in the production of food, beverages, and pharmaceutical items.
Nitrogen (N)	A considerable part of the total nitrogen of the Earth is present as nitrogen gas in the atmosphere. Small quantities of nitrogen are present in rock, but the element is more concentrated in soils or biological material. Nitrogen is a cyclic element and may occur in water in several forms. The forms of most interest in water in order of increasing oxidation state, include organic nitrogen, ammonia nitrogen (NH_4-N), nitrite nitrogen (NO_2-N) and nitrate nitrogen (NO_3-N). These forms of nitrogen in water may be derived naturally from the leaching of rocks, soils, and decaying vegetation; from rainfall, or from biochemical conversion of one form to another. Other important sources of nitrogen in water include effluent from wastewater treatment plants, septic tanks, and cesspools and drainage from barnyards, feed lots, and fertilized fields. Nitrate is the most stable form of nitrogen in an oxidizing environment and usually is the dominant form of nitrogen in natural water and in polluted water that have undergone self-purification or aerobic treatment processes. Significant quantities of reduced nitrogen often are present in some ground water, deep unoxygenated water of stratified lakes and reservoirs, and water containing partially stabilized sewage or animal wastes.	Concentrations of any of the forms of nitrogen in water significantly larger than the local average may suggest pollution. Nitrate and nitrite are objectionable in drinking water because of the potential risk to bottle-fed infants for methemoglobinemia, a sometimes fatal illness related to the impairment of the oxygen-carrying ability of the blood. According to the National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1976), the maximum contaminant level of nitrate (as N) in drinking water is 10 mg/L. Although a maximum contaminant level for nitrite is not specified in the drinking water regulations, Appendix A to the regulations (U.S. Environmental Protection Agency, 1976) indicates that waters with nitrite concentrations (as N) more than 1 mg/L should not be used for infant feeding. Excessive nitrate and nitrite concentrations also are objectionable in water supplies for some industries, particularly in water used for the dyeing of wool and silk fabrics and for brewing.
Phosphorus (P)	Phosphorus is a major component of the mineral apatite, which is widespread in igneous rock and marine sediments. Phosphorus also is a component of household detergents, fertilizers, human and animal metabolic wastes, and other biological material. Although small concentrations of phosphorus may occur naturally in water as a result of leaching from rocks, soils, and decaying vegetation, larger concentrations likely are to occur as a result of pollution.	Phosphorus stimulates the growth of algae and other nuisance aquatic plant growth, which may impart undesirable tastes and odor to the water, become aesthetically unpleasant, alter the chemistry of the water supply, and affect water treatment processes.
Dissolved solids	Theoretically, dissolved solids are anhydrous residues of the dissolved substance in water. In reality, the term "dissolved solids" is defined by the method used in the determination. In most water, the dissolved solids consist predominantly of silica, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, and sulfate with minor or trace quantities of other inorganic and organic constituents. In regions of large rainfall and relatively insoluble rocks, water may contain dissolved-solids concentrations of less than 25 mg/L; but saturated sodium chloride brines in other areas may contain more than 300,000 mg/L.	Dissolved-solids values are widely used in evaluating water quality and in comparing water. The following classification based on the concentrations of dissolved solids commonly is used by the U.S. Geological Survey (Winslow and Kister, 1956). Classification — Dissolved-solids concentration (mg/L) Fresh — <1,000 Slightly saline — 1,000 - 3,000 Moderately saline — 3,000 - 10,000 Very saline — 10,000 - 35,000 Brine — >35,000 National Secondary Drinking Regulations (U.S. Environmental Protection Agency, 1977a) set a

Table 4.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Dissolved-solids--Cont.		dissolved-solids concentration of 500 mg/L as the secondary maximum contaminant level for public water systems. This level was set primarily on the basis of taste thresholds and potential physiological effects, particularly the laxative effect on unacclimated users. Although drinking water containing more than 500 mg/L is undesirable, such water is used without any obvious ill effects in many areas where less mineralized supplies are not available. Dissolved solids in industrial water supplies can cause foaming in boilers; interfere with clearness, color, or taste of many finished products; and accelerate corrosion. Uses of water for irrigation also are limited by excessive dissolved-solids concentrations. Dissolved solids in irrigation water may adversely affect plants directly by the development of high osmotic conditions in the soil solution and the presence of phytoxins in the water or indirectly by their effect on soils.
Specific conductance (microsiemens)	Specific conductance is a measure of the ability of water to transmit an electrical current and depends on the concentrations of ionized constituents dissolved in the water. Natural water in contact only with granite, well-leached soil, or other sparingly soluble material often has a conductance of less than 50 µS. The specific conductance of some brines exceed several hundred thousand microsiemens.	The specific conductance is an indication of the degree of mineralization of water and may be used to estimate the concentration of dissolved solids in the water.
Hardness as $CaCO_3$	Hardness of water is attributable to all polyvalent metals but principally to calcium and magnesium ions expressed as $CaCO_3$ (calcium carbonate). Water hardness results naturally from the solution of calcium and magnesium, both of which are widely distributed in common minerals of rocks and soil. Hardness of water in contact with limestone commonly exceeds 200 mg/L. In water from gypsiferous formations, a hardness of 1,000 mg/L is not uncommon.	Hardness values are used in evaluating water quality and in comparing water. The following classification is commonly used by the U.S. Geological Survey. Hardness (mg/L as $CaCO_3$) — Classification 0 - 60 — Soft 61 - 120 — Moderately hard 121 - 180 — Hard >180 — Very hard Excessive hardness of water for domestic use is objectionable because it causes incrustations on cooking utensils and water heaters and increased soap or detergent consumption. Excessive hardness also is undesirable in many industrial supplies. (See discussions concerning calcium and magnesium.)
pH	The pH of a solution is a measure of its hydrogen ion activity. By definition, the pH of pure water at a temperature of 25 °C is 7.00. Natural water contains dissolved gases and minerals, and the pH may deviate significantly from that of pure water. Rainwater not affected significantly by atmospheric pollution generally has a pH of 5.6 due to the solution of carbon dioxide from the atmosphere. The pH range of most natural surface and ground water is about 6.0 to 8.5. Natural water generally is slightly basic (pH >7.0) because of the prevalence of carbonates and bicarbonates, which tend to increase the pH.	The pH of a domestic or industrial water supply is significant because it may affect taste, corrosion potential, and water-treatment processes. Acidic water may have a sour taste and cause corrosion of metals and concrete. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977a) set a pH range of 6.5 to 8.5 as the secondary maximum contaminant level for public water systems.

1/ Most of the material in this table has been summarized from several references. For a more thorough discussion of the source and significance of these and other water-quality properties and constituents, the reader is referred to the following additional references: American Public Health Association and others (1975); Hem (1970); McKee and Wolf (1963); National Academy of Sciences, National Academy of Engineering (1973); National Technical Advisory Committee to the Secretary of the Interior (1968); and U.S. Environmental Protection Agency (1977b).

are listed in table 5. Suggested allowable levels for those constituents and properties not covered in the U.S. Environmental Protection Agency publications are taken from a study by the National Academy of Sciences and National Academy of Engineering (1973). Data available in Chow (1964), Hem (1970), and Briggs and Ficke (1977) provided information on other regions which were used for comparisons.

Statistical summaries of the data, grouped in the six categories, are presented in tables 6-11. These tables include not only the mean, standard deviation, maximum, minimum, and selected percentile values, but also the number of samples collected which exceeded maximum contaminant levels. The range is the most useful statistic for describing the quality of water. The percentile values selected--10th, 50th (median), and 90th--are useful for viewing the distribution of the concentrations or readings for a selected constituent or property. The number of samples collected which exceed accepted water-quality criteria best illustrate how the water compares to acceptable public water supplies.

Some of the water-quality data were reported by the Geological Survey laboratory and stored as "less than " (<) values or as "not detected" (ND) values. The "less than" values mean that the constituent value when analyzed was less than the lower limit of detection for that particular constituent using the applicable analytical methodology. The "not detected" values indicate that a lower limit of detection for that constituent had not been established at the time of the analysis, and the constituent could not be "detected" using the applicable analytical methodology. For the purpose of this report, values reported as "less than" were converted to the detection limit value and values reported as "not detected" were converted to zero. Consequently, some of the computed statistics vary from their "true" values, but are considered suffiiently accurate for this study. Constituents for which these "less than" or "not detected" values were adjusted include dissolved fluoride, some of the nutrient data, much of the trace-element data, and most of the pesticide and PCB data. These adjusted values are reflected in tables 8-11 and are presented in the appendix.

Field Measurements, Biochemical Oyxgen Demand, and Bacteria

The water-quality constituents and properties in this group are: water temperature, pH, dissolved oxygen, dissolved oxygen percent saturation, specific conductance, 5-day BOD, total-coliform bacteria, fecal-coliform bacteria, fecal-streptococci bacteria, and fecal-coliform bacteria/fecal-streptococci bacteria. The ranges shown in table 6 are compared with the abovementioned criteria where applicable.

Water temperature ranged from 5.0 to 29.0 °C. This range is well within suggested guidelines for thermal limits on natural streams (short-term maximum, 32.5 °C), although some aquatic life would not survive at the warmer temperatures (U.S. Environmental Protection Agency, 1976).

The values of pH ranged from 5.7 to 7.9. No value exceeded the upper limit for drinking water supplies of 8.5. Thirty-seven percent of the samples were less than the accepted lower limit of 6.5. However, the minimum pH value obtained, 5.7, is still slightly greater than the frequently observed value of 5.6 for rainwater (Hem, 1970).

Table 5.--Summary of standards for selected water-quality constituents and properties for public water systems 1/

[µg/L, microgram per liter; mg/L, milligram per liter; °C, degree Celsius]

Constituent 2/	Maximum contaminant level 3/	Secondary maximum contaminant level 4/
	Inorganic chemicals and related properties	
pH (standard units)	--	6.5 - 8.5
Arsenic (As)	50 µg/L	--
Barium (Ba)	1,000 µg/L	--
Cadmium (Cd)	10 µg/L	--
Chloride (Cl)	--	250 mg/L
Chromium (Cr)	50 µg/L	--
Copper (Cu)	--	1,000 µg/L
Iron (Fe)	--	300 µg/L
Lead (Pb)	50 µg/L	--
Manganese (Mn)	--	50 µg/L
Mercury (Hg)	2 µg/L	--
Nitrate (as N)	10 mg/L	--
Selenium (Se)	10 µg/L	--
Silver (Ag)	50 µg/L	--
Sulfate (SO_4)	--	250 mg/L
Zinc (Zn)	--	5,000 µg/L
Dissolved solids	--	500 mg/L
Fluoride (F) 5/		
Average of maximum daily air temperature (°C)		
12.0 and below	2.4 mg/L	--
12.1 - 14.6	2.2 mg/L	--
14.7 - 17.6	2.0 mg/L	--
17.7 - 21.4	1.8 mg/L	--
21.5 - 26.2	1.6 mg/L	--
26.3 - 32.5	1.4 mg/L	--
	Organic chemicals	
Chlorinated hydrocarbons		
Endrin	0.2 µg/L	--
Lindane	4 µg/L	--
Methoxychlor	100 µg/L	--
Toxaphene	5 µg/L	--
Chlorophenoxys		
2,4-D	100 µg/L	--
Silvex	10 µg/L	--

1/ Public water system.--A system for the provision of piped water to the public for human consumption, if such system has at least 15 service connections or regularly serves at least 25 individuals daily at least 60 days out of the year.

2/ Constituent.--Any physical, chemical, biological, or radiological substance or matter in water.

3/ Maximum contaminant level.--The maximum permissible level of a contaminant in water which is delivered to the free-flowing outlet of the ultimate user of a public water system. Maximum contaminant levels are those levels set by the U.S. Environmental Protection Agency (1976) in the National Interim Primary Drinking Water Regulations. These regulations deal with contaminants that may have a significant direct impact on the health of the consumer and are enforceable by the U.S. Environmental Protection Agency.

4/ Secondary maximum contaminant level.--The advisable maximum level of a contaminant in water which is delivered to the free-flowing outlet of the ultimate user of a public water system. Secondary maximum contaminant levels are those levels proposed by the U.S. Environmental Protection Agency (1977a) in the National Secondary Drinking Water Regulations. These regulations deal with contaminants that may not have a significant direct impact on the health of the consumer, but their presence in excessive quantities may affect the aesthetic qualities of the water and may discourage the use of a drinking-water supply by the public.

5/ Fluoride.--The maximum contamination level for fluoride depends on the annual average of the maximum daily air temperatures for the location in which the public water system is situated.

Table 6.--Statistical summary of water-quality data grouped as field measurements, biochemical oxygen demand, and bacteria

[°C, degree Celsius; mg/L, milligram per liter; microsiemens, microsiemens per centimeter at 25°C; cols./100 mL, colonies per 100 milliliters; <, less than; >, more than; --, level not defined]

Constituent or property	Number of samples	Mean	Standard deviation	Range		Percent of samples in which values were less than or equal to those shown			Number of samples with concentrations greater than 0.0	Maximum contaminant level	Number of samples exceeding maximum contaminant level
				Minimum	Maximum	10	50 (median)	90			
Water temperature (°C)	408	20.69	5.43	5.00	29.0	11.00	22.50	25.00	408	32.5	0
pH (units)	409	6.66	.48	5.7	7.9	6.1	6.7	7.2	409	<6.5 >8.5	153 1
Dissolved oxygen (mg/L)	410	4.43	3.31	0	12.6	.20	4.30	9.49	406	>5.0	235
Dissolved oxygen percent saturation (percent)	387	48.79	32.48	0	116.0	2.00	52.00	88.20	383	--	--
Specific conductivity (microsiemens)	410	143.49	117.75	49.00	920.0	78.00	109.00	200.00	410	--	--
5-day biochemical oxygen demand (mg/L)	227	6.07	4.29	.9	22.0	2.8	4.5	14.0	227	10.0	35
Total coliform (cols./100 mL)	223	18,985.20	45,138.20	290	620,000	2,500	9,300	38,000	223	20,000.0	55
Fecal coliform (cols./100 mL)	223	1,823.18	5,387.78	14	75,000	48	580	4,320	223	2,000.0	55
Fecal streptococci (cols./100 mL)	223	2,127.26	3,045.02	12	16,000	102	650	7,000	223	16,000.0	--
Ratio of fecal coliform to fecal streptococci	223	1.45	3.87	.02	48.3	.16	.70	2.73	223	<.7 >4.0	111 12

The values for dissolved oxygen and dissolved oxygen percent saturation, show differences between the sites inside the reservoirs and those outside the reservoirs. Dissolved oxygen ranged from 2.9 to 12.6 mg/L (milligrams per liter) for sites outside the reservoirs. However, dissolved oxygen at sites inside the reservoirs ranged from 0.0 to 10.0 mg/L. These values indicate that anaerobic conditions can occur in the reservoir during short storage periods. Small concentrations of dissolved oxygen are harmful to fish populations and aquatic life in general (minimum, 5.0 mg/L as per U.S. Environmental Protection Agency, 1976). Values of dissolved oxygen were smaller than 5.0 mg/L in 57 percent of the samples. This indicates that the water, in general, is not very supportive of aquatic life. The values of dissolved oxygen percent saturation also indicate some differences between the water in the reservoirs and the water flowing in the inflow and outflow streams (reaeration in the flowing streams may increase dissolved oxygen). Dissolved oxygen-percent saturation values ranged from 33 to 116 for flowing streams and from 0 to 90 in the reservoirs.

Specific conductance is measured in units of microsiemens per centimeter at 25 °C (µS). Values ranged from 49 to 920 µS with a median of 109 µS. Only 4 percent of the samples exceeded 500 µS. There are no maximum levels defined for public water supplies, but as table 4 shows, these values are considered small.

BOD values ranged from 0.9 to 22.0 mg/L with a median of 4.5 mg/L. This indicates that at least 50 percent of the time, BOD will be much less than the maximum values indicated. BOD values as small as 1.0 to 2.0 mg/L have been observed for unpolluted river water (Chow, 1964). Current State requirements seek a maximum BOD value of 10.0 mg/L for effluent from domestic wastewater-treatment facilities (Texas Department of Water Resources, written commun., 1985). This value was exceeded by 15 percent of the samples.

One of the primary concerns of authorities who manage public water supplies is disease-producing organisms or pathogens. While it is expensive, time consuming, and complicated to identify all pathogens, the microbiological assessment of drinking water traditionally has been measured by the occurrence and density of fecal contamination in water sources. Members of the fecal-coliform and fecal-streptococci groups of bacteria are used in measuring this fecal density. In addition, the ratio of fecal coliform to fecal streptococci also is used to evaluate and identify contamination sources (human or animal). The ranges of these measurements are compared with the aforementioned criteria where that criteria is applicable.

The measured densities of total-coliform bacteria ranged from 290 to 620,000 cols./100 mL (colonies per 100 milliliters) with a median value of 9,300 cols./100 mL. A stated limit for total-coliform bacteria is that the geometric mean not exceed 20,000 cols./100 mL (National Academy of Sciences, National Academy of Engineering, 1973). This limit was exceeded by 25 percent of the samples. The geometric mean computed from all samples collected during the study equaled 9,580 cols./100 mL.

A major problem with the use of total-coliform bacteria as an indicator of pathogenic microorganisms is the uncertain correlation of the density value to the occurrence of pathogens. However, the presence of fecal-coliform bacteria in water confirms the presence of fecal contamination, which is the most probable source of pathogens. Fecal-coliform bacteria densities ranged from 14 to 75,000 cols./100 mL with a median of 580 cols./100 mL. A stated limit for fecal-coliform bacteria is that the geometric mean not exceed 2,000 cols./100 mL (National Academy of Sciences, National Academy of Engineering, 1973). This limit was exceeded by 25 percent of the samples. The geometric mean for the samples collected equaled 520 cols./100 mL.

Data on fecal-streptococci bacteria are collected as an aid in determining the fecal densities and probable sources of bacterial pollution. Both fecal-streptococci bacteria and fecal-coliform bacteria are found in all warm-blooded animals. However, fecal-streptococci bacteria are much more numerous in animals, while humans have more fecal-coliform bacteria. Densities for fecal-streptococci bacteria ranged from 12 to 16,000 cols./100 mL with a median of 650 cols./100 mL. The geometric mean computed for all samples equaled 750 cols./100 mL. No stated limit for this property was found in the literature.

As indicated above, the value of fecal streptococci bacteria has been used as an aid in determining the probable source of bacterial pollution. Geldriech and Kenner (1969) found that a ratio of fecal-coliform bacteria to fecal-streptococci bacteria larger than 4.0 indicates predominantly human sources while a ratio of less than 0.7 indicates predominantly animal sources (farm animals or farmland drainage). Ratios in the range of 0.7 to 4.0, indicate a combination of human and animal sources. Ratios of fecal-coliform bacteria to fecal-streptococci bacteria ranged from 0.02 to 48.33 with a median of 0.70. It is interesting to note that of the total 223 bacterial samples, less than 6 percent had a ratio of fecal-coliform to fecal-streptococci bacteria more than 4.0, while 50 percent had ratios less than or equal to 0.7.

Physical and Aesthetic Properties

The water-quality constituents and properties in this group are suspended solids, volatile suspended solids, turbidity, and color. The ranges shown in table 7 for each of these are compared with previously mentioned criteria where applicable.

The three properties--suspended solids, volatile suspended solids, and turbidity--will directly affect the photosynthetic activity in the water body. Values of suspended solids ranged from 4 to 1,290 mg/L and had a median of 101 mg/L; 34 percent of the samples had values larger than 150 mg/L. Values of volatile suspended solids ranged from 0 to 200 mg/L and had a median of 18 mg/L; 6 percent of the samples had a value of 0, and 34 percent had values that exceeded 25 mg/L. Values of turbidity ranged from 1.5 to 800 NTU (nephelometric turbidity units) and had a median of 80 NTU; 33 percent of the samples had values that exceeded 100 NTU. Actual standards for these three properties are not readily available in the literature.

One of the effects that occurs in reservoirs is the settling of suspended material. The magnitude of this effect is shown by dividing the data at the reservoirs into one group and all other sites into another group. These data are summarized below by tabulating the minimum and maximum of several percentiles from a group of sites.

Table 7.--Statistical summary of water-quality data grouped as physical and aesthetic properties

[mg/L, milligram per liter; NTU, nephelometric turbidity unit; Pt-Co unit, platinum-cobalt unit; --, level not defined]

Constituent or property	Number of samples	Mean	Standard deviation	Range		Percent of samples in which values were less than or equal to those shown			Number of samples with concentrations greater than 0.0	Maximum contaminant level	Number of samples exceeding maximum contaminant level
				Minimum	Maximum	10	50 (median)	90			
Suspended solids (mg/L)	218	148.41	163.28	4	1,290	19	101	320	218	--	--
Volatile suspended solids (mg/L)	217	29.66	33.51	0	200	3	18	77	204	--	--
Turbidity (NTU)	196	102.15	97.05	1.5	800	17.0	80.0	223.0	196	--	--
Color (Pt-Co unit)	226	170.03	106.47	10	1,100	60	160	253	226	75	190

Parameter	Range among sites				
	Minimum	Maximum	10th percentile	Medina	90th percentile
			Barker and Addicks Reservoirs		
Suspended solids (mg/L)	4 to 11	435 to 682	9 to 15	44 to 68	270 to 324
Volatile suspended solids (mg/L)	0 to 0	123 to 140	3 to 3	16 to 16	69 to 74
Turbidity (NTU)	1.6 to 4.4	380 to 480	7 to 12	65 to 68	244 to 302
			All sites except the reservoirs		
Suspended solids (mg/L)	5 to 38	352 to 1,290	21 to 41	80 to 149	246 to 619
Volatile suspended solids (mg/L)	0 to 4	54 to 200	0 to 9	12 to 23	35 to 120
Turbidity (NTU)	1.5 to 8.6	220 to 800	7.4 to 25	75 to 100	192 to 506

A comparison of the ranges for each statistic shows that the reservoir is acting as a settling basin.

Color, measured in platinum-cobalt units (Pt-Co units), ranged from 10 to 1,100 in the study area with a median of 160. The large value, which occurred at the Buffalo Bayou near Katy streamflow station on December 12, 1978, may be an anomaly. Removing this value, the range for color becomes 10 to 450. This is compared to a maximum level of 75 for domestic water supplies (U.S. Environmental Protection Agency, 1976). Eighty-four percent of the samples exceeded this level, indicating that the water consistently exceeds the level for color.

The values obtained for the constituents and properties included in this category indicate that the water is not very pleasing aesthetically, and though not confirmed by this study, probably results in low levels of photosynthetic activity.

Major Inorganic Constituents and Related Properties

The water-quality constituents and properties in this group include: dissolved solids, alkalinity, hardness, calcium, magnesium, sodium, sodium adsorption ratio, potassium, chloride, sulfate, fluoride, and silica. A summary of the sources and significance of these constituents and properties is given in table 4. The ranges shown in table 8 for each of these are compared with the aforementioned criteria where that criteria is applicable.

Table 8.--Statistical summary of water-quality data grouped as major inorganic constituents and related properties

[mg/L, milligram per liter; >, more than; --, level not defined]

Constituent or property	Number of samples	Mean	Standard deviation	Range		Percent of samples in which values were less than or equal to those shown			Number of samples with concentrations greater than 0.0	Maximum contaminant level	Number of samples exceeding maximum contaminant level
				Minimum	Maximum	10	50 (median)	90			
Dissolved solids (mg/L)	204	89.96	78.25	27.0	509.0	44.00	67.00	130.00	204	500.0	1
Bicarbonate (mg/L)	166	50.49	38.77	13.0	250.0	22.00	38.00	85.30	166	400.0	0
Carbonate (mg/L)	165	0	0	0	0	0	0	0	0	--	--
Hardness, carbonate (mg/L)	206	42.89	29.49	16.0	190.0	21.00	35.00	71.00	206	0-60 60-120 120-180 >180	180 17 8 1
Hardness, noncarbonate (mg/L)	123	4.13	5.40	0	47.0	0	3.00	9.00	106	--	--
Calcium (mg/L)	206	13.34	9.50	4.6	62.0	6.37	11.00	22.30	206	--	--
Magnesium (mg/L)	206	2.40	1.51	.6	9.6	1.30	1.90	3.80	206	--	--
Sodium (mg/L)	206	12.36	17.40	.5	120.0	4.00	7.70	19.30	206	--	--
Sodium adsorption ration, SAR (units)	206	.74	.62	0	5.0	.40	.60	1.00	205	4.0	1
Potassium (mg/L)	206	4.00	1.40	1.9	9.5	2.40	3.75	6.10	206	--	--
Chloride (mg/L)	204	15.42	21.18	2.9	160.0	5.00	8.85	22.50	204	250.0	0
Sulfate (mg/L)	205	9.25	11.76	2.0	140.0	3.86	6.10	17.00	205	250.0	0
Fluoride (mg/L)	205	.17	.11	0	.9	.10	.10	.30	204	1.4	0
Silica (mg/L)	205	7.88	3.92	1.3	25.0	4.02	6.90	13.40	205	--	--

Values for dissolved solids ranged from 27 to 509 mg/L with a median of 67 mg/L. A maximum dissolved-solids level of 500 mg/L for drinking water has been proposed (U.S. Environmental Protection Agency, 1976), whereas water with concentrations less than 1,000 mg/L have been considered fresh as indicated in table 4. Only 1 sample (0.5 percent of total) exceeded the stated drinking water standard, and only 12 samples (6 percent of total) exceeded 250 mg/L.

Alkalinity is reported as an equivalent quantity of calcium carbonate. The values in table 8 for bicarbonate (HCO_3) and carbonate (CO_3) ions may be converted to alkalinity as calcium carbonate using the relation:

$$\text{alkalinity as } CaCO_3 = 50.0 \times [(\text{bicarbonate} \times 0.016) + (\text{carbonate} \times 0.033)]$$

Most samples did not contain carbonate ions. Values for bicarbonate ranged from 13 to 250 mg/L and had a median of 38 mg/L. In terms of alkalinity as calcium carbonate, the range becomes 11 to 205 mg/L with a median of 31 mg/L. These values indicate that alkalinity is well below the recommended maximum contaminant level of 400 mg/L for human health (U.S. Environmental Protection Agency, 1976).

Hardness of water is attributed principally to calcium and magnesium. It is expressed in milligrams per liter of calcium carbonate. Values ranged from 16 to 190 mg/L and had a median of 35 mg/L. Table 4 indicates that ranges of hardness from 0 to 60 mg/L apply to water described as "soft", 60 to 120 mg/L as "moderately hard", 120 to 180 mg/L as "hard", and more than 180 mg/L as very hard". The water is considered soft in 87 percent of the samples, moderately hard in 8 percent, hard in 4 percent, and very hard in 0.5 percent.

Calcium and magnesium are alkaline-earth metals of which calcium was found to be the more abundant constituent in this study. Values for calcium ranged from 4.6 to 62 mg/L and had a median of 11 mg/L. There are no stated limits in the literature, but these values appear small. Magnesium concentrations for the study ranged from 0.6 to 9.6 mg/L and had a median of 1.9 mg/L. These values are well below the limit of 50 mg/L suggested for drinking water (Chow, 1964).

Sodium and potassium are alkali metals of which sodium was found in more abundance than potassium during this study. Neither element has stated limits in the literature. Values for sodium ranged from 0.5 to 120 mg/L and had a median of 7.7 mg/L. The sodium adsorption ratio (SAR) is used to predict the degree to which irrigation water may enter into cation-exchange reactions in a soil. Large values imply a danger of sodium replacing adsorbed calcium and magnesium, and subsequent damage to the soil structure (Hem, 1970). SAR ranged from 0 to 5.0 and had a median of 0.6; only one sample (0.5 percent of total) exceeded 4.0. Irrigation water with SAR values larger than 4.0 may be harmful for certain sensitive crops (Hem, 1970). Values for potassium ranged from 1.9 to 9.5 mg/L and had a median of 3.75 mg/L. Values of potassium in most natural water usually are less than 10 mg/L (Chow, 1964).

Chlorides are present in all natural water. Values ranged from 2.9 to 160 mg/L and had a median of 8.85 mg/L. Public water systems are limited to a recommended maximum contaminant level for chloride of 250 mg/L (U.S. Environmental Protection Agency, 1976).

Sulfate is available to natural water from igneous and sedimentary rocks and soil. Values ranged from 2.0 to 140 mg/L and had a median of 6.1 mg/L. Sulfate concentrations were found to be well below the recommended maximum contaminant level of 250 mg/L for public water systems (U.S. Environmental Protection Agency, 1976).

Fluoride values ranged from 0.0 to 0.9 mg/L and had a median of 0.1 mg/L. The minimum value was found in one sample and reflects a "not detected" quantity of fluoride. The recommended maximum contaminant levels for fluoride are temperature dependent as illustrated by table 5. However, the worst case shown in table 5 indicates that for the temperature range of 26.3 to 32.5 °C, a maximum level of 1.4 mg/L has been set. The values for this study are less than that level.

Silica is the oxide of silicon and is formed by dissolution of silicon rocks. Silica values ranged from 1.3 to 25 mg/L and had a median of 6.90 mg/L. Values of 100 mg/L or more may occur naturally, but natural water usually has concentrations less than 40 mg/L (Chow, 1964).

Nutrients and Total Organic Carbon

The water-quality constituents in this group are: total organic nitrogen, total ammonia nitrogen, total nitrite nitrogen, total nitrate nitrogen, total phosphorus, and TOC. A summary of the sources and significance of the various forms of nitrogen and phosphorus is given in table 4. The ranges, shown in table 9, are compared with the aforementioned water-quality criteria where applicable. As mentioned previously, the statistics presented in table 9 reflect the adjustment of "not detected" and "less than" values reported for individual samples.

Total organic nitrogen values ranged from 0.10 to 3.50 mg/L and had a median of 1.20 mg/L as nitrogen (N). Eighteen percent of the samples had values larger than 1.5 mg/L as N. There are no limits indicated in the literature.

Total ammonia nitrogen concentrations ranged from 0.01 to 8.60 mg/L as N and had a median of 0.14 mg/L as N. The largest value, which occurred at the Buffalo Bayou near Katy streamflow station on March 3, 1981, at a discharge of 1.50 ft^3/s, may be associated with agricultural related activities near the site. The same sample also yielded large values of nitrite nitrogen (1.50 mg/L as N) and nitrate nitrogen (8.10 mg/L as N). There is a possible toxicity to freshwater aquatic life in water containing ammonia nitrogen due to the simultaneous presence of un-ionized ammonia (NH_3), as a result of chemical equilibrium. This toxicity is related to certain ranges of pH, water temperature, and total ammonia nitrogen concentrations (U.S. Environmental Protection Agency, 1976). Only the sample of March 3, 1981, at Buffalo Bayou near Katy exceeded the toxicity for un-ionized ammonia. The public water supply limit for total ammonia nitrogen of 0.5 mg/L (National Academy of Sciences, National Academy of Engineering, 1973) was exceeded by 8 percent of the samples.

Total nitrite nitrogen ranged from 0.01 to 1.50 mg/L as N with a median of 0.04 mg/L as N. Removing the previously mentioned large value reduces this range to 0.01 to 0.68 mg/L as N. To prevent the possibility of methemoglobin-

Table 9.--Statistical summary of water-quality data grouped as nutrients and total organic carbon

[mg/L, milligram per liter; --, level not defined]

Constituent or property	Number of samples	Mean	Standard deviation	Range		Percent of samples in which values were less than or equal to those shown			Number of samples with concentrations greater than 0.0	Maximum contaminant level	Number of samples exceeding maximum contaminant level
				Minimum	Maximum	10	50 (median)	90			
Organic nitrogen (mg/L as N)	224	1.21	0.46	0.10	3.50	0.74	1.20	1.70	224	--	--
Ammonia nitrogen (mg/L as N)	226	.25	.61	.01	8.60	.04	.14	.41	226	0.5	17
Nitrite nitrogen (mg/L as N)	226	.073	.13	.01	1.50	.01	.04	.16	226	1.0	1
Nitrate nitrogen (mg/L as N)	224	.30	.83	0	8.10	0	.16	.95	178	10.0	0
NO_2 + NO_3 nitrogen (mg/L as N)	224	.37	.85	.01	9.60	.01	.15	.94	224	--	--
Total nitrogen (mg/L as N)	224	1.83	1.43	.23	18.00	.91	1.60	3.15	224	--	--
Total phosphorus (mg/L as P)	226	.56	.91	.01	9.70	.18	.33	1.00	226	.10	222
Total organic carbon (mg/L as C)	216	14.27	5.24	4.2	56.0	8.8	14.0	20.00	216	--	--

emia, public water supplies should not exceed a maximum of 1.0 mg/L as N total nitrite nitrogen concentration (U.S. Environmental Protection Agency, 1976). Only one sample (0.4 percent of total) exceeded this level.

Total nitrate nitrogen ranged from 0.00 to 8.10 mg/L as N and had a median of 0.16 mg/L as N. If the largest value is removed, this range becomes 0.00 to 4.90 mg/L as N. The maximum level of nitrate should not be exceeded in public water supplies because of its potential adverse health effects on infants and its adverse effect for certain industrial uses. The maximum concentration level of nitrate allowed in public water supplies is 10 mg/L (U.S. Environmental Protection Agency, 1976). No samples exceeded this value during the study; 21 percent of the samples collected had no detectable nitrate nitrogen.

Total phosphorus values ranged from 0.01 to 9.70 mg/L as P and had a median of 0.33 mg/L as P. As with several of the nitrogen forms, the largest value occurred at the Buffalo Bayou near Katy streamflow site on March 3, 1981. The removal of this value changes the range to 0.01 to 4.60 mg/L as P. Total phosphorus values of 0.03 mg/L as P are considered the upper limit for preventing nuisance algae growths in reservoirs, whereas, values of 0.10 mg/L are considered the upper limit for water which would interfere with water-treatment processes (U.S. Environmental Protection Agency, 1976). A total phosphorus concentration of 0.10 mg/L as P was exceeded by 98 percent of the samples. The data indicate that there is a large probability that this water would have growths of nuisance algae that depend on phosphorus.

TOC is a measure of the quantity of carbon present in solution as well as in suspended material in the water. TOC provides a gross measure of plant detritus, decay products, living cells, and organic chemicals. Large quantities of TOC often are associated with large nutrient concentrations. TOC values ranged from 4.2 to 56 mg/L and had a median of 14 mg/L. The median value found in this study is more than 75 percent of TOC concentrations determined in a national study (Briggs and Ficke, 1977). However, values for this study are typical for the Texas-Gulf area (Briggs and Ficke, 1977). It is assumed that the Texas-Gulf area, as compared to a less vegetated area, would yield larger values of TOC because of the readily available source of humic material and detritus bordering on the streams of the area. There are no known published limits for TOC concentrations as required for public water supplies.

Trace Elements

Trace elements usually occur in relatively small quantities in natural water. They are of concern because even in trace quantities they may be toxic to humans, animals, the biota of the aquatic ecosystem, and irrigated crops. Most trace elements are highly insoluble and usually are present in natural water in concentrations below normal detection limits, therefore, only a limited number of trace element samples were collected to define the ranges in concentration that might have occurred during the study. These samples cover the range of flow experienced during the study. Of the 22 total samples, 10 were collected at the reservoir outflows, 11 samples were collected at the Buffalo Bayou near Addicks site, and 1 was collected at the Langham Creek site.

The dissolved trace elements are: arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, silver, and zinc. These data are summarized in table 10 and compared to an accepted maximum limit for public water supplies. The statistics of table 10 reflect the adjustment of "not detected" and "less than" values reported for some samples.

Table 10 shows that the values of only two elements, iron and manganese, exceed the recommended maximum contaminant levels for public water supplies shown in table 5.

The recommended maximum contaminant level for iron was exceeded not only by the April 23, 1979, samples at both reservoir outflows and the Buffalo Bayou near Addicks site, but also by the sample of May 15, 1981, at the outflow from Barker Reservoir. An examination of the data listed in the supplemental data section shows that these concentrations occurred at flow rates larger than 190 ft^3/s, and that other large iron concentrations, more than 100 µg/L (micrograms per liter), occurred in 9 of the 11 other samples where flow was larger than 120 ft^3/s. This indicates the possibility that iron concentrations approaching the accepted maximum at larger flows may be related to reservoir releases. However, it should be noted that iron has been found to frequently exceed this limit in other regions of the country (Briggs and Ficke, 1977). Also, iron is not considered toxic at the levels indicated, but may affect the aesthetics of a public water supply (taste, color, and staining of laundry).

The limit for manganese was exceeded in the samples of March 3, 1981, at both reservoir outflows and at Buffalo Bayou near Addicks. These samples were collected during low-flow conditions. However, there were only six samples collected during low flow to determine trace element concentrations. Thus, a statement cannot be made as to the frequency that total dissolved manganese exceeds the maximum value at low flow. As with iron, manganese is not considered toxic at the levels indicated but may cause problems with the aesthetics of a public water supply.

Pesticides and Polychlorinated Biphenyls

Most pesticides are compounds of organic chemicals which are used to control insects, fungi, and weeds. PCB are industrial organic compounds. Pesticides and PCB are of concern because of their toxicity not only to humans but also to the overall environment, even in trace quantities. Only a limited number of pesticide and PCB samples were collected during this study. The ranges in values shown in table 11 are compared with the previously mentioned criteria, where applicable. The statistics summarized in table 11 reflect the adjustment of "not detected" and "less than" values as previously explained. Table 5 summarizes these criteria for some pesticides and PCB.

A total of 26 pesticides and PCB were analyzed for this study. These are grouped into three separate categories of compounds, the chlorinated hydrocarbons, the organophosphorous compounds, and the chlorophenoxy compounds. Each analysis represents both the dissolved and suspended phases, and concentrations are reported as total concentrations.

The chlorinated hydrocarbon compounds analyzed consist of 16 pesticides and 1 industrial organic compound: endrin, lindane, methoxychlor, toxaphene, perthane, polychlor napthalene, aldrin, chlordane, DDD, DDE, DDT, dieldrin, endosulfan, heptachlor, heptachlor epoxide, mirex, and PCB. Of these 17, only

Table 10.--Statistical summary of water-quality data grouped as trace elements

[µg/L, microgram per liter]

Constituent or property	Number of samples	Mean	Standard deviation	Range		Percent of samples in which values were less than or equal to those shown			Number of samples with concentrations greater than 0.0	Maximum contaminant level	Number of samples exceeding maximum contaminant level
				Minimum	Maximum	10	50 (median)	90			
Arsenic (µg/L)	22	3.45	1.60	1	6.0	2.00	3.0	6.00	22	50	0
Barium (µg/L)	22	113.18	94.74	50	500.0	50.00	100.0	200.00	22	1,000	0
Cadmium (µg/L)	22	1.18	.80	0	3.0	0	1.0	2.00	18	10	0
Chromium (µg/L)	22	5.91	7.34	0	20.0	0	0	20.00	10	50	0
Copper (µg/L)	22	5.27	4.17	0	10.0	0	3.5	10.00	19	1,000	0
Iron (µg/L)	22	198.64	201.24	10	680.0	13.00	125.0	600.00	22	300	4
Lead (µg/L)	22	7.86	9.98	0	40.0	0	6.0	23.90	15	50	0
Manganese (µg/L)	22	24.77	46.19	1	170.0	1.00	10.0	125.00	22	50	3
Mercury (µg/L)	22	.08	.05	0	.2	0	.1	.10	17	2	0
Selenium (µg/L)	22	.50	.51	0	1.0	0	.5	1.00	11	10	0
Silver (µg/L)	22	0	0	0	0	0	0	0	0	50	0
Zinc (µg/L)	22	13.59	9.10	0	30.0	3.00	15.0	27.00	21	5,000	0

Table 11.--Statistical summary of water-quality data grouped as pesticides and polychlorinated biphenyls

[μg/L, microgram per liter]

Constituent	Number of samples	Mean	Standard deviation	Range		Percent of samples in which values were less than or equal to those shown			Number of samples with concentrations greater than 0.0	Maximum contaminant level	Number of samples exceeding maximum contaminant level
				Minimum	Maximum	10	50 (median)	90			
Chlorinated hydrocarbon compounds											
Endrin (μg/L)	39	0	0	0	0	0	0	0	0	0.200	0
Lindane (μg/L)	39	.003	.007	0	.02	0	0	.020	6	4.000	0
Methoxychlor (μg/L)	17	0	0	0	0	0	0	0	0	100.000	0
Toxaphene (μg/L)	39	0	0	0	0	0	0	0	0	5.000	0
Perthane (μg/L)	37	0	0	0	0	0	0	0	0	0	0
Napthalene, polychlorinated (μg/L)	29	0	0	0	0	0	0	0	0	0	0
Aldrin (μg/L)	39	0	0	0	0	0	0	0	0	0	0
Chlordane (μg/L)	39	0	0	0	0	0	0	0	0	0	0
DDD (μg/L)	39	0	0	0	0	0	0	0	0	0	0
DDE (μg/L)	39	0	0	0	0	0	0	0	0	0	0
DDT (μg/L)	39	0	0	0	0	0	0	0	0	0	0
Dieldrin (μg/L)	39	.002	.004	0	.01	0	0	.010	6	.100	0
Endosulfan (μg/L)	39	0	0	0	0	0	0	0	0	0	0
Heptachlor (μg/L)	39	.001	.008	0	.05	0	0	0	1	.500	0
Heptachlor epoxide (μg/L)	39	.000	.002	0	.01	0	0	0	1	.100	0
PCB (μg/L)	39	.017	.038	0	.10	0	0	.100	6	.001	6
Mirex (μg/L)	39	0	0	0	0	0	0	0	0	0	0
Organophosphorous compounds											
Ethion (μg/l)	36	0	0	0	0	0	0	0	0	0	0
Malathion (μg/L)	36	.021	.094	0	.56	0	0	.032	10	.100	1
Parathion (μg/L)	36	.000	.002	0	.01	0	0	0	1	.040	0
Diazinon (μg/L)	36	.160	.192	0	.91	0	.105	.400	31	.910	3
Methyl parathion (μg/L)	36	.010	.017	0	.07	0	0	.030	12	.070	1
Trithion (μg/L)	36	0	0	0	0	0	0	0	0	0	0
Methyl trithion (μg/L)	36	0	0	0	0	0	0	0	0	0	0
Chlorophenoxy compounds											
2,4-D (μg/L)	41	.071	.113	0	.64	0	.030	.210	27	100.000	0
2,4,5-T (μg/L)	41	.015	.037	0	.22	0	.005	.033	18	2.000	0
Silvex (μg/L)	41	.003	.006	0	.02	0	0	.013	9	10.000	0

5 were shown to have any detectable concentrations during this study--lindane, dieldrin, heptachlor, heptachlor epoxide, and PCB. Only PCB exceeded the recommended maximum contaminant level. PCB values ranged from 0.0 to 0.10 µg/L. The maximum value is above the recommended level for PCB of 0.001 µg/L (U.S. Environmental Protection Agency, 1976). Of the 39 samples analyzed for PCB, the maximum value occurred in 6 samples, which also were the only samples in which PCB was detected. All six of these samples were taken either on April 21, 1979, or on April 23, 1979, at the Buffalo Bayou near Katy station, within both reservoirs, and the outflow from Barker Reservoir.

The organophosphorous compounds analyzed consist of seven pesticides: ethion, malathion, parathion, diazinon, methyl parathion, trithion, and methyl trithion. Four of these pesticides were shown to have detectable concentrations--malathion, parathion, diazinon, and methyl parathion. Malathion values ranged from 0.0 to 0.56 µg/L. Only 1 sample, that of June 27, 1979, at the Buffalo Bayou near Addicks station, of the total of 36 samples, exceeded the recommended maximum contaminant level of 0.1 µg/L (U.S. Environmental Protection Agency, 1976). Parathion values ranged from 0.0 to 0.01 µg/L, which were less than the stated recommended maximum contaminant level of 0.04 µg/L (U.S. Environmental Protection Agency, 1976). Total diazinon values ranged from 0.0 to 0.91 µg/L and had a median of 0.105 µg/L. Diazinon is the most prevalent of the 27 pesticides sampled in the study, occurring at all 7 sites sampled. No accepted maximum contaminant levels were found in the literature. Methyl parathion values ranged from 0.0 to 0.07 µg/L. No stated maximum levels were found in the literature.

The chlorophenoxy compounds analyzed consist of three pesticides: 2,4-D (2,4-dichlorophenoxyacetic acid), 2,4,5-T (2,4,5-trichlorophenoxyacetic acid), and silvex (2,4,5-trichlorophenoxy propionic acid). Each of these pesticides were detected; however, none of them exceeded the recommended maximum contaminant level.

EFFECTS ON WATER QUALITY DUE TO FLOOD-WATER DETENTION

For the purpose of this study, the effects on water quality due to flood-water detention are defined as the change in the value (discharge-weighted average) of the water-quality constituent or property between a reservoir's inflow and outflow. The effect is viewed as beneficial if the quality of water at the outflow improves or as detrimental if the quality of water at the outflow deteriorates.

The effects on water quality due to flood-water detention are illustrated using three approaches. The first approach was a computation of the discharge-weighted average value (Hem, 1970) for selected constituents and properties during each selected event. The nine selected water-quality constituents and properties are BOD, suspended solids, volatile suspended solids, turbidity, color, dissolved solids, total nitrogen, total phosphorus, and TOC. Special emphasis is placed on the May 1-22, 1981, event as it was the only event in which runoff was appreciably detained. The second approach was a computation of the means of the weighted values of each selected constituent for all events. A Student t-test was used to test the statistical significance of the difference between types of sites. The third approach was an analysis of selected constituents and properties which could not be subjected to computations of discharge-weighted values. Because these properties had little or no relation to discharge, they were studied by analyzing statistical measures at each site. These constituents and properties were water temperature, pH, dissolved oxygen, dissolved oxygen percent saturation, total-coliform bacteria, fecal-coliform bacteria, and fecal-streptococci bacteria.

Variation of Discharge-Weighted Average Values for Selected Hydrologic Events

The computed discharge-weighted average values are presented in table 12. These data are discussed below in two ways. First, the variation of the discharge-weighted average values are examined for each selected event (November 26 - December 13, 1978; February 2-28, 1979; September 17 - October 18, 1979; and May 1-22, 1981). Second, the event of May 1-22, 1981, is examined alone and in detail. It should be noted that each inflow site is assumed to also represent the contributions of the drainage area which intervenes between the site and the reservoirs.

Summary of Events

Table 13 summarizes the effects of flood-water detention of each reservoir on water quality. A positive sign indicates a beneficial effect of detention and a negative sign indicates a detrimental effect. "AVE" is used for the Addicks Reservoir system and indicates that the value of the outflow site is between the values at the two inflow sites.

The summary of results for the first three events shows little similarity between the two reservoirs with respect to detention and effects. The first event, November 26 - December 13, 1978, indicates that detention at each reservoir produced a similar effect for only one constituent, dissolved solids. For this event, water quality, as measured by dissolved solids, deteriorated, and the effect of detention was detrimental. During the second event, February 2-28, 1979, discharge-weighted values of color increased during detention, while total phosphorus values decreased. Thus, for this event, color deteriorated during detention, while total phosphorus showed an improvement. The third event, September 17 - October 18, 1979, had similar effects for four constituents and properties--BOD, suspended solids, turbidity, and TOC. Both BOD and TOC deteriorated (values increased), while suspended solids and turbidity benefited (values decreased). More similarity between effects and detention is shown in table 13 for the fourth event, May 1-22, 1981. Only one of the nine selected constituents and volatile suspended solids was not affected consistently. Six constituents or properties--BOD, suspended solids, turbidity, color, total nitrogen, and TOC--were improved by detention as discharge-weighted values decreased. The effect of detention on two constituents--dissolved solids and total phosphorus--was considered detrimental because their discharge-weighted values increased. This event differs from the others because flood runoff was detained for the longest period (almost 9 days) without any release of flow from either reservoir. Thus, the results from this event suggest that the effects of flood-water detention becomes more evident as detention time increases.

The results in table 13 also can be used to examine each of the nine selected constituents and properties. Six of the constituents and proper-

Table 12.--Computed discharge-weighted average values for selected events

[mg/L, milligram per liter; NTU, nephelometric turbidity unit; Pt-Co unit, platinum-cobalt unit; IF, inflow; OF, outflow]

Reservoir system	Station number	Biochemical oxygen demand (mg/L)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (pt-Co unit)	Dissolved solids (mg/L)	Total nitrogen (mg/L as N)	Total phosphorus (mg/L as P)	Total organic carbon (mg/L as C)
				November 26 - December 13, 1978						
Barker	08072300(IF)	5.03	333	58.0	225.0	417	91	2.49	0.49	29
	08072501(OF)	3.35	104	27.0	82.0	224	102	1.20	.31	18
Addicks	08072730(IF)	3.57	111	27.0	71.0	201	72	1.44	.31	18
	08072760(IF)	3.51	262	39.0	110.0	246	68	1.97	.27	16
	08073001(OF)	4.13	282	62.0	150.0	283	81	1.45	.43	19
				February 2-28, 1979						
Barker	08072300(IF)	6.31	237	38.0	120.0	197	93	1.68	.87	22
	08072501(OF)	3.95	141	26.0	80.0	230	62	1.23	.23	13
Addicks	08072730(IF)	4.07	87	7.1	67.0	150	45	1.23	.35	12
	08072760(IF)	3.33	206	41.0	85.0	190	42	1.16	.24	10
	08073001(OF)	3.94	161	36.0	86.0	225	56	1.32	.20	15
				September 17 - October 18, 1979						
Barker	08072300(IF)	3.90	83	11.0	27.0	73	90	1.34	.38	12
	08072501(OF)	7.99	11	10.0	5.7	72	82	1.19	.25	13
Addicks	08072730(IF)	3.09	101	21.0	135.0	134	59	.73	.23	12
	08072760(IF)	3.66	43	9.2	86.0	89	65	1.24	.30	13
	08073001(OF)	10.91	36	21.0	40.0	90	65	1.01	.26	14
				May 1-22, 1981						
Barker	08072300(IF)	8.79	247	11.0	136.0	141	78	2.31	.53	16
	08072501(OF)	5.13	11	5.6	28.0	79	94	1.68	.67	13
Addicks	08072730(IF)	6.17	233	8.6	209.0	137	53	1.74	.37	15
	08072760(IF)	5.43	196	18.0	155.0	178	63	2.23	.42	17
	08073001(OF)	4.97	102	19.0	46.0	112	70	1.48	.44	14

Table 13.--Summary of results, by events, for effects of detention on selected constituents and properties

[+, beneficial effect; -, detrimental effect;
AVE, concentration at the outflow site is between the concentrations at the two inflow sites]

Event			Event characteristics				Relative changes in discharge-weighted values								
Number	Beginning date	Ending date	Antecedent conditions	Precipitation (inches)	Days without releases	Average storage (acre-feet)	Biochemical oxygen demand	Suspended solids	Volatile suspended solids	Turbidity	Color	Dissolved solids	Total nitrogen	Total phosphorus	Total organic carbon
							Barker Reservoir system								
1	Nov. 26, 1978	Dec. 13, 1978	Dry	3.14	2 3/4	1,030	+	+	+	+	+	-	+	+	+
2	Feb. 2, 1979	Feb. 28, 1979	Wet	3.00	0	3,020	+	+	+	+	-	+	+	+	+
3	Sept. 17, 1979	Oct. 18, 1979	Dry	9.90	3	15,340	-	+	+	+	+	+	+	+	-
4	May 1, 1981	May 22, 1981	Wet	4.22	8 5/6	1,600	+	+	+	+	+	-	+	-	+
							Addicks Reservoir system								
1	Nov. 26, 1978	Dec. 13, 1978	Dry	3.14	0	153	-	-	-	-	-	-	AVE	-	-
2	Feb. 2, 1979	Feb. 28, 1979	Wet	3.00	0	1,180	AVE	AVE	AVE	AVE	-	-	-	+	-
3	Sept. 17, 1979	Oct. 18, 1979	Dry	9.90	4 1/4	10,240	-	+	AVE	+	AVE	AVE	AVE	AVE	-
4	May 1, 1981	May 22, 1981	Wet	4.22	8 3/4	3,000	+	+	-	+	+	-	+	-	+

ties--BOD, suspended solids, turbidity, color, total nitrogen, and TOC--show a similar effect within each reservoir during an event when flood water was detained for more than 2 days. For example, the discharged-weighted value of BOD increased during the third event for both reservoirs. Four of these constituents and properties--suspended solids, turbidity, color, and total nitrogen--illustrate a consistent beneficial effect of detaining water at each reservoir for more than 2 days. Thus, suspended solids and turbidity improved at each reservoir when water was detained more than 2 days, while color and total nitrogen either improved during detention, or at least, did not exceed the largest value of the inflow. This emphasizes that the detention of flood water for more than 2 days tends to lower the turbidity and suspended solids for flow subsequently released from these reservoirs. It also is interesting to note the lack of consistency in the effects caused by detention on two of the constituents--BOD and TOC. The changes shown for BOD and TOC emphasize the complexities of the processes that occur within each reservoir when flow is not released. Other variables that may affect the detained flow could include season, magnitude of storm, and antecedent moisture conditions.

Event of May 1-22, 1981

As mentioned previously, this event had the longest period of complete gate closures (detention when there was no flow released from storage). Flow was completely detained for slightly more than 8 days in both reservoirs. Total rainfall of the event was 4.22 in. Because the 10-day antecedent rainfall (2.27 in.) was greater than 1.5 in., the event's antecedent conditions are classified as wet. Table 12 shows that, for all sites, only color (79 to 178 pt-co units) and total phosphorus (0.37 to 0.67 mg/L as P) are greater than the stated maximum contaminant levels mentioned previously. The values for suspended solids (11 to 247 mg/L) and turbidity (28 to 209 NTU) appear large at most sampling sites.

Barker Reservoir system

The maximum-daily storage during this event was 4,280 acre-ft; average storage during the event was 1,600 acre-ft. Flow was detained for 8 days and 20 hours without releases (fig. 7). Afterward, flow releases were controlled by gate settings. Table 12 shows that discharge-weighted values for seven constituents and properties were decreased between the inflow site and reservoir outflow. These are BOD (8.79 to 5.13 mg/L), suspended solids (247 to 11 mg/L), volatile suspended solids (11 to 5.6 mg/L), turbidity (136 to 28 NTU), color (141 to 79 pt-co units), total nitrogen (2.31 to 1.68 mg/L as N), and TOC (16 to 13 mg/L). Two constituents showed an increase, dissolved solids (78 to 94 mg/L) and total phosphorus (0.53 to 0.67 mg/L as P).

Apparently the increased residence time for the water affected all of the constituents. In the case of those that decreased, the opportunity to either physically settle out or to be subjected to plant, animal, or chemical actions has been beneficial to the water quality. However, for those constituents that increased, the larger residence time was detrimental.

Addicks Reservoir system

The maximum-daily storage during this event was 7,830 acre-ft; average storage during the event was 3,000 acre-ft. Flow was detained without release for 8 days and 18 hours (fig. 7). Afterward, flow releases were adjusted by gate settings. Table 12 shows that discharge-weighted average values for six constituents and properties were decreased between the inflow sites and the reservoir outflow. These are BOD (5.43 and 6.17 to 4.97 mg/L), suspended solids (196 and 233 to 102 mg/L), turbidity (155 and 209 to 46 NTU), color (137 and 178 to 112 Pt-Co units), total nitrogen (1.74 and 2.23 to 1.48 mg/L as N), and TOC (15 and 17 to 14 mg/L). Three constituents showed an increase, volatile suspended solids (8.6 and 18 to 19 mg/L), dissolved solids (53 and 63 to 70 mg/L), and total phosphorus (0.37 and 0.42 to 0.44 mg/L as P).

Summary

The changes in discharge-weighted average values which occurred during the event of May 1-22, 1981, illustrate the effects of flood-water detention on water quality. Detention provided a beneficial effect as discharge-weighted average values decreased for six of the nine constituents considered--BOD, suspended solids, turbidity, color, total nitrogen, and TOC. Detention proved detrimental as discharge-weighted average values increased for two constituents--dissolved solids and total phosphorus. The only constituent which did not show a consistent effect from detention was volatile suspended solids.

Statistical Analysis of Discharge-Weighted Average Values

The discharge- or volume-weighted average values were computed for each of the nine selected constituents and properties at each of the various types of sites--inflows, reservoirs, outflows, and the study area outflow site (08073500 Buffalo Bayou near Addicks gaging station). A statistical test, the Student t-test (Ray, 1982), was selected to test whether or not differences in discharge-weighted average values were statistically significant among the several types of sites. The results of the Student t-test were used to show general differences in water quality caused by flood-water detention rather than differences during any single event.

Several assumptions were made for this analysis. First, the four events discussed previously are assumed to adequately reflect all storm events which required detention during the study period but were not sampled. Second, the discharge-weighted average values for the nine selected constituents at the inflow to Barker Reservoir (station 08072300) were considered to be representative of that for the combined inflows to Addicks Reservoir (stations 08072730 and 08072760). Third, the volume-weighted average values for the selected constituents in the two reservoirs were considered to be similar. Finally, the discharge-weighted values for the selected constituents of the two reservoir outlets also were similar. The final three assumptions are considered valid because means computed for the constituents and properties determined for samples from each site in a group were shown to be statistically similar to the other sites in the group by Student t-tests.

The Student t-test, at the 0.05 level of significance, was performed for the following combinations of sites:

I. The reservoir outflows (stations 08072501 and 08073001) versus area outflow at Buffalo Bayou near Addicks (station 08073500),

II. Inflows (stations 08072300, 08072730, and 08072760) versus reservoirs (stations 08072500 and 08073000),

III. Reservoirs versus outflows (stations 08072501, 08073001, and 08073500), and

IV. Inflows versus outflows.

The F statistic at the 0.05 level of significance, was used to determine whether or not the variances computed for the different groups could be considered equal (pooled) or considered unequal (separate)(Ray, 1982). The t-test allows the determination of whether or not there is a prolonged effect due to reservoir detention during runoff events. The results of these t-tests are given in table 14.

The first t-test was performed on data from reservoir outflows versus the area outflow at Buffalo Bayou near Addicks station. This was done to determine if there were any constituents which differed between these sites. As indicated in table 14, no significant difference was found in the means between these sites. Thus, these sites are grouped statistically as one for the remaining t-tests; the composited data set is referred to as "Outflows".

The second combination of sites subjected to the t-test for equal means were the inflows versus the reservoirs. Three constituents are of interest here with two significant at the 0.05 level--turbidity and TOC. The mean for turbidity's weighted value varied from 119 NTU at the inflows to 71 NTU in the reservoirs. The means for TOC varied from 15.9 mg/L at the inflows to 12.3 mg/L in the reservoirs. The third constituent, suspended solids, shows a probability of finding a larger t-value equal 0.067. Means for weighted values of suspended solids varied from 178 mg/L at the inflows to 102 mg/L in the reservoirs.

The third combination of sites used the t-test to determine whether or not the differences between the reservoirs and the "Outflows" were significant. Two constituents were shown to be different at the 0.05 level. The means for dissolved solids increased from 60 mg/L at the reservoirs to 79 mg/L at the downstream sites, and the means for TOC increased from 12.3 to 15.3 mg/L.

The fourth and final combination is of the "Outflows," or more correctly, the sites downstream from the reservoirs, versus the inflows, or sites upstream from the reservoirs. The results are shown in table 14. Two constituents are shown to be significantly different at the 0.05 level; the mean for suspended solids varies from 178 mg/L at the inflows to 105 mg/L downstream from the reservoirs, and the mean for turbidity varies from 119 to 66 NTU. These significant differences are the result of the reservoirs functioning as settling basins. This conclusion is confirmed by the results shown above for the inflows versus the reservoirs.

An underlying assumption of the Student t-test is that the variables normally are distributed within each group. Due to the small number of sample sites available, it is possible that the data analyzed violate this assumption. Thus, in order to check the results of table 14, a nonparametric, or distribution-free, procedure was chosen to determine whether or not the Student t-test

Table 14.--Results of Student t-test

Constituent or property	Group	Sample size	Mean	Standard deviation	Standard error	F value	F value probability	Type of variance estimate used	T value	Degrees of freedom	T value probability
I. Reservoir outflows (group 3) versus area outflows at Buffalo Bayou near Addicks station (group 4)											
Biochemical oxygen demand	3	8	5.55	2.60	0.918	2.85	0.419	Pooled	0.45	10	0.665
	4	4	4.91	1.54	.768						
Total suspended solids	3	8	106	91.2	32.2	2.64	.458	Pooled	.05	10	.964
	4	4	104	56.2	28.1						
Volatile suspended solids	3	8	25.7	17.4	6.15	1.03	1.085	Pooled	.02	10	.982
	4	4	25.5	17.1	8.57						
Turbidity	3	8	64.7	44.9	15.9	1.85	.661	Pooled	-.21	10	.840
	4	4	70.0	33.0	16.5						
Color	3	8	164	84.4	29.9	1.23	.951	Pooled	.16	10	.874
	4	4	156	76.3	38.1						
Dissolved solids	3	8	76.4	16.3	5.75	1.10	1.034	Pooled	-.78	10	.451
	4	4	84.1	15.5	7.76						
Total nitrogen	3	8	1.32	.210	.074	3.14	.193	Pooled	-1.11	10	.293
	4	4	1.50	.371	.186						
Total phosphorus	3	8	.349	.157	.056	1.17	.771	Pooled	-.67	10	.518
	4	4	.415	.171	.085						
Total organic carbon	3	8	14.9	2.43	.859	2.21	.350	Pooled	-.71	10	.493
	4	4	16.1	3.61	1.81						
II. Inflows (group 1) versus reservoirs (group 2)											
Biochemical oxygen demand	1	12	4.84	1.67	.482	1.62	.537	Pooled	.68	18	.506
	2	8	4.37	1.32	.465						
Suspended solids	1	12	178	90.1	26.0	1.39	.680	Pooled	1.95	18	.067
	2	8	102	76.4	27.0						
Volatile suspended solids	1	12	24.2	16.6	4.78	3.28	.077	Pooled	-.65	18	.522
	2	8	31.0	30.0	10.6						
Turbidity	1	12	119	57.9	16.7	6.62	.019	Separate	2.55	15	.022
	2	8	71.5	22.5	7.96						
Color	1	12	179	89.2	25.7	1.16	.876	Pooled	.21	18	.838
	2	8	171	82.8	29.3						
Dissolved solids	1	12	68.1	17.4	5.03	1.70	.495	Pooled	1.05	18	.308
	2	8	60.5	13.4	4.72						
Total nitrogen	1	12	1.63	.536	.155	2.36	.264	Pooled	1.72	18	.103
	2	8	1.26	.349	.123						
Total phosphorus	1	12	.397	.176	.051	1.30	.754	Pooled	1.10	18	.286
	2	8	.312	.154	.055						
Total organic carbon	1	12	15.9	5.11	1.47	4.82	.047	Separate	2.14	16	.047
	2	8	12.3	2.33	.822						

Table 14.--Results of Student t-test--Continued

Constituent or property	Group	Sample size	Mean	Standard deviation	Standard error	F value	F value probability	Type of variance estimate used	T value	Degrees of freedom	T value probability
				III. Reservoirs (group 2) versus all outflow sites (groups 3 and 4)							
Biochemical oxygen demand	2	8	4.37	1.32	0.465	2.91	0.166	Pooled	-1.10	18	0.287
	3 and 4	12	5.33	2.24	.648						
Suspended solids	2	8	102	76.4	27.0	1.05	.980	Pooled	-.08	18	.938
	3 and 4	12	105	78.4	22.6						
Volatile suspended solids	2	8	31.0	30.0	10.6	3.31	.075	Pooled	.51	18	.614
	3 and 4	12	25.6	16.5	4.77						
Turbidity	2	8	71.5	22.5	7.96	3.13	.141	Pooled	.32	18	.752
	3 and 4	12	66.5	39.8	11.5						
Color	2	8	171	82.8	29.3	1.12	.834	Pooled	.26	18	.797
	3 and 4	12	162	78.4	22.6						
Dissolved solids	2	8	60.5	13.4	4.72	1.39	.682	Pooled	-2.73	18	.014
	3 and 4	12	79.0	15.8	4.55						
Total nitrogen	2	8	1.26	.349	.123	1.65	.439	Pooled	-.87	18	.395
	3 and 4	12	1.38	.271	.078						
Total phosphorus	2	8	.312	.154	.055	1.04	.997	Pooled	-.82	18	.424
	3 and 4	12	.371	.157	.045						
Total organic carbon	2	8	12.3	2.33	.822	1.42	.659	Pooled	-2.54	18	.020
	3 and 4	12	15.3	2.77	.800						
				IV. Inflows (group 1) versus all outflow sites (groups 3 and 4)							
Biochemical oxygen demand	1	12	4.84	1.67	.482	1.80	.343	Pooled	-.61	22	.550
	3 and 4	12	5.33	2.24	.648						
Suspended solids	1	12	178	90.1	26.0	1.32	.653	Pooled	2.12	22	.046
	3 and 4	12	105	78.4	22.6						
Volatile suspended solids	1	12	24.2	16.6	4.78	1.01	.990	Pooled	-.22	22	.831
	3 and 4	12	25.6	16.5	4.77						
Turbidity	1	12	119	57.9	16.7	2.12	.230	Pooled	2.58	22	.017
	3 and 4	12	66.5	39.8	11.5						
Color	1	12	179	89.2	25.7	1.29	.676	Pooled	.52	22	.609
	3 and 4	12	162	78.4	22.6						
Dissolved solids	1	12	68.1	17.4	5.03	1.22	.746	Pooled	-1.60	22	.123
	3 and 4	12	79.0	15.8	4.55						
Total nitrogen	1	12	1.63	.536	.155	3.90	.033	Separate	1.44	16	.169
	3 and 4	12	1.38	.271	.078						

results were valid. The Wilcoxon rank sum test (Ray, 1982) was selected, and the results verified the Student t-test results of table 14.

Variation of Means, Maximums, and Minimums for Selected Constituents and Properties

There are several water-quality constituents and properties which do not correlate well with discharge. Seven of these were analyzed for their variation in the study area. The selected constituents and properties are water temperature, pH, dissolved oxygen, dissolved oxygen percent saturation, total-coliform bacteria, fecal-coliform bacteria, and fecal-streptococci bacteria. Three statistics, the mean, maximum, and minimum, were computed for these constituents and properties at each site used in the study. The differences in these statistics are illustrated in the schematic maps of the study area shown in figures 8-14. The significance of differences and the effect of reservoir detention is discussed below. Note that values shown for the reservoirs are volume weighted for a sample.

The variation of the mean, maximum, and minimum water temperature, in degrees Celsius, is shown in figure 8. The water detained in the reservoirs was found to have smaller maximums, larger means, and larger minimums than the other sites. The water temperature for flow released from the reservoirs (at the outflows) was quite similar to that which was found at the inflows, indicating reservoir detention has very little lasting effect on water temperature. The temperature of water flowing out of the study area exhibited a slightly larger mean than the temperature of water released from the reservoirs.

The variation for the mean, maximum, and minimum of pH is shown in figure 9. The water detained in the reservoirs has a smaller mean and minimum than water at the inflow sites. Water released from detention has larger maximums than either the inflows or the reservoirs, but the mean and minimums tend to converge to those values found at the inflows at the study area outlet (station 08073500). It appears that detention does raise the maximum pH for the downstream water, but the mean and minimum are not appreciably affected.

The variation of the mean, maximum, and minimum is shown for dissolved oxygen in figure 10 and for dissolved oxygen percent saturation in figure 11. Both of these illustrations show that dissolved oxygen of water stored in the reservoir deteriorates as the mean, maximum, and minimum are smallest in the reservoirs. However, the detrimental effect of detention is quickly overcome when water is released from the reservoir (possibly by turbulence in the reservoir outlet structure). Values of the outflows closely approximate those of the inflows. Note that the values for the area outlet show that the released flow deteriorates before leaving the area, possibly due to the influence of the increased urbanization between the outflows and the outlet.

Figure 12 illustrates the variation of total-coliform bacteria, in colonies per 100 milliliters, as indicated by the mean, maximum, and minimum values. The large values for the inflow to Barker Reservoir are reduced considerably in the reservoir whereas the values for Addicks Reservoir are between those measured in the two inflows. Similarly, the values for the reservoir outflows are smaller than for the respective reservoirs. This indicates that reservoir detention tends to moderate the total-coliform bacteria count, that is, it does

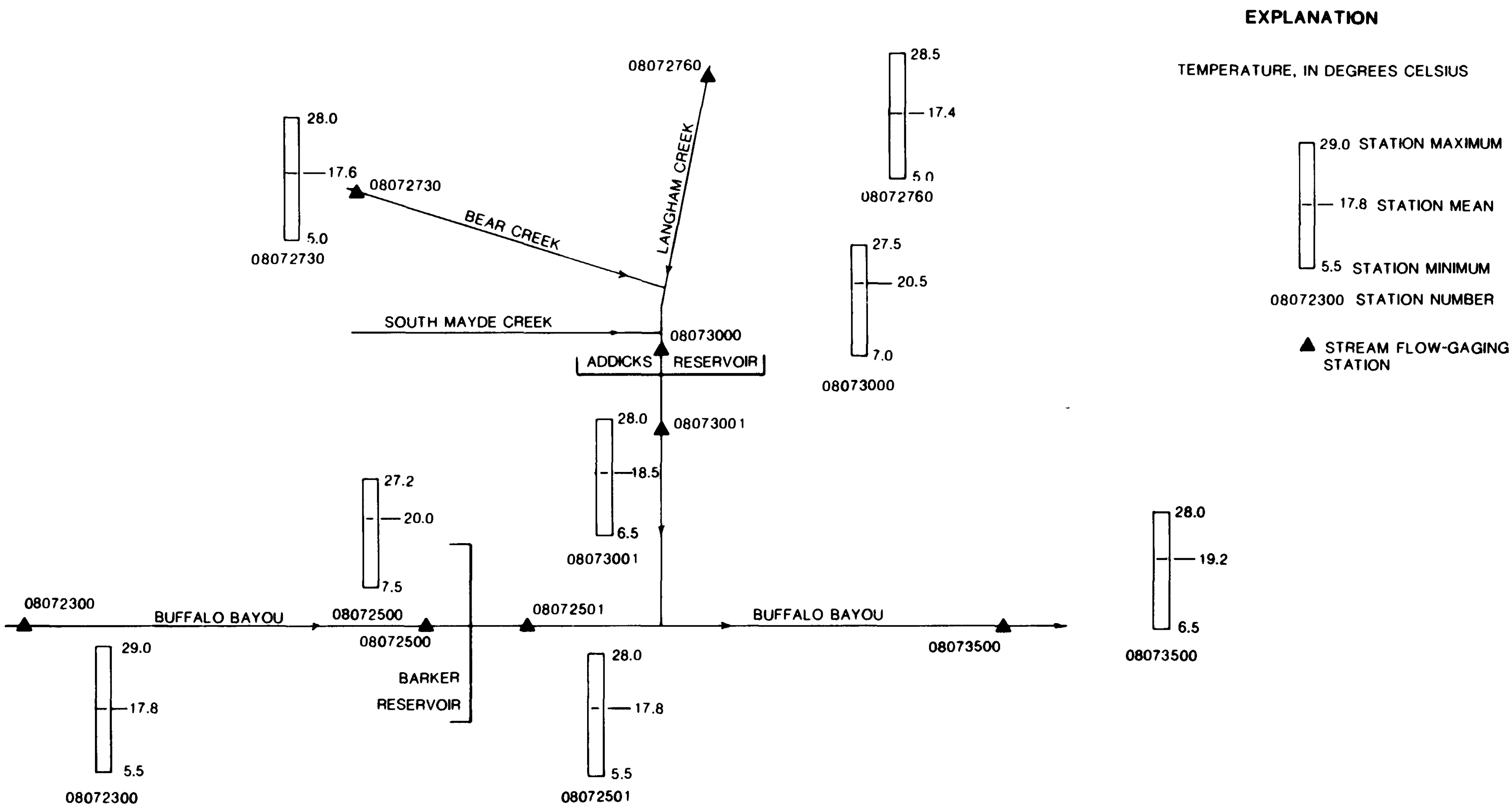

Figure 8.--Schematic diagrams showing areal variation of water temperature.

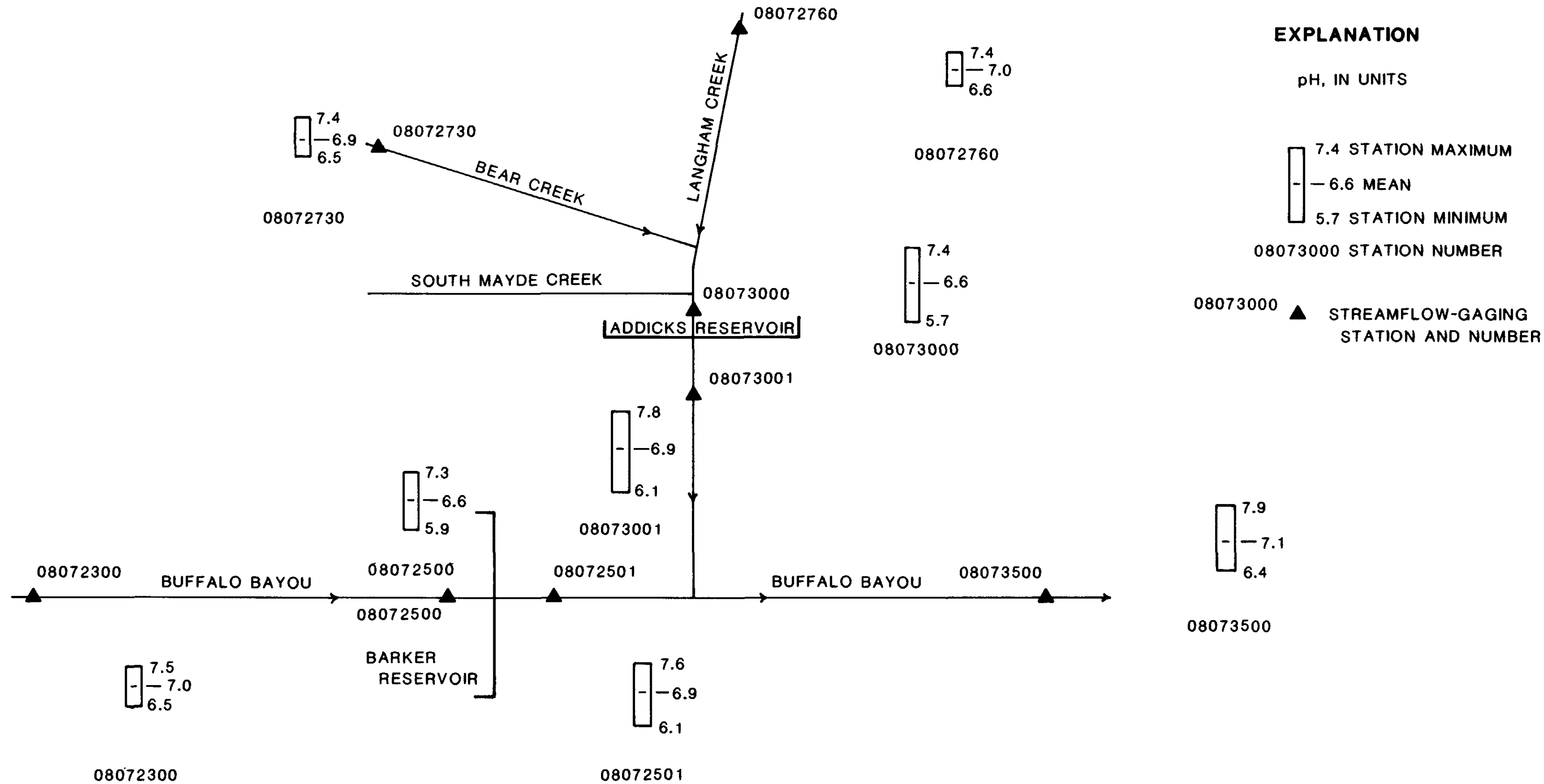

Figure 9.--Schematic diagrams showing areal variation of pH.

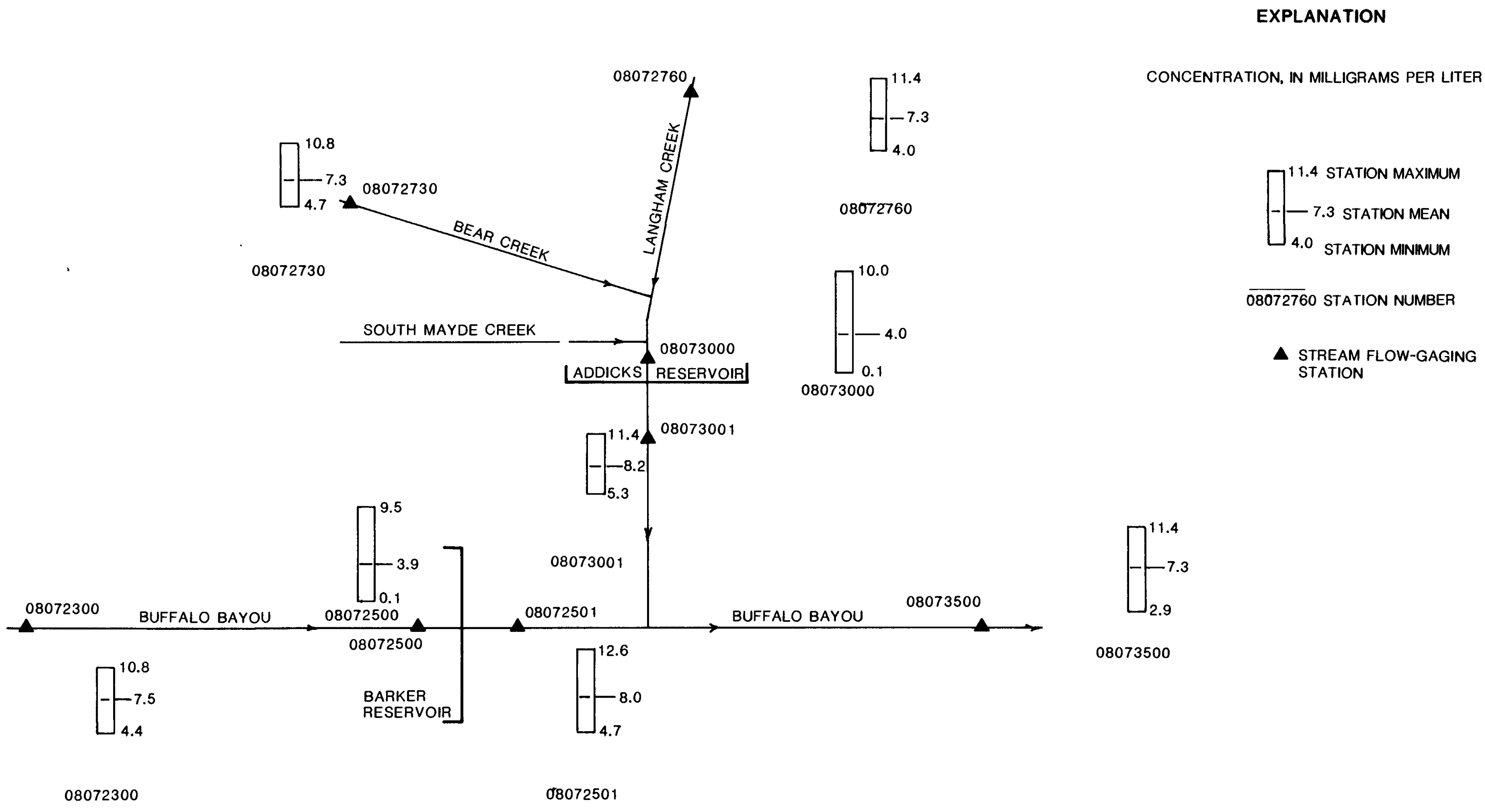

Figure 10.--Schematic diagrams showing areal variation of dissolved oxygen

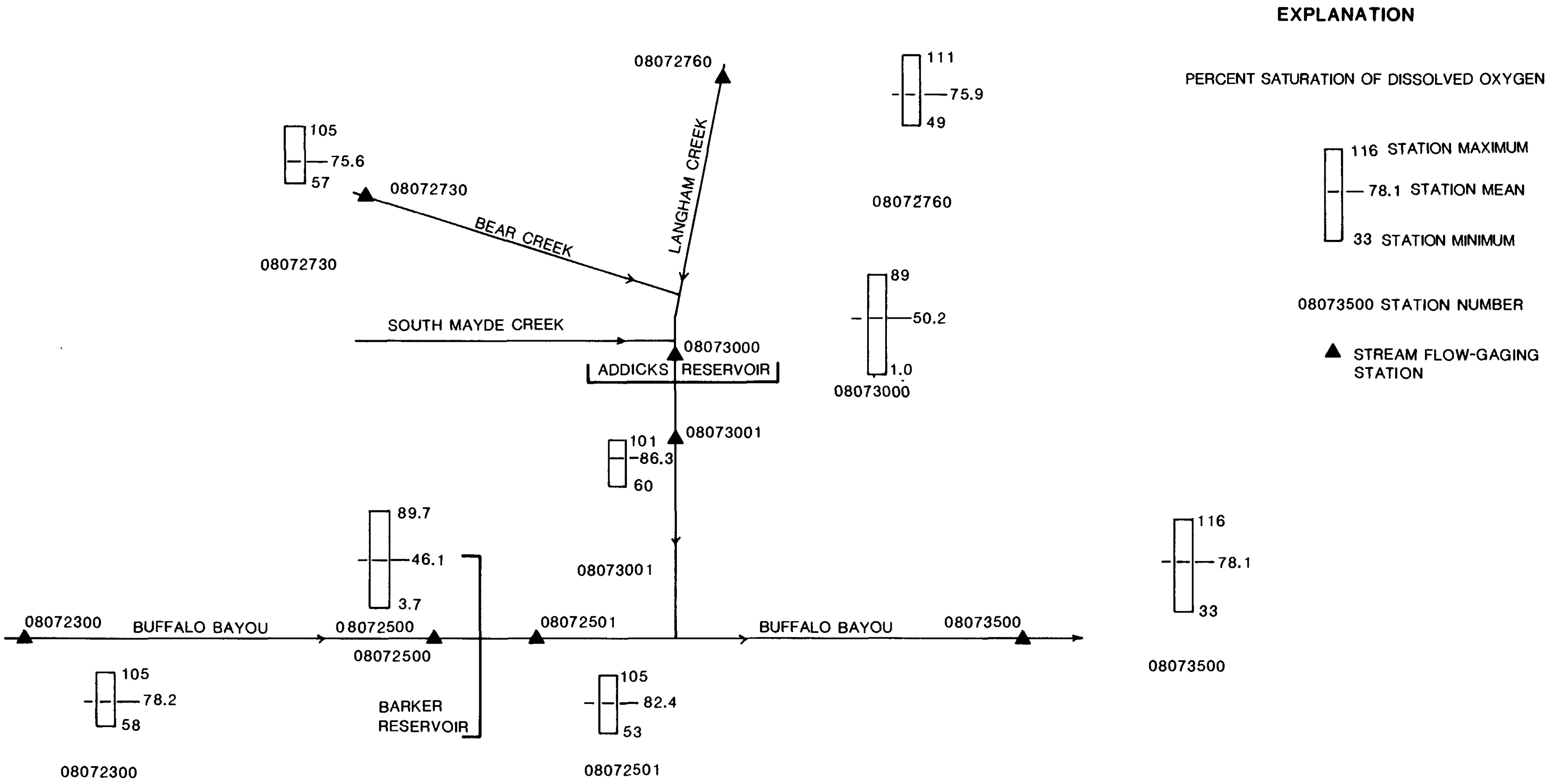

Figure 11.--Schematic diagrams showing areal variation of dissolved oxygen percent saturation.

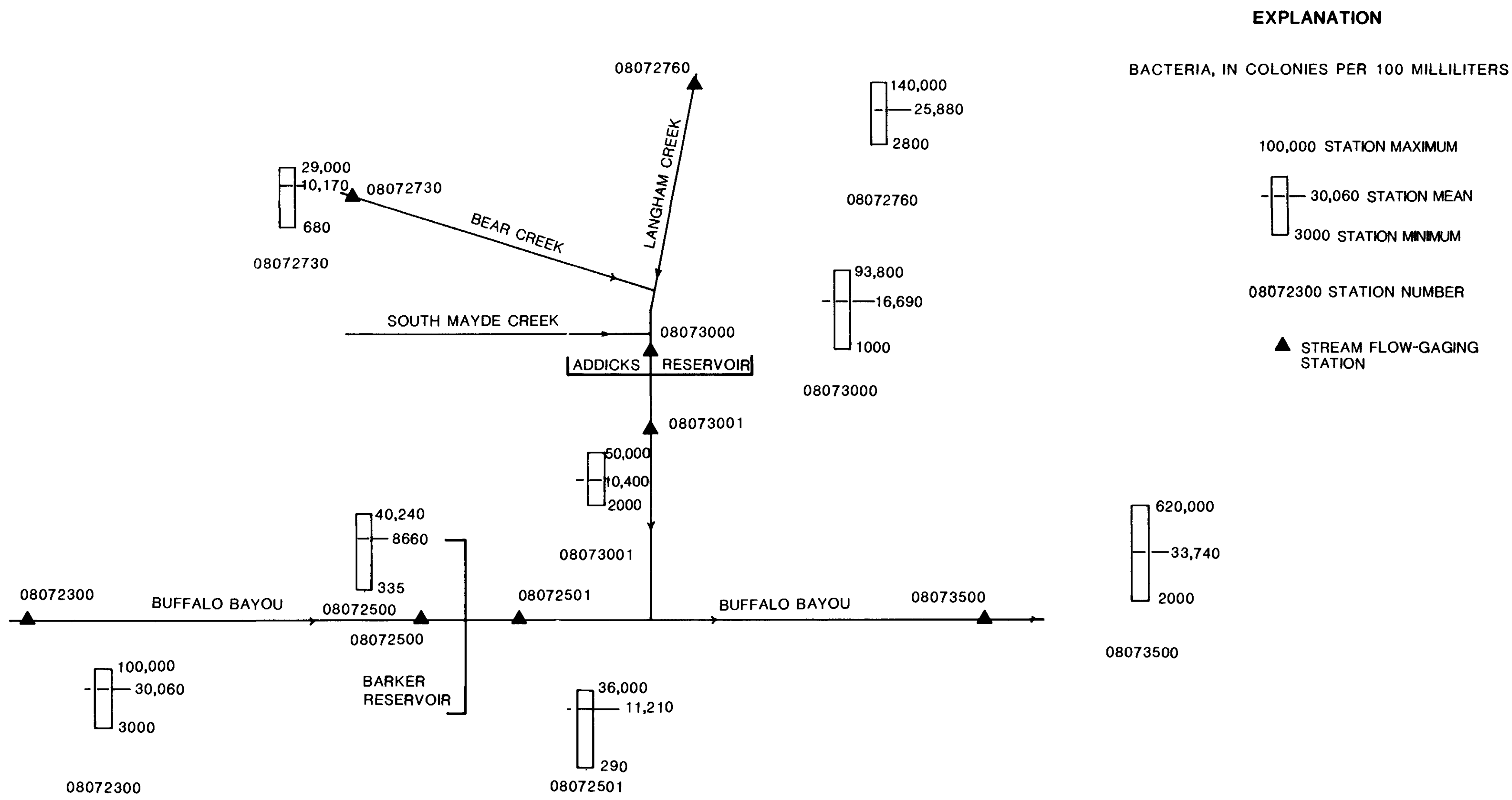

Figure 12.--Schematic diagrams showing areal variation of total-coliform bacteria.

not escalate this count. The effect of reservoir detention appears to be somewhat beneficial. However, the largest values in the study area for the mean and maximum were found at the area outlet. This is another example of the influence of the increased urbanization between the reservoir outflows and the area outlet.

Figure 13 illustrates the variation of fecal-coliform bacteria, in colonies per 100 milliliters. Both reservoirs have smaller means, maximums, and minimums than the respective inflows. The values for the outflows also are much smaller than for the respective inflows, and, except for one minimum, these statistical values are smaller than the reservoir values. This indicates a beneficial effect of flood-water detention as the counts for this group of bacteria decreased. However, the values of the area outflow are the most extreme in the study area. These increases at the area outlet possibly are an indication of the presence of increased fecal-coliform bacteria sources in the urbanizing area downstream from the reservoirs.

The variation of fecal-streptococci bacteria, in colonies per 100 milliliters, is illustrated in figure 14. While there are some slight inconsistencies with regard to maximums and minimums, the mean values are largest for the inflow sites. The mean is reduced by a factor ranging from 0.3 to 0.6 by reservoir detention, and is further reduced at the outflows by a factor of 0.6. This illustrates a beneficial effect of detention. The mean increases in the reach between the reservoirs and the area outlet but the area outflow value remains considerably below that for the inflow values. This indicates that the sources for fecal-streptococci bacteria may not be as numerous in the more urban downstream part of the study area as in the more rural areas upstream from the reservoirs.

SUMMARY AND CONCLUSIONS

The purposes of this study were to describe the water quality in the vicinity of Barker and Addicks Reservoirs during 1978-81 and to define the effects on water quality due to the detention of flood waters by the Barker and Addicks Reservoirs.

Generally, the quality of surface water in the study area meets U.S. Environmental Protection Agency public water supply standards of 1976 and 1977. Most of the water-supply standards that were not met pertained to aesthetic or nuisance measures of water quality as opposed to substances that may be toxic or that affect human health. The water quality is described in six groups of constituents and properties.

The first group includes field measurements (water temperature, pH, dissolved oxygen, and specific conductance), BOD, and bacteria. Water temperature was always within acceptable limits. No values for pH exceeded the upper limit of 18.5, while 37 percent of the samples were less than the lower limit of 6.5 but more than the value for rainfall of 5.6. Dissolved-oxygen readings indicate that anaerobic conditions occur in the reservoirs. In fact, 57 percent of all samples had dissolved oxygen values below 5.0 mg/L, thus indicating a stressful environment for aquatic life. Specific-conductance values indicated no problem with mineralized water as its values reached a maximum of 920 µS. BOD values were as large as 22 mg/L, but only 15 percent of the samples col-

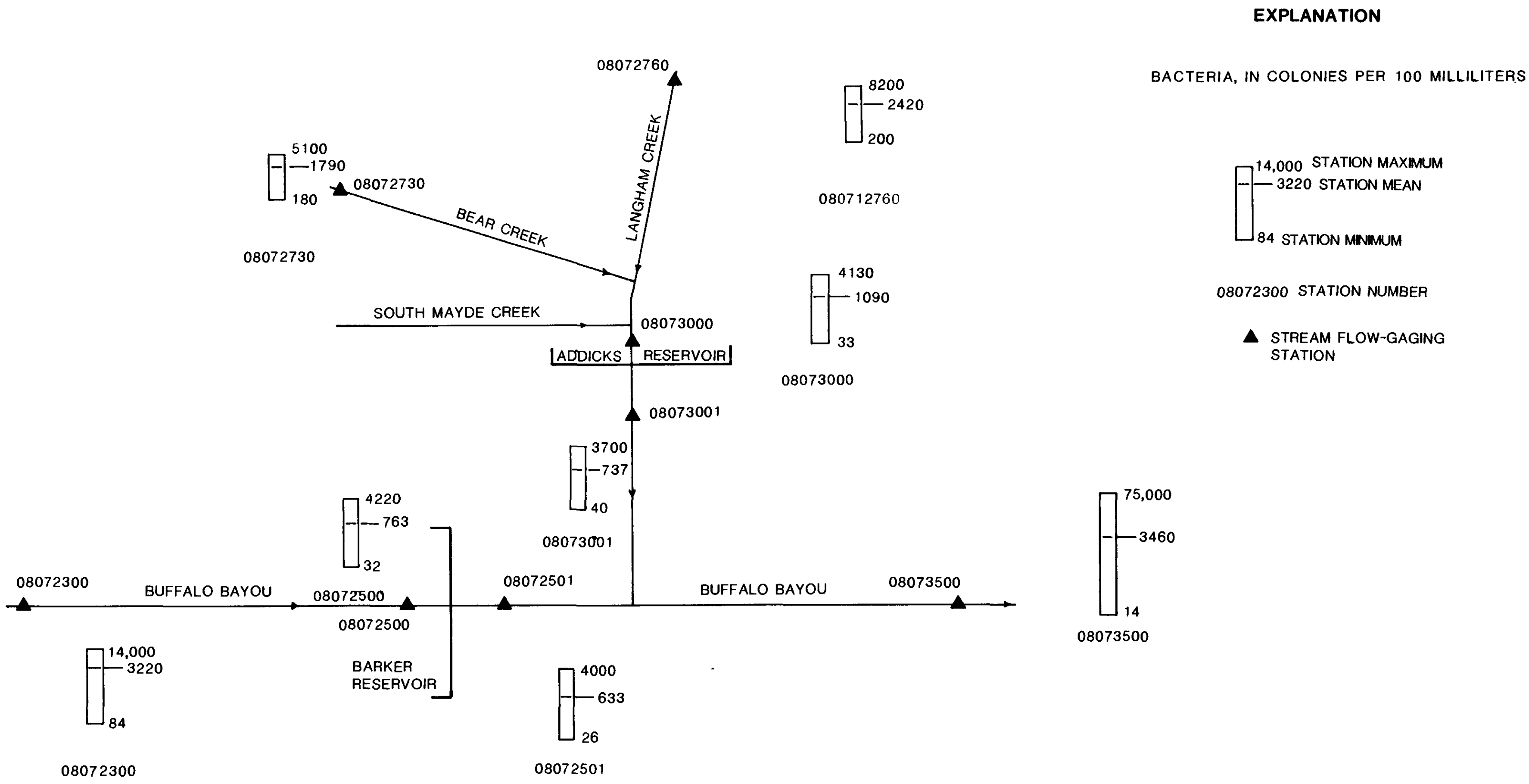

Figure 13.--Schematic diagrams showing areal variation of Fecal-coliform bacteria.

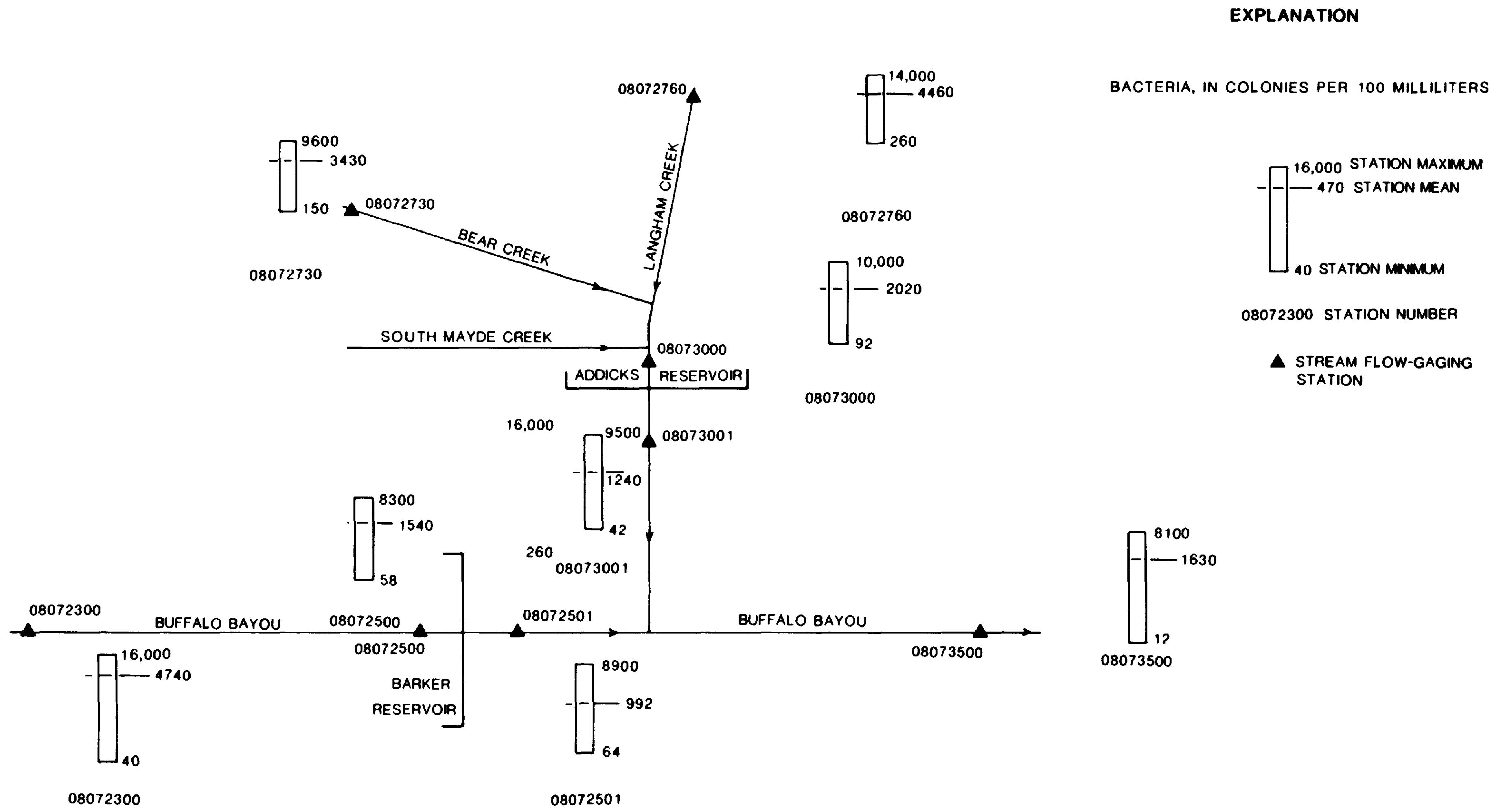

Figure 14.--Schematic diagrams showing areal variation of fecal-streptococci bacteria.

lected exceeded 10 mg/L. Microbiological data include total-coliform bacteria, fecal-coliform bacteria, and fecal-streptococci bacteria. In addition, the ratio of fecal-coliform bacteria to fecal-streptococci bacteria is computed to give an indication of possible sources of bacterial pollution. Densities for total-coliform bacteria reached a maximum of 620,000 cols./100 mL, a median value of 9,300 cols./100 mL, and a geometric mean of 9,580 cols./100 mL. A total of 25 percent of the samples exceeded 20,000 cols./100 mL. Fecal-coliform bacterial densities reached a maximum of 75,000 cols./100 mL, a median of 580 cols./100 mL, and a geometric mean of 520 cols./100 mL. A total of 25 percent of the samples exceeded 2,000 cols./100 mL. Fecal-streptococci bacteria densities reached a maximum of 16,000 cols./100 mL, a median of 650 cols./100 mL, and a geometric mean of 750 cols./100 mL. No maximum limits were found in the literature for fecal-streptococci bacteria. Thus, the values for total-coliform and fecal-coliform bacteria, while indicating that periodic problems may arise, do not indicate continuing problems with bacterial pollution. The values computed for the ratio of fecal-coliform bacteria to fecal-streptococci bacteria show that 5 percent of the samples probably reflected dominant human sources and 50 percent of the samples are believed to be dominated by animal sources.

The second group consists of the physical and aesthetic properties (suspended solids, volatile suspended solids, turbidity, and color). No stated maximum contaminant levels for suspended solids, volatile suspended solids, or turbidity were found in the literature. Values determined for suspended solids indicated a maximum of 1,290 mg/L and a median of 101 mg/L. Values determined for volatile suspended solids indicated a maximum of 200 mg/L and a median of 18 mg/L. Several samples had no volatile suspended solids. Turbidity values reached a maximum of 800 NTU and a median of 80 NTU. Thirty-three percent of the samples exceeded 100 NTU. Values for color reached a maximum of 1,100 Pt-Co units and a median of 160 Pt-Co units. Eighty-four percent of the samples exceeded the maximum contaminant level of 75 Pt-Co units. The values for these properties indicate that the surface water of the study area is not aesthetically pleasing.

The third group includes the major inorganic constituents and related properties (dissolved solids, alkalinity, hardness, calcium, magnesium, sodium, SAR, potassium, chloride, sulfate, fluoride, and silica). Dissolved solids was the only constituent in this group that exceeded the recommended maximum contaminant level. Only one sample had a value (509 mg/L) exceeding the recommended level of 500 mg/L. The median value for dissolved solids was 67 mg/L.

The fourth group includes nutrients (nitrogen in its various forms and total phosphorus) and TOC. Few samples for the various forms of nitrogen had values that exceeded recommended maximum contaminant levels. Values for total organic nitrogen reached a maximum of 3.50 mg/L as N and a median of 1.20 mg/L as N. There are no maximum limits found in the literature. Total ammonia nitrogen values reached a maximum of 8.60 mg/L as N and a median of 0.14 mg/L as N. A total of 8 percent of the samples exceeded the recommended level for total ammonia nitrogen of 0.5 mg/L as N. Total nitrite nitrogen values reached a maximum of 1.50 mg/L as N and a median of 0.04 mg/L as N. One sample (0.4 percent) exceeded the recommended limit for total nitrite nitrogen of 1.0 mg/L as N. Total nitrate nitrogen values reached a maximum of 8.10 mg/L as N and a median of 0.16 mg/L as N. No samples exceeded the maximum recommended level of 10.0 mg/L as N. Total phosphorus values reached a maximum of 9.70 mg/L as P and a median of 0.33 mg/L as P. A total of 98 percent of the samples exceeded the maximum recommended level for total phosphorus of 0.10 mg/L as P. This indicates a high probability that nuisance algae growths may occur. Values for TOC reached a maximum of 56 mg/L and a median of 14 mg/L). No maximum recommended levels were found in the literature, although the values found for TOC were within background levels for the coastal areas of Texas.

The final two groups of constituents considered were trace elements, pesticides, and PCB. Only a limited number of samples were collected for these constituents.

The trace elements analyzed were arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, silver, and zinc. Only iron and manganese exceeded maximum recommended contaminant levels. Of the 22 samples analyzed for trace elements, 4 exceeded the maximum recommended level of 300 µg/L for iron (maximum, 680 µg/L; median, 125 µg/L). Flow during collection of these samples was more than 190 ft^3/s. Values of iron larger than 100 µg/L were found in 9 of 11 samples where flow was more than 120 ft^3/s. Manganese values (maximum, 170 µg/L; median, 10 µg/L) were larger than the limit of 50 µg/L in 3 samples, all of which occurred at low flow. Both of these elements are not considered toxic to humans at the levels found but do affect the aesthetics of the water.

Three categories of pesticides and PCB were analyzed, the chlorinated hydrocarbons, the organophosphorous compounds, and the chlorophenoxy compounds. Of the five chlorinated hydrocarbons detected (lindane, dieldrin, heptachlor, heptachlor epoxide, and PCB), only PCB exceeded the maximum recommended contaminant level. This occurred in 6 of the 39 samples analyzed for PCB. Four organophosphorous compounds were detected: Malathion, parathion, diazinon, and methyl parathion. Only 1 of the 36 samples for malathion exceeded the maximum contaminant level. Diazinon (maximum, 0.91 µg/L; median, 0.10 µg/L) was the only pesticide found at all 5 sampling sites. All of the 3 chlorophenoxy compounds analyzed (2,4-D, 2,4,5-T, and silvex) were detected; however, none of them reached maximum contaminant levels.

The first of three approaches used to investigate the effects of floodwater detention was an analysis of the discharge-weighted average values for nine selected constituents and properties (BOD, suspended solids, volatile suspended solids, turbidity, color, dissolved solids, total nitrogen, total phosphorus, and TOC) during each of four selected events (November 26 - December 13, 1978; February 2-28, 1979; September 17 - October 18, 1979; and May 1-22, 1981). The detention time without flow releases ranged from 0 to 4-1/4 days for the first three events and almost 9 days for the fourth event. A comparison of the water-quality effects of detention for the first three events did not show consistent changes between the reservoirs. During the first event, only the dissolved-solids concentration, which increased due to detention, was similarly affected in both reservoirs. The second event resulted in color increasing and total phosphorus decreasing in both reservoirs. The third event resulted in detrimental effects for BOD and TOC, as discharge-weighted average values increased, and beneficial effects for suspended solids and turbidity, as those values decreased, in both reservoirs. During the fourth event, only volatile suspended solids was not similarly affected in each reservoir. Six constituents and properties benefited from detention as the discharge-weighted average values decreased--BOD, suspended solids, turbidity, color, total nitrogen, and TOC. Two constituents, dissolved solids and total phosphorus, were detrimentally affected, as those values increased.

The second approach was an analysis of the means of the discharge-weighted average values for the above selected constituents and properties over the four selected events. The mean was viewed as a measure of the constituent's weighted value resulting from all events occurring during the study period. A Student t-test was performed to test the statistical significance of differences in mean values between the various types of sites. Suspended solids and turbidity were shown to be significantly different at the 0.05 level between the inflows and the outflows. Suspended solids decreased from 178 mg/L at the inflows to 105 mg/L at the outflows. Turbidity decreased from 119 NTU at the inflows to 66 NTU at the outflows. No changes in other constituents or properties were statistically significant.

The third approach was an analysis of constituents and properties that did not correlate with discharge. These included water temperature, pH, dissolved oxygen, dissolved oxygen percent saturation, total-coliform bacteria, fecal-coliform bacteria, and fecal-streptococci bacteria. Three statistics, the mean, maximum, and minimum, were used in the analysis. Detention of flood waters in the reservoir had an effect on each of the seven constituents or properties. For example, water temperature was found to have smaller maximums, larger means, and larger minimums in the reservoirs. Values for pH had a smaller mean and minimum in the reservoirs compared to at the inflows. Dissolved oxygen deteriorates in reservoir detention as shown by the fact that the smallest values of the mean, maximum, and minimum occurred in the reservoirs. Total-coliform bacteria densities at the inflow site to Barker Reservoir are greatly reduced in Barker Reservoir and are between the densities measured at the two inflows to Addicks Reservoir. Fecal-coliform bacteria density counts have smaller means, maximums, and minimums in the reservoirs compared to counts measured at the inflow site. Means for fecal-streptococci bacteria density counts are largest for the inflow site, but decreased during reservoir detention. The three bacteria groups indicate that a water-quality change between the inflows and the reservoirs occurs. Reservoir detention improved water quality by decreasing the bacterial densities. It also is of interest to note the effect of the more urban downstream part of the study area on the three bacteria groups. Thus, the increases in total-coliform and fecal-coliform bacteria counts and the decrease in fecal-streptococci bacteria at the study area outlet apparently is an effect of the increased urbanization between the reservoir outflows and the study area outlet.

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Appendix A.--Field measurements, biochemical oxygen demand, and bacteria

[ft, foot; ft^3/s, cubic foot per second; acre-ft, acre-foot; °C, degree Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter at 25°C; cols./100 mL, colonies per 100 milliliters]

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1010	27.68	-	190.0	27.0	7.0	5.3	67	9.6	185	25000	780	1000	0.780
06-15-78	1255	25.74	-	19.0	29.0	6.7	4.4	58	14.0	241	50000	750	2800	0.268
11-28-78	1145	27.85	-	217.0	12.5	6.9	10.8	105	4.0	135	8700	2000	5000	0.400
11-29-78	1315	27.64	-	186.0	13.5	7.2	10.1	100	4.6	160	7300	2500	6100	0.410
12-04-78	1205	27.30	-	143.0	10.5	7.5	9.0	83	5.5	169	100000	12000	16000	0.750
02-05-79	1315	31.42	-	814.0	7.5	6.9	9.5	82	3.9	78	14000	1300	11000	0.118
02-06-79	1240	32.37	-	1050.0	6.5	7.0	10.1	85	3.1	70	14000	2000	13000	0.154
02-07-79	1315	29.75	-	491.0	5.5	7.1	10.4	85	3.0	64	25000	500	7000	0.071
02-12-79	1015	25.96	-	31.0	11.0	6.9	8.7	81	11.0	144	12000	500	56	8.929
04-21-79	1145	27.50	-	182.0	21.0	7.0	6.6	76	4.4	85	29000	980	250	3.920
04-26-79	1045	25.30	-	8.1	24.5	7.1	6.4	78	4.5	314	40000	1100	250	4.400
09-19-79	1400	32.71	-	1180.0	22.0	6.9	6.8	80	5.1	98	38000	14000	5900	2.373
09-21-79	0925	34.02	-	1580.0	21.5	6.9	5.4	61	2.1	95	61000	5800	1500	3.867
09-27-79	0950	27.38	-	169.0	24.0	6.9	6.4	74	3.2	155	29000	500	520	0.962
03-03-81	1030	24.87	-	1.5	16.5	7.3	8.3	85	7.5	884	3000	85	41	2.073
05-03-81	1910	28.72	-	337.0	22.5	6.5	5.9	68	13.0	109	31000	7700	10000	0.770
05-04-81	1130	29.86	-	515.0	22.0	7.2	5.4	61	11.0	80	40000	3500	3900	0.897
05-05-81	1515	27.95	-	227.0	23.5	7.1	5.4	-	5.5	88	14000	2000	1000	2.000
	Station Mean				17.81	7.01	7.49	78.2	6.39	175.2	30056	3222	4740	1.841
	Station Maximum				29.0	7.5	10.8	105	14.0	884	100000	14000	16000	8.929
	Station Minimum				5.5	6.5	4.4	58	2.1	64	3000	85	41	.071

STATION: 294617095390501

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1100	89.03	1.0	7120.0	26.0	6.8	2.3	29	--	137	--	--	--	--
	1102	89.03	4.0	7120.0	25.0	6.4	0.3	4	--	137	--	--	--	--
	1104	89.03	7.0	7120.0	25.0	6.4	0.3	4	--	137	--	--	--	--
04-21-79	1112	87.83	1.0	4440.0	21.5	7.0	4.9	57	--	106	--	--	--	--
	1113	87.83	4.0	4440.0	21.0	7.1	5.3	61	--	106	--	--	--	--
	1114	87.83	7.0	4440.0	21.0	7.1	5.3	61	--	106	--	--	--	--
	1115	87.83	10.0	4440.0	21.0	7.1	5.3	61	--	106	--	--	--	--
04-26-79	0930	87.92	1.0	4610.0	24.5	7.1	6.4	78	--	103	--	--	--	--
	0932	87.92	5.0	4610.0	22.0	6.9	2.7	32	--	103	--	--	--	--
	0934	87.92	8.0	4610.0	21.0	6.7	1.4	16	--	94	--	--	--	--
09-21-79	1225	92.90	1.0	23390.0	23.0	6.3	5.7	66	--	76	--	--	--	--
	1227	92.90	9.0	23390.0	22.5	6.3	4.2	48	--	80	--	--	--	--
09-26-79	1310	94.03	1.0	33490.0	23.5	6.4	2.1	24	--	90	--	--	--	--
	1312	94.03	6.0	33490.0	23.0	6.3	0.8	9	--	90	--	--	--	--
	1314	94.03	13.5	33490.0	22.5	6.3	0.5	6	--	90	--	--	--	--
10-04-79	1339	92.03	1.0	18080.0	25.5	6.5	0.9	11	--	114	--	--	--	--
	1341	92.03	5.0	18080.0	25.5	6.5	0.8	10	--	114	--	--	--	--
	1343	92.03	9.0	18080.0	25.0	6.5	0.1	1	--	109	--	--	--	--
10-11-79	1400	88.70	1.0	6290.0	25.0	6.8	3.3	39	--	160	--	--	--	--
	1407	88.70	8.0	6290.0	22.0	6.6	0.2	2	--	148	--	--	--	--
05-04-81	1243	81.79	1.0	231.0	24.5	6.8	4.1	49	--	208	--	--	--	--
	1245	81.79	3.0	231.0	23.5	6.7	4.0	47	--	208	--	--	--	--
05-07-81	1144	85.82	1.0	3670.0	23.5	6.3	3.6	42	--	143	--	--	--	--
	1146	85.82	6.0	3670.0	22.5	6.2	0.2	2	--	140	--	--	--	--
	1148	85.82	12.0	3670.0	22.0	6.1	0.3	3	--	140	--	--	--	--
05-11-81	1120	86.15	1.0	4250.0	23.5	6.0	2.2	25	--	139	--	--	--	--
	1122	86.15	5.0	4250.0	22.0	5.9	0.2	2	--	139	--	--	--	--
	1124	86.15	9.5	4250.0	22.0	6.1	0.4	4	--	139	--	--	--	--
05-13-81	1045	85.46	1.0	3090.0	23.5	6.2	3.1	36	--	139	--	--	--	--
	1047	85.46	5.0	3090.0	23.0	6.0	1.4	16	--	139	--	--	--	--

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 294617095390501--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
05-13-81	1049	85.46	9.5	3090.0	22.0	6.0	0.3	3	--	141	--	--	--	--
05-15-81	1020	83.72	1.0	1150.0	23.0	6.2	0.9	10	--	145	--	--	--	--
	1022	83.72	3.5	1150.0	23.0	6.2	0.9	10	--	145	--	--	--	--
	1024	83.72	7.5	1150.0	22.5	6.1	0.7	8	--	147	--	--	--	--
	Station Mean				23.12	6.47	2.21	25.8	--	127.0	--	--	--	--
	Station Maximum				26.0	7.1	6.4	78	--	208	--	--	--	--
	Station Minimum				21.0	5.9	0.1	1	--	76	--	--	--	--

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1202	89.03	1.0	7120.0	27.0	6.6	3.2	41	5.9	137	6700	500	720	0.694
	1204	89.03	5.0	7120.0	25.5	6.4	2.4	30	--	137	--	--	--	--
	1206	89.03	10.0	7120.0	24.5	6.4	1.7	21	--	137	--	--	--	--
	1208	89.03	12.0	7120.0	24.0	6.4	0.9	11	6.6	116	7300	520	920	0.565
06-15-78	0930	82.35	1.0	158.0	27.0	6.7	0.9	11	20.0	206	32000	200	490	0.408
	0935	82.35	5.0	158.0	27.5	6.7	0.9	12	20.0	204	40000	170	1000	0.170
11-29-78	1405	86.73	1.0	2680.0	14.5	6.4	3.8	38	2.9	123	3100	370	500	0.740
	1410	86.73	10.0	2680.0	14.0	6.3	4.0	40	2.9	122	3800	780	580	1.345
12-04-78	0935	85.19	1.0	1130.0	13.5	7.0	3.8	38	3.1	200	4000	320	350	0.914
	0940	85.19	10.0	1130.0	13.5	7.0	3.9	39	3.2	190	7700	270	440	0.614
02-05-79	1135	82.86	1.0	233.0	9.5	7.3	9.3	84	4.5	131	9700	3200	7800	0.410
	1140	82.86	10.0	233.0	9.5	7.3	9.3	84	4.6	131	--	--	--	--
02-09-79	1025	89.68	1.0	8920.0	7.5	7.0	9.5	82	4.0	73	9300	820	8300	0.099
	1030	89.68	16.0	8920.0	7.5	7.2	8.8	76	3.8	77	--	--	--	--
02-15-79	1030	88.37	1.0	5540.0	15.0	7.1	8.8	90	4.0	83	330	63	79	0.797
	1035	88.37	13.0	5540.0	9.0	7.0	8.1	72	2.7	80	600	53	160	0.331
02-21-79	0850	82.81	1.0	224.0	9.5	7.0	8.2	74	5.0	154	3800	620	320	1.937
	0855	82.81	9.0	224.0	9.5	7.1	8.2	74	5.2	161	4100	720	290	2.483
04-21-79	1125	87.85	1.0	4480.0	21.5	7.0	4.4	51	3.4	106	11000	2000	3600	0.556
	1126	87.85	4.0	4480.0	21.5	7.0	4.0	47	--	106	--	--	--	--
	1127	87.85	8.0	4480.0	21.5	7.0	3.7	43	--	106	--	--	--	--
	1128	87.85	12.0	4480.0	21.0	6.9	2.9	33	--	106	--	--	--	--
	1130	87.85	16.0	4480.0	20.5	6.9	2.7	31	6.0	108	10000	2200	2000	1.100
04-26-79	1000	87.92	1.0	4610.0	24.0	6.7	4.7	57	3.7	103	7700	31	230	0.135
	1002	87.92	5.0	4610.0	22.5	7.0	4.6	54	--	103	--	--	--	--
	1004	87.92	10.0	4610.0	22.0	6.9	2.8	33	--	94	--	--	--	--
04-26-79	1005	87.92	14.0	4610.0	21.0	6.8	1.2	14	3.4	94	6700	53	720	0.074
05-03-79	0840	84.34	1.0	641.0	22.0	6.9	5.1	60	4.8	141	6700	500	800	0.625
	0845	84.34	10.0	641.0	22.0	6.9	3.1	36	4.8	140	12000	720	920	0.783
09-21-79	1242	92.91	1.0	23470.0	23.0	6.3	4.7	56	1.4	80	6700	2000	520	3.846
	1244	92.91	9.0	23470.0	22.5	6.3	4.1	47	0.9	80	6700	1500	520	2.885
09-26-79	1252	94.03	1.0	33490.0	23.5	6.4	1.4	16	2.7	90	2500	28	67	0.418
	1254	94.03	5.0	33490.0	23.5	6.4	0.	0	--	95	--	--	--	--
	1256	94.03	10.0	33490.0	23.0	6.3	0.	0	--	95	--	--	--	--
	1258	94.03	15.0	33490.0	23.0	6.3	0.	0	--	95	--	--	--	--
	1300	94.03	20.0	33490.0	23.0	6.3	0.	0	2.0	94	2900	150	150	1.000
10-04-79	1314	92.04	1.0	18130.0	25.5	6.5	0.4	5	6.9	119	3900	61	58	1.052
	1316	92.04	6.0	18130.0	25.0	6.5	0.1	1	--	119	--	--	--	--
	1318	92.04	13.0	18130.0	24.5	6.4	0.1	1	--	119	--	--	--	--
	1320	92.04	18.0	18130.0	23.5	6.1	0.1	1	20.0	121	12000	24	61	0.393
10-11-79	1330	88.72	1.0	6340.0	23.0	6.8	0.4	5	15.0	188	8000	35	130	0.269
	1338	88.72	8.0	6340.0	--	6.7	0.2	2	--	188	--	--	--	--
	1345	88.72	15.0	6340.0	21.5	6.6	0.2	2	15.0	182	9000	32	160	0.200
05-04-81	1150	81.68	1.0	208.0	22.5	6.7	4.3	-	9.6	208	38000	4200	5600	0.750
	1152	81.68	5.0	208.0	22.5	6.7	4.0	46	--	204	--	--	--	--

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 294617095390502 (08072500)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
05-04-81	1154	81.68	8.0	208.0	22.5	6.7	4.0	-	11.0	200	88000	4600	7400	0.622
05-07-81	1116	85.81	1.0	3650.0	24.5	6.3	3.8	-	5.1	138	7300	140	580	0.241
	1118	85.81	5.0	3650.0	22.0	6.0	0.2	2	--	138	--	--	--	--
	1120	85.81	11.5	3650.0	22.0	6.2	0.2	-	4.8	125	6700	500	1400	0.357
05-11-81	1138	86.15	1.0	4250.0	23.0	6.0	2.9	-	5.2	140	2200	63	81	0.778
	1140	86.15	6.5	4250.0	22.0	6.0	0.8	9	--	139	--	--	--	--
	1142	86.15	13.0	4250.0	21.5	5.9	0.2	-	6.4	140	8300	170	650	0.262
05-13-81	1055	85.45	1.0	3070.0	22.5	5.9	0.1	-	5.3	120	2100	41	190	0.216
	1057	85.45	6.5	3070.0	22.5	5.8	0.1	1	--	125	--	--	--	--
	1059	85.45	13.0	3070.0	22.0	5.9	0.1	-	6.1	120	2900	67	230	0.291
05-15-81	1250	83.64	1.0	1090.0	22.5	6.1	0.4	-	5.4	178	2000	77	150	0.513
	1252	83.64	5.5	1090.0	22.0	6.2	0.4	4	--	191	--	--	--	--
	1254	83.64	11.0	1090.0	22.0	6.3	0.4	-	4.9	197	1800	63	190	0.332
	Station Mean				20.49	6.58	2.90	32.8	6.30	132.7	10461	733	1273	.769
	Station Maximum				27.5	7.3	9.5	90	20.0	208	88000	4600	8300	3.846
	Station Minimum				7.5	5.8	0.0	0	.9	73	330	24	58	.074

STATION: 294617095390503

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1210	89.03	1.0	7120.0	27.5	6.9	5.8	74	--	137	--	--	--	--
	1212	89.03	3.0	7120.0	27.0	6.8	5.1	65	--	137	--	--	--	--
	1214	89.03	5.0	7120.0	25.0	6.4	1.7	21	--	137	--	--	--	--
	1216	89.03	6.5	7120.0	25.0	6.4	0.6	7	--	137	--	--	--	--
04-21-79	1205	87.88	1.0	4530.0	21.5	6.7	5.0	58	--	106	--	--	--	--
	1207	87.88	4.0	4530.0	21.5	6.7	4.7	55	--	106	--	--	--	--
04-26-79	1030	87.91	1.0	4590.0	24.5	6.9	6.2	76	--	103	--	--	--	--
	1032	87.91	5.0	4590.0	23.5	6.9	6.1	73	--	103	--	--	--	--
	1034	87.91	10.0	4590.0	21.5	7.1	6.0	70	--	101	--	--	--	--
09-21-79	1301	92.92	1.0	23540.0	23.0	6.4	4.5	52	--	78	--	--	--	--
	1303	92.92	6.5	23540.0	23.0	6.5	4.4	51	--	76	--	--	--	--
	1305	92.92	12.0	23540.0	23.0	6.5	4.3	50	--	76	--	--	--	--
09-26-79	1226	94.03	1.0	33490.0	24.5	--	2.5	30	--	91	--	--	--	--
	1228	94.03	6.0	33490.0	24.0	6.5	1.6	19	--	100	--	--	--	--
	1230	94.03	12.5	33490.0	23.5	6.4	0.2	2	--	94	--	--	--	--
10-04-79	1256	92.05	1.0	18180.0	25.0	6.6	0.1	1	--	140	--	--	--	--
	1258	92.05	6.0	18180.0	25.0	6.6	0.1	1	--	140	--	--	--	--
	1300	92.05	12.0	18180.0	24.0	6.4	0.1	1	--	135	--	--	--	--
10-11-79	1300	88.74	1.0	6390.0	23.0	6.9	3.4	39	--	148	--	--	--	--
	1305	88.74	7.0	6390.0	21.0	6.7	3.7	41	--	147	--	--	--	--
05-04-81	1304	81.80	1.0	233.0	24.0	6.6	3.5	42	--	200	--	--	--	--
	1306	81.80	3.0	233.0	23.0	6.6	3.4	40	--	200	--	--	--	--
05-07-81	1052	85.80	1.0	3630.0	24.5	6.5	3.3	39	--	138	--	--	--	--
	1054	85.80	4.5	3630.0	24.0	6.4	1.4	16	--	144	--	--	--	--
05-11-81	1220	86.16	1.0	4270.0	24.5	6.1	2.1	25	--	141	--	--	--	--
	1222	86.16	3.0	4270.0	22.0	6.1	1.5	17	--	141	--	--	--	--
	1224	86.16	7.5	4270.0	22.0	6.1	1.5	17	--	141	--	--	--	--
05-13-81	1145	85.43	1.0	3040.0	24.0	6.3	3.1	36	--	144	--	--	--	--
	1147	85.43	3.5	3040.0	24.0	6.3	2.5	29	--	144	--	--	--	--
	1149	85.43	7.0	3040.0	23.5	6.2	1.7	20	--	145	--	--	--	--
05-15-81	1325	83.62	1.0	1070.0	23.5	6.3	2.9	34	--	144	--	--	--	--
	1327	83.62	4.5	1070.0	23.0	6.2	2.5	29	--	144	--	--	--	--
	Station Mean				23.69	6.52	2.98	35.3	--	128.7	--	--	--	--
	Station Maximum				27.5	7.1	6.2	76	--	200	--	--	--	--
	Station Minimum				21.0	6.1	0.1	1	--	76	--	--	--	--

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1455	89.02	-	784.0	26.5	6.4	5.8	73	4.9	125	6700	170	820	0.207
06-15-78	1145	81.66	-	404.0	28.0	6.5	5.7	73	18.0	214	32000	160	1000	0.160
10-17-78	1050	75.61	-	7.2	18.5	7.1	9.2	101	8.7	657	9700	980	390	2.513
12-01-78	1310	87.35	-	184.0	16.0	6.9	8.1	84	3.7	125	3100	220	240	0.917
12-04-78	1345	84.81	-	655.0	14.0	7.6	7.9	79	3.4	169	8300	270	390	0.692
01-30-79	1130	85.08	-	500.0	6.5	7.0	10.7	90	2.8	138	4000	750	65	11.538
01-31-79	1045	83.19	-	454.0	6.0	7.2	10.2	84	5.2	179	36000	3600	1200	3.000
02-01-79	1110	79.28	-	226.0	5.5	6.9	12.6	103	5.4	155	25000	1200	1100	1.091
02-05-79	1240	83.00	-	300.0	10.0	7.3	10.6	97	4.8	130	12000	4000	8900	0.449
02-09-79	1150	89.62	-	400.0	7.0	7.0	11.5	97	3.5	80	11000	600	4700	0.128
02-15-79	1345	88.30	-	573.0	15.0	7.1	9.5	97	3.0	81	780	48	73	0.658
02-21-79	1010	82.56	-	433.0	8.0	7.1	9.4	82	4.9	151	6700	680	300	2.267
04-11-79	0945	75.68	-	33.0	22.5	7.2	6.5	76	12.0	400	32000	820	950	0.863
04-23-79	1450	88.86	-	390.0	22.5	6.7	7.5	88	4.4	96	8300	200	850	0.235
04-26-79	1200	87.90	-	376.0	24.5	6.9	7.1	87	3.1	95	9300	91	580	0.157
05-03-79	1045	84.25	-	320.0	22.0	6.1	7.4	87	4.7	141	14000	650	980	0.663
09-24-79	1050	94.11	-	229.0	23.0	6.8	7.4	84	1.9	90	6700	210	190	1.105
09-26-79	1050	94.04	-	915.0	23.5	6.8	6.2	72	2.4	93	290	150	170	0.882
10-04-79	1005	92.05	-	805.0	25.5	6.9	4.8	58	6.6	118	9700	39	75	0.520
10-11-79	1025	88.82	-	780.0	22.0	7.0	4.7	53	14.0	178	12000	27	71	0.380
03-03-81	1010	73.68	-	9.0	15.0	7.6	10.6	105	10.0	681	13000	130	120	1.083
05-12-81	1050	86.13	-	539.0	22.0	6.4	7.4	83	5.3	127	4200	81	200	0.405
05-13-81	0940	85.49	-	529.0	22.5	6.9	5.8	66	5.4	127	2800	61	270	0.226
05-15-81	0945	83.73	-	445.0	21.5	7.0	5.2	58	4.8	195	1600	67	170	0.394
	Station Mean				17.81	6.93	7.99	82.4	5.95	189.4	11215	634	992	1.272
	Station Maximum				28.0	6.8	12.6	105	18.0	681	36000	4000	8900	11.538
	Station Minimum				5.5	6.1	4.7	53	1.9	80	290	27	65	.128

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1220	8.75	-	118.0	27.5	6.8	4.8	62	9.3	132	7300	310	600	0.517
06-15-78	1110	5.77	-	9.2	28.0	6.8	4.7	60	22.0	204	12000	190	260	0.731
11-28-78	1330	8.61	-	111.0	12.5	6.7	10.8	105	3.5	109	14000	1200	2700	0.444
11-29-78	1140	8.25	-	94.0	13.0	7.1	9.8	96	3.5	109	14000	2600	7000	0.371
12-04-78	1050	6.72	-	35.0	11.0	7.3	8.5	79	3.6	150	25000	3900	4800	0.812
02-05-79	1135	11.22	-	276.0	7.5	7.0	9.2	79	3.4	69	10000	4200	9300	0.452
02-06-79	1050	12.46	-	372.0	6.0	7.0	9.8	81	3.2	52	6700	3000	9600	0.312
02-07-79	1110	10.99	-	254.0	5.0	7.0	10.3	83	3.0	50	6700	390	4400	0.089
02-12-79	1150	5.99	-	14.0	11.0	6.9	8.9	83	4.1	70	2200	190	270	0.704
04-21-79	1020	8.03	-	84.0	21.0	6.8	6.1	70	4.2	65	10000	720	1000	0.720
04-26-79	0930	7.20	-	51.0	25.0	6.8	6.4	79	3.8	65	7300	220	400	0.550
09-19-79	1235	12.48	-	371.0	22.0	6.7	7.4	87	5.4	68	29000	5100	5600	0.911
09-21-79	1035	14.82	-	600.0	22.0	6.8	5.1	58	2.1	77	3100	2700	2000	1.350
09-27-79	1155	9.08	-	134.0	24.0	6.9	4.9	57	2.8	108	8700	180	250	0.720
03-03-81	0930	4.26	-	0.2	14.5	7.4	7.4	73	3.1	210	680	190	150	1.267
05-03-81	1815	6.64	-	63.0	22.5	6.5	6.4	74	13.0	122	9300	4000	7500	0.533
05-04-81	0940	7.59	-	110.0	21.5	7.0	5.3	60	5.1	70	10000	2400	4900	0.490
05-05-81	1415	6.92	-	75.0	23.0	6.9	5.6	-	7.5	78	7000	650	980	0.663
	Station Mean				17.61	6.91	7.30	75.6	5.70	100.4	10166	1786	3428	0.646
	Station Maximum				28.0	7.4	10.8	105	22.0	210	29000	5100	9600	1.350
	Station Minimum				5.0	6.5	4.7	57	2.1	50	680	180	150	.089

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1130	16.52	-	160.0	28.0	6.8	4.0	51	4.6	105	2800	200	950	0.211
06-15-78	1005	13.27	-	12.0	28.5	7.1	4.6	60	16.0	219	31000	500	630	0.794
11-28-78	1250	16.18	-	189.0	12.5	6.9	11.4	111	4.0	95	7700	2800	4100	0.683
11-29-78	1110	15.38	-	127.0	12.5	7.3	9.6	93	3.6	95	13000	3900	6300	0.619
12-04-78	0950	13.78	-	23.0	9.5	7.4	9.7	87	4.4	134	34000	4900	6300	0.778
02-05-79	1010	17.80	-	323.0	7.5	6.9	9.4	81	3.4	59	32000	3300	8000	0.413
02-06-79	1010	19.24	-	459.0	6.0	6.8	10.3	85	3.1	49	9300	1500	9400	0.160
02-07-79	1030	17.74	-	318.0	5.0	7.0	10.4	84	3.0	50	8300	600	5200	0.115
02-12-79	1110	13.20	-	9.5	11.0	6.8	8.8	82	3.6	81	6700	210	260	0.808
04-21-79	0935	16.06	-	176.0	21.0	6.8	6.5	75	3.8	76	140000	2900	1700	1.706
04-26-79	0835	12.98	-	5.0	22.5	6.6	6.6	78	4.6	123	38000	1000	920	1.087
09-19-79	1145	20.91	-	630.0	22.5	7.1	6.6	78	4.2	88	39000	4900	4500	1.089
09-21-79	1130	21.22	-	667.0	22.0	6.9	5.2	59	2.0	73	9700	2700	2300	1.174
09-27-79	1100	14.56	-	75.0	22.5	7.0	6.2	70	2.5	125	35000	580	340	1.706
03-03-81	0850	12.85	-	1.0	15.0	7.3	7.8	77	3.4	819	4100	580	1600	0.362
05-03-81	1710	16.87	-	208.0	22.5	6.9	6.1	70	7.8	84	16000	8200	14000	0.586
	2045	16.95	-	214.0	23.0	6.3	4.9	57	8.4	123	13000	5800	10000	0.580
05-04-81	1025	16.08	-	147.0	22.0	6.8	4.3	49	7.8	90	30000	3700	8200	0.451
05-05-81	1340	16.07	-	146.0	22.5	6.8	4.6	-	5.8	98	9300	1000	5500	0.182
	Station Mean				17.68	6.92	7.21	74.8	5.05	136.1	25205	2593	4747	0.711
	Station Maximum				28.5	7.4	11.4	111	16.0	819	140000	8200	14000	1.706
	Station Minimum				5.0	6.3	4.0	49	2.0	49	2800	200	260	.115

STATION: 294729095372501

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1325	91.53	1.0	3610.0	24.5	6.5	3.1	38	--	89	--	--	--	--
	1327	91.53	3.0	3610.0	24.5	6.3	1.4	17	--	89	--	--	--	--
	1329	91.53	5.0	3610.0	24.5	6.2	0.4	5	--	89	--	--	--	--
	1331	91.53	10.0	3610.0	24.0	6.2	0.2	2	--	89	--	--	--	--
	1333	91.53	13.0	3610.0	24.0	6.2	0.2	2	--	91	--	--	--	--
06-15-78	1030	82.53	1.0	94.0	28.0	6.9	0.7	9	--	170	--	--	--	--
04-21-79	1450	89.68	1.0	1770.0	21.5	7.1	5.2	60	--	105	--	--	--	--
	1452	89.68	5.0	1770.0	21.5	7.1	5.0	58	--	105	--	--	--	--
04-21-79	1454	89.68	10.0	1770.0	21.0	7.0	4.5	52	--	109	--	--	--	--
	1456	89.68	14.0	1770.0	21.0	7.0	4.2	48	--	109	--	--	--	--
04-26-79	1415	88.72	1.0	1130.0	25.5	6.8	4.9	61	--	100	--	--	--	--
	1419	88.72	10.0	1130.0	22.0	6.9	1.8	21	--	100	--	--	--	--
09-21-79	1050	96.47	1.0	17140.0	22.5	6.2	3.5	40	--	60	--	--	--	--
	1052	96.47	8.0	17140.0	22.5	6.2	3.6	41	--	60	--	--	--	--
	1054	96.47	16.5	17140.0	22.5	6.2	3.7	43	--	60	--	--	--	--
09-26-79	1037	98.00	1.0	24840.0	24.0	6.1	3.0	35	--	80	--	--	--	--
	1039	98.00	5.0	24840.0	23.5	6.1	2.2	26	--	80	--	--	--	--
	1041	98.00	10.0	24840.0	23.5	6.2	1.7	20	--	78	--	--	--	--
	1043	98.00	15.0	24840.0	23.0	6.1	0.3	3	--	80	--	--	--	--
	1045	98.00	19.5	24840.0	23.0	6.1	0.3	3	--	80	--	--	--	--
10-04-79	0959	95.12	1.0	11800.0	25.0	6.1	0.1	1	--	105	--	--	--	--
	1001	95.12	5.0	11800.0	25.0	6.1	0.1	1	--	105	--	--	--	--
	1003	95.12	10.0	11800.0	25.0	6.1	0.1	1	--	105	--	--	--	--
	1005	95.12	17.0	11800.0	24.5	6.1	0.1	1	--	105	--	--	--	--
10-11-79	1010	89.07	1.0	1340.0	22.0	6.6	0.4	5	--	146	--	--	--	--
	1015	89.07	9.0	1340.0	21.5	6.7	0.4	5	--	142	--	--	--	--
05-04-81	1513	85.88	1.0	1610.0	26.0	6.2	4.4	54	--	95	--	--	--	--
	1515	85.88	4.0	1610.0	22.5	6.2	3.8	44	--	95	--	--	--	--
	1517	85.88	8.0	1610.0	22.5	6.2	4.2	49	--	95	--	--	--	--
05-07-81	1428	89.88	1.0	5520.0	27.0	6.2	6.0	74	--	105	--	--	--	--
	1430	89.88	7.0	5520.0	22.5	5.9	0.6	7	--	105	--	--	--	--
	1432	89.88	16.0	5520.0	22.5	6.0	0.9	10	--	105	--	--	--	--
05-11-81	0948	90.84	1.0	7220.0	22.5	5.9	1.5	17	--	108	--	--	--	--
	0950	90.84	7.5	7220.0	22.5	5.9	1.8	20	--	106	--	--	--	--
	0952	90.84	15.0	7220.0	22.0	6.0	2.0	22	--	106	--	--	--	--

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 294729095372501--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
05-13-81	0920	90.50	1.0	6560.0	23.0	6.1	3.0	34	--	106	--	--	--	--
	0922	90.50	7.5	6560.0	23.0	6.0	3.0	34	--	107	--	--	--	--
	0924	90.50	15.0	6560.0	22.5	6.1	2.2	25	--	107	--	--	--	--
05-15-81	1050	87.33	1.0	2580.0	23.0	6.0	0.1	1	--	113	--	--	--	--
	1052	87.33	5.5	2580.0	22.5	6.0	0.2	2	--	113	--	--	--	--
	1054	87.33	12.0	2580.0	22.5	6.0	0.4	5	--	113	--	--	--	--
	Station Mean				23.32	6.29	2.08	24.3	--	100.2	--	--	--	--
	Station Maximum				28.0	7.1	6.0	74	--	170	--	--	--	--
	Station Minimum				21.0	5.9	0.1	1	--	60	--	--	--	--

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1352	91.53	1.0	3610.0	25.0	6.2	3.8	48	4.3	89	5000	210	500	0.420
	1354	91.53	5.0	3610.0	24.0	6.1	2.2	27	--	89	--	--	--	--
	1356	91.53	7.0	3610.0	23.0	6.1	1.6	19	--	89	--	--	--	--
	1358	91.53	10.0	3610.0	23.0	6.1	0.3	4	--	89	--	--	--	--
	1400	91.53	12.5	3610.0	23.5	6.1	0.3	4	5.0	91	1200	1000	520	1.923
06-15-78	1050	82.47	4.0	92.0	27.5	6.7	0.9	12	16.0	170	30000	170	210	0.810
11-28-78	1415	88.45	1.0	995.0	14.5	6.4	5.5	56	3.8	103	10000	3900	3100	1.258
	1425	88.45	10.0	995.0	15.5	6.4	5.3	55	3.9	103	11000	5300	2800	1.893
11-29-78	1100	88.20	1.0	879.0	14.5	6.6	5.3	54	3.0	104	46000	2000	1200	1.667
	1105	88.20	15.0	879.0	14.0	6.5	4.7	47	3.1	109	4500	1100	900	1.222
02-05-79	1420	83.86	1.0	130.0	9.0	7.4	10.0	89	4.6	83	--	--	--	--
	1425	83.86	10.0	130.0	9.0	7.4	10.0	89	4.0	83	11000	3200	10000	0.320
02-09-79	1315	92.60	1.0	5240.0	7.0	7.0	9.8	85	2.6	65	8700	1000	6700	0.149
	1320	92.60	17.0	5240.0	8.0	7.2	9.4	80	3.1	60	--	--	--	--
02-15-79	1200	87.32	1.0	574.0	14.0	6.9	7.2	72	3.2	84	2000	190	140	1.357
	1205	87.32	12.0	574.0	10.0	7.0	8.6	79	3.4	91	2800	140	110	1.273
04-21-79	1415	89.65	1.0	1740.0	22.0	7.2	5.6	66	4.2	96	98000	2000	2900	0.690
	1416	89.65	5.0	1740.0	21.0	7.1	5.1	59	--	109	--	--	--	--
	1417	89.65	9.0	1740.0	20.5	7.1	4.5	51	--	109	--	--	--	--
	1419	89.65	13.0	1740.0	20.5	7.1	4.0	45	--	109	--	--	--	--
	1420	89.65	16.0	1740.0	20.5	7.0	3.6	41	4.2	105	52000	3400	3100	1.097
04-26-79	1330	88.78	1.0	1170.0	25.5	7.0	6.4	80	4.6	100	8300	41	800	0.051
	1332	88.78	5.0	1170.0	24.5	6.9	6.0	73	--	100	--	--	--	--
	1334	88.78	10.0	1170.0	22.0	6.9	5.0	59	--	100	--	--	--	--
	1335	88.78	17.0	1170.0	21.5	6.9	1.6	19	5.2	101	7000	61	980	0.062
05-03-79	0930	73.90	1.0	1.0	22.5	7.2	5.9	69	16.0	250	35000	1000	800	1.250
09-21-79	1024	96.45	1.0	17050.0	22.5	6.1	3.2	36	1.8	60	9700	2000	3700	0.541
	1026	96.45	8.0	17050.0	22.0	6.1	3.1	35	--	62	--	--	--	--
	1028	96.45	13.0	17050.0	22.0	6.2	3.1	35	--	65	--	--	--	--
	1030	96.45	17.5	17050.0	22.0	6.2	3.5	40	1.8	60	6700	2400	500	4.800
09-26-79	1014	98.01	1.0	24900.0	24.0	7.4	4.4	52	2.8	76	2400	45	180	0.250
	1016	98.01	6.0	24900.0	23.5	7.2	2.4	28	--	81	--	--	--	--
	1018	98.01	13.0	24900.0	23.5	7.0	1.5	17	--	85	--	--	--	--
	1020	98.01	18.0	24900.0	23.0	6.9	0.4	5	2.6	78	3000	170	190	0.895
10-04-79	1017	95.12	1.0	11800.0	25.0	6.1	0.1	1	14.0	90	11000	41	95	0.432
	1019	95.12	5.0	11800.0	25.0	6.1	0.1	1	--	100	--	--	--	--
	1021	95.12	10.0	11800.0	25.0	6.2	0.1	1	--	105	--	--	--	--
	1023	95.12	15.0	11800.0	24.0	6.2	0.1	1	--	114	--	--	--	--
	1025	95.12	23.0	11800.0	23.0	6.1	0.1	1	15.0	114	10000	96	67	1.433
10-11-79	1035	89.01	1.0	1310.0	22.5	6.7	0.4	4	21.0	142	11000	33	900	0.037
	1045	89.01	6.0	1310.0	22.0	6.6	0.4	5	--	142	--	--	--	--
	1050	89.01	13.0	1310.0	21.5	6.5	0.4	4	14.0	169	9700	41	2000	0.021
05-04-81	1435	85.76	1.0	1550.0	23.0	6.2	3.9	-	5.6	110	30000	4000	6600	0.606
	1437	85.76	7.0	1550.0	22.5	6.2	3.8	44	--	104	--	--	--	--
	1439	85.76	13.5	1550.0	22.5	6.5	3.8	-	5.2	104	25000	3100	3900	0.795

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 294729095372502 (08073000)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
05-07-81	1400	89.88	1.0	5520.0	26.0	6.2	3.7	-	4.1	98	2500	92	220	0.418
	1402	89.88	8.0	5520.0	22.5	6.0	1.0	11	--	104	--	--	--	--
	1404	89.88	16.5	5520.0	22.5	6.3	0.5	-	4.3	111	7300	160	1300	0.123
05-11-81	0936	90.83	1.0	7200.0	22.5	5.7	0.7	-	4.4	106	700	19	53	0.358
	0938	90.83	9.0	7200.0	22.0	5.7	0.4	4	--	111	--	--	--	--
	0940	90.83	17.5	7200.0	22.0	5.8	0.1	-	7.4	110	3400	210	650	0.323
05-13-81	0900	90.51	1.0	6580.0	23.0	6.1	2.0	-	4.3	108	820	35	130	0.269
	0902	90.51	7.5	6580.0	21.5	5.9	0.1	1	--	108	--	--	--	--
	0904	90.51	15.5	6580.0	20.5	6.1	0.1	-	4.5	95	2700	260	310	0.839
05-15-81	1026	87.36	1.0	2600.0	22.5	5.8	0.7	-	5.0	111	1800	120	580	0.207
	1028	87.36	7.5	2600.0	21.0	5.7	0.4	4	--	106	--	--	--	--
	1030	87.36	15.0	2600.0	21.0	5.9	0.4	-	4.5	108	1700	77	240	0.321
	Station Mean				20.83	6.50	3.11	36.4	6.01	102.1	13880	1106	1658	0.827
	Station Maximum				27.5	7.4	10.0	89	21.0	250	98000	5300	10000	4.800
	Station Minimum				7.0	5.7	0.1	1	1.8	60	700	19	53	.021

STATION: 294729095372503

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1345	91.53	1.0	3610.0	26.0	6.5	4.4	55	--	89	--	--	--	--
	1347	91.53	5.5	3610.0	24.5	6.3	2.9	35	--	89	--	--	--	--
	1349	91.53	7.0	3610.0	23.5	6.1	0.4	5	--	89	--	--	--	--
	1351	91.53	10.0	3610.0	23.5	6.2	0.5	6	--	89	--	--	--	--
04-21-79	1350	89.64	1.0	1740.0	21.5	7.0	5.4	63	--	100	--	--	--	--
	1352	89.64	5.0	1740.0	21.0	7.0	4.9	56	--	100	--	--	--	--
	1353	89.64	9.0	1740.0	20.5	7.1	4.2	48	--	109	--	--	--	--
	1355	89.64	13.0	1740.0	20.5	7.0	3.2	36	--	119	--	--	--	--
04-26-79	1315	88.80	1.0	1180.0	23.0	6.9	4.6	55	--	100	--	--	--	--
	1317	88.80	5.0	1180.0	21.0	6.8	3.9	45	--	101	--	--	--	--
	1319	88.80	10.0	1180.0	20.5	6.8	4.1	47	--	103	--	--	--	--
	1321	88.80	14.0	1180.0	20.5	6.8	0.2	2	--	103	--	--	--	--
09-21-79	1000	96.43	1.0	16960.0	22.5	6.1	3.2	37	--	60	--	--	--	--
	1002	96.43	10.5	16960.0	22.5	6.1	3.4	39	--	62	--	--	--	--
	1004	96.43	17.0	16960.0	22.5	6.2	3.3	38	--	68	--	--	--	--
09-26-79	0946	98.02	1.0	24950.0	24.0	6.5	4.3	51	--	85	--	--	--	--
	0948	98.02	6.5	24950.0	24.0	6.5	3.5	41	--	85	--	--	--	--
	0950	98.02	13.5	24950.0	23.0	6.0	0.2	2	--	85	--	--	--	--
10-04-79	1046	95.10	1.0	11730.0	24.5	6.4	0.1	1	--	109	--	--	--	--
	1048	95.10	5.0	11730.0	24.5	6.4	0.1	1	--	109	--	--	--	--
	1050	95.10	13.0	11730.0	24.0	6.3	0.1	1	--	109	--	--	--	--
10-11-79	1100	88.98	1.0	1290.0	22.5	6.7	0.4	5	--	158	--	--	--	--
	1105	88.98	10.0	1290.0	21.5	6.5	0.4	5	--	159	--	--	--	--
05-04-81	1423	85.73	1.0	1540.0	25.0	6.5	3.6	43	--	137	--	--	--	--
	1425	85.73	3.0	1540.0	23.0	6.5	2.7	31	--	137	--	--	--	--
05-07-81	1316	89.87	1.0	5500.0	25.0	6.1	3.3	39	--	106	--	--	--	--
	1318	89.87	7.0	5500.0	22.5	6.0	0.4	5	--	106	--	--	--	--
	1320	89.87	15.0	5500.0	22.5	6.1	0.5	6	--	106	--	--	--	--
05-11-81	0922	90.83	1.0	7200.0	22.5	5.8	0.6	7	--	111	--	--	--	--
	0924	90.83	7.0	7200.0	22.0	5.8	0.2	2	--	111	--	--	--	--
	0926	90.83	14.0	7200.0	22.0	5.9	0.2	2	--	114	--	--	--	--
05-13-81	0850	90.52	1.0	6600.0	22.5	6.0	1.2	14	--	121	--	--	--	--
	0852	90.52	6.5	6600.0	21.0	5.9	0.3	3	--	99	--	--	--	--
	0854	90.52	13.5	6600.0	20.5	6.0	0.3	3	--	101	--	--	--	--
05-15-81	0956	87.42	1.0	2650.0	22.0	6.0	0.5	6	--	130	--	--	--	--
	0958	87.42	5.0	2650.0	22.0	6.0	0.4	4	--	130	--	--	--	--
	1000	87.42	10.0	2650.0	21.0	5.9	0.3	3	--	117	--	--	--	--
	Station Mean				22.57	6.34	1.95	22.8	--	105.6	--	--	--	--
	Station Maximum				26.0	7.1	5.4	63	--	159	--	--	--	--
	Station Minimum				20.5	5.8	0.1	1	--	60	--	--	--	--

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-09-78	1430	91.53	-	604.0	25.5	6.2	6.3	79	3.8	94	3300	190	500	0.380
06-15-78	1125	82.36	-	286.0	28.0	6.2	5.6	72	15.0	171	12000	150	260	0.577
10-17-78	0930	73.33	-	9.0	17.5	6.9	7.1	76	13.0	520	6700	170	270	0.630
11-29-78	1430	88.05	-	726.0	14.5	7.0	10.0	101	3.5	95	8000	800	1200	0.667
12-01-78	1355	82.56	-	583.0	15.5	7.1	8.4	87	3.9	130	2000	950	980	0.969
12-04-78	1455	74.06	-	144.0	13.5	7.1	8.7	86	4.6	180	16000	3000	3800	0.789
01-30-79	1015	84.14	-	313.0	6.5	7.2	11.3	95	4.5	141	4800	250	150	1.667
02-05-79	1515	84.13	-	312.0	9.5	7.2	11.2	101	4.2	80	10000	3700	9500	0.389
02-09-79	1350	92.59	-	622.0	8.0	7.0	11.4	99	3.0	65	9300	2300	3600	0.639
02-16-79	0910	86.38	-	340.0	13.5	7.6	9.9	98	3.5	109	4200	150	61	2.459
02-21-79	1150	75.15	-	146.0	11.0	7.8	9.8	92	6.8	175	50000	2300	600	3.833
04-11-79	1045	73.53	-	16.0	21.5	7.0	7.4	86	5.9	339	36000	500	1400	0.357
04-23-79	1255	90.69	-	197.0	21.5	6.8	7.9	92	3.2	93	6700	500	950	0.526
04-26-79	1330	88.79	-	372.0	23.5	6.8	7.4	89	4.4	105	10000	56	480	0.117
05-03-79	0910	73.92	-	33.0	22.0	5.9	8.2	96	12.0	247	13000	680	850	0.800
09-24-79	1150	98.05	-	235.0	22.5	6.7	8.1	91	1.6	68	9300	150	170	0.882
09-26-79	1145	98.00	-	936.0	24.0	6.9	7.2	84	2.4	75	6700	270	190	1.421
10-04-79	1100	95.10	-	880.0	25.0	6.7	6.2	74	12.0	95	7000	41	43	0.953
10-11-79	1145	88.92	-	752.0	22.0	6.9	5.3	60	19.0	164	8300	45	1900	0.024
03-03-81	0840	72.14	-	39.0	15.0	7.5	9.5	94	4.2	579	2600	360	190	1.895
05-12-81	0945	91.27	-	792.0	22.0	6.3	7.0	79	6.2	116	6700	190	700	0.271
05-13-81	0845	90.51	-	1165.0	22.0	6.9	7.2	81	4.9	111	4100	150	370	0.405
05-15-81	0900	87.51	-	1070.0	21.5	7.1	6.6	74	4.7	111	2400	51	390	0.131
	Station Mean				18.50	6.90	8.16	86.4	6.36	168.0	10396	737	1241	0.904
	Station Maximum				28.0	7.8	11.4	101	19.0	579	50000	3700	9500	3.833
	Station Minimum				6.5	5.9	5.3	60	1.6	65	2000	41	43	.024

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
06-08-78	1325	56.46	-	591.0	26.5	7.1	6.4	81	4.9	136	54000	2100	340	6.176
06-09-78	1220	61.31	-	1310.0	26.5	6.4	6.2	78	4.2	117	25000	500	800	0.625
06-15-78	0905	57.78	-	781.0	28.0	6.6	3.1	40	13.0	204	34000	190	580	0.328
07-12-78	0940	50.80	-	50.0	28.0	7.2	5.4	69	9.3	512	12000	2000	900	2.222
08-02-78	1020	51.85	-	163.0	28.0	7.0	6.7	86	4.1	368	9300	600	220	2.727
08-23-78	1130	50.40	-	25.0	25.0	7.1	4.9	60	4.9	539	100000	7000	950	7.368
09-27-78	0950	50.50	-	28.0	24.0	7.3	6.0	73	6.7	449	13000	500	150	3.333
10-17-78	0830	50.39	-	20.0	18.0	6.8	5.9	64	11.0	629	2700	130	58	2.241
11-07-78	1445	51.83	-	153.0	17.5	7.3	7.4	80	15.0	523	110000	7700	3100	2.484
11-28-78	1435	55.78	1.0	627.0	15.0	6.9	11.4	116	4.1	135	32000	8700	3200	2.719
11-29-78	1015	58.06	-	946.0	14.0	7.2	9.0	90	3.5	125	32000	5000	3200	1.562
12-01-78	1435	56.98	-	796.0	16.0	7.1	8.3	86	3.5	141	7300	300	450	0.667
12-04-78	0845	57.16	-	814.0	--	7.3	8.1	79	3.6	175	9700	2000	390	5.128
12-13-78	1005	50.67	-	37.0	9.0	7.1	10.9	97	3.6	354	3000	28	41	0.683
01-23-79	1010	58.48	-	1000.0	12.0	7.4	9.3	89	5.5	117	6700	780	850	0.918
01-30-79	1225	57.10	-	812.0	7.0	7.1	10.5	89	4.0	152	7700	1000	620	1.613
02-05-79	1435	57.40	-	850.0	8.0	7.2	9.8	85	4.5	130	38000	7300	7800	0.936
02-06-79	1335	60.24	-	1280.0	7.5	7.1	10.1	87	3.3	105	11000	2200	6900	0.319
02-07-79	0945	59.26	-	1120.0	6.5	7.1	10.2	86	3.3	95	25000	1200	6200	0.194
02-09-79	1455	58.65	-	1020.0	8.0	7.0	11.0	96	2.8	79	620000	75000	6000	12.500
02-12-79	0920	58.09	-	946.0	8.5	6.8	9.6	85	3.4	80	4800	200	370	0.541
02-16-79	1000	56.92	-	773.0	14.0	7.5	9.6	96	3.6	104	4000	500	180	2.778
02-21-79	0905	54.74	-	507.0	8.5	6.7	9.3	82	4.7	163	13000	980	300	3.267
03-12-79	1250	50.54	-	30.0	16.5	7.5	7.8	82	5.8	600	14000	580	12	48.333
04-11-79	1135	50.91	-	56.0	22.0	7.3	6.4	75	9.6	425	9000	160	190	0.842
04-23-79	1355	56.92	-	784.0	22.0	6.8	7.8	92	3.8	108	29000	750	1000	0.750
04-26-79	1205	56.92	-	781.0	23.0	6.8	7.2	86	3.9	108	14000	130	460	0.283
05-03-79	1200	53.94	-	408.0	22.5	6.4	7.5	88	9.9	166	13000	600	720	0.833
05-21-79	1405	50.62	-	34.0	25.5	7.7	6.6	82	16.0	920	16000	820	140	5.857
06-27-79	0955	51.62	-	128.0	27.5	7.2	5.9	76	17.0	328	56000	4400	6000	0.733
09-12-79	1045	51.00	-	64.0	25.5	7.3	7.1	89	5.7	463	4000	350	160	2.187

Appendix A.--Field measurements, biochemical oxygen demand, and bacteria--Continued

STATION: 08073500--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Water temperature (°C)	pH (units)	Oxygen, dissolved (mg/L)	Oxygen, dissolved (percent saturation)	Oxygen demand, biochemical, 5 day, (mg/L)	Specific conductance (µS/cm)	Coliform, total, immed. (cols./100 mL)	Coliform, fecal, .7UM-MF (cols./100 mL)	Streptococci, fecal, KF Agar (cols./100 mL)	Ratio of fecal coliform to fecal streptococci
09-17-79	1940	51.65	-	132.0	24.5	7.3	7.3	89	16.0	330	49000	9300	7600	1.224
09-20-79	1045	63.18	-	1630.0	22.5	6.9	6.7	79	3.4	86	30000	4800	2100	2.286
09-24-79	1300	56.75	-	632.0	24.0	7.0	7.0	81	2.3	102	12000	600	240	2.500
09-26-79	0935	63.92	-	1730.0	23.0	6.9	6.3	72	2.5	95	7000	320	500	0.640
10-04-79	0900	63.06	-	1580.0	25.0	6.8	3.1	37	6.2	111	10000	41	41	1.000
10-11-79	0935	61.82	-	1370.0	22.0	6.9	2.9	33	14.0	165	12000	14	350	0.040
10-15-79	1005	55.46	-	496.0	21.0	7.1	6.8	76	4.0	250	3100	41	61	0.672
11-28-79	1055	60.28	-	1200.0	14.0	6.9	9.1	86	4.5	139	6700	240	620	0.387
01-29-80	1255	61.90	-	1570.0	12.0	6.7	7.0	64	3.2	95	2000	190	240	0.792
05-19-80	1130	54.92	-	489.0	23.0	6.7	7.0	80	6.5	200	31000	5200	8100	0.642
05-21-80	0950	59.82	-	1150.0	24.0	6.7	5.6	66	5.8	109	6700	1400	820	1.707
08-04-80	1140	50.36	-	54.0	28.0	7.6	6.5	82	4.5	600	13000	820	99	8.283
09-09-80	1130	59.32	-	985.0	26.0	7.1	7.3	89	3.5	190	15000	1000	1300	0.769
03-03-81	1135	49.88	-	20.0	16.0	7.6	7.2	73	11.0	700	65000	7700	4000	1.925
03-23-81	1020	49.84	-	16.0	14.5	7.9	6.5	62	5.4	786	38000	2800	330	8.485
05-12-81	1200	56.30	-	647.0	22.5	6.4	6.2	70	6.6	139	9000	680	820	0.829
05-13-81	1040	62.43	-	1600.0	22.5	6.8	5.5	61	5.2	119	7700	140	290	0.483
05-15-81	1045	61.66	-	1460.0	22.0	7.1	5.5	62	4.4	143	6700	550	270	2.037
	Station Mean				19.30	7.06	7.32	78.1	6.27	263.4	33737	3460	1634	3.11
	Station Maximum				28.0	7.9	11.4	116	17.0	920	620000	75000	8100	48.333
	Station Minimum				6.5	6.4	2.9	33	2.3	79	2000	14	12	.040

Appendix B.--Physical and aesthetic properties

[ft, foot; ft^3/s, cubic foot per second; acre-ft, acre-foot; mg/L, milligram per liter; NTU, nephelometric turbidity unit; Pt-Co unit, platinum-cobalt unit]

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1010	27.68	-	190.0	119	32	--	140
06-15-78	1255	25.74	-	19.0	130	45	--	239
11-28-78	1145	27.85	-	217.0	147	23	80.0	219
11-29-78	1315	27.64	-	186.0	134	16	80.0	350
12-04-78	1205	27.30	-	143.0	1290	200	300.0	1100
02-05-79	1315	31.42	-	814.0	280	76	120.0	200
02-06-79	1240	32.37	-	1050.0	252	11	90.0	200
02-07-79	1315	29.75	-	491.0	150	13	75.0	140
02-12-79	1015	25.96	-	31.0	180	44	80.0	239
04-21-79	1145	27.50	-	182.0	243	68	240.0	250
04-26-79	1045	25.30	-	8.1	137	45	180.0	200
09-19-79	1400	32.71	-	1180.0	231	27	73.0	80
09-21-79	0925	34.02	-	1580.0	36	0	8.8	55
09-27-79	0950	27.38	-	169.0	22	13	5.7	70
03-03-81	1030	24.87	-	1.5	47	4	29.0	15
05-03-81	1910	28.72	-	337.0	545	20	230.0	119
05-04-81	1130	29.86	-	515.0	225	9	120.0	119
05-05-81	1515	27.95	-	227.0	145	7	90.0	150
		Station Mean			239.61	36.28	112.594	215.83
		Station Maximum			1290	200	300.0	1100
		Station Minimum			22	0	5.7	15

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1202	89.03	1.0	7120.0	339	128	--	219
	1208	89.03	12.0	7120.0	435	108	--	2--
06-15-78	0930	82.35	1.0	158.0	59	3	--	160
	0935	82.35	5.0	158.0	86	55	--	140
11-29-78	1405	86.73	1.0	2680.0	308	140	120.0	260
	1410	86.73	10.0	2680.0	195	16	120.0	360
12-04-78	0935	85.19	1.0	1130.0	81	22	60.0	219
	0940	85.19	10.0	1130.0	75	19	60.0	219
02-05-79	1135	82.86	1.0	233.0	320	132	120.0	239
	1140	82.86	10.0	233.0	316	100	120.0	280
02-09-79	1025	89.68	1.0	8920.0	91	20	75.0	239
	1030	89.68	16.0	8920.0	88	47	80.0	239
02-15-79	1030	88.37	1.0	5540.0	76	10	65.0	239
	1035	88.37	13.0	5540.0	72	4	60.0	239
02-21-79	0850	82.81	1.0	224.0	102	42	65.0	200
	0855	82.81	9.0	224.0	115	38	65.0	239
04-21-79	1125	87.85	1.0	4480.0	206	8	240.0	150
	1130	87.85	16.0	4480.0	136	6	250.0	75
04-26-79	1000	87.92	1.0	4610.0	4	4	130.0	75
	1005	87.92	14.0	4610.0	13	8	130.0	200
05-03-79	0840	84.34	1.0	641.0	208	38	200.0	100
	0845	84.34	10.0	641.0	132	27	190.0	270
09-21-79	1242	92.91	1.0	23470.0	91	3	130.0	119
	1244	92.91	9.0	23470.0	64	0	160.0	100
09-26-79	1252	94.03	1.0	33490.0	15	15	11.0	60
	1300	94.03	20.0	33490.0	36	22	72.0	55
10-04-79	1314	92.04	1.0	18130.0	7	5	2.5	60
	1320	92.04	18.0	18130.0	22	3	13.0	80
10-11-79	1330	88.72	1.0	6340.0	9	0	2.4	90
	1345	88.72	15.0	6340.0	8	7	1.6	90

STATION: 294617095390502 (08072500)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
05-04-81	1150	81.68	1.0	208.0	333	16	230.0	150
	1154	81.68	8.0	208.0	364	16	380.0	270
05-07-81	1116	85.81	1.0	3650.0	31	16	62.0	119
	1120	85.81	11.5	3650.0	55	18	70.0	119
05-11-81	1138	86.15	1.0	4250.0	21	13	35.0	90
	1142	86.15	13.0	4250.0	27	19	25.0	119
05-13-81	1055	85.45	1.0	3070.0	22	3	29.0	90
	1059	85.45	13.0	3070.0	20	13	29.0	90
05-15-81	1250	83.64	1.0	1090.0	19	18	22.0	50
	1254	83.64	11.0	1090.0	130	2	24.0	100
			Station Mean		118.27	29.10	95.792	160.77
			Station Maximum		435	140	380.0	360
			Station Minimum		4	0	1.6	50

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1455	89.02	-	784.0	320	100	--	239
06-15-78	1145	81.66	-	404.0	32	1	--	160
10-17-78	1050	75.61	-	7.2	64	22	30.0	119
12-01-78	1310	87.35	-	184.0	180	40	120.0	360
12-04-78	1345	84.81	-	655.0	106	27	80.0	239
01-30-79	1130	85.08	-	500.0	108	64	80.0	239
01-31-79	1045	83.19	-	454.0	204	72	110.0	239
02-01-79	1110	79.28	-	226.0	239	88	120.0	239
02-05-79	1240	83.00	-	300.0	320	76	120.0	239
02-09-79	1150	89.62	-	400.0	147	4	100.0	239
02-15-79	1345	88.30	-	573.0	60	0	60.0	239
02-21-79	1010	82.56	-	433.0	130	44	60.0	200
04-11-79	0945	75.68	-	33.0	352	17	170.0	200
04-23-79	1450	88.86	-	390.0	50	15	160.0	250
04-26-79	1200	87.90	-	376.0	11	9	120.0	210
05-03-79	1045	84.25	-	320.0	169	42	220.0	250
09-24-79	1050	94.11	-	229.0	--	--	--	100
09-26-79	1050	94.04	-	915.0	--	--	--	60
10-04-79	1005	92.05	-	805.0	10	10	5.3	60
10-11-79	1025	88.82	-	780.0	7	0	1.5	80
03-03-81	1010	73.68	-	9.0	70	7	54.0	40
05-12-81	1050	86.13	-	539.0	19	18	35.0	119
05-13-81	0940	85.49	-	529.0	18	7	28.0	90
05-15-81	0945	83.73	-	445.0	5	0	26.0	60
			Station Mean		119.14	30.14	84.990	177.92
			Station Maximum		352	100	220.0	360
			Station Minimum		5	0	1.5	40

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1220	8.75	-	118.0	72	13	--	140
06-15-78	1110	5.77	-	9.2	50	18	--	140
11-28-78	1330	8.61	-	111.0	65	33	40.0	180
11-29-78	1140	8.25	-	94.0	143	8	90.0	219
12-04-78	1050	6.72	-	35.0	81	28	40.0	219

Appendix B.--Physical and aesthetic properties--Continued

STATION: 08072730--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
02-05-79	1135	11.22	-	276.0	130	8	80.0	140
02-06-79	1050	12.46	-	372.0	79	5	50.0	200
02-07-79	1110	10.99	-	254.0	57	10	45.0	140
02-12-79	1150	5.99	-	14.0	55	2	40.0	140
04-21-79	1020	8.03	-	84.0	96	11	120.0	250
04-26-79	0930	7.20	-	51.0	49	13	100.0	200
09-19-79	1235	12.48	-	371.0	300	54	800.0	330
09-21-79	1035	14.82	-	600.0	40	0	17.0	65
09-27-79	1155	9.08	-	134.0	38	23	4.5	80
03-03-81	0930	4.26	-	0.2	147	8	320.0	360
05-03-81	1815	6.64	-	63.0	940	21	380.0	30
05-04-81	0940	7.59	-	110.0	156	11	100.0	119
05-05-81	1415	6.92	-	75.0	147	0	140.0	180
			Station Mean		146.94	14.78	147.906	174.00
			Station Maximum		940	54	800.0	360
			Station Minimum		38	0	4.5	30

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1130	16.52	-	160.0	70	22	--	140
06-15-78	1005	13.27	-	12.0	276	57	--	239
11-28-78	1250	16.18	-	189.0	96	21	60.0	239
11-29-78	1110	15.38	-	127.0	416	64	200.0	280
12-04-78	0950	13.78	-	23.0	704	119	300.0	450
02-05-79	1010	17.80	-	323.0	395	152	100.0	239
02-06-79	1010	19.24	-	459.0	223	16	120.0	200
02-07-79	1030	17.74	-	318.0	93	11	50.0	140
02-12-79	1110	13.20	-	9.5	100	10	60.0	200
04-21-79	0935	16.06	-	176.0	123	36	150.0	200
04-26-79	0835	12.98	-	5.0	168	35	250.0	250
09-19-79	1145	20.91	-	630.0	84	16	240.0	140
09-21-79	1130	21.22	-	667.0	17	0	8.6	55
09-27-79	1100	14.56	-	75.0	33	19	17.0	70
03-03-81	0850	12.85	-	1.0	30	11	36.0	60
05-03-81	1710	16.87	-	208.0	441	20	290.0	180
	2045	16.95	-	214.0	318	13	200.0	150
05-04-81	1025	16.08	-	147.0	143	13	80.0	119
05-05-81	1340	16.07	-	146.0	145	7	93.0	180
			Station Mean		203.95	33.79	132.624	185.84
			Station Maximum		704	152	300.0	450
			Station Minimum		17	0	8.6	55

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1352	91.53	1.0	3610.0	183	64	--	13
	1400	91.53	12.5	3610.0	636	123	--	200
06-15-78	1050	82.47	4.0	92.0	74	22	--	160
11-28-78	1415	88.45	1.0	995.0	272	84	150.0	450
	1425	88.45	10.0	995.0	268	84	150.0	400
11-29-78	1100	88.20	1.0	879.0	164	64	100.0	219
	1105	88.20	15.0	879.0	111	0	100.0	239
02-05-79	1420	83.86	1.0	130.0	320	95	120.0	239
	1425	83.86	10.0	130.0	328	88	120.0	239
02-09-79	1315	92.60	1.0	5240.0	143	4	80.0	239

Appendix B.--Physical and aesthetic properties--Continued

STATION: 294729095372502 (08073000)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
02-09-79	1320	92.60	17.0	5240.0	102	6	60.0	160
02-15-79	1200	87.32	1.0	574.0	38	2	45.0	200
	1205	87.32	12.0	574.0	60	8	50.0	200
04-21-79	1415	89.65	1.0	1740.0	145	23	230.0	300
	1420	89.65	16.0	1740.0	--	--	480.0	250
04-26-79	1330	88.78	1.0	1170.0	38	19	89.0	200
	1335	88.78	17.0	1170.0	42	16	100.0	239
05-03-79	0930	73.90	1.0	1.0	682	--	150.0	150
09-21-79	1024	96.45	1.0	17050.0	73	3	260.0	90
	1030	96.45	17.5	17050.0	79	4	130.0	100
09-26-79	1014	98.01	1.0	24900.0	--	--	--	65
	1020	98.01	18.0	24900.0	--	--	--	70
10-04-79	1017	95.12	1.0	11800.0	15	11	21.0	90
	1025	95.12	23.0	11800.0	17	17	5.8	90
10-11-79	1035	89.01	1.0	1310.0	13	3	4.4	100
	1050	89.01	13.0	1310.0	38	16	19.0	119
05-04-81	1435	85.76	1.0	1550.0	171	5	230.0	210
	1439	85.76	13.5	1550.0	--	--	--	270
05-07-81	1400	89.88	1.0	5520.0	34	20	46.0	150
	1404	89.88	16.5	5520.0	31	22	66.0	119
05-11-81	0936	90.83	1.0	7200.0	19	4	36.0	90
	0940	90.83	17.5	7200.0	45	20	42.0	150
05-13-81	0900	90.51	1.0	6580.0	11	10	30.0	119
	0904	90.51	15.5	6580.0	70	25	68.0	119
05-15-81	1026	87.36	1.0	2600.0	22	16	30.0	100
	1030	87.36	15.0	2600.0	13	9	38.0	100
			Station Mean		133.03	28.61	101.673	173.56
			Station Maximum		682	123	480.0	450
			Station Minimum		11	0	4.4	13

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-09-78	1430	91.53	-	604.0	264	91	--	180
06-15-78	1125	82.36	-	286.0	55	23	--	160
10-17-78	0930	73.33	-	9.0	76	20	50.0	180
11-29-78	1430	88.05	-	726.0	156	20	100.0	260
12-01-78	1355	82.56	-	583.0	191	60	90.0	260
12-04-78	1455	74.06	-	144.0	483	91	200.0	239
01-30-79	1015	84.14	-	313.0	147	68	80.0	280
02-05-79	1515	84.13	-	312.0	304	72	120.0	239
02-09-79	1350	92.59	-	622.0	119	13	80.0	200
02-16-79	0910	86.38	-	340.0	85	30	65.0	239
02-21-79	1150	75.15	-	146.0	252	55	90.0	239
04-11-79	1045	73.53	-	16.0	320	19	200.0	150
04-23-79	1255	90.69	-	197.0	78	26	87.0	200
04-26-79	1330	88.79	-	372.0	19	8	100.0	100
05-03-79	0910	73.92	-	33.0	478	94	220.0	250
09-24-79	1150	98.05	-	235.0	36	11	56.0	80
09-26-79	1145	98.00	-	936.0	--	--	--	65
10-04-79	1100	95.10	-	880.0	36	26	23.0	80
10-11-79	1145	88.92	-	752.0	22	22	4.3	119
03-03-81	0840	72.14	-	39.0	123	4	96.0	20
05-12-81	0945	91.27	-	792.0	30	18	46.0	119
05-13-81	0845	90.51	-	1165.0	27	15	46.0	119
05-15-81	0900	87.51	-	1070.0	169	21	43.0	100
			Station Mean		157.73	36.68	89.815	168.61
			Station Maximum		483	94	220.0	280
			Station Minimum		19	4	4.3	20

Appendix B.--Physical and aesthetic properties--Continued

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Turbidity (NTU)	Color (Pt-Co units)
06-08-78	1325	56.46	-	591.0	245	44	--	160
06-09-78	1220	61.31	-	1310.0	162	55	--	200
06-15-78	0905	57.78	-	781.0	64	19	--	140
07-12-78	0940	50.80	-	50.0	197	40	--	60
08-02-78	1020	51.85	-	163.0	180	31	--	119
08-23-78	1130	50.40	-	25.0	245	36	--	60
09-27-78	0950	50.50	-	28.0	49	23	50.0	160
10-17-78	0830	50.39	-	20.0	57	16	40.0	100
11-07-78	1445	51.83	-	153.0	283	156	200.0	119
11-28-78	1435	55.78	1.0	627.0	320	36	200.0	400
11-29-78	1015	58.06	-	946.0	164	20	120.0	280
12-01-78	1435	56.98	-	796.0	191	23	100.0	219
12-04-78	0845	57.16	-	814.0	156	72	80.0	200
12-13-78	1005	50.67	-	37.0	143	52	100.0	239
01-23-79	1010	58.48	-	1000.0	190	23	110.0	439
01-30-79	1225	57.10	-	812.0	136	52	85.0	239
02-05-79	1435	57.40	-	850.0	208	80	100.0	239
02-06-79	1335	60.24	-	1280.0	167	11	85.0	239
02-07-79	0945	59.26	-	1120.0	160	32	100.0	119
02-09-79	1455	58.65	-	1020.0	36	3	85.0	200
02-12-79	0920	58.09	-	946.0	102	13	60.0	239
02-16-79	1000	56.92	-	773.0	85	22	60.0	200
02-21-79	0905	54.74	-	507.0	134	42	80.0	239
03-12-79	1250	50.54	-	30.0	105	1	60.0	30
04-11-79	1135	50.91	-	56.0	231	38	130.0	150
04-23-79	1355	56.92	-	784.0	216	40	200.0	250
04-26-79	1205	56.92	-	781.0	54	11	140.0	200
05-03-79	1200	53.94	-	408.0	225	44	75.0	250
05-21-79	1405	50.62	-	34.0	64	5	25.0	15
06-27-79	0955	51.62	-	128.0	770	108	460.0	80
09-12-79	1045	51.00	-	64.0	85	0	35.0	20
09-17-79	1940	51.65	-	132.0	184	38	75.0	70
09-20-79	1045	63.18	-	1630.0	223	3	61.0	80
09-24-79	1300	56.75	-	632.0	40	0	41.0	70
09-26-79	0935	63.92	-	1730.0	--	--	--	65
10-04-79	0900	63.06	-	1580.0	21	17	12.0	70
10-11-79	0935	61.82	-	1370.0	19	3	4.3	100
10-15-79	1005	55.46	-	496.0	11	13	3.8	109
11-28-79	1055	60.28	-	1200.0	15	0	50.0	160
01-29-80	1255	61.90	-	1570.0	30	20	96.0	140
05-21-80	0950	59.82	-	1150.0	95	13	160.0	160
08-04-80	1140	50.36	-	54.0	67	30	39.0	30
09-09-80	1130	59.32	-	985.0	76	8	72.0	85
03-03-81	1135	49.88	-	20.0	71	10	66.0	40
03-23-81	1020	49.84	-	16.0	11	7	16.0	10
05-12-81	1200	56.30	-	647.0	95	25	52.0	90
05-13-81	1040	62.43	-	1600.0	32	18	40.0	119
05-15-81	1045	61.66	-	1460.0	27	2	36.0	50
			Station Mean		137.04	28.83	87.905	146.92
			Station Maximum		770	156	460.0	439
			Station Minimum		11	0	3.8	10

Appendix C.--Major inorganic constituents and related properties

[ft, foot; ft^3/s, cubic foot per second; acre-ft, acre-foot; mg/L, milligram per liter]

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1010	27.68	-	190.0	96	52	0	45	3	16.0	1.4	13.0	0.9
06-15-78	1255	25.74	-	19.0	119	57	0	55	7	19.0	1.8	19.0	1.0
11-28-78	1145	27.85	-	217.0	83	38	0	33	2	9.4	2.2	11.0	0.9
11-29-78	1315	27.64	-	186.0	89	42	0	37	3	11.0	2.2	12.0	0.9
12-04-78	1205	27.30	-	143.0	94	44	0	37	0	11.0	2.2	12.0	0.9
02-05-79	1315	31.42	-	814.0	49	23	0	25	5	7.7	1.3	4.0	0.4
02-06-79	1240	32.37	-	1050.0	36	22	0	19	1	5.8	1.1	3.2	0.3
02-07-79	1315	29.75	-	491.0	34	20	0	20	4	6.2	1.1	3.3	0.3
02-12-79	1015	25.96	-	31.0	75	40	0	36	2	11.0	2.0	12.0	0.9
04-21-79	1145	27.50	-	182.0	47	21	0	26	9	8.3	1.2	4.8	0.4
04-26-79	1045	25.30	-	8.1	169	81	0	83	16	27.0	3.9	26.0	1.0
09-19-79	1400	32.71	-	1180.0	62	35	0	32	3	10.0	1.7	4.9	0.4
09-21-79	0925	34.02	-	1580.0	62	38	0	27	--	8.2	1.8	6.6	0.6
09-27-79	0950	27.38	-	169.0	99	60	0	47	--	14.0	2.9	11.0	0.7
03-03-81	1030	24.87	-	1.5	509	--	--	169	47	52.0	8.9	110.0	4.0
05-03-81	1910	28.72	-	337.0	78	--	--	36	11	12.0	1.5	8.4	0.6
05-04-81	1130	29.86	-	515.0	50	--	--	26	6	8.3	1.2	4.3	0.4
05-05-81	1515	27.95	-	227.0	52	--	--	23	13	7.8	1.2	4.7	0.4
Station Mean					100.17	40.93	0.	43.11	8.25	13.594	2.200	15.011	0.833
Station Maximum					509	81	0	169	47	52.0	8.9	110.0	4.0
Station Minimum					34	20	0	19	0	5.8	1.1	3.2	0.3

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1010	27.68	-	190.0	--	2.7	20.0	10.0	0.2	7.5
06-15-78	1255	25.74	-	19.0	--	4.4	23.0	22.0	0.2	4.6
11-28-78	1145	27.85	-	217.0	--	6.3	18.0	8.6	0.1	9.2
11-29-78	1315	27.64	-	186.0	--	6.2	19.0	8.3	0.1	9.9
12-04-78	1205	27.30	-	143.0	--	5.3	21.0	9.2	0.2	11.0
02-05-79	1315	31.42	-	814.0	--	2.1	5.4	13.0	0.1	3.6
02-06-79	1240	32.37	-	1050.0	--	1.9	4.2	5.4	0.2	3.2
02-07-79	1315	29.75	-	491.0	--	1.9	4.4	4.6	0.1	2.9
02-12-79	1015	25.96	-	31.0	--	3.3	11.0	12.0	0.2	3.4
04-21-79	1145	27.50	-	182.0	--	3.0	5.9	9.6	0.2	4.8
04-26-79	1045	25.30	-	8.1	31.0	4.5	28.0	29.0	0.4	10.0
09-19-79	1400	32.71	-	1180.0	8.8	3.9	7.1	8.3	0.1	9.2
09-21-79	0925	34.02	-	1580.0	10.0	3.7	9.3	5.0	0.1	8.3
09-27-79	0950	27.38	-	169.0	16.0	4.9	15.0	5.7	0.1	16.0
03-03-81	1030	24.87	-	1.5	--	9.5	100.0	140.0	0.9	13.0
05-03-81	1910	28.72	-	337.0	--	3.8	8.5	24.0	0.	4.7
05-04-81	1130	29.86	-	515.0	--	3.2	5.4	10.0	0.1	5.5
05-05-81	1515	27.95	-	227.0	--	3.3	7.9	15.0	0.2	5.7
Station Mean					16.450	4.106	17.394	18.872	0.194	7.361
Station Maximum					31.0	9.5	100.0	140.0	0.9	16.0
Station Minimum					8.8	1.9	4.2	4.6	0.	2.9

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1202	89.03	1.0	7120.0	76	44	0	42	6	13.0	2.3	8.5	0.6
	1208	89.03	12.0	7120.0	67	38	0	36	5	11.0	2.0	7.1	0.5
06-15-78	0930	82.35	1.0	158.0	119	85	0	68	--	21.0	3.7	12.0	0.7
	0935	82.35	5.0	158.0	109	86	0	66	--	20.0	3.9	12.0	0.7
11-29-78	1405	86.73	1.0	2680.0	67	36	0	32	2	9.5	2.0	8.4	0.7
	1410	86.73	10.0	2680.0	66	35	0	32	3	9.4	2.0	8.3	0.7
12-04-78	0935	85.19	1.0	1130.0	100	54	0	44	--	13.0	2.8	13.0	0.9
	0940	85.19	10.0	1130.0	100	54	0	44	--	13.0	2.8	12.0	0.8
02-05-79	1135	82.86	1.0	233.0	76	42	0	35	1	11.0	1.9	9.3	0.7
	1140	82.86	10.0	233.0	75	42	0	35	1	11.0	1.9	9.3	0.7
02-09-79	1025	89.68	1.0	8920.0	44	27	0	23	2	7.4	1.4	4.0	0.4
	1030	89.68	16.0	8920.0	45	27	0	25	3	7.7	1.4	4.4	0.4
02-15-79	1030	88.37	1.0	5540.0	42	22	0	25	7	7.3	1.6	4.6	0.4
	1035	88.37	13.0	5540.0	45	30	0	26	1	8.0	1.5	4.5	0.4
02-21-79	0850	82.81	1.0	224.0	89	54	0	45	1	14.0	2.5	11.0	0.7
	0855	82.81	9.0	224.0	93	55	0	47	3	15.0	2.6	11.0	0.7
04-21-79	1125	87.85	1.0	4480.0	57	28	0	27	4	8.4	1.6	6.3	0.5
	1130	87.85	16.0	4480.0	57	27	0	28	6	8.9	1.6	6.7	0.6
04-26-79	1000	87.92	1.0	4610.0	54	33	0	30	3	9.4	1.6	6.0	0.5
	1005	87.92	14.0	4610.0	50	27	0	27	6	8.6	1.5	5.4	0.5
05-03-79	0840	84.34	1.0	641.0	74	40	0	38	4	12.0	2.0	9.8	0.7
	0845	84.34	10.0	641.0	73	40	0	38	4	12.0	1.9	9.5	0.7
09-21-79	1242	92.91	1.0	23470.0	47	26	0	22	2	6.7	1.5	5.8	0.5
	1244	92.91	9.0	23470.0	47	28	0	22	--	6.5	1.5	5.7	0.5
09-26-79	1252	94.03	1.0	33490.0	54	35	0	33	4	9.2	2.4	0.5	0.
	1300	94.03	20.0	33490.0	59	35	0	30	0	8.6	2.0	6.9	0.6
10-04-79	1314	92.04	1.0	18130.0	74	47	0	40	2	12.0	2.7	6.7	0.5
	1320	92.04	18.0	18130.0	67	49	0	34	--	10.0	2.2	6.1	0.5
10-11-79	1330	88.72	1.0	6340.0	119	80	0	57	--	17.0	3.8	10.0	0.6
	1345	88.72	15.0	6340.0	119	79	0	59	--	17.0	4.0	10.0	0.6
05-04-81	1150	81.68	1.0	208.0	119	--	--	50	0	16.0	2.8	18.0	1.0
	1154	81.68	8.0	208.0	119	--	--	50	1	16.0	2.8	22.0	1.0
05-07-81	1116	85.81	1.0	3650.0	71	--	--	36	--	11.0	2.0	11.0	0.8
	1120	85.81	11.5	3650.0	66	--	--	34	0	11.0	1.5	8.3	0.6
05-11-81	1138	86.15	1.0	4250.0	77	--	--	39	1	12.0	2.2	10.0	0.7
	1142	86.15	13.0	4250.0	83	--	--	42	--	13.0	2.4	9.5	0.7
05-13-81	1055	85.45	1.0	3070.0	71	--	--	39	1	12.0	2.3	7.7	0.6
	1059	85.45	13.0	3070.0	77	--	--	42	0	13.0	2.3	7.9	0.6
05-15-81	1250	83.64	1.0	1090.0	99	--	--	55	1	17.0	3.1	13.0	0.8
05-15-81	1254	83.64	11.0	1090.0	109	--	--	59	--	18.0	3.3	15.0	0.9
	Station Mean				76.37	43.50	0.	38.90	2.55	11.915	2.282	8.930	0.625
	Station Maximum				119	86	0	68	7	21.0	4.0	22.0	1.0
	Station Minimum				42	22	0	22	0	6.5	1.4	0.5	0.

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1202	89.03	1.0	7120.0	--	2.9	11.0	7.6	0.2	8.8
	1208	89.03	12.0	7120.0	--	2.7	9.4	7.8	0.2	7.9
06-15-78	0930	82.35	1.0	158.0	--	3.7	15.0	9.0	0.2	10.0
	0935	82.35	5.0	158.0	--	3.6	16.0	3.9	0.1	7.4
11-29-78	1405	86.73	1.0	2680.0	--	4.5	10.0	6.8	0.1	7.6
	1410	86.73	10.0	2680.0	--	4.4	9.9	7.2	0.1	7.8
12-04-78	0935	85.19	1.0	1130.0	--	6.0	18.0	9.9	0.1	12.0
	0940	85.19	10.0	1130.0	--	6.1	20.0	9.3	0.1	13.0
02-05-79	1135	82.86	1.0	233.0	--	3.0	18.0	6.0	0.2	6.2
	1140	82.86	10.0	233.0	--	3.0	16.0	7.1	0.2	6.0

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 294617095390502 (08072500)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
02-09-79	1025	89.68	1.0	8920.0	--	2.1	4.5	6.4	0.1	4.4
	1030	89.68	16.0	8920.0	--	2.1	4.8	6.3	0.1	4.6
02-15-79	1030	88.37	1.0	5540.0	--	2.3	5.3	6.3	0.1	4.6
	1035	88.37	13.0	5540.0	--	2.2	5.4	4.9	0.1	4.6
02-21-79	0850	82.81	1.0	224.0	--	2.8	17.0	8.2	0.1	6.8
	0855	82.81	9.0	224.0	--	2.8	19.0	8.4	0.2	6.8
04-21-79	1125	87.85	1.0	4480.0	--	3.4	8.0	11.0	0.2	5.0
	1130	87.85	16.0	4480.0	--	3.4	8.3	10.0	0.3	4.9
04-26-79	1000	87.92	1.0	4610.0	--	2.8	6.4	5.5	0.2	5.5
	1005	87.92	14.0	4610.0	8.2	2.8	5.7	7.0	0.2	5.2
05-03-79	0840	84.34	1.0	641.0	13.0	2.9	10.0	11.0	0.2	5.8
	0845	84.34	10.0	641.0	--	2.8	10.0	11.0	0.2	5.8
09-21-79	1242	92.91	1.0	23470.0	8.3	2.5	5.6	5.8	0.1	6.6
	1244	92.91	9.0	23470.0	8.2	2.5	5.7	5.3	0.2	5.9
09-26-79	1252	94.03	1.0	33490.0	3.6	3.1	7.1	4.6	0.1	10.0
	1300	94.03	20.0	33490.0	9.9	3.0	8.2	4.6	0.1	8.1
10-04-79	1314	92.04	1.0	18130.0	11.0	4.1	9.3	4.9	0.1	11.0
	1320	92.04	18.0	18130.0	9.8	3.7	7.9	4.3	0.1	9.0
10-11-79	1330	88.72	1.0	6340.0	15.0	5.4	19.0	6.3	0.1	17.0
	1345	88.72	15.0	6340.0	15.0	5.4	18.0	6.0	0.1	16.0
05-04-81	1150	81.68	1.0	208.0	--	5.9	18.0	23.0	0.3	8.8
	1154	81.68	8.0	208.0	--	6.1	19.0	20.0	0.2	8.5
05-07-81	1116	85.81	1.0	3650.0	--	4.5	12.0	2.2	0.1	6.9
	1120	85.81	11.5	3650.0	--	4.8	8.7	5.1	0.1	6.7
05-11-81	1138	86.15	1.0	4250.0	--	5.1	13.0	4.6	0.1	7.3
	1142	86.15	13.0	4250.0	--	5.2	15.0	4.3	0.1	7.8
05-13-81	1055	85.45	1.0	3070.0	--	4.6	8.6	4.8	0.1	7.9
	1059	85.45	13.0	3070.0	--	4.7	13.0	3.3	0.1	7.8
05-15-81	1250	83.64	1.0	1090.0	--	4.6	14.0	4.1	0.2	11.0
05-15-81	1254	83.64	11.0	1090.0	--	4.6	16.0	3.9	0.2	12.0
	Station Mean				10.200	3.802	11.645	7.192	0.147	7.975
	Station Maximum				15.0	6.1	20.0	23.0	0.3	17.0
	Station Minimum				3.6	2.1	4.5	2.2	0.1	4.4

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1455	89.02	-	784.0	69	37	0	39	9	12.0	2.1	7.5	0.5
06-15-78	1145	81.66	-	404.0	119	89	0	71	--	22.0	3.8	13.0	0.7
10-17-78	1050	75.61	-	7.2	360	180	0	150	2	47.0	7.9	68.0	3.0
12-01-78	1310	87.35	-	184.0	73	38	0	31	0	9.3	1.9	8.1	0.7
12-04-78	1345	84.81	-	655.0	99	52	0	44	0	13.0	2.7	11.0	0.8
01-30-79	1130	85.08	-	500.0	85	50	0	39	--	12.0	2.3	8.8	0.6
01-31-79	1045	83.19	-	454.0	100	59	0	54	6	17.0	2.8	13.0	0.8
02-01-79	1110	79.28	-	226.0	90	50	0	47	6	15.0	2.5	11.0	0.7
02-05-79	1240	83.00	-	300.0	66	42	0	37	3	12.0	1.8	8.1	0.6
02-09-79	1150	89.62	-	400.0	47	28	0	27	3	8.2	1.6	4.8	0.4
02-15-79	1345	88.30	-	573.0	47	30	0	27	3	8.4	1.6	4.6	0.4
02-21-79	1010	82.56	-	433.0	88	52	0	45	2	14.0	2.4	10.0	0.7
04-11-79	0945	75.68	-	33.0	200	119	0	100	7	34.0	4.8	33.0	1.0
04-23-79	1450	88.86	-	390.0	55	27	0	28	7	9.3	1.5	6.3	0.5
04-26-79	1200	87.90	-	376.0	50	31	0	27	3	8.6	1.5	5.7	0.5
05-03-79	1045	84.25	-	320.0	83	45	0	40	4	13.0	2.0	9.5	0.7
09-24-79	1050	94.11	-	229.0	--	33	0	--	--	--	--	--	--
09-26-79	1050	94.04	-	915.0	--	35	0	--	--	--	--	--	--
10-04-79	1005	92.05	-	805.0	71	47	0	38	--	11.0	2.6	6.6	0.5
10-11-79	1025	88.82	-	780.0	109	75	0	57	--	17.0	3.8	9.8	0.6

STATION: 294610095385400 (08072501)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
03-03-81	1010	73.68	-	9.0	380	--	--	150	--	46.0	8.1	79.0	3.0
05-12-81	1050	86.13	-	539.0	74	--	--	39	0	12.0	2.3	9.2	0.7
05-13-81	0940	85.49	-	529.0	72	--	--	40	2	12.0	2.4	8.1	0.6
05-15-81	0945	83.73	-	445.0	100	--	--	57	--	17.0	3.4	14.0	0.8
Station Mean					110.77	55.95	0.	53.95	3.56	16.809	2.991	15.868	0.855
Station Maximum					380	180	0	150	9	47.0	8.1	79.0	3.0
Station Minimum					47	27	0	27	0	8.2	1.5	4.6	0.4

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1455	89.02	-	784.0	--	2.7	12.0	6.0	0.2	8.2
06-15-78	1145	81.66	-	404.0	--	3.7	10.0	8.1	0.2	11.0
10-17-78	1050	75.61	-	7.2	--	7.8	84.0	38.0	0.4	20.0
12-01-78	1310	87.35	-	184.0	--	4.5	14.0	8.2	0.1	7.6
12-04-78	1345	84.81	-	655.0	--	6.2	18.0	11.0	0.1	11.0
01-30-79	1130	85.08	-	500.0	--	3.3	20.0	7.0	0.2	7.5
01-31-79	1045	83.19	-	454.0	--	3.9	22.0	5.6	0.2	7.9
02-01-79	1110	79.28	-	226.0	--	3.4	21.0	5.1	0.2	7.1
02-05-79	1240	83.00	-	300.0	--	2.9	9.7	4.6	0.2	6.2
02-09-79	1150	89.62	-	400.0	--	2.2	5.1	5.6	0.1	5.1
02-15-79	1345	88.30	-	573.0	--	2.1	5.4	6.4	0.1	4.6
02-21-79	1010	82.56	-	433.0	--	2.8	18.0	8.4	0.1	6.7
04-11-79	0945	75.68	-	33.0	37.0	4.2	50.0	17.0	0.2	2.1
04-23-79	1450	88.86	-	390.0	--	2.9	6.7	10.0	0.2	4.9
04-26-79	1200	87.90	-	376.0	--	2.7	6.3	5.3	0.2	5.4
05-03-79	1045	84.25	-	320.0	--	2.9	16.0	11.0	0.3	5.9
09-24-79	1050	94.11	-	229.0	--	--	--	--	--	--
09-26-79	1050	94.04	-	915.0	--	--	--	--	--	--
10-04-79	1005	92.05	-	805.0	11.0	4.0	8.6	4.3	0.1	10.0
10-11-79	1025	88.82	-	780.0	15.0	5.2	16.0	6.3	0.1	16.0
03-03-81	1010	73.68	-	9.0	--	7.2	91.0	43.0	0.3	14.0
05-12-81	1050	86.13	-	539.0	--	5.0	9.7	5.0	0.1	7.4
05-13-81	0940	85.49	-	529.0	--	4.7	8.8	5.2	0.2	7.8
05-15-81	0945	83.73	-	445.0	--	4.4	14.0	4.0	0.2	12.0
Station Mean					21.000	4.032	21.195	10.232	0.182	8.564
Station Maximum					37.0	7.8	91.0	43.0	0.4	20.0
Station Minimum					11.0	2.1	5.1	4.0	0.1	2.1

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1220	8.75	-	118.0	62	37	0	36	6	13.0	0.9	6.2	0.5
06-15-78	1110	5.77	-	9.2	100	57	0	60	13	21.0	2.0	11.0	0.6
11-28-78	1330	8.61	-	111.0	68	34	0	26	--	7.2	1.9	7.7	0.7
11-29-78	1140	8.25	-	94.0	62	34	0	25	--	7.0	1.8	6.7	0.6
12-04-78	1050	6.72	-	35.0	95	55	0	44	--	13.0	2.8	10.0	0.7
02-05-79	1135	11.22	-	276.0	38	21	0	21	4	6.1	1.4	3.2	0.3
02-06-79	1050	12.46	-	372.0	28	18	0	17	2	5.1	1.1	2.2	0.2
02-07-79	1110	10.99	-	254.0	27	17	0	17	3	4.9	1.1	2.2	0.2
02-12-79	1150	5.99	-	14.0	37	26	0	22	1	6.7	1.3	3.0	0.3
04-21-79	1020	8.03	-	84.0	37	13	0	16	5	5.3	0.6	3.0	0.3

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 08072730--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
04-26-79	0930	7.20	-	51.0	37	17	0	20	6	5.8	1.3	2.8	0.3
09-19-79	1235	12.48	-	371.0	54	22	0	22	3	5.8	1.8	5.2	0.5
09-21-79	1035	14.82	-	600.0	50	30	0	21	--	5.8	1.6	4.4	0.4
09-27-79	1155	9.08	-	134.0	67	42	0	33	--	9.1	2.6	5.7	0.4
03-03-81	0930	4.26	-	0.2	130	--	--	55	--	17.0	3.4	20.0	1.0
05-03-81	1815	6.64	-	63.0	85	--	--	33	8	10.0	1.9	12.0	0.9
05-04-81	0940	7.59	-	110.0	40	--	--	20	--	6.1	1.1	4.2	0.4
05-05-81	1415	6.92	-	75.0	54	--	--	22	4	6.9	1.2	4.0	0.4
Station Mean					59.50	30.21	0.	28.33	5.00	8.656	1.656	6.306	0.483
Station Maximum					130	57	0	60	13	21.0	3.4	20.0	1.0
Station Minimum					27	13	0	16	1	4.9	0.6	2.2	0.2

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1220	8.75	-	118.0	--	2.7	8.2	5.8	0.1	7.6
06-15-78	1110	5.77	-	9.2	--	3.8	18.0	12.0	0.2	6.0
11-28-78	1330	8.61	-	111.0	--	6.7	13.0	6.1	0.1	8.2
11-29-78	1140	8.25	-	94.0	--	6.6	10.0	5.5	0.1	8.1
12-04-78	1050	6.72	-	35.0	--	8.2	15.0	6.9	0.1	12.0
02-05-79	1135	11.22	-	276.0	--	3.3	5.6	4.6	0.1	3.5
02-06-79	1050	12.46	-	372.0	--	2.6	3.3	2.6	0.1	2.9
02-07-79	1110	10.99	-	254.0	--	2.4	2.9	3.6	0.1	2.6
02-12-79	1150	5.99	-	14.0	--	3.0	3.9	4.7	0.1	1.3
04-21-79	1020	8.03	-	84.0	6.2	3.2	4.3	10.0	0.2	4.4
04-26-79	0930	7.20	-	51.0	6.3	3.5	3.2	8.7	0.2	3.4
09-19-79	1235	12.48	-	371.0	9.2	4.0	6.2	6.8	0.2	13.0
09-21-79	1035	14.82	-	600.0	8.9	4.5	6.7	3.8	0.1	8.0
09-27-79	1155	9.08	-	134.0	9.8	4.1	7.7	4.5	0.1	12.0
03-03-81	0930	4.26	-	0.2	--	7.3	22.0	15.0	0.3	3.3
05-03-81	1815	6.64	-	63.0	--	4.5	10.0	28.0	0.1	4.9
05-04-81	0940	7.59	-	110.0	--	2.9	4.4	2.6	0.2	5.6
05-05-81	1415	6.92	-	75.0	--	3.7	6.5	14.0	0.2	6.3
Station Mean					8.080	4.278	8.383	8.067	0.144	6.283
Station Maximum					9.8	8.2	22.0	28.0	0.3	13.0
Station Minimum					6.2	2.4	2.9	2.6	0.1	1.3

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1130	16.52	-	160.0	57	36	0	32	2	10.0	1.6	6.2	0.5
06-15-78	1005	13.27	-	12.0	119	94	0	72	--	24.0	2.9	12.0	0.6
11-28-78	1250	16.18	-	189.0	59	34	0	25	--	6.8	1.9	5.8	0.5
11-29-78	1110	15.38	-	127.0	54	32	0	22	--	6.7	1.5	5.6	0.5
12-04-78	0950	13.78	-	23.0	72	45	0	32	--	9.9	1.8	8.8	0.7
02-05-79	1010	17.80	-	323.0	--	21	0	20	3	6.9	0.7	3.5	0.4
02-06-79	1010	19.24	-	459.0	30	17	0	16	2	4.7	1.0	2.5	0.3
02-07-79	1030	17.74	-	318.0	28	18	0	16	1	4.6	1.1	2.7	0.3
02-12-79	1110	13.20	-	9.5	45	27	0	27	4	8.4	1.4	4.9	0.4
04-21-79	0935	16.06	-	176.0	38	13	0	19	8	5.8	1.0	4.6	0.5

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 08072760--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
04-26-79	0835	12.98	-	5.0	68	47	0	42	3	14.0	1.8	5.6	0.4
09-19-79	1145	20.91	-	630.0	57	28	0	26	2	7.8	1.6	5.4	0.5
09-21-79	1130	21.22	-	667.0	49	30	0	19	--	5.1	1.4	5.5	0.6
09-27-79	1100	14.56	-	75.0	80	50	0	40	--	12.0	2.4	8.6	0.6
03-03-81	0850	12.85	-	1.0	459	--	--	119	--	39.0	5.6	120.0	5.0
05-03-81	1710	16.87	-	208.0	45	--	--	20	--	6.2	1.2	6.5	0.7
	2045	16.95	-	214.0	67	--	--	25	--	7.6	1.5	11.0	1.0
05-04-81	1025	16.08	-	147.0	55	--	--	20	4	5.9	1.2	8.8	0.9
05-05-81	1340	16.07	-	146.0	55	--	--	22	--	6.7	1.3	8.2	0.8
Station Mean					79.83	35.14	0.	32.32	3.22	10.111	1.732	12.432	0.800
Station Maximum					459	94	0	119	8	39.0	5.6	120.0	5.0
Station Minimum					28	13	0	16	1	4.6	0.7	2.5	0.3

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1130	16.52	-	160.0	--	2.2	8.6	7.4	0.1	3.9
06-15-78	1005	13.27	-	12.0	--	4.3	17.0	3.8	0.2	9.0
11-28-78	1250	16.18	-	189.0	--	5.3	7.5	7.6	0.1	6.8
11-29-78	1110	15.38	-	127.0	--	5.2	7.1	5.2	0.1	6.9
12-04-78	0950	13.78	-	23.0	--	5.6	9.2	5.6	0.1	8.4
02-05-79	1010	17.80	-	323.0	--	2.3	--	--	--	--
02-06-79	1010	19.24	-	459.0	--	2.1	3.4	4.7	0.1	2.7
02-07-79	1030	17.74	-	318.0	--	2.1	3.3	3.5	0.1	2.7
02-12-79	1110	13.20	-	9.5	--	2.8	7.0	4.9	0.1	2.1
04-21-79	0935	16.06	-	176.0	--	2.6	6.2	7.0	0.2	4.1
04-26-79	0835	12.98	-	5.0	--	3.0	6.4	8.1	0.2	5.4
09-19-79	1145	20.91	-	630.0	9.9	4.5	6.7	7.5	0.1	8.7
09-21-79	1130	21.22	-	667.0	9.3	3.8	6.0	4.5	0.1	7.7
09-27-79	1100	14.56	-	75.0	13.0	4.5	10.0	4.6	0.1	13.0
03-03-81	0850	12.85	-	1.0	--	7.6	160.0	30.0	0.2	16.0
05-03-81	1710	16.87	-	208.0	--	4.0	6.8	2.7	0.2	4.8
	2045	16.95	-	214.0	--	4.9	15.0	3.6	0.2	7.9
05-04-81	1025	16.08	-	147.0	--	2.9	12.0	8.7	0.1	6.5
05-05-81	1340	16.07	-	146.0	--	3.2	11.0	3.9	0.2	6.4
Station Mean					10.733	3.837	16.844	6.850	0.139	6.833
Station Maximum					13.0	7.6	160.0	30.0	0.2	16.0
Station Minimum					9.3	2.1	3.3	2.7	0.1	2.1

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1352	91.53	1.0	3610.0	49	27	0	27	5	8.6	1.5	4.6	0.4
	1400	91.53	12.5	3610.0	50	31	0	28	23	8.9	1.6	5.2	0.4
06-15-78	1050	82.47	4.0	92.0	90	70	0	50	--	16.0	2.7	9.6	0.6
11-28-78	1415	88.45	1.0	995.0	57	34	0	27	--	8.0	1.7	6.3	0.5
	1425	88.45	10.0	995.0	55	34	0	26	--	7.7	1.7	5.9	0.5
11-29-78	1100	88.20	1.0	879.0	57	35	0	27	--	8.1	1.8	6.4	0.6
	1105	88.20	15.0	879.0	65	37	0	30	--	8.7	1.9	7.0	0.6
02-05-79	1420	83.86	1.0	130.0	47	27	0	22	0	7.0	1.4	4.9	0.5
	1425	83.86	10.0	130.0	45	30	0	22	--	7.0	1.4	4.9	0.5
02-09-79	1315	92.60	1.0	5240.0	37	22	0	21	2	6.4	1.3	3.6	0.4

STATION: 294729095372502 (08073000)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
02-09-79	1320	92.60	17.0	5240.0	36	22	0	21	3	6.3	1.3	3.2	0.3
02-15-79	1200	87.32	1.0	574.0	47	30	0	27	2	8.3	1.5	4.5	0.4
	1205	87.32	12.0	574.0	52	35	0	28	0	9.0	1.7	5.2	0.4
04-21-79	1415	89.65	1.0	1740.0	54	21	0	27	10	8.3	1.5	6.3	0.6
	1420	89.65	16.0	1740.0	57	27	0	28	6	8.7	1.7	6.6	0.6
04-26-79	1330	88.78	1.0	1170.0	60	40	0	30	--	9.5	1.6	5.6	0.5
	1335	88.78	17.0	1170.0	59	32	0	31	5	9.8	1.7	5.7	0.5
05-03-79	0930	73.90	1.0	1.0	130	84	0	71	2	23.0	3.3	18.0	1.0
09-21-79	1024	96.45	1.0	17050.0	38	25	0	20	--	5.9	1.4	3.1	0.3
	1030	96.45	17.5	17050.0	37	25	0	20	--	5.8	1.4	3.1	0.3
09-26-79	1014	98.01	1.0	24900.0	--	31	0	--	--	--	--	--	--
	1020	98.01	18.0	24900.0	--	32	0	--	--	--	--	--	--
10-04-79	1017	95.12	1.0	11800.0	55	39	0	32	0	9.1	2.3	4.6	0.4
	1025	95.12	23.0	11800.0	71	49	0	37	--	11.0	2.3	6.2	0.5
10-11-79	1035	89.01	1.0	1310.0	90	70	0	49	--	14.0	3.5	6.3	0.4
	1050	89.01	13.0	1310.0	100	73	0	50	--	15.0	3.2	11.0	0.7
05-04-81	1435	85.76	1.0	1550.0	62	--	--	32	--	10.0	1.8	7.5	0.6
	1439	85.76	13.5	1550.0	62	--	--	33	--	10.0	1.9	7.8	0.6
05-07-81	1400	89.88	1.0	5520.0	55	--	--	28	0	8.9	1.6	7.0	0.6
	1404	89.88	16.5	5520.0	60	--	--	32	2	10.0	1.8	8.2	0.7
05-11-81	0936	90.83	1.0	7200.0	65	--	--	36	2	11.0	2.0	7.4	0.6
	0940	90.83	17.5	7200.0	67	--	--	36	--	11.0	2.0	7.7	0.6
05-13-81	0900	90.51	1.0	6580.0	66	--	--	35	--	11.0	1.8	7.8	0.6
	0904	90.51	15.5	6580.0	55	--	--	31	0	9.6	1.6	6.4	0.5
05-15-81	1026	87.36	1.0	2600.0	64	--	--	36	2	11.0	2.0	7.6	0.6
	1030	87.36	15.0	2600.0	64	--	--	35	--	11.0	1.9	7.7	0.6
Station Mean					60.53	37.77	0.	31.91	3.76	9.812	1.876	6.556	0.526
Station Maximum					130	84	0	71	23	23.0	3.5	18.0	1.0
Station Minimum					36	21	0	20	0	5.8	1.3	3.1	0.3

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1352	91.53	1.0	3610.0	--	2.4	6.4	5.1	0.2	6.2
	1400	91.53	12.5	3610.0	--	2.8	6.1	4.7	0.2	6.7
06-15-78	1050	82.47	4.0	92.0	--	3.8	13.0	4.6	0.1	7.1
11-28-78	1415	88.45	1.0	995.0	--	5.2	7.9	4.8	0.1	6.8
	1425	88.45	10.0	995.0	--	5.0	7.4	4.8	0.1	6.6
11-29-78	1100	88.20	1.0	879.0	--	4.9	7.6	5.6	0.1	6.7
	1105	88.20	15.0	879.0	--	5.9	8.9	6.5	0.1	7.8
02-05-79	1420	83.86	1.0	130.0	--	2.7	8.2	4.6	0.2	4.6
	1425	83.86	10.0	130.0	--	2.7	5.6	4.7	0.2	4.6
02-09-79	1315	92.60	1.0	5240.0	--	2.3	3.9	4.6	0.1	3.9
	1320	92.60	17.0	5240.0	--	2.3	3.7	4.6	0.1	3.6
02-15-79	1200	87.32	1.0	574.0	--	2.7	5.8	5.1	0.1	3.8
	1205	87.32	12.0	574.0	--	2.8	5.8	5.8	0.2	4.2
04-21-79	1415	89.65	1.0	1740.0	9.5	3.2	6.0	13.0	0.3	5.4
	1420	89.65	16.0	1740.0	10.0	3.6	6.8	10.0	0.4	5.3
04-26-79	1330	88.78	1.0	1170.0	--	3.6	5.2	8.9	0.2	5.4
	1335	88.78	17.0	1170.0	--	3.6	5.4	11.0	0.2	5.5
05-03-79	0930	73.90	1.0	1.0	22.0	4.2	16.0	15.0	0.3	8.5
09-21-79	1024	96.45	1.0	17050.0	5.8	2.7	3.4	3.7	0.1	5.4
	1030	96.45	17.5	17050.0	5.9	2.8	3.4	3.0	0.1	5.2
09-26-79	1014	98.01	1.0	24900.0	--	--	--	--	--	--
	1020	98.01	18.0	24900.0	--	--	--	--	--	--
10-04-79	1017	95.12	1.0	11800.0	8.4	3.8	5.3	4.0	0.1	7.3
	1025	95.12	23.0	11800.0	11.0	4.4	7.6	4.3	0.1	11.0
10-11-79	1035	89.01	1.0	1310.0	11.0	4.5	7.2	6.5	0.1	13.0

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 294729095372502 (08073000)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
10-11-79	1050	89.01	13.0	1310.0	17.0	5.7	11.0	6.5	0.1	16.0
05-04-81	1435	85.76	1.0	1550.0	--	4.4	9.7	3.2	0.2	6.5
	1439	85.76	13.5	1550.0	--	4.3	8.7	3.0	0.1	6.2
05-07-81	1400	89.88	1.0	5520.0	--	4.1	7.9	3.1	0.1	5.8
	1404	89.88	16.5	5520.0	--	4.5	9.0	2.0	0.1	6.3
05-11-81	0936	90.83	1.0	7200.0	--	4.5	8.4	4.7	0.1	6.8
	0940	90.83	17.5	7200.0	--	4.6	8.5	4.2	0.1	7.0
05-13-81	0900	90.51	1.0	6580.0	--	4.5	8.3	4.7	0.1	6.9
	0904	90.51	15.5	6580.0	--	3.7	7.4	4.1	0.1	5.6
05-15-81	1026	87.36	1.0	2600.0	--	3.8	8.4	3.7	0.2	7.4
	1030	87.36	15.0	2600.0	--	3.5	8.3	2.1	0.2	6.3
Station Mean					11.178	3.809	7.418	5.476	0.150	6.629
Station Maximum					22.0	5.9	16.0	15.0	0.4	16.0
Station Minimum					5.8	2.3	3.4	2.0	0.1	3.6

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-09-78	1430	91.53	-	604.0	49	28	0	27	4	8.4	1.6	4.8	0.4
06-15-78	1125	82.36	-	286.0	89	70	0	54	--	17.0	2.9	9.6	0.6
10-17-78	0930	73.33	-	9.0	270	169	0	109	--	37.0	5.3	47.0	2.0
11-29-78	1430	88.05	-	726.0	59	36	0	27	--	7.8	1.7	6.0	0.5
12-01-78	1355	82.56	-	583.0	74	45	0	33	--	9.9	2.1	8.8	0.7
12-04-78	1455	74.06	-	144.0	98	64	0	42	--	13.0	2.6	11.0	0.8
01-30-79	1015	84.14	-	313.0	75	52	0	42	--	13.0	2.2	8.9	0.6
02-05-79	1515	84.13	-	312.0	44	27	0	26	3	8.1	1.5	4.6	0.4
02-09-79	1350	92.59	-	622.0	38	23	0	22	2	6.5	1.3	3.6	0.4
02-16-79	0910	86.38	-	340.0	62	45	0	39	2	12.0	2.3	6.4	0.5
02-21-79	1150	75.15	-	146.0	100	65	0	54	1	17.0	2.9	12.0	0.7
04-11-79	1045	73.53	-	16.0	160	119	0	88	--	28.0	4.3	29.0	1.0
04-23-79	1255	90.69	-	197.0	52	25	0	28	8	9.1	1.6	5.5	0.5
04-26-79	1330	88.79	-	372.0	57	35	0	32	3	10.0	1.8	6.3	0.5
05-03-79	0910	73.92	-	33.0	140	85	0	72	2	23.0	3.5	18.0	1.0
09-24-79	1150	98.05	-	235.0	42	27	0	21	--	6.2	1.4	3.7	0.4
09-26-79	1145	98.00	-	936.0	--	31	0	--	--	--	--	--	--
10-04-79	1100	95.10	-	880.0	57	42	0	32	--	9.0	2.2	4.6	0.4
10-11-79	1145	88.92	-	752.0	96	70	0	50	--	15.0	3.1	9.3	0.6
03-03-81	0840	72.14	-	39.0	320	--	--	109	--	36.0	5.8	72.0	3.0
05-12-81	0945	91.27	-	792.0	72	--	--	38	2	12.0	2.0	8.0	0.6
05-13-81	0845	90.51	-	1165.0	64	--	--	35	2	11.0	1.9	7.3	0.6
05-15-81	0900	87.51	-	1070.0	71	--	--	35	3	11.0	1.9	7.1	0.5
Station Mean					94.95	55.68	0.	46.14	2.91	14.545	2.541	13.341	0.759
Station Maximum					320	169	0	109	8	37.0	5.8	72.0	3.0
Station Minimum					38	23	0	21	1	6.2	1.3	3.6	0.4

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 294706095372400 (08073001)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-09-78	1430	91.53	-	604.0	--	2.6	6.3	4.7	0.2	6.3
06-15-78	1125	82.36	-	286.0	--	3.6	10.0	5.1	0.2	6.3
10-17-78	0930	73.33	-	9.0	--	7.4	58.0	13.0	0.3	23.0
11-29-78	1430	88.05	-	726.0	--	4.9	8.8	5.3	0.1	6.9
12-01-78	1355	82.56	-	583.0	--	6.1	10.0	5.5	0.1	9.2
12-04-78	1455	74.06	-	144.0	--	6.9	16.0	6.0	0.2	11.0
01-30-79	1015	84.14	-	313.0	--	3.9	9.7	4.8	0.2	6.7
02-05-79	1515	84.13	-	312.0	--	2.9	5.4	3.3	0.2	4.6
02-09-79	1350	92.59	-	622.0	--	2.3	3.8	5.1	0.1	3.9
02-16-79	0910	86.38	-	340.0	--	2.7	6.2	4.7	0.2	6.6
02-21-79	1150	75.15	-	146.0	--	3.1	19.0	8.5	0.2	8.1
04-11-79	1045	73.53	-	16.0	--	4.0	26.0	11.0	0.3	3.2
04-23-79	1255	90.69	-	197.0	8.8	3.3	5.9	10.0	0.2	5.0
04-26-79	1330	88.79	-	372.0	9.6	3.3	5.8	6.0	0.2	5.9
05-03-79	0910	73.92	-	33.0	22.0	4.1	23.0	14.0	0.3	8.7
09-24-79	1150	98.05	-	235.0	6.9	3.2	4.4	3.3	0.1	6.4
09-26-79	1145	98.00	-	936.0	--	--	--	--	--	--
10-04-79	1100	95.10	-	880.0	8.4	3.8	5.4	4.2	0.1	8.1
10-11-79	1145	88.92	-	752.0	15.0	5.3	10.0	6.2	0.1	14.0
03-03-81	0840	72.14	-	39.0	--	6.7	86.0	27.0	0.4	14.0
05-12-81	0945	91.27	-	792.0	--	4.7	11.0	4.9	0.1	7.3
05-13-81	0845	90.51	-	1165.0	--	4.2	8.3	4.5	0.1	6.5
05-15-81	0900	87.51	-	1070.0	--	3.6	7.7	13.0	0.2	6.7
Station Mean					11.783	4.209	15.759	7.732	0.186	8.109
Station Maximum					22.0	7.4	86.0	27.0	0.4	23.0
Station Minimum					6.9	2.3	3.8	3.3	0.1	3.2

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
06-15-78	0905	57.78	-	781.0	109	85	0	68	--	21.0	3.7	12.0	0.7
07-12-78	0940	50.80	-	50.0	270	169	0	130	--	41.0	6.3	49.0	2.0
10-17-78	0830	50.39	-	20.0	310	169	0	130	--	40.0	6.5	57.0	2.0
11-28-78	1435	55.78	1.0	627.0	68	40	0	33	0	10.0	2.0	7.9	0.6
11-29-78	1015	58.06	-	946.0	67	42	0	32	--	9.5	1.9	7.0	0.6
12-01-78	1435	56.98	-	796.0	78	44	0	37	0	11.0	2.3	9.5	0.7
12-04-78	0845	57.16	-	814.0	109	55	0	44	--	13.0	2.7	12.0	0.8
12-13-78	1005	50.67	-	37.0	200	94	0	85	9	26.0	5.0	32.0	2.0
01-30-79	1225	57.10	-	812.0	88	52	0	42	--	13.0	2.4	10.0	0.7
02-05-79	1435	57.40	-	850.0	69	45	0	36	--	11.0	2.1	8.6	0.6
02-06-79	1335	60.24	-	1280.0	60	39	0	32	0	11.0	1.1	6.2	0.5
02-07-79	0945	59.26	-	1120.0	55	35	0	31	2	9.3	1.9	5.9	0.5
02-09-79	1455	58.65	-	1020.0	45	28	0	26	2	7.9	1.5	4.6	0.4
02-12-79	0920	58.09	-	946.0	45	30	0	26	0	7.9	1.5	4.6	0.4
02-16-79	1000	56.92	-	773.0	64	37	0	35	5	11.0	1.9	6.6	0.5
02-21-79	0905	54.74	-	507.0	95	55	0	49	3	15.0	2.7	12.0	0.8
03-12-79	1250	50.54	-	30.0	330	180	0	140	--	44.0	8.1	61.0	2.0
04-11-79	1135	50.91	-	56.0	219	140	0	109	--	35.0	6.2	37.0	2.0
04-23-79	1355	56.92	-	784.0	66	28	0	38	13	12.0	1.9	6.8	0.5
04-26-79	1205	56.92	-	781.0	60	35	0	32	3	10.0	1.8	6.7	0.5
05-03-79	1200	53.94	-	408.0	--	250	--	47	--	15.0	2.4	12.0	0.8
05-21-79	1405	50.62	-	34.0	479	219	0	190	13	62.0	9.6	100.0	3.0
06-27-79	0955	51.62	-	128.0	160	90	0	67	--	21.0	3.5	30.0	2.0
09-20-79	1045	63.18	-	1630.0	50	37	0	28	--	9.1	1.6	3.9	0.3
09-24-79	1300	56.75	-	632.0	65	44	0	31	--	9.1	2.1	6.6	0.5

Appendix C.--Major inorganic constituents and related properties--Continued

STATION: 08073500--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Solids, sum of constituents, dissolved (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hardness as $CaCO_3$ (mg/L)	Hardness, noncarbonate as $CaCO_3$ (mg/L)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Sodium adsorption ratio
10-04-79	0900	63.06	-	1580.0	69	47	0	38	--	11.0	2.5	6.3	0.5
10-11-79	0935	61.82	-	1370.0	100	73	0	52	--	15.0	3.6	9.2	0.6
05-19-80	1130	54.92	-	489.0	109	68	0	57	2	19.0	2.6	14.0	0.8
08-04-80	1140	50.36	-	54.0	350	200	0	150	--	48.0	7.6	65.0	2.0
03-03-81	1135	49.88	-	20.0	389	--	--	160	13	51.0	8.6	75.0	3.0
05-12-81	1200	56.30	-	647.0	78	--	--	42	--	13.0	2.3	9.4	0.7
05-13-81	1040	62.43	-	1600.0	70	--	--	36	--	11.0	2.0	7.9	0.6
05-15-81	1045	61.66	-	1460.0	75	--	--	40	--	12.0	2.4	8.3	0.6
Station Mean					137.53	83.79	0	63.42	4.64	19.842	3.464	21.333	1.036
Station Maximum					479	250	0	190	13	62.0	9.6	100.0	3.0
Station Minimum					45	28	0	26	0	7.9	1.1	3.9	0.3

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Sum of sodium plus potassium (mg/L)	Potassium, dissolved (mg/L)	Chloride, dissolved (mg/L)	Sulfate, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)
06-15-78	0905	57.78	-	781.0	--	3.8	14.0	8.2	0.2	10.0
07-12-78	0940	50.80	-	50.0	--	3.6	57.0	18.0	0.4	14.0
10-17-78	0830	50.39	-	20.0	--	7.3	73.0	23.0	0.3	21.0
11-28-78	1435	55.78	1.0	627.0	--	4.6	9.8	6.7	0.1	7.6
11-29-78	1015	58.06	-	946.0	--	4.9	8.7	6.7	0.1	7.4
12-01-78	1435	56.98	-	796.0	--	5.6	12.0	6.1	0.1	9.9
12-04-78	0845	57.16	-	814.0	--	6.1	18.0	9.2	0.1	18.0
12-13-78	1005	50.67	-	37.0	--	6.0	36.0	27.0	0.2	18.0
01-30-79	1225	57.10	-	812.0	--	3.6	18.0	6.9	0.2	7.4
02-05-79	1435	57.40	-	850.0	--	2.9	9.1	5.5	0.2	7.0
02-06-79	1335	60.24	-	1280.0	--	2.6	6.8	7.8	0.1	6.4
02-07-79	0945	59.26	-	1120.0	--	2.5	6.2	6.4	0.1	6.0
02-09-79	1455	58.65	-	1020.0	--	2.2	4.9	5.4	0.2	4.9
02-12-79	0920	58.09	-	946.0	--	2.3	5.3	5.5	0.1	4.5
02-16-79	1000	56.92	-	773.0	--	2.4	6.9	11.0	0.1	5.5
02-21-79	0905	54.74	-	507.0	--	2.9	19.0	8.1	0.2	7.1
03-12-79	1250	50.54	-	30.0	--	4.7	63.0	36.0	0.7	19.0
04-11-79	1135	50.91	-	56.0	41.0	4.3	47.0	16.0	0.3	7.1
04-23-79	1355	56.92	-	784.0	10.0	3.3	9.8	11.0	0.2	5.9
04-26-79	1205	56.92	-	781.0	--	3.3	5.9	9.8	0.2	5.8
05-03-79	1200	53.94	-	408.0	15.0	2.9	--	17.0	0.2	6.7
05-21-79	1405	50.62	-	34.0	110.0	5.9	140.0	36.0	0.4	16.0
06-27-79	0955	51.62	-	128.0	35.0	5.4	32.0	17.0	0.3	7.8
09-20-79	1045	63.18	-	1630.0	6.5	2.6	3.7	4.0	0.1	7.6
09-24-79	1300	56.75	-	632.0	10.0	3.4	7.0	5.5	0.1	9.4
10-04-79	0900	63.06	-	1580.0	10.0	4.0	7.6	4.6	0.1	9.6
10-11-79	0935	61.82	-	1370.0	14.0	5.1	14.0	6.3	0.1	15.0
05-19-80	1130	54.92	-	489.0	--	3.7	15.0	11.0	0.7	8.7
08-04-80	1140	50.36	-	54.0	--	6.1	80.0	17.0	0.4	25.0
03-03-81	1135	49.88	-	20.0	--	6.6	89.0	53.0	0.5	15.0
05-12-81	1200	56.30	-	647.0	--	4.8	11.0	4.4	0.1	7.4
05-13-81	1040	62.43	-	1600.0	--	4.5	8.6	5.9	0.1	7.1
05-15-81	1045	61.66	-	1460.0	--	3.7	10.0	3.9	0.2	8.2
Station Mean					27.944	4.170	26.509	12.724	0.224	10.182
Station Maximum					110.0	7.3	140.0	53.0	0.7	25.0
Station Minimum					6.5	2.2	3.7	3.9	0.1	4.5

Appendix D.--Nutrients and total organic carbon

[ft, foot; ft^3/s, cubic foot per second; acre-ft, acre-foot; mg/L, milligram per liter]

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1010	27.68	-	190.0	1.10	0.41	0.11	0.16	0.27	1.80	0.01	9.9
06-15-78	1255	25.74	-	19.0	1.70	0.21	0.27	1.13	1.40	3.30	0.62	11.0
11-28-78	1145	27.85	-	217.0	1.10	0.06	0.01	0.07	0.08	1.30	0.27	15.0
11-29-78	1315	27.64	-	186.0	1.40	0.12	0.01	0.16	0.17	1.70	0.36	13.0
12-04-78	1205	27.30	-	143.0	3.50	0.27	0.02	0.28	0.30	4.10	0.76	56.0
02-05-79	1315	31.42	-	814.0	1.10	0.16	0.02	0.14	0.16	1.50	0.23	--
02-06-79	1240	32.37	-	1050.0	0.79	0.91	0.04	0.10	0.14	1.80	1.40	12.0
02-07-79	1315	29.75	-	491.0	0.27	0.32	0.06	0.03	0.09	0.68	0.54	11.0
02-12-79	1015	25.96	-	31.0	1.20	0.22	0.12	0.28	0.40	1.80	0.41	25.0
04-21-79	1145	27.50	-	182.0	1.60	0.20	0.08	0.20	0.28	2.10	0.15	18.0
04-26-79	1045	25.30	-	8.1	1.80	0.09	0.21	1.59	1.80	3.70	1.00	19.0
09-19-79	1400	32.71	-	1180.0	1.10	0.20	0.04	0.15	0.19	1.50	0.44	12.0
09-21-79	0925	34.02	-	1580.0	0.64	0.05	0.02	0.01	0.03	0.72	0.19	8.3
09-27-79	0950	27.38	-	169.0	1.70	0.07	0.02	0.	0.02	1.79	0.26	11.0
03-03-81	1030	24.87	-	1.5	0.10	8.60	1.50	8.10	9.60	18.00	9.70	8.9
05-03-81	1910	28.72	-	337.0	2.40	0.44	0.05	0.47	0.52	3.30	0.81	17.0
05-04-81	1130	29.86	-	515.0	2.50	0.36	0.05	0.39	0.44	3.30	0.63	14.0
05-05-81	1515	27.95	-	227.0	1.30	0.32	0.06	0.38	0.44	2.00	0.39	15.0
Station Mean					1.4056	0.7228	0.1494	0.7578	0.9072	3.0217	1.0094	16.241
Station Maximum					3.50	8.60	1.50	8.10	9.60	18.00	9.70	56.0
Station Minimum					0.10	0.05	0.01	0.	0.02	0.68	0.01	8.3

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1202	89.03	1.0	7120.0	1.00	0.18	0.06	0.19	0.25	1.50	0.24	--
	1208	89.03	12.0	7120.0	1.20	0.18	0.05	0.15	0.20	1.60	0.25	11.0
06-15-78	0930	82.35	1.0	158.0	2.40	0.01	0.01	0.	0.01	2.42	0.40	14.0
	0935	82.35	5.0	158.0	1.80	0.01	0.01	0.02	0.03	1.80	0.39	13.0
11-29-78	1405	86.73	1.0	2680.0	1.10	0.06	0.01	0.19	0.20	1.40	0.27	14.0
	1410	86.73	10.0	2680.0	1.10	0.06	0.01	0.19	0.20	1.40	0.27	13.0
12-04-78	0935	85.19	1.0	1130.0	1.00	0.05	0.03	0.05	0.08	1.20	0.30	19.0
	0940	85.19	10.0	1130.0	0.95	0.05	0.01	0.05	0.06	1.10	0.31	21.0
02-05-79	1135	82.86	1.0	233.0	1.40	0.27	0.04	0.28	0.32	2.00	0.34	19.0
	1140	82.86	10.0	233.0	1.30	0.26	0.06	0.26	0.32	1.90	0.36	17.0
02-09-79	1025	89.68	1.0	8920.0	0.85	0.15	0.06	0.08	0.14	1.10	0.30	9.9
	1030	89.68	16.0	8920.0	0.92	0.18	0.06	0.09	0.15	1.20	0.30	10.0
02-15-79	1030	88.37	1.0	5540.0	0.92	0.05	0.02	0.02	0.04	1.00	0.15	11.0
	1035	88.37	13.0	5540.0	0.84	0.06	0.02	0.06	0.08	0.98	0.17	11.0
02-21-79	0850	82.81	1.0	224.0	1.10	0.32	0.04	0.21	0.25	1.70	0.27	14.0
	0855	82.81	9.0	224.0	1.10	0.36	0.04	0.23	0.27	1.80	0.29	15.0
04-21-79	1125	87.85	1.0	4480.0	1.30	0.34	0.10	0.32	0.42	2.00	0.39	15.0
	1130	87.85	16.0	4480.0	1.00	0.37	0.10	0.36	0.46	1.90	0.38	--
04-26-79	1000	87.92	1.0	4610.0	1.10	0.10	0.04	0.08	0.12	1.30	0.27	13.0
	1005	87.92	14.0	4610.0	1.00	0.29	0.06	0.21	0.27	1.60	0.35	12.0
05-03-79	0840	84.34	1.0	641.0	1.10	0.32	0.14	0.18	0.32	1.70	0.37	19.0
	0845	84.34	10.0	641.0	0.98	0.32	0.16	0.17	0.33	1.60	0.37	16.0
09-21-79	1242	92.91	1.0	23470.0	0.77	0.06	0.04	0.10	0.14	0.97	0.24	4.2
	1244	92.91	9.0	23470.0	0.24	0.13	0.02	0.	0.02	0.39	0.22	8.5
09-26-79	1252	94.03	1.0	33490.0	0.49	0.01	0.01	0.	0.01	0.51	0.16	8.0
	1300	94.03	20.0	33490.0	0.85	0.06	0.01	0.04	0.05	0.96	0.23	7.9
10-04-79	1314	92.04	1.0	18130.0	1.50	0.02	0.02	0.	0.02	1.54	0.19	13.0
	1320	92.04	18.0	18130.0	0.85	0.35	0.02	0.	0.02	1.22	0.30	15.0
10-11-79	1330	88.72	1.0	6340.0	1.70	0.06	0.02	0.	0.02	1.78	0.41	17.0
	1345	88.72	15.0	6340.0	2.30	0.03	0.02	0.	0.02	2.35	0.35	16.0

Appendix D.--Nutrients and total organic carbon--Continued

STATION: 294617095390502 (08072500)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
05-04-81	1150	81.68	1.0	208.0	2.20	0.46	0.11	1.09	1.20	3.90	1.50	16.0
	1154	81.68	8.0	208.0	2.50	0.41	0.08	0.76	0.84	3.70	4.00	14.0
05-07-81	1116	85.81	1.0	3650.0	1.70	0.26	0.08	0.49	0.57	2.60	0.64	11.0
	1120	85.81	11.5	3650.0	1.90	0.26	0.02	0.02	0.04	2.20	0.60	13.0
05-11-81	1138	86.15	1.0	4250.0	1.20	0.09	0.03	0.06	0.09	1.40	0.61	11.0
	1142	86.15	13.0	4250.0	1.50	0.12	0.01	0.	0.01	1.63	0.65	18.0
05-13-81	1055	85.45	1.0	3070.0	1.60	0.10	0.01	0.	0.01	1.71	0.49	14.0
	1059	85.45	13.0	3070.0	1.60	0.10	0.01	0.	0.01	1.71	0.64	7.8
05-15-81	1250	83.64	1.0	1090.0	1.50	0.28	0.02	0.	0.02	1.80	0.67	--
	1254	83.64	11.0	1090.0	1.40	0.37	0.04	0.	0.04	1.81	0.72	15.0
	Station Mean				1.2815	0.1790	0.0425	0.1487	0.1912	1.6595	0.4840	13.414
	Station Maximum				2.50	0.46	0.16	1.09	1.20	3.90	4.00	21.0
	Station Minimum				0.24	0.01	0.01	0.	0.01	0.39	0.15	4.2

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1455	89.02	-	784.0	1.00	0.16	0.05	0.16	0.21	1.40	0.22	12.0
06-15-78	1145	81.66	-	404.0	1.60	0.01	0.01	0.	0.01	1.62	0.38	14.0
10-17-78	1050	75.61	-	7.2	1.30	0.11	0.04	1.36	1.40	2.80	1.70	18.0
12-01-78	1310	87.35	-	184.0	0.86	0.08	0.02	0.15	0.17	1.10	0.28	15.0
12-04-78	1345	84.81	-	655.0	1.00	0.06	0.02	0.06	0.08	1.20	0.30	18.0
01-30-79	1130	85.08	-	500.0	1.10	0.20	0.02	0.09	0.11	1.40	0.28	12.0
01-31-79	1045	83.19	-	454.0	1.30	0.39	0.06	0.20	0.26	2.00	0.51	15.0
02-01-79	1110	79.28	-	226.0	1.50	0.29	0.06	0.20	0.26	2.10	0.34	--
02-05-79	1240	83.00	-	300.0	1.20	0.29	0.06	0.27	0.33	1.80	0.35	17.0
02-09-79	1150	89.62	-	400.0	0.41	0.11	0.06	0.10	0.16	0.68	0.22	13.0
02-15-79	1345	88.30	-	573.0	0.81	0.06	0.02	0.09	0.11	0.98	0.15	11.0
02-21-79	1010	82.56	-	433.0	1.10	0.33	0.04	0.20	0.24	1.60	0.26	14.0
04-11-79	0945	75.68	-	33.0	1.60	0.64	0.43	0.67	1.10	3.30	0.70	20.0
04-23-79	1450	88.86	-	390.0	0.78	0.20	0.04	0.21	0.25	1.20	0.30	14.0
04-26-79	1200	87.90	-	376.0	1.00	0.15	0.06	0.12	0.18	1.40	0.36	13.0
05-03-79	1045	84.25	-	320.0	1.00	0.30	0.16	0.15	0.31	1.60	0.33	15.0
09-24-79	1050	94.11	-	229.0	0.52	0.04	0.02	0.	0.02	0.58	0.20	7.5
09-26-79	1050	94.04	-	915.0	0.55	0.01	0.01	0.	0.01	0.57	0.18	7.2
10-04-79	1005	92.05	-	805.0	1.10	0.04	0.02	0.11	0.13	1.20	0.19	12.0
10-11-79	1025	88.82	-	780.0	1.50	0.06	0.02	0.	0.02	1.58	0.31	17.0
03-03-81	1010	73.68	-	9.0	1.60	0.94	0.11	4.89	5.00	7.50	3.20	12.0
05-12-81	1050	86.13	-	539.0	1.10	0.06	0.01	0.	0.01	1.17	0.55	13.0
05-13-81	0940	85.49	-	529.0	1.50	0.07	0.01	0.	0.01	1.58	0.46	7.5
05-15-81	0945	83.73	-	445.0	1.50	0.31	0.03	0.	0.03	1.84	0.71	16.0
	Station Mean				1.1221	0.2046	0.0575	0.3762	0.4337	1.7583	0.5200	13.617
	Station Maximum				1.60	0.94	0.43	4.89	5.00	7.50	3.20	20.0
	Station Minimum				0.41	0.01	0.01	0.	0.01	0.57	0.15	7.2

Appendix D.--Nutrients and total organic carbon--Continued

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1220	8.75	-	118.0	1.00	0.90	0.11	0.05	0.16	2.10	0.01	10.0
06-15-78	1110	5.77	-	9.2	1.50	0.84	0.41	0.35	0.76	3.10	0.44	17.0
11-28-78	1330	8.61	-	111.0	1.20	0.04	0.01	0.02	0.03	1.20	0.31	13.0
11-29-78	1140	8.25	-	94.0	1.20	0.04	0.01	0.06	0.07	1.30	0.31	--
12-04-78	1050	6.72	-	35.0	1.20	0.09	0.01	0.05	0.06	1.40	0.42	24.0
02-05-79	1135	11.22	-	276.0	1.30	0.18	0.04	0.26	0.30	1.80	0.32	11.0
02-06-79	1050	12.46	-	372.0	0.75	0.09	0.02	0.06	0.08	0.92	0.20	11.0
02-07-79	1110	10.99	-	254.0	0.73	0.08	0.06	0.	0.06	0.87	0.19	11.0
02-12-79	1150	5.99	-	14.0	0.76	0.12	0.08	0.03	0.11	0.99	0.23	7.8
04-21-79	1020	8.03	-	84.0	1.40	0.26	0.06	0.09	0.15	1.90	0.19	20.0
04-26-79	0930	7.20	-	51.0	1.20	0.08	0.02	0.	0.02	1.30	0.26	17.0
09-19-79	1235	12.48	-	371.0	1.00	0.07	0.04	0.04	0.08	1.20	0.19	22.0
09-21-79	1035	14.82	-	600.0	0.75	0.02	0.01	0.	0.01	0.78	0.22	9.4
09-27-79	1155	9.08	-	134.0	0.19	0.03	0.02	0.06	0.08	0.30	0.24	8.4
03-03-81	0930	4.26	-	0.2	1.90	0.15	0.22	0.07	0.29	2.40	0.11	20.0
05-03-81	1815	6.64	-	63.0	1.90	0.94	0.10	0.26	0.36	3.20	0.47	20.0
05-04-81	0940	7.59	-	110.0	1.10	0.38	0.05	0.17	0.22	1.70	0.34	12.0
05-05-81	1415	6.92	-	75.0	1.40	0.49	0.09	0.20	0.29	2.20	0.40	16.0
	Station Mean				1.1378	0.2667	0.0756	0.0983	0.1739	1.5922	0.2694	14.682
	Station Maximum				1.90	0.94	0.41	0.35	0.76	3.20	0.47	24.0
	Station Minimum				0.19	0.02	0.01	0.	0.01	0.30	0.01	7.8

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1130	16.52	-	160.0	0.99	0.11	0.02	0.02	0.04	1.10	0.01	9.7
11-28-78	1250	16.18	-	189.0	0.96	0.04	0.01	0.07	0.08	1.10	0.28	--
11-29-78	1110	15.38	-	127.0	1.40	0.04	0.01	0.16	0.17	1.60	0.29	14.0
12-04-78	0950	13.78	-	23.0	1.50	0.07	0.02	0.26	0.28	1.90	0.29	21.0
02-05-79	1010	17.80	-	323.0	1.20	0.11	0.02	0.13	0.15	1.50	0.25	13.0
02-06-79	1010	19.24	-	459.0	0.86	0.10	0.02	0.08	0.10	1.10	0.22	4.7
02-07-79	1030	17.74	-	318.0	0.76	0.06	0.06	0.01	0.07	0.89	0.15	8.8
02-12-79	1110	13.20	-	9.5	1.00	0.07	0.06	0.04	0.10	1.20	0.16	--
04-21-79	0935	16.06	-	176.0	1.20	0.28	0.06	0.14	0.20	1.70	0.26	21.0
04-26-79	0835	12.98	-	5.0	1.70	0.12	0.10	0.07	0.17	2.00	0.26	25.0
09-19-79	1145	20.91	-	630.0	1.00	0.07	0.04	0.09	0.13	1.20	0.33	15.0
09-21-79	1130	21.22	-	667.0	0.64	0.04	0.02	0.01	0.03	0.71	0.24	11.0
09-27-79	1100	14.56	-	75.0	0.20	0.07	0.02	2.08	2.10	2.40	0.34	12.0
03-03-81	0850	12.85	-	1.0	1.40	0.20	0.21	2.49	2.70	4.30	4.60	11.0
05-03-81	1710	16.87	-	208.0	2.00	0.30	0.04	0.45	0.49	2.80	0.81	17.0
	2045	16.95	-	214.0	2.20	0.36	0.08	0.39	0.47	3.10	0.72	16.0
05-04-81	1025	16.08	-	147.0	1.70	0.17	0.03	0.26	0.29	2.20	0.40	--
05-05-81	1340	16.07	-	146.0	1.60	0.24	0.06	0.15	0.21	2.00	0.42	18.0
	Station Mean				1.2584	0.1384	0.0542	0.3726	0.4268	1.8368	0.5537	14.575
	Station Maximum				2.20	0.36	0.21	2.49	2.70	4.30	4.60	25.0
	Station Minimum				0.20	0.04	0.01	0.01	0.03	0.71	0.01	4.7

Appendix D.--Nutrients and total organic carbon--Continued

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1352	91.53	1.0	3610.0	0.80	0.20	0.04	0.11	0.15	1.20	0.18	8.9
	1400	91.53	12.5	3610.0	0.88	0.12	0.04	0.11	0.15	1.20	0.28	13.0
06-15-78	1050	82.47	4.0	92.0	1.70	0.04	0.02	--	--	--	0.44	14.0
11-28-78	1415	88.45	1.0	995.0	1.20	0.05	0.01	0.14	0.15	1.40	0.30	14.0
	1425	88.45	10.0	995.0	1.20	0.06	0.01	0.14	0.15	1.50	0.25	18.0
11-29-78	1100	88.20	1.0	879.0	1.10	0.06	0.01	0.10	0.11	1.30	0.29	15.0
	1105	88.20	15.0	879.0	0.94	0.06	0.01	0.08	0.09	1.10	0.31	11.0
02-05-79	1420	83.86	1.0	130.0	1.20	0.12	0.02	0.16	0.18	1.50	0.27	15.0
	1425	83.86	10.0	130.0	1.20	0.12	0.02	0.16	0.18	1.50	0.27	16.0
02-09-79	1315	92.60	1.0	5240.0	0.79	0.06	0.06	0.02	0.08	0.93	0.17	8.0
	1320	92.60	17.0	5240.0	0.81	0.05	0.06	0.09	0.15	1.00	0.19	8.8
02-15-79	1200	87.32	1.0	574.0	0.85	0.09	0.02	0.04	0.06	1.00	0.16	11.0
	1205	87.32	12.0	574.0	0.98	0.12	0.02	0.06	0.08	1.20	0.19	11.0
04-21-79	1415	89.65	1.0	1740.0	1.20	0.35	0.08	0.29	0.37	2.00	0.22	20.0
	1420	89.65	16.0	1740.0	1.50	0.32	0.10	0.31	0.41	2.20	0.24	18.0
04-26-79	1330	88.78	1.0	1170.0	1.30	0.13	0.04	0.08	0.12	1.50	0.35	17.0
	1335	88.78	17.0	1170.0	1.20	0.16	0.08	0.10	0.18	1.60	0.31	18.0
05-03-79	0930	73.90	1.0	1.0	1.70	0.68	0.30	0.62	0.92	3.30	0.68	20.0
09-21-79	1024	96.45	1.0	17050.0	0.82	0.03	0.02	0.03	0.05	0.90	0.19	8.3
	1030	96.45	17.5	17050.0	0.69	0.06	0.02	0.04	0.06	0.81	0.20	8.7
09-26-79	1014	98.01	1.0	24900.0	0.40	0.01	0.01	0.	0.01	0.42	0.15	7.2
	1020	98.01	18.0	24900.0	0.49	0.01	0.01	0.	0.01	0.51	0.19	9.0
10-04-79	1017	95.12	1.0	11800.0	1.20	0.02	0.02	0.	0.02	1.24	0.16	17.0
	1025	95.12	23.0	11800.0	0.71	0.39	0.02	0.	0.02	1.12	0.36	16.0
10-11-79	1035	89.01	1.0	1310.0	1.90	0.04	0.02	0.	0.02	1.96	0.24	20.0
	1050	89.01	13.0	1310.0	1.80	0.33	0.02	0.	0.02	2.15	0.56	27.0
05-04-81	1435	85.76	1.0	1550.0	1.70	0.34	0.10	0.34	0.44	2.40	0.59	15.0
	1439	85.76	13.5	1550.0	1.50	0.17	0.04	0.30	0.34	2.00	0.57	15.0
05-07-81	1400	89.88	1.0	5520.0	0.98	0.12	0.04	0.23	0.27	1.40	0.36	14.0
	1404	89.88	16.5	5520.0	1.10	0.18	0.03	0.08	0.11	1.40	0.47	15.0
05-11-81	0936	90.83	1.0	7200.0	1.20	0.08	0.02	0.	0.02	1.30	0.38	15.0
	0940	90.83	17.5	7200.0	1.20	0.29	0.01	0.	0.01	1.50	0.56	18.0
05-13-81	0900	90.51	1.0	6580.0	1.20	0.11	0.01	0.	0.01	1.32	0.38	7.9
	0904	90.51	15.5	6580.0	1.70	0.09	0.01	0.	0.01	1.80	0.42	15.0
05-15-81	1026	87.36	1.0	2600.0	1.20	0.21	0.04	0.	0.04	1.45	0.42	13.0
	1030	87.36	15.0	2600.0	1.20	0.25	0.05	0.	0.05	1.50	0.46	11.0
	Station Mean				1.1539	0.1533	0.0397	0.1037	0.1440	1.4460	0.3267	14.133
	Station Maximum				1.90	0.68	0.30	0.62	0.92	3.30	0.68	27.0
	Station Minimum				0.40	0.01	0.01	0.	0.01	0.42	0.15	7.2

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-09-78	1430	91.53	-	604.0	1.10	0.14	0.03	0.10	0.13	1.30	0.19	9.8
06-15-78	1125	82.36	-	286.0	1.60	0.04	0.03	0.08	0.11	1.70	0.42	12.0
10-17-78	0930	73.33	-	9.0	1.50	1.30	0.22	1.18	1.40	4.20	2.30	13.0
11-29-78	1430	88.05	-	726.0	0.95	0.05	0.01	0.09	0.10	1.10	0.29	14.0
12-01-78	1355	82.56	-	583.0	0.99	0.11	0.03	0.10	0.13	1.20	0.43	20.0
12-04-78	1455	74.06	-	144.0	1.30	0.19	0.04	0.26	0.30	1.80	0.56	22.0
01-30-79	1015	84.14	-	313.0	1.10	0.32	0.06	0.19	0.25	1.70	0.34	14.0
02-05-79	1515	84.13	-	312.0	1.20	0.12	0.04	0.13	0.17	1.50	0.26	17.0
02-09-79	1350	92.59	-	622.0	0.90	0.06	0.06	0.04	0.10	1.10	0.19	11.0
02-16-79	0910	86.38	-	340.0	1.00	0.10	0.02	0.08	0.10	1.20	0.14	17.0

Appendix D.--Nutrients and total organic carbon--Continued

STATION: 294706095372400 (08073001)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
02-21-79	1150	75.15	-	146.0	1.50	0.28	0.04	0.22	0.26	2.10	0.20	19.0
04-11-79	1045	73.53	-	16.0	1.50	0.34	0.34	1.06	1.40	3.20	0.90	20.0
04-23-79	1255	90.69	-	197.0	1.10	0.36	0.08	0.20	0.28	1.80	0.26	18.0
04-26-79	1330	88.79	-	372.0	1.00	0.19	0.06	0.10	0.16	1.40	0.30	18.0
05-03-79	0910	73.92	-	33.0	2.10	0.73	0.31	0.58	0.89	3.70	0.51	17.0
09-24-79	1150	98.05	-	235.0	0.49	0.03	0.01	0.04	0.05	0.57	0.16	5.7
09-26-79	1145	98.00	-	936.0	0.30	0.02	0.01	0.02	0.03	0.35	0.17	6.5
10-04-79	1100	95.10	-	880.0	0.97	0.02	0.02	0.	0.02	1.01	0.17	12.0
10-11-79	1145	88.92	-	752.0	1.60	0.10	0.02	0.	0.02	1.72	0.47	24.0
03-03-81	0840	72.14	-	39.0	1.40	0.17	0.20	1.70	1.90	3.50	2.60	16.0
05-12-81	0945	91.27	-	792.0	1.40	0.14	0.01	0.	0.01	1.55	0.48	16.0
05-13-81	0845	90.51	-	1165.0	1.30	0.09	0.01	0.	0.01	1.40	0.43	14.0
05-15-81	0900	87.51	-	1070.0	1.20	0.25	0.04	0.	0.04	1.49	0.43	13.0
Station Mean					1.1957	0.2239	0.0735	0.2683	0.3417	1.7648	0.5304	15.174
Station Maximum					2.10	1.30	0.34	1.70	1.90	4.20	2.60	24.0
Station Minimum					0.30	0.02	0.01	0.	0.01	0.35	0.14	5.7

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
06-08-78	1325	56.46	-	591.0	1.20	0.10	0.05	0.27	0.32	1.60	0.30	12.0
06-09-78	1220	61.31	-	1310.0	0.71	0.16	0.05	0.17	0.22	1.10	0.01	12.0
06-15-78	0905	57.78	-	781.0	2.00	0.07	0.01	0.	0.01	2.08	0.41	13.0
07-12-78	0940	50.80	-	50.0	1.40	0.15	0.15	0.63	0.78	2.40	1.10	10.0
08-02-78	1020	51.85	-	163.0	0.74	0.26	0.05	0.35	0.40	1.40	0.46	8.9
08-23-78	1130	50.40	-	25.0	1.20	0.39	0.17	1.23	1.40	3.00	1.80	11.0
09-27-78	0950	50.50	-	28.0	1.40	0.14	0.12	1.08	1.20	2.70	1.40	12.0
10-17-78	0830	50.39	-	20.0	1.20	0.59	0.24	1.46	1.70	3.50	2.60	11.0
11-07-78	1445	51.83	-	153.0	1.50	0.64	0.09	0.87	0.96	3.10	1.80	16.0
11-28-78	1435	55.78	1.0	627.0	1.30	0.07	0.01	0.35	0.36	1.80	0.35	16.0
11-29-78	1015	58.06	-	946.0	1.20	0.08	0.01	0.21	0.22	1.50	0.33	15.0
12-01-78	1435	56.98	-	796.0	0.84	0.08	0.03	0.20	0.23	1.10	0.42	17.0
12-04-78	0845	57.16	-	814.0	0.89	0.11	0.02	0.11	0.13	1.10	0.39	27.0
12-13-78	1005	50.67	-	37.0	1.50	0.55	0.07	0.59	0.66	2.70	1.40	14.0
01-23-79	1010	58.48	-	1000.0	1.20	0.22	0.04	0.08	0.12	1.50	0.30	13.0
01-30-79	1225	57.10	-	812.0	1.10	0.30	0.04	0.17	0.21	1.60	0.35	33.0
02-05-79	1435	57.40	-	850.0	1.30	0.19	0.04	0.27	0.31	1.80	0.33	18.0
02-06-79	1335	60.24	-	1280.0	0.88	0.12	0.04	0.22	0.26	1.30	0.25	12.0
02-07-79	0945	59.26	-	1120.0	0.93	0.07	0.06	0.14	0.20	1.20	0.18	24.0
02-09-79	1455	58.65	-	1020.0	0.88	0.08	0.06	0.08	0.14	1.10	0.22	9.4
02-12-79	0920	58.09	-	946.0	0.35	0.11	0.06	0.07	0.13	0.59	0.23	11.0
02-16-79	1000	56.92	-	773.0	0.89	0.11	0.02	0.06	0.08	1.10	0.18	11.0
02-21-79	0905	54.74	-	507.0	1.20	0.30	0.04	0.25	0.29	1.80	0.27	14.0
03-12-79	1250	50.54	-	30.0	--	0.83	0.51	--	--	--	1.50	12.0
04-11-79	1135	50.91	-	56.0	1.40	0.36	0.40	1.10	1.50	3.30	1.10	18.0
04-23-79	1355	56.92	-	784.0	2.60	0.18	0.08	0.16	0.24	3.00	0.21	--
04-26-79	1205	56.92	-	781.0	1.10	0.13	0.04	0.10	0.14	1.30	0.31	15.0
05-03-79	1200	53.94	-	408.0	1.50	0.28	0.18	0.27	0.45	2.30	0.45	18.0
05-21-79	1405	50.62	-	34.0	0.89	0.41	0.41	0.69	1.10	2.40	1.40	9.7
06-27-79	0955	51.62	-	128.0	1.10	0.51	0.32	0.59	0.91	2.50	0.44	12.0
09-12-79	1045	51.00	-	64.0	0.60	2.30	0.68	0.72	1.40	4.30	3.40	11.0
09-17-79	1940	51.65	-	132.0	1.00	0.36	0.25	0.56	0.81	2.20	1.00	20.0
09-20-79	1045	63.18	-	1630.0	0.79	0.05	0.02	0.04	0.06	0.90	0.24	9.7
09-24-79	1300	56.75	-	632.0	0.22	0.07	0.02	0.12	0.14	0.43	0.24	8.1
09-26-79	0935	63.92	-	1730.0	0.94	0.01	0.01	0.	0.01	0.96	0.19	8.6

Appendix D.--Nutrients and total organic carbon--Continued

STATION: 08073500--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Nitrogen, organic, total as N (mg/L)	Nitrogen, ammonia, total as N (mg/L)	Nitrogen, nitrite, total as N (mg/L)	Nitrogen, nitrate, total as N (mg/L)	Nitrogen, sum of nitrite and nitrate, total as N (mg/L)	Nitrogen, total as N (mg/L)	Phosphorus, total as P (mg/L)	Carbon, organic, total (mg/L)
10-04-79	0900	63.06	-	1580.0	1.20	0.03	0.02	0.	0.02	1.25	0.18	12.0
10-11-79	0935	61.82	-	1370.0	1.50	0.12	0.02	0.	0.02	1.64	0.31	23.0
10-15-79	1005	55.46	-	496.0	1.90	0.22	0.04	0.	0.04	2.16	0.56	15.0
11-28-79	1055	60.28	-	1200.0	--	0.14	0.02	0.10	0.12	0.23	0.28	12.0
01-29-80	1255	61.90	-	1570.0	1.00	0.06	0.01	0.07	0.08	1.20	0.19	12.0
05-21-80	0950	59.82	-	1150.0	1.20	0.24	0.04	0.43	0.47	1.90	0.35	13.0
08-04-80	1140	50.36	-	54.0	1.20	0.35	0.12	0.87	0.99	2.50	0.87	9.1
09-09-80	1130	59.32	-	985.0	1.10	0.08	0.03	0.07	0.10	1.30	0.44	11.0
03-03-81	1135	49.88	-	20.0	1.50	0.74	0.13	3.17	3.30	5.50	4.10	10.0
03-23-81	1020	49.84	-	16.0	1.10	0.60	0.36	2.64	3.00	4.70	3.80	11.0
05-12-81	1200	56.30	-	647.0	1.50	0.14	0.02	0.01	0.03	1.60	0.63	15.0
05-13-81	1040	62.43	-	1600.0	1.30	0.07	0.01	0.	0.01	1.38	0.46	16.0
05-15-81	1045	61.66	-	1460.0	1.40	0.29	0.03	0.02	0.05	1.70	0.53	14.0
	Station Mean				1.1707	0.2804	0.1092	0.4381	0.5387	1.9515	0.7971	13.947
	Station Maximum				2.60	2.30	0.68	3.17	3.30	5.50	4.10	33.0
	Station Minimum				0.22	0.01	0.01	0.	0.01	0.23	0.01	8.1

Appendix E.--Trace elements

[ft, foot; ft^3/s, cubic foot per second; µg/L, microgram per liter]

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Discharge (ft^3/s)	Arsenic (µg/L)	Barium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Manganese (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Zinc (µg/L)
12-01-78	1310	87.35	184	2	60	2	0	3	90	19	2	0.1	1	0	20
04-23-79	1450	88.86	390	2	100	2	0	2	680	2	10	0.1	1	0	20
03-03-81	1010	73.68	9	6	100	1	0	10	10	10	170	0.2	0	0	20
05-12-81	1050	86.13	539	3	70	1	0	10	190	10	2	0.	0	0	3
05-15-81	0945	83.73	445	4	100	1	10	10	410	10	20	0.	0	0	30

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Discharge (ft^3/s)	Arsenic (µg/L)	Barium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Manganese (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Zinc (µg/L)
04-21-79	0935	16.06	176	1	100	0	20	2	40	0	10	0.1	1	0	20

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Discharge (ft^3/s)	Arsenic (µg/L)	Barium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Manganese (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Zinc (µg/L)
11-29-78	1430	88.05	726	2	50	2	0	3	110	26	1	0.1	1	0	5
04-23-79	1255	90.69	197	2	100	2	0	2	600	2	10	0.1	1	0	20
03-03-81	0840	72.14	39	6	100	1	0	10	90	10	140	0.1	0	0	7
05-12-81	0945	91.27	792	5	70	1	10	10	170	10	5	0.	0	0	3
05-15-81	0900	87.51	1070	5	200	1	10	10	230	10	20	0.1	0	0	6

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Discharge (ft^3/s)	Arsenic (µg/L)	Barium (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Manganese (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Zinc (µg/L)
07-12-78	0940	50.80	50	5	500	0	20	4	20	0	10	0.1	1	0	0
03-12-79	1250	50.54	30	2	100	0	0	0	10	0	10	0.1	1	0	20
04-23-79	1355	56.92	784	2	100	2	0	3	600	0	10	0.1	1	0	20
06-27-79	0955	51.62	128	3	100	0	20	2	140	0	10	0.1	1	0	20
09-20-79	1045	63.18	1630	2	50	2	0	0	250	2	2	0.1	1	0	9
09-24-79	1300	56.75	632	2	50	3	0	0	110	2	1	0.1	1	0	7
05-19-80	1130	54.92	489	3	90	1	0	4	80	0	6	0.1	0	0	10
08-04-80	1140	50.36	54	5	200	1	10	1	20	0	1	0.	0	0	3
03-03-81	1135	49.88	20	6	100	1	10	10	40	10	90	0.1	0	0	30
05-12-81	1200	56.30	647	4	70	1	10	10	210	10	5	0.1	0	0	6
05-15-81	1045	61.66	1460	4	80	1	10	10	270	40	10	0.	0	0	20

Appendix F.--Pesticides and polychlorinated biphenyls

Chlorinated hydrocarbon compounds

[ft, foot; ft³/s, cubic foot per second; acre-ft, acre-feet; µg/L, microgram per liter]

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
11-28-78	1145	27.85	-	217	0	0.	--	0	0	--	0	0	0	0	0
04-21-79	1145	27.50	-	182	0	0.	--	0	0	0	0	0	0	0	0
09-19-79	1400	32.71	-	1180	0	0.	0	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft³/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
11-28-78	1145	27.85	-	217	0.01	0	0.	0.	0.	0
04-21-79	1145	27.50	-	182	0.01	0	0.	0.	0.1	0
09-19-79	1400	32.71	-	1180	0.	0	0.	0.	0.	0

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
04-21-79	1125	87.85	1	4480	0	0.	--	0	0	0	0	0	0	0	0
	1130	87.85	16	4480	0	0.	--	0	0	0	0	0	0	0	0
09-21-79	1242	92.91	1	23470	0	0.	0	0	0	0	0	0	0	0	0
	1244	92.91	9	23470	0	0.	0	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft³/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
04-21-79	1125	87.85	1	4480	0.	0	0.	0.	0.1	0
	1130	87.85	16	4480	0.	0	0.	0.	0.1	0
09-21-79	1242	92.91	1	23470	0.	0	0.	0.	0.1	0
	1244	92.91	9	23470	0.	0	0.	0.	0.	0

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
04-23-79	1450	88.86	-	390	0	0.	--	0	0	0	0	0	0	0	0
09-24-79	1050	94.11	-	229	0	0.	0	0	0	0	0	0	0	0	0
03-03-81	1010	73.68	-	9	0	0.01	0	0	0	0	0	0	0	0	0
05-12-81	1050	86.13	-	539	0	0.	0	0	0	0	0	0	0	0	0
05-15-81	0945	83.73	-	445	0	0.	0	0	0	0	0	0	0	0	0

Appendix F.--Pesticides and polychlorinated biphenyls--Continued

Chlorinated hydrocarbon compounds--Continued

STATION: 294610095385400 (08072501)--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft³/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
04-23-79	1450	88.86	-	390	0.	0	0.	0.	0.1	0
09-24-79	1050	94.11	-	229	0.	0	0.	0.	0.	0
03-03-81	1010	73.68	-	9	0.	0	0.	0.	0.	0
05-12-81	1050	86.13	-	539	0.	0	0.	0.	0.	0
05-15-81	0945	83.73	-	445	0.	0	0.	0.	0.	0

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
11-28-78	1330	8.61	-	111	0	0.	--	0	0	0	0	0	0	0	0
02-05-79	1135	11.22	-	276	0	0.	--	0	0	--	0	0	0	0	0
04-21-79	1020	8.03	-	84	0	0.	--	0	0	0	0	0	0	0	0
09-19-79	1235	12.48	-	371	0	0.	0	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft³/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
11-28-78	1330	8.61	-	111	0.	0	0.	0.	0.	0
02-05-79	1135	11.22	-	276	0.	0	0.	0.	0.	0
04-21-79	1020	8.03	-	84	0.01	0	0.	0.	0.	0
09-19-79	1235	12.48	-	371	0.	0	0.	0.	0.	0

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft³/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
11-28-78	1250	16.18	-	189	0	0.	--	0	0	--	0	0	0	0	0
02-05-79	1010	17.80	-	323	0	0.	--	0	0	--	0	0	0	0	0
04-21-79	0935	16.06	-	176	0	0.	--	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft³/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
11-28-78	1250	16.18	-	189	0.	0	0.	0.	0.	0
02-05-79	1010	17.80	-	323	0.01	0	0.	0.	0.	0
04-21-79	0935	16.06	-	176	0.	0	0.	0.	0.	0

Appendix F.--Pesticides and polychlorinated biphenyls--Continued

Chlorinated hydrocarbon compounds--Continued

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
11-28-78	1415	88.45	1	995	0	0.	--	0	0	--	0	0	0	0	0
	1425	88.45	10	995	0	0.	--	0	0	--	0	0	0	0	0
04-21-79	1415	89.65	1	1740	0	0.	--	0	0	0	0	0	0	0	0
	1420	89.65	16	1740	0	0.	--	0	0	0	0	0	0	0	0
09-21-79	1024	96.45	1	17050	0	0.	0	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
11-28-78	1415	88.45	1	995	0.	0	0.	0.	0.	0
	1425	88.45	10	995	0.	0	0.	0.	0.	0
04-21-79	1415	89.65	1	1740	0.	0	0.	0.	0.1	0
	1420	89.65	16	1740	0.	0	0.	0.	0.1	0
09-21-79	1024	96.45	1	17050	0.	0	0.	0.	0.	0

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
04-23-79	1255	90.69	-	197	0	0.	--	0	0	0	0	0	0	0	0
09-24-79	1150	98.05	-	235	0	0.	0	0	0	0	0	0	0	0	0
03-03-81	0840	72.14	-	39	0	0.02	0	0	0	0	0	0	0	0	0
05-12-81	0945	91.27	-	792	0	0.	0	0	0	0	0	0	0	0	0
05-15-81	0900	87.51	-	1070	0	0.	0	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
04-23-79	1255	90.69	-	197	0.	0	0.	0.	0.	0
09-24-79	1150	98.05	-	235	0.	0	0.	0.	0.	0
03-03-81	0840	72.14	-	39	0.	0	0.	0.	0.	0
05-12-81	0945	91.27	-	792	0.	0	0.	0.	0.	0
05-15-81	0900	87.51	-	1070	0.	0	0.	0.	0.	0

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
07-12-78	0940	50.80	-	50	0	0.01	--	0	--	0	0	0	0	0	0
08-02-78	1020	51.85	-	163	0	0.	--	0	--	0	0	0	0	0	0
11-28-78	1435	55.78	1	627	0	0.	--	0	0	--	0	0	0	0	0
02-05-79	1435	57.40	-	850	0	0.	--	0	0	--	0	0	0	0	0
03-12-79	1250	50.54	-	30	0	0.	--	0	0	--	0	0	0	0	0

Appendix F.--Pesticides and polychlorinated biphenyls--Continued

Chlorinated hydrocarbon compounds--Continued

STATION: 08073500--Continued

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Endrin, total (µg/L)	Lindane, total (µg/L)	Methoxychlor, total (µg/L)	Toxaphene, total (µg/L)	Perthane, total (µg/L)	Naphthalenes, polychlor., total (µg/l)	Aldrin, total (µg/L)	Chlordane, total (µg/L)	DDD, total (µg/L)	DDE, total (µg/L)	DDT, total (µg/L)
06-27-79	0955	51.62	-	128	0	0.02	--	0	0	--	0	0	0	0	0
05-19-80	1130	54.92	-	489	0	0.	0	0	0	0	0	0	0	0	0
08-04-80	1140	50.36	-	54	0	0.02	0	0	0	0	0	0	0	0	0
03-03-81	1135	49.88	-	20	0	0.02	0	0	0	0	0	0	0	0	0
05-15-81	1045	61.66	-	1460	0	0.	0	0	0	0	0	0	0	0	0

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	Dieldrin, total (µg/L)	Endosulfan, total (µg/L)	Heptachlor, total (µg/L)	Heptachlor epoxide, total (µg/L)	PCB, total (µg/L)	Mirex, total (µg/L)
07-12-78	0940	50.80	-	50	0.01	0	0.	0.	0.	0
08-02-78	1020	51.85	-	163	0.01	0	0.	0.	0.	0
11-28-78	1435	55.78	1	627	0.	0	0.	0.	0.	0
02-05-79	1435	57.40	-	850	0.	0	0.	0.	0.	0
03-12-79	1250	50.54	-	30	0.	0	0.	0.01	0.	0
06-27-79	0955	51.62	-	128	0.	0	0.	0.	0.	0
05-19-80	1130	54.92	-	489	0.	0	0.05	0.	0.	0
08-04-80	1140	50.36	-	54	0.	0	0.	0.	0.	0
08-03-81	1135	49.88	-	20	0.	0	0.	0.	0.	0
05-15-81	1045	61.66	-	1460	0.	0	0.	0.	0.	0

Appendix F.--Pesticides and polychlorinated biphenyls--Continued

Organophosphorous compounds

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
11-28-78	1145	27.85	-	217	0	0.	0.	0.	0.03	0	0
04-21-79	1145	27.50	-	182	0	0.	0.	0.01	0.	0	0
09-19-79	1400	32.71	-	1180	0	0.07	0.	0.02	0.03	0	0

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
04-21-79	1125	87.85	1	4480	0	0.	0.	0.21	0.	0	0
	1130	87.85	16	4480	0	0.	0.	0.34	0.	0	0
09-21-79	1244	92.91	9	23470	0	0.06	0.	0.24	0.	0	0

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
04-23-79	1450	88.86	-	390	0	0.	0.	0.12	0.	0	0
03-03-81	1010	73.68	-	9	0	0.	0.	0.53	0.	0	0
05-12-81	1050	86.13	-	539	0	0.01	0.	0.22	0.	0	0
05-15-81	0945	83.73	-	445	0	0.	0.	0.06	0.	0	0

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
11-28-78	1330	8.61	-	111	0	0.	0.	0.	0.03	0	0
02-05-79	1135	11.22	-	276	0	0.	0.	0.	0.03	0	0
04-21-79	1020	8.03	-	84	0	0.	0.	0.01	0.	0	0
09-19-79	1235	12.48	-	371	0	0.	0.	0.01	0.02	0	0

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
11-28-78	1250	16.18	-	189	0	0.	0.	0.	0.	0	0
02-05-79	1010	17.80	-	323	0	0.	0.	0.	0.	0	0
04-21-79	0935	16.06	-	176	0	0.	0.	0.01	0.	0	0

Appendix F.--Pesticides and polychlorinated biphenyls--Continued

Organophosphorous compounds--Continued

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
11-28-78	1415	88.45	1	995	0	0.	0.01	0.03	0.07	0	0
	1425	88.45	10	995	0	0.	0.	0.02	0.03	0	0
04-21-79	1415	89.65	1	1740	0	0.	0.	0.16	0.	0	0
	1420	89.65	16	1740	0	0.	0.	0.18	0.	0	0
09-21-79	1024	96.45	1	17050	0	0.	0.	0.08	0.01	0	0

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
04-23-79	1255	90.69	-	197	0	0.	0.	0.09	0.	0	0
03-03-81	0840	72.14	-	39	0	0.	0.	0.37	0.	0	0
05-12-81	0945	91.27	-	792	0	0.02	0.	0.37	0.	0	0
05-15-81	0900	87.51	-	1070	0	0.01	0.	0.17	0.	0	0

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge (ft^3/s) or storage (acre-ft)	Ethion, total (µg/L)	Malathion, total (µg/L)	Parathion, total (µg/L)	Diazinon, total (µg/L)	Methyl parathion, total (µg/L)	Trithion, total (µg/L)	Methyl trithion, total (µg/L)
07-12-78	0940	50.80	-	50	0	0.	0.	0.30	0.01	0	0
08-02-78	1020	51.85	-	163	0	0.	0.	0.10	0.01	0	0
11-28-78	1435	55.78	1	627	0	0.	0.	0.05	0.05	0	0
02-05-79	1435	57.40	-	850	0	0.	0.	0.02	0.03	0	0
03-12-79	1250	50.54	-	30	0	0.	0.	0.11	0.	0	0
06-27-79	0955	51.62	-	128	0	0.56	0.	0.91	0.	0	0
05-19-80	1130	54.92	-	489	0	0.01	0.	0.20	0.	0	0
08-04-80	1140	50.36	-	54	0	0.01	0.	0.19	0.	0	0
03-03-81	1135	49.88	-	20	0	0.01	0.	0.47	0.	0	0
05-15-81	1045	61.66	-	1460	0	0.01	0.	0.15	0.	0	0

Chlorophenoxy compounds

STATION: 08072300

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
11-28-78	1145	27.85	-	217	0.04	0.	0.01
02-05-79	1315	31.42	-	814	0.01	0.	0.
04-21-79	1145	27.50	-	182	0.02	0.01	0.
09-19-79	1400	32.71	-	1180	0.	0.	0.

STATION: 294617095390502 (08072500)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
04-21-79	1125	87.85	1.0	4480	0.08	0.03	0.
	1130	87.85	16.0	4480	0.09	0.04	0.01
09-21-79	1242	92.91	1.0	23470	0.	0.	0.
	1244	92.91	9.0	23470	0.	0.	0.

STATION: 294610095385400 (08072501)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
04-23-79	1450	88.86	-	390	0.05	0.01	0.02
09-24-79	1050	94.11	-	229	0.16	0.	0.
03-03-81	1010	73.68	-	9	0.10	0.	0.
05-12-81	1050	86.13	-	539	0.09	0.22	0.01
05-15-81	0945	83.73	-	445	0.08	0.10	0.02

STATION: 08072730

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
11-28-78	1330	8.61	-	111	0.05	0.	0.
02-05-79	1135	11.22	-	276	0.	0.	0.01
04-21-79	1020	8.03	-	84	0.	0.02	0.
09-19-79	1235	12.48	-	371	0.	0.	0.

STATION: 08072760

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
11-28-78	1250	16.18	-	189	0.	0.	0.
02-05-79	1010	17.80	-	323	0.	0.	0.
04-21-79	0935	16.06	-	176	0.	0.	0.

Appendix F.--Pesticides and polychlorinated biphenyls--Continued

Chlorophenoxy compounds--Continued

STATION: 294729095372502 (08073000)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
11-28-78	1415	88.45	1.0	995	0.06	0.	0.
	1425	88.45	10.0	995	0.03	0.	0.
04-21-79	1415	89.65	1.0	1740	0.02	0.01	0.
	1420	89.65	16.0	1740	0.01	0.	0.
09-21-79	1024	96.45	1.0	17050	0.	0.	0.
	1030	96.45	17.5	17050	0.	0.	0.

STATION: 294706095372400 (08073001)

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
04-23-79	1255	90.69	-	197	0.03	0.01	0.
09-24-79	1150	98.05	-	235	0.64	0.	0.
03-03-81	0840	72.14	-	39	0.21	0.	0.
05-12-81	0945	91.27	-	792	0.13	0.01	0.
05-15-81	0900	87.51	-	1070	0.05	0.02	0.01

STATION: 08073500

Date of sample	Time of sample	Stage (ft)	Sampling depth (ft)	Discharge, (ft^3/s) or storage (acre-ft)	2,4-D, total (µg/L)	2,4,5-T, total (µg/L)	Silvex, total (µg/L)
07-12-78	0940	50.80	-	50	0.01	0.01	0.
08-02-78	1020	51.85	-	163	0.02	0.03	0.
11-28-78	1435	55.78	1.0	627	0.06	0.01	0.01
02-05-79	1435	57.40	-	850	0.02	0.	0.
03-12-79	1250	50.54	-	30	0.03	0.	0.
06-27-79	0955	51.62	-	128	0.22	0.02	0.
05-19-80	1130	54.92	-	489	0.24	0.01	0.
08-04-80	1140	50.36	-	54	0.21	0.03	0.02
03-03-81	1135	49.88	-	20	0.12	0.	0.
05-15-81	1045	61.66	-	1460	0.03	0.02	0.