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WATER-QUALITY CONDITIONS IN THE MILNER REACH, SNAKE RIVER, SOUTH-CENTRAL IDAHO, OCTOBER 18-21, 1977

By Walton H. Low

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CONVERSION FACTORS

The following conversion table is included for the convenience of those who prefer to use SI (International System of Units) rather than the inch-pound system of units. Constituent concentrations are given in mg/L (milligrams per liter) or µg/L (micrograms per liter), which are (within the range of values presented) numerically equal to parts per million, or parts per billion, respectively.

Multiply Inch-Pound Unit	By	To Obtain SI Unit
	Length	
inch (in.)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	0.4047	square hectometer (hm^2)
square mile (mi^2)	2.590	square kilometer (km^2)
square foot (ft^2)	0.0929	square meter (m^2)
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
million gallons per day (Mgal/d)	.04381	cubic meters per second (m^3/s)
	Mass Per Unit Time	
pound per day (lb/d)	0.4536	kilogram per day (kg/d)

Conversion of °C (degrees Celsius) to °F (degrees Fahrenheit) is based on the equation $°F = (1.8)(°C) + 32$.

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ABSTRACT

During late October 1977, water discharge from Minidoka Dam into the Milner reach of the Snake River was less than 22 cubic meters per second, compared to normal flows for that time of year of about 42 cubic meters per second or more. To determine if impaired water-quality conditions existed, samples were collected at several sites above and below major point-source waste discharges near Burley, Idaho. Data collected for this study indicate some water-quality impairment within the study reach. At site 15 near Milner Dam, dissolved oxygen was below the 90-percent saturation standard prescribed by the Idaho water-quality standards. The total coliform and fecal coliform standards were exceeded at about one-third of the sites sampled on the main stem of the Snake River. Un-ionized ammonia concentration exceeded U.S. Environmental Protection Agency water-quality criteria at one site near Burley. Concentrations of trace metals, insecticides, and herbicides were all low; none exceeded existing criteria.

INTRODUCTION

The Milner reach of the Snake River between Minidoka and Milner Dams in south-central Idaho (fig. 1) has been designated class A_2, primary contact recreational water, by the Idaho Department of Health and Welfare (1975). Water quality in this reach may, under certain conditions, be threatened by low concentrations of DO (dissolved oxygen) and high concentrations of nutrients, bacteria, and turbidity, which are caused partly by wastes discharging from three municipal sewage-treatment and two food-processing plants (fig. 1). In a previous study (Yearsley, 1975), critical water-quality conditions were predicted to occur in the Milner reach when stream discharge is below 57 m^3/s and waste discharge is equal to that observed during October 1974. In 1977, a severe drought resulted in low flows of less than 22 m^3/s, compared to normal flows of about 42 m^3/s or more, during late October and early November. Although this flow was less than normal, waste discharge was also much less than that observed by Yearsley in October 1974.

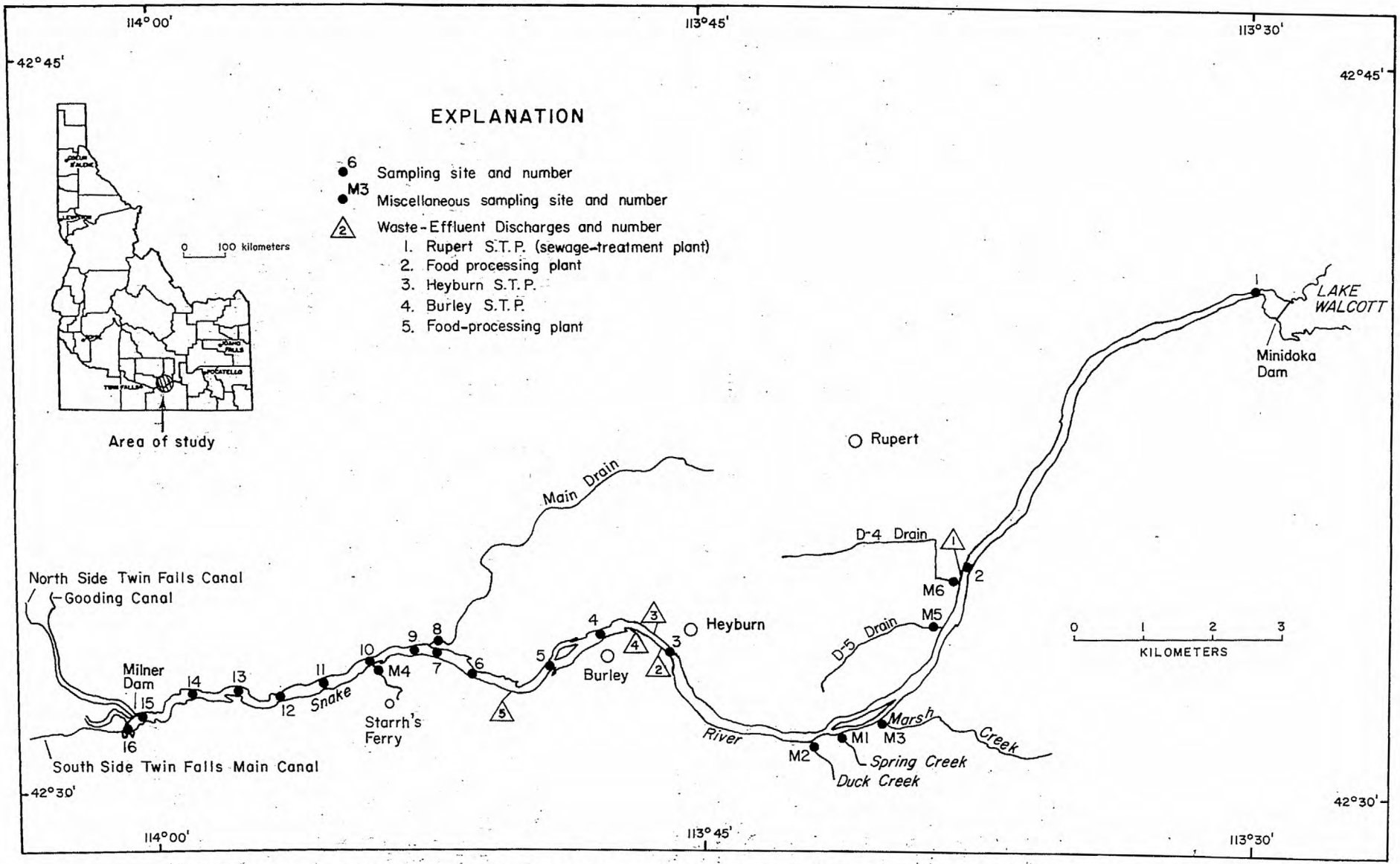

Figure 1.--Locations of sampling sites and major waste-effluent discharges into the Milner reach, Snake River, Idaho.

Study Reach

The Milner reach of the Snake River is located between Minidoka Dam (river kilometer 1,083.4) and Milner Dam (river kilometer 1,020.8) in south-central Idaho (fig. 1). The land-surface elevation of the 54-km river reach averages about 1,250 m (National Geodetic Vertical Datum). Drainage area above Milner Dam is about 44,500 km^2, which excludes an indeterminate nontributary area of the Snake River Plain to the north. Average annual precipitation at Burley is about 250 mm.

Canals and lift pumps divert water from Lake Walcott (fig. 1) and the Milner reach for irrigation of about 185,000 hm^2 of land. Principal crops are potatoes, sugar beets, corn, wheat, and alfalfa. Four irrigation drains and three small creeks carried irrigation-return flows to the Milner reach during the study period.

Major point sources of waste effluent into the reach are three sewage-treatment plants in Burley, Heyburn, and Rupert, and two food-processing plants near Burley (fig. 1). All of the above sources, except the sewage-treatment plant in Rupert, discharge downstream from the State Highway 30 bridge in Heyburn (site 3).

Purpose and Scope

This study was a cooperative effort by the U.S. Geological Survey and the U.S. Environmental Protection Agency, Region X, Seattle, Wash.

Purposes of this study were to: (1) Document the cause-and-effect relations between point sources and receiving water in the Milner reach of the Snake River, and (2) describe the stream channel and streamflow characteristics of this reach during a period of low flow. Intensive water-quality sampling was conducted during a 4-day period, October 18-21, 1977, at selected sampling sites (table 1). Characteristics determined for each sample site and frequency of determination are shown in table 2.

Discharges into and diversions from the Milner reach and stream cross-section and water-surface elevation data at sites 5, 6, 7, 9, 10, 11, 12, 13, 14, and 15 were also determined.

Table 1. Locations of sampling sites

Site	Latitude	Longitude	Station name
1	42°40'23"	113°29'58"	Snake River near Minidoka
2	42°34'51"	113°37'33"	Snake River at Highway 25 bridge near Rupert
3	42°32'43"	113°45'40"	Snake River at Highway 30 bridge near Rupert
4	42°33'30"	113°47'30"	Snake River at Burley
5	42°32'24"	113°49'20"	Snake River below Custer Island at Burley
6	42°32'20"	113°50'45"	Snake River at sewage ponds near Burley
7	42°32'51"	113°52'03"	Snake River above Main Drain near Burley
8	42°33'07"	113°52'11"	Main Drain at Milner Lake near Burley
9	42°32'59"	113°52'42"	Snake River below Main Drain near Burley
10	42°32'44"	113°52'59"	Snake River above Hobson siding near Burley
11	42°32'18"	113°55'18"	Snake River at Hobson siding near Burley
12	42°31'59"	113°56'21"	Snake River above Minidoka North Side Pump Canal near Milner
13	42°32'06"	113°57'52"	Snake River above PA Lateral near Milner
14	42°32'04"	113°58'49"	Snake River below PA Lateral near Milner
15	42°31'37"	114°00'15"	Snake River above Milner Dam near Milner
16	42°31'26"	114°00'40"	Lake Milner at Milner Dam
		Miscellaneous Sampling Sites	
M1	42°31'04"	113°41'07"	Spring Creek near Springdale
M2	42°31'05"	113°41'55"	Duck Creek near Springdale
M3	42°31'26"	113°40'00"	Marsh Creek near Delco
M4	42°32'23"	113°53'50"	Irrigation drain near Starrh's Ferry
M5	42°33'15"	113°38'30"	D5 Drain near Rupert
M6	42°34'12"	113°37'57"	D4 Drain near Rupert

Table 2. Characteristics and frequency of determination for sampling sites in the Milner reach, October 18-21, 1977

Site numbers	Characteristics	Frequency
1, 3, 4, 8, 9, 10	Nutrients, organic carbon, suspended sediment	Twice daily
1, 2, 3, 4, 7, 8, 9, 12, 15	Water temperature, specific conductance, dissolved oxygen, pH, depth of light penetration	Twice daily
1, 2, 3, 4, 7, 8, 9, 12, 15	Total coliform, fecal coliform, fecal streptococci	Once daily
1, 9, 15	BOD-2, -5, -10, -15, -20 days	Once daily
3, 4, 8	BOD-5 days	Once daily
16	Water temperature, specific conductance, dissolved oxygen, pH	Continuously
3, 15	Trace metals, insecticides, herbicides	Once
2, 4, 7, 9, 13, 15	Discharge	Once
5, 6, 10, 11, 12, 14	Channel cross-section	Once

Acknowledgments

The author gratefully acknowledges the assistance of the U.S. Environmental Protection Agency, Region X, Seattle, in providing some of the water-quality instrumentation used in this study. Special thanks are given to the many landowners along the Milner reach for allowing access to sampling sites. In addition, the author thanks personnel of the Division of Environment, Idaho Department of Health and Welfare, for collection and analyses of samples from point-source waste discharges, and to personnel of the College of Forestry, Wildlife, and Range Sciences, University of Idaho, for collection and analyses of phytoplankton and seston samples.

METHODS OF COLLECTION AND ANALYSIS

Samples for laboratory analyses were taken from a composite of 10 depth-integrated samples collected at equal-width increments at each site using a depth-integrated, equal transit rate sampling technique, described by Guy and Norman (1970). Onsite measurements of water temperature, specific conductance, DO, and pH were made at the time of collection from depth-integrated samples taken at the one-quarter, one-half, and three-quarter cross-section verticals.

Samples collected for analyses of nutrients, trace metals, insecticides, and herbicides were treated and prepared at each site and shipped for analysis to the U.S. Geological Survey National Water Quality Laboratory in Arvada, Colo. (Brown and others, 1970, and Goerlitz and Brown, 1972). Samples collected for BOD (biochemical-oxygen demand) analyses were sent chilled to the Idaho Department of Health and Welfare laboratory in Boise, Idaho, within 6 hours of collection. Samples from the major waste-effluent point sources were collected, prepared, and sent to the Idaho Department of Health and Welfare for analysis using analytical methodology described by the U.S. Environmental Protection Agency (1974) and the American Public Health Association (1975). Phytoplankton, primary productivity, and seston samples were collected and analyzed by the University of Idaho, College of Forestry, Wildlife, and Range Sciences, using analytical methodology described by the American Public Health Association (1971), U.S. Environmental Protection Agency (1973), and Slack and others (1973).

Discharge into the Milner reach of the Snake River from Minidoka Dam decreased from 19.6 to 15.8 m^3/s and averaged 18.2 m^3/s during the 4-day study (table 3). During this period, instantaneous discharge from creeks and drains totaled about 1.9 m^3/s (table 3) and about 0.4 m^3/s from waste-effluent discharges (table A).

Diversions by the Gooding and North Side and South Side Twin Falls canals included almost all the outflow from the Milner reach during the study period. Diversions near Milner Dam were about 30 m^3/s for the first 2 days and averaged about 19 m^3/s for the last 2 days of the study (table 4). Decrease in diversions was caused by gradual shutoff of the South Side Twin Falls Canal. Mean discharge between October 18 and 21 at the U.S. Geological Survey gage in the main stem of the Snake River below Milner Dam ranged from 0.24 to 0.28 m^3/s (U.S. Geological Survey, 1979). Table 5 and figure 2 provide information on stream velocities and cross sections for 10 of 16 sites.

RESULTS OF WATER-QUALITY ANALYSES

Nutrients

Results of nitrogen, phosphorus, and organic carbon analyses are shown in table 6. Concentrations and loadings of the nitrogen, phosphorus, and organic carbon nutrients are reported in units of the basic elements N, P, and C. Also, nitrite plus nitrate nitrogen will hereafter be called nitrate. Mean concentration of nitrate in the study reach ranged from 0.72 mg/L at site 1 to 1.05 mg/L at site 9. Mean concentration of ammonia nitrogen ranged from 0.01 mg/L at site 1 to 0.46 mg/L at site 4. The ammonia concentration measured at site 4 exceeded the recommended total ammonia concentration criteria for freshwater aquatic life (U.S. Environmental Protection Agency, 1976). Between sites 1 and 3, nitrate and ammonia concentrations increased slightly (fig. 3). About 35 kg/d of ammonia and about 370 kg/d of nitrate entered between sites 1 and 3; about 30 kg/d of ammonia and 1 kg/d of nitrate were from the Rupert sewage-treatment plant ($m^3/s \times mg/L \times 86.4 = kg/d$) and about 5 kg/d of ammonia and 370 kg/d of nitrate from miscellaneous sites M1, M2, M3, M5, and M6 (table 6). Between sites 3 and 4, ammonia concentration increased sharply, and there was a slight increase in nitrate concentration. The majority of the nutrient inflow between sites 3 and 4 came from a food-processing plant and the sewage-treatment plants at Heyburn and Burley, which contributed a total of about 240 kg/d of ammonia and 1 kg/d of nitrate.

Table 3. Daily mean discharge in the Milner reach of the Snake River, and tributary inflow into the Milner reach from creeks and drains, October 18-21, 1977

Site number	Date	Mean discharge (m^3/s)	Instantaneous discharge (m^3/s)
		Milner Reach	
1	10-18	19.6	--
	10-19	18.9	--
	10-20	18.6	--
	10-21	15.8	--
2	10-18	--	23.2
7	10-19	--	22.9
9	10-19	--	23.2
		Creeks and Drains	
8	10-20	--	0.59e
M1	10-18	--	.28e
M2	10-20	--	.17e
M3	10-18	--	.42
M4	10-19	--	.03e
M5	10-19	--	.13
M6	10-19	--	.31

Table 4. Diversions from the Milner reach, Snake River, Idaho, October 18-21, 1977

Site name	Date	Mean discharge (m^3/s)
Gooding plus North Side Twin Falls Canals	10-18	17.2
	10-19	16.8
	10-20	16.7
	10-21	17.3
South Side Twin Falls Canal	10-18	14.2
	10-19	11.6
	10-20	4.4
	10-21	0.0

Table 5. Cross-sectional area and stream velocities at selected sites for the Milner reach of the Snake River

Site number	Date	Cross-sectional area (m^2)	Depth below water surface (tenths of total depth)	Stream velocity (m/s)		
				Verticals from left bank		
				1/4	1/2	3/4
2	10-18	121	0.2	--	0.26	0.27
			.8	--	.24	.20
			.6	0.08	--	--
4	10-18	223	.2	.18	.18	--
			.8	.11	.14	--
			.6	--	--	.16
5	10-21	310	--	--	--	--
6	10-21	310	--	--	--	--
7	10-19	391	.2	.08	.11	.05
			.8	.07	.06	.04
9	10-19	139	.2	.33	--	--
			.8	.27	--	--
			.6	--	.07	.10
10	10-21	481	--	--	--	--
11	10-21	660	--	--	--	--
12	10-21	527	--	--	--	--
13	10-20	815	.2	.03	.02	.03
			.8	.03	.03	.05
14	10-21	1,107	--	--	--	--
15	10-19	1,774	.2	.03	.01	.04
			.8	.03	.06	.03

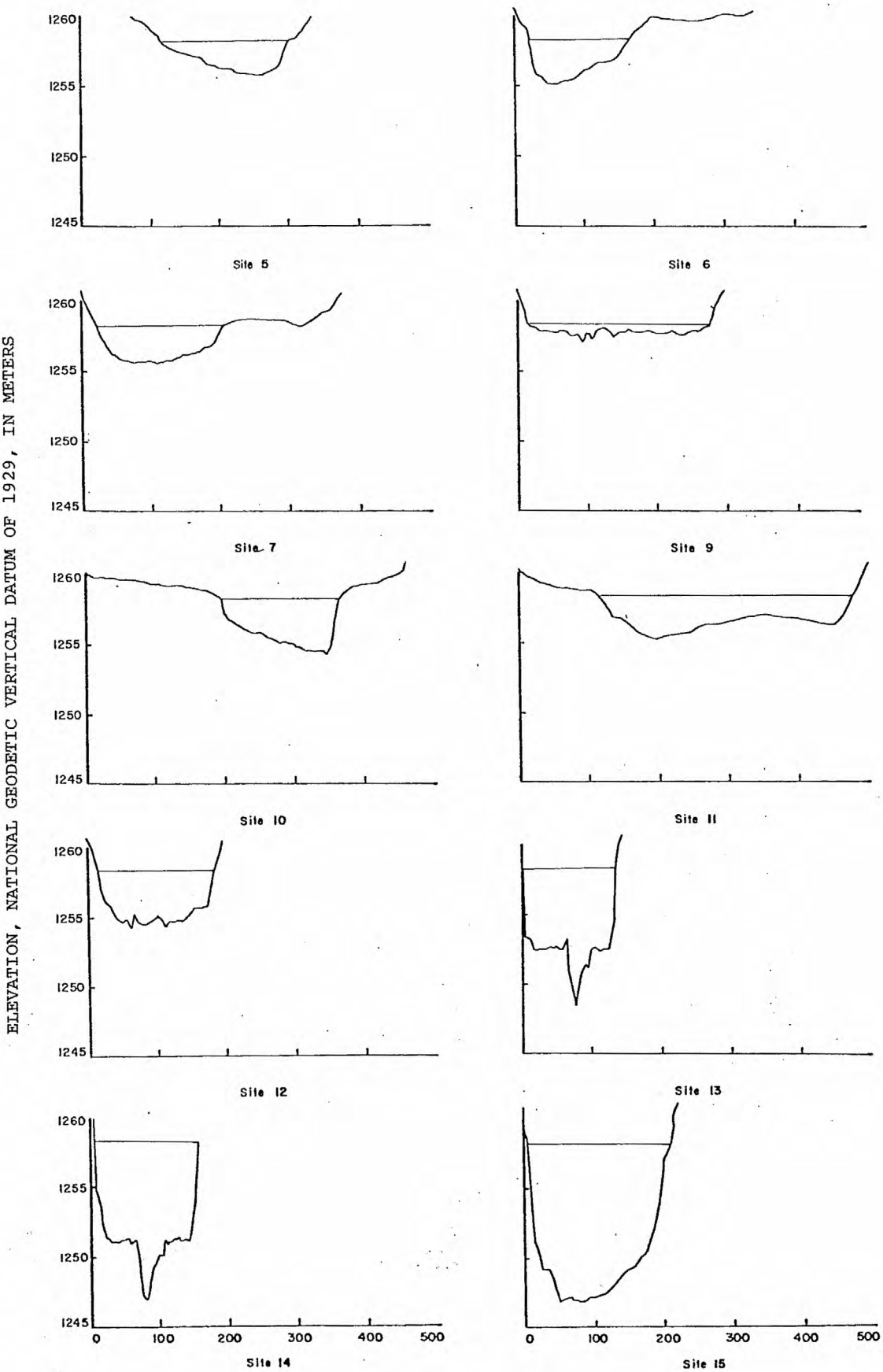

Figure 2.--Channel cross-sections at selected sites in the Milner reach of the Snake River, Idaho.

Table 6. Mean concentrations of nutrients, bacteria, and sediment at selected sampling sites along the Milner reach of the Snake River, October 18-21, 1977

Site number	Nitrogen nitrite plus nitrate, total (mg/L as N)	Nitrogen ammonia, total (mg/L as N)	Phosphorus orthophos-phate, total (mg/L as P)	Phosphorus, total (mg/L as P)	Carbon organic, total (mg/L as C)	Suspended sediment (mg/L)	Total coliform[1] (col/100 ml)	Fecal coliform[1] 0.7 um-MF (col/100 ml)	Fecal strep-tococci,[1] KF AGAR (col/100 ml)
1	0.72	0.01	0.06	0.08	1.8	5	[2]K18	K10	K26
2	--	--	--	--	--	--	K170	K24	83
3	.74	.06	.02	.07	2.3	11	110	K87	43
4	.80	.46	.14	.22	3.3	15	150	41	K60
[3]7	--	--	--	--	--	--	320	K76	86
8	.93	.11	.04	.12	5.1	115	K59	K46	120
9	1.05	.25	.14	.20	2.5	18	630	K82	74
13	--	--	--	--	--	--	K360	K13	K8
15	.97	.32	.10	.18	2.9	28	K87	K4	K11
				Miscellaneous Sampling Sites[3]					
M1	4.4	.06	.06	.09	--	--	K110	K100	K160
M2	4.7	.01	.07	.08	4.9	--	250	210	400
M3	3.4	.05	.07	.09	--	--	K280	K400	K360
M4	.12	.36	.02	.06	3.4	23	1,100	K270	770
M5	1.5	.02	.06	.09	3.1	--	40	K39	79
M6	2.1	.07	.06	.10	2.7	--	110	72	150

[1]Geometric mean
[2]K, results based on counts outside ideal colony count range
[3]Results based on one sample, only

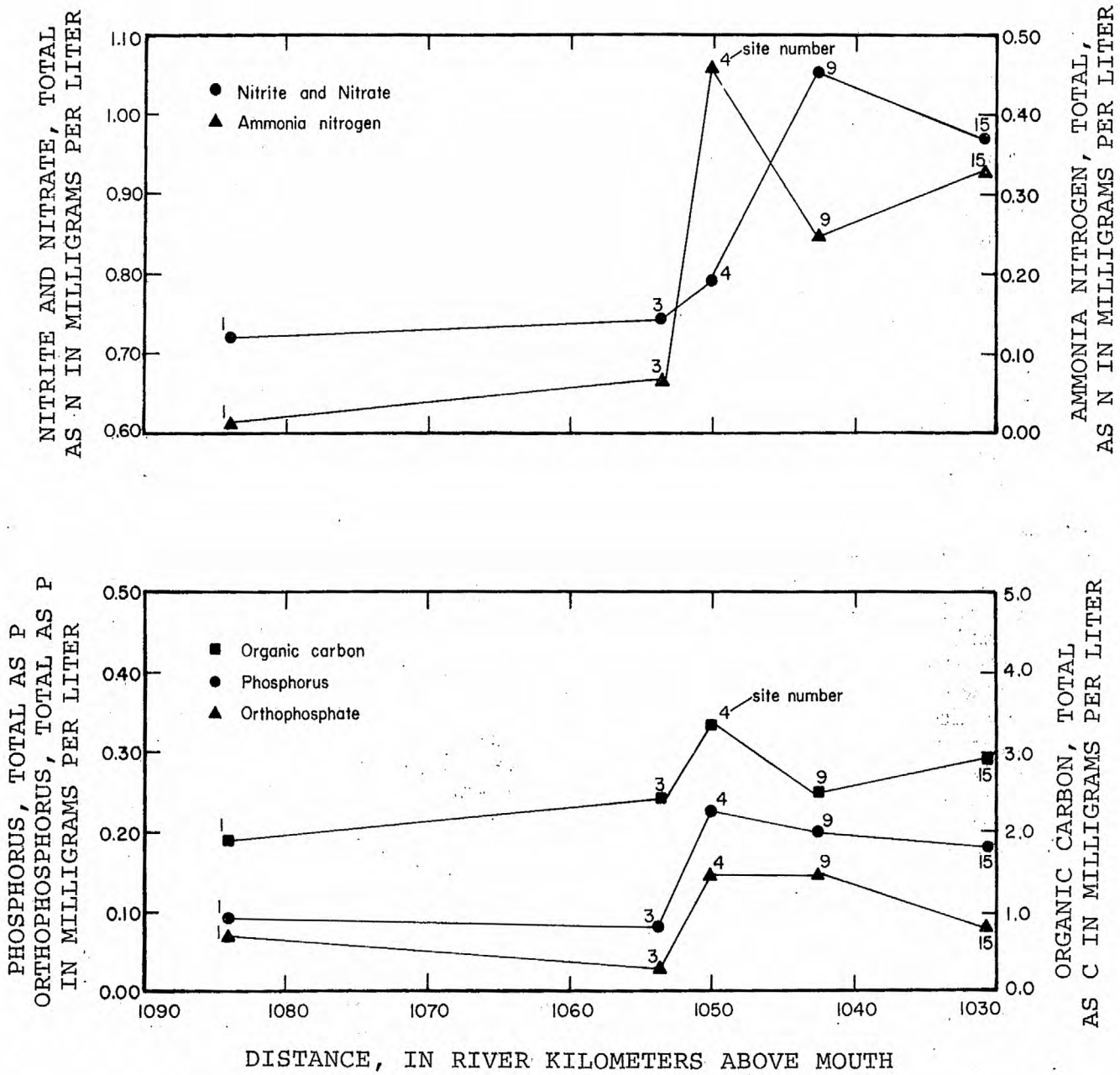

Figure 3.--Mean concentrations of nutrients at selected sites along the Milner reach of the Snake River, Idaho.

Below site 4, ammonia concentration decreased and nitrate concentrations increased, indicating that ammonia oxidation was occurring. Ammonia inputs were about 20 kg/d from the food-processing plant and 6 kg/d from the Main drain. Increase in nitrate concentration was also partly attributable to nitrate loading from a second food-processing plant below Burley and the Main drain (site 8). Nitrate input was about 550 kg/d from the food-processing plant and about 50 kg/d from the Main drain. Between sites 9 and 15, the ammonia concentration increased about 0.1 mg/L; nitrate concentration remained about the same.

Mean concentration of TOC (total organic carbon) in the Milner reach ranged from 1.8 mg/L at site 1 to 3.3 mg/L at site 4 (table 6). Concentrations of TOC at sites along the Milner reach are shown in figure 3. The majority of point-source effluent discharged into the study reach within about 1 km above site 4. Decrease in carbon concentration from sites 4 to 9 was due mainly to oxidation of organic material and effluent settling.

Mean concentration of total phosphorus ranged from 0.07 mg/L at site 3 to 0.22 mg/L at site 4 (table 6). Mean concentration of orthophosphorus ranged from 0.02 mg/L at site 3 to 0.14 mg/L at sites 4 and 9 (table 6). Concentrations of total and orthophosphorus at sites along the Milner reach are shown in figure 3. Phosphorus concentration increased between sites 3 and 4 due to waste-effluent discharge from the food-processing plant and the Heyburn and Rupert sewage-treatment plants. Concentration decreased downstream from site 4, probably due to the uptake of phosphorus by algae. This assumption is supported by a sharp increase in concentration of chlorophyll a (table B) below site 4, which indicated a large increase in algal density.

Biochemical-Oxygen Demand

Computed 5-day BOD point-source loading into the Milner reach between sites 2 and 9 was about 2,800 kg/d (table A). The BOD samples were not treated to inhibit nitrifying bacteria; therefore, the samples include both carbonaceous and nitrogenous demand (fig. 4 and table C).

Onsite Water-Quality Measurements

Measurement of temperature, specific conductance, DO, pH, and light penetration were made in the morning and again in the afternoon, between 0800 and 1700 hours (table 7). Small

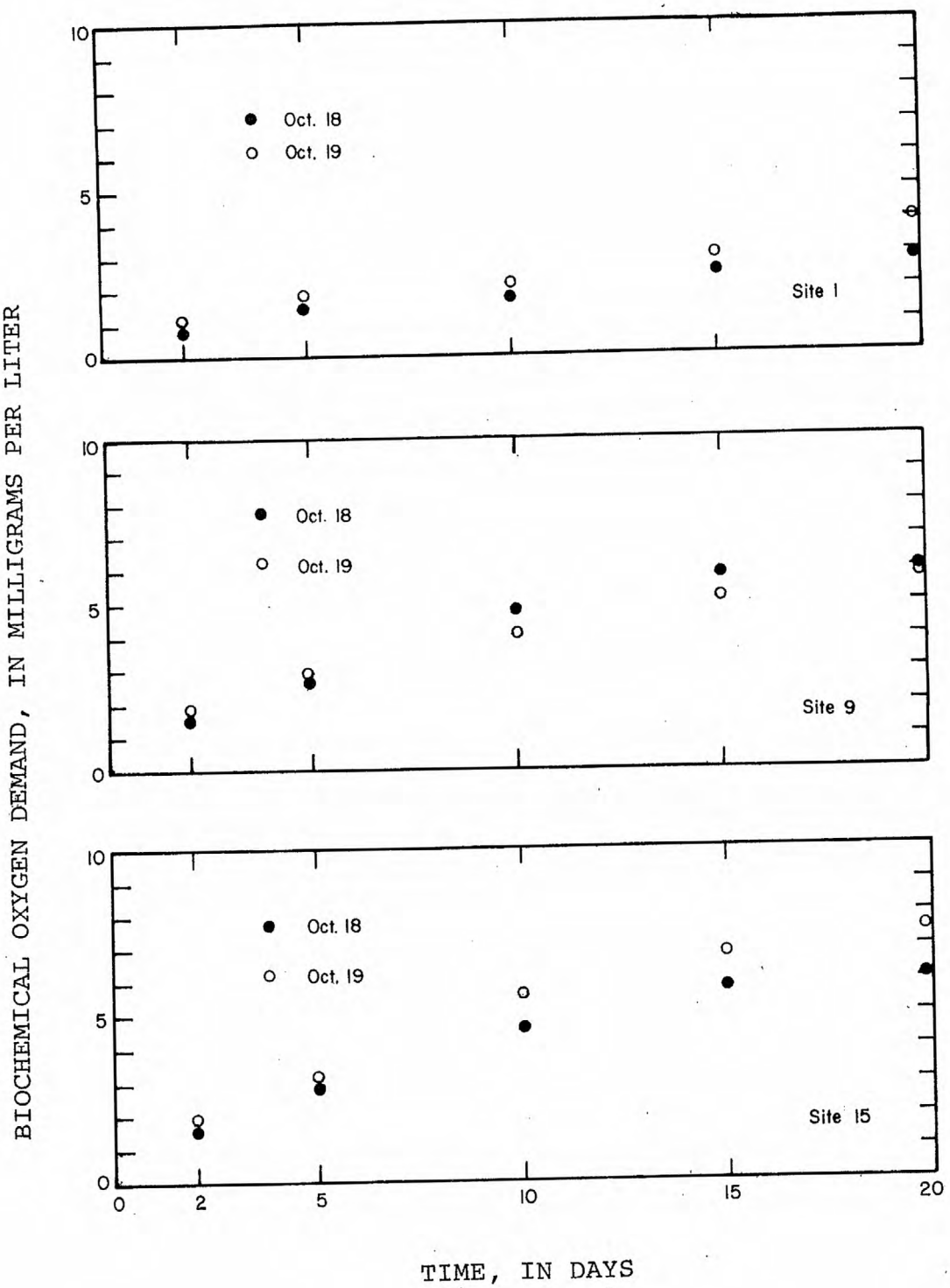

Figure 4.--Analyses of biochemical-oxygen demand for sites 1, 9, and 15 in the Milner reach, Snake River, Idaho, October 18-19, 1977

Table 7. Mean values of water-quality data in the Milner reach, Snake River, Idaho, October 18-21, 1977

Site number	Cross-section location from left edge of water	Water temperature (°C)		Specific conductance (µmhos at 25°C)		Dissolved oxygen (mg/L)		pH (units)		Depth of light penetration (m)	
		AM[1]	PM[1]	AM[1]	PM[1]	AM[1]	PM[1]	AM[1]	PM[1]	AM[1]	PM[1]
1	1/4	9.5	11.0	540	550	9.4	10.5	8.4	8.5	1.3	1.2
	1/2	9.5	11.0	540	550	9.4	10.5	8.4	8.5	1.3	1.2
	3/4	9.5	11.0	540	550	9.4	10.5	8.4	8.5	[2].9	[2].9
2	1/4	9.5	13.0	490	515	9.7	13.3	8.6	8.7	[2].4	[2].4
	1/2	9.5	12.5	510	550	9.7	13.3	8.3	8.6	[2]1.0	[2]1.0
	3/4	9.5	13.0	515	525	9.6	13.5	8.3	8.6	[2]1.3	[2]1.4
3	1/4	10.5	11.5	545	550	11.3	11.3	8.6	8.6	.9	1.0
	1/2	10.5	11.5	530	555	11.3	11.3	8.6	8.7	[2]3.0	[2]3.0
	3/4	10.5	11.5	530	535	10.9	11.2	8.6	8.7	.9	1.0
4	1/4	10.5	12.0	520	565	11.4	11.4	8.4	8.6	.8	.8
	1/2	10.5	11.0	520	540	11.5	11.6	8.5	8.7	.8	.8
	3/4	10.5	11.0	525	545	11.5	11.7	8.5	8.7	[2]--	[2]--
7	1/4	11.5	13.0	580	600	10.0	10.4	8.5	8.5	.7	.8
	1/2	11.5	13.0	580	615	10.0	10.2	8.5	8.4	.7	.9
	3/4	11.5	13.0	600	640	9.8	10.0	8.5	8.4	.8	.8
9	1/4	11.5	12.5	585	620	10.0	10.0	8.4	8.5	.7	.6
	1/2	11.5	12.5	585	610	10.2	9.9	8.4	8.4	.7	.7
	3/4	11.5	12.5	590	630	10.1	9.9	8.3	8.4	.6	.7
13	1/4	12.0	12.0	580	600	9.3	9.7	8.3	8.4	.7	.7
	1/2	12.0	12.0	580	595	9.5	9.7	8.3	8.5	.8	.8
	3/4	12.0	12.0	580	590	9.4	9.9	8.3	8.4	.8	.7
15	1/4	11.5	12.0	595	605	9.2	10.0	8.5	8.6	1.2	1.2
	1/2	11.5	12.0	590	595	9.1	9.7	8.4	8.4	1.2	1.2
	3/4	11.5	12.0	585	595	9.3	9.6	8.4	8.5	1.0	1.2

[1]Measurements taken between 0800 and 1700 hours
[2]Stream bottom

increases in water temperatures between morning and afternoon were probably due to solar heating. Morning and afternoon water temperature at site 2 varied the most--9.5° to 13.0°C. Water temperature varied least at sites 13 and 15, which are the deepest sites. Between sites 1 and 15, water temperature increased an average of 2°C in the morning and 1°C in the afternoon (fig. 5).

Specific conductance at all sites generally increased from morning to afternoon (table 7). Specific conductance increased by about 10 percent between sites 1 and 15.

Dissolved-oxygen concentration varied most between morning and afternoon at site 2; site 1 showed the second greatest variation. The average AM and PM DO values at site 3 just upstream from the point sources were 2.0 mg/L to 1.5 mg/L, respectively, higher than at site 15 (fig. 5). Water-quality vertical profile data obtained at sites 13 and 15 are shown in table D. Due to shallow water at sites 1, 2, 3, 4, 7, 8, and 9, there were no measurable changes with depth in water temperature, specific conductance, DO, and pH. Some stratification of DO and water temperature was observed at site 13. Water temperature and DO were most stratified at site 15, where DO, below the 7.6-m depth, was below the State's 90-percent saturation standard (Idaho Department of Environmental and Community Services, 1973). The DO decrease with depth was probably due to consumption of organic loads near the stream bottom by bacterial and aquatic organisms.

Bacteria

Bacteria are of primary concern to recreational and public water-supply users because of potential health hazards. The presence of indicator bacteria, such as total coliform, FC (fecal coliform), and FS (fecal streptococci), indicate the potential presence of pathogenic organisms in water. Total coliform bacteria in water originate from many sources. Their presence in high numbers is indicative of contamination. Tests for FC and FS may indicate more specifically the presence of human and animal (livestock and poultry) wastes.

Results of indicator bacteria analyses are shown in table 6. Presence of bacteria in the study reach is primarily due to municipal sewage-treatment and food-processing plants and agricultural sources. The mean total coliform count for the 3-day study period showed a 35-fold increase from sites 1 to 9, below all waste-effluent discharges. FC and FS counts showed increases of 8- and 4.6-fold, respectively, at or below site 4, in the urbanized area of Burley.

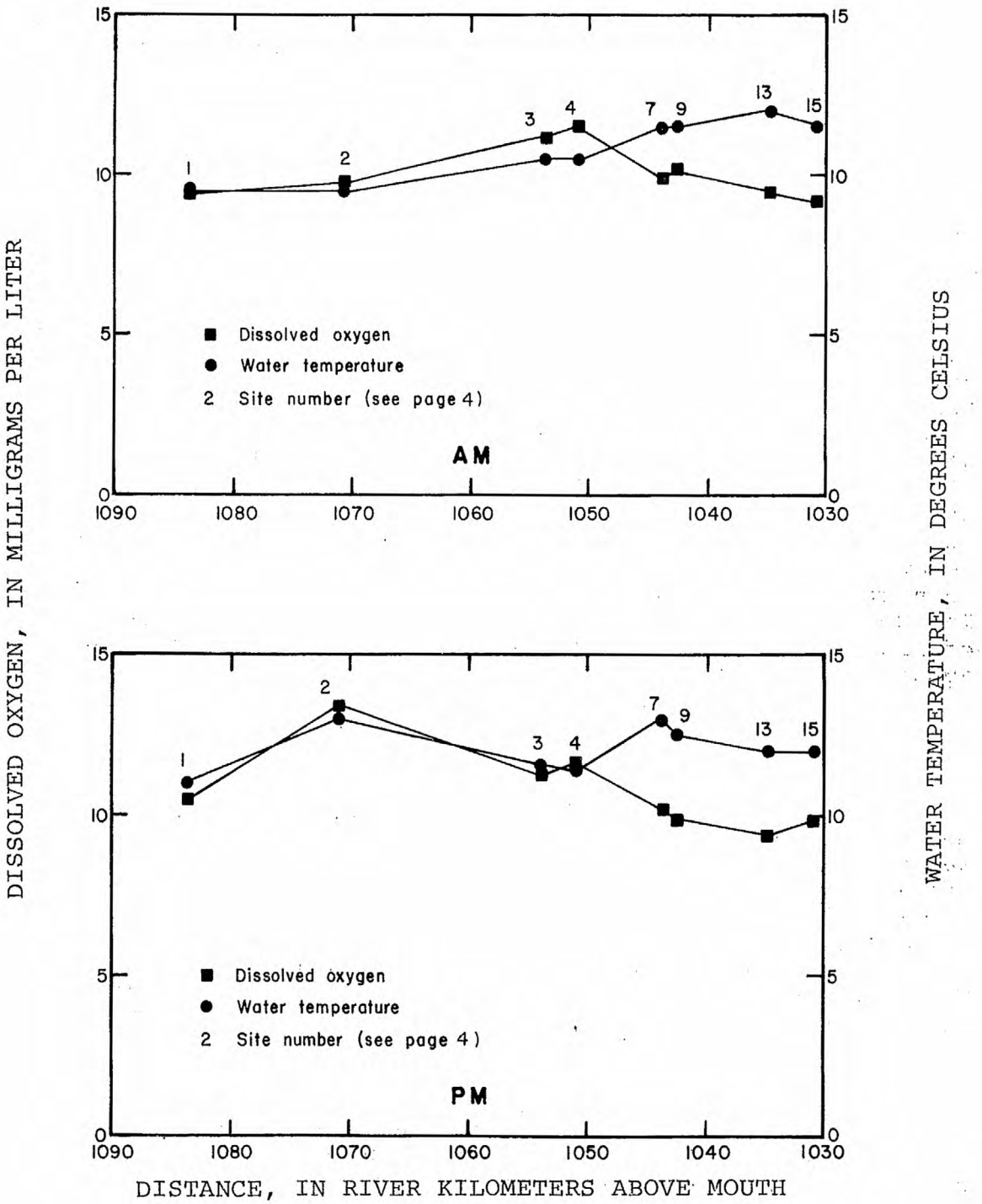

Figure 5.--Variations in dissolved oxygen and water temperature between Minidoka and Milner Dams.

The State's standard for total coliform was exceeded at sites 7, 9, and 13, and the standard for FC was exceeded at sites 3, 7, and 9 (Idaho Department of Environmental and Community Services, 1973).

Twenty-Four-Hour Monitoring Results

Hourly water-quality data (water temperatures, DO concentrations, specific-conductance values, and pH values) from 0900 hours, October 18, to 2000 hours, October 19, for site 16 at Milner Dam, are shown in figure 6. These data were collected within 0.5 m below the water surface.

Water temperatures varied about 1°C. Concentrations of DO showed diel variations on October 18. The lack of variation on October 19 may have been partly due to the high wind speed and resultant wave action near the recording probe, which may have caused constant DO saturation.

Specific-conductance values varied generally between 600 to 640 µmhos. Conductance values were slightly higher at site 16 than at site 15, which may have been related to instrument variation. The pH values at site 16 were about 0.4 pH units lower than at site 15. Data were not collected at site 16 to verify the possibility of deep reservoir water of dissimilar quality mixing with near-surface reservoir water.

Trace Metals, Insecticides, and Herbicides

Results of trace metal, insecticide, and herbicide analyses on water and bottom material samples collected at sites 3 and 15 are shown in table 8. Concentration of trace metals and organic compounds were all low; none exceeded existing criteria (U.S. Environmental Protection Agency, 1976).

SUMMARY

Daily mean discharge entering the reach during the study period (October 18-21) was less than 19.6 m^3/s and followed a declining trend. Diversions from the reach were about 30 m^3/s, except on October 20 and 21, when they were reduced to about 21 m^3/s and 17 m^3/s, respectively. Point-source waste discharge contributed about 290 kg/d ammonia, 550 kg/d nitrate, and 2,800 kg/d BOD. Miscellaneous creeks and drains contributed about 30 kg/d ammonia and 370 kg/d nitrate. The ammonia concentration at site 4 exceeded the recommended total ammonia concentration criteria for freshwater aquatic life.

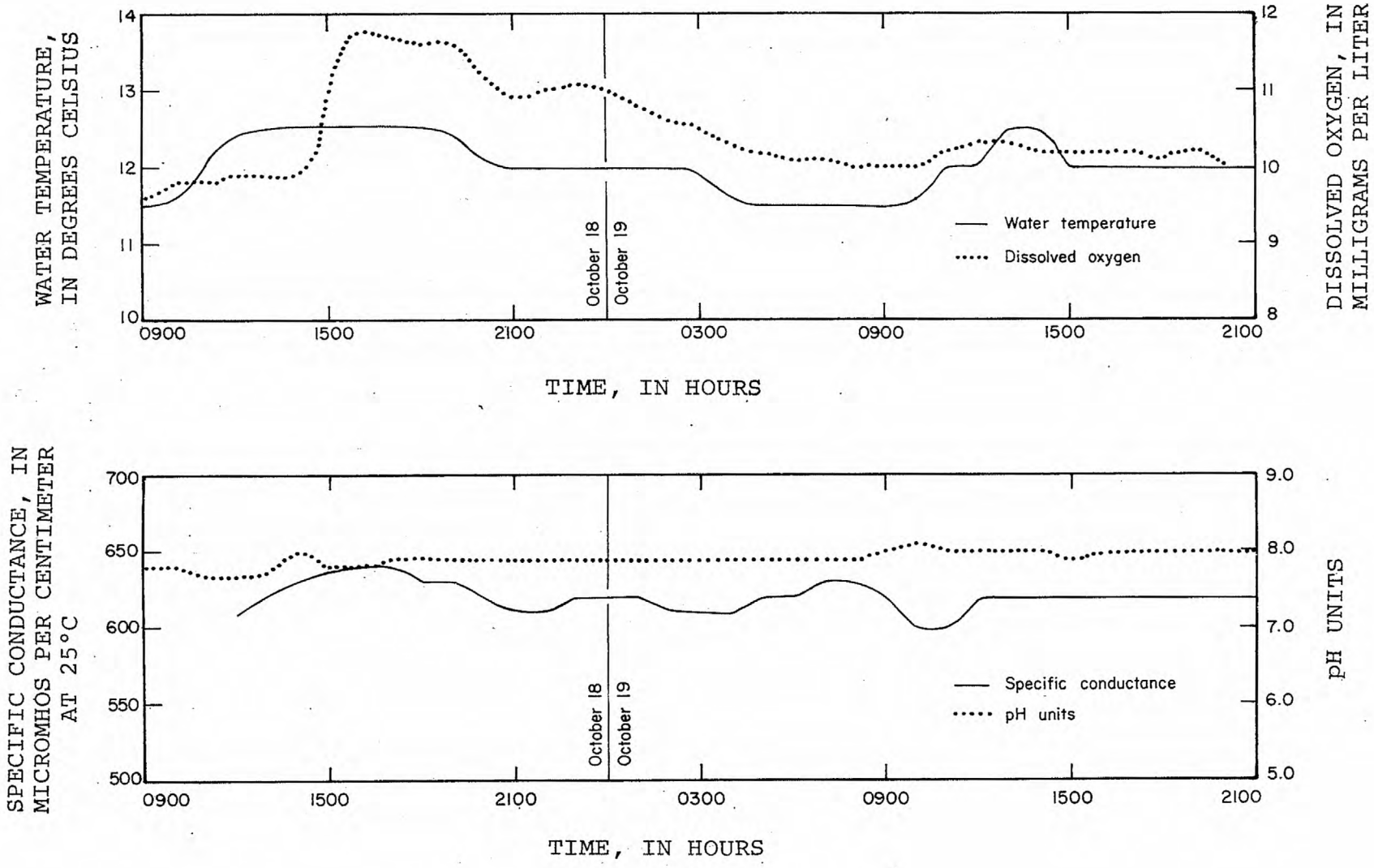

Figure 6.--Hourly water-quality data for site 16 in the Milner reach, Snake River, Idaho, October 18-19, 1977.

Table 8. Results of trace metal, insecticide, and herbicide analyses in the Milner reach, Snake River, October 19 and 20, 1977

Constituents	Site 3 (Oct. 19)	Site 15 (Oct. 20)
Trace metals		
Arsenic (As)	4	4
Arsenic in bottom material	1	2
Antimony (Sb)	0	0
Antimony in bottom material	1	0
Beryllium (Be)	0	0
Beryllium in bottom material	0	0
Cadmium (Cd)	1	0
Cadmium in bottom material	0	0
Chromium (Cr)	0	0
Chromium in bottom material	2	8
Copper (Cu)	8	11
Copper in bottom material	2	9
Lead (Pb)	6	17
Lead in bottom material	4	6
Mercury (Hg)	.0	.1
Mercury in bottom material	.0	.0
Nickel (Ni)	8	10
Nickel in bottom material	3	5
Selenium (Se)	1	1
Selenium in bottom material	0	0
Silver (Ag)	0	2
Silver in bottom material	0	0
Zinc (Zn)	20	30
Zinc in bottom material	8	30
Cyanide (Cn) (mg/L)	.00	.00
Cyanide in bottom material	0	0
Insecticides and herbicides		
Aldrin	.00	.00
Aldrin in bottom material	.0	.0
Chlordane	.0	.0
Chlordane in bottom material	0	0
DDD	.00	.00
DDD in bottom material	.0	.2
DDE	.00	.00
DDE in bottom material	.2	.3
DDT	.00	.00
DDT in bottom material	.0	1.2
Dieldrin	.00	.00
Dieldrin in bottom material	.0	.0
Endrin	.00	.00
Endrin in bottom material	.0	.0
Heptachlor	.00	.00
Heptachlor in bottom material	.0	.0
Heptachlor epoxide	.00	.00
Heptachlor epoxide in bottom material	.0	.0
Lindane	.00	.00
Lindane in bottom material	.0	.0
Toxaphene	0	0
Toxaphene in bottom material	0	0
PCB	.0	.0
PCB in bottom material	0	1
Aroclor (1260 PCB series)	.0	.0
Aroclor (1260 PCB series) in bottom material	0	0
Aroclor (1254 PCB series)	.0	.0
Aroclor (1254 PCB series in bottom material	0	0
Aroclor (1248 PCB series)	.0	.0
Aroclor (1248 PCB series) in bottom material	0	0

Note: Except as indicated, units of concentrations in water are in micrograms per liter. Units of trace metal concentrations in bottom material are in micrograms per gram. Units of insecticide and herbicide concentrations in bottom material are in micrograms per kilogram.

The average AM and PM DO values decreased 2.0 mg/L to 1.5 mg/L, respectively, between sites 3 and 15. Dissolved-oxygen concentration was below the State's 90-percent saturation standard below the 7.6 m depth at site 15. Between sites 1 and 15, water temperatures in the morning and afternoon increased 2.0°C and 1.0°C, respectively. Large concentrations of indicator bacteria were found in the reach, suggesting the presence of pathogenic organisms. State standards for total and fecal coliform were exceeded at three of nine sample locations in the main stem of the Snake River.

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DATA TABLES

Table A. Water-quality data for the major waste-effluent point sources in the Milner reach, Snake River, Idaho, October 18-20, 1977[1]

Date	Flow (m^3/s)	Temperature (°C)	Dissolved oxygen (mg/L)	pH (units)	BOD (mg/L)	Nitrogen nitrate (N) (mg/L)	Nitrogen nitrite (N) (mg/L)	Nitrogen ammonia (N) (mg/L)	Nitrogen Kjeldahl total (N) (mg/L)	Phosphorus total (P) (mg/L)	Phosphorus ortho (P) (mg/L)	Suspended solids (mg/L)	Specific conductance (µmhos)	Total coliform (col/100 ml)	Fecal coliform (col/100 ml)	Fecal strep (col/100 ml)
Food-Processing Plant[2]																
10-18	0.18	14	2.0	7.0	179	<0.01	0.052	14.8	31.8	8.81	5.23	112	1,413	680,000	7,000	20,000
10-19	.18	14	1.6	7.1	115	.01	.051	13.8	22.4	6.88	4.98	86	1,359	440,000	—	61,000
10-20	.18	13	1.3	7.0	85	<.01	.029	10.5	25.7	6.37	4.23	90	1,308	$4.7x10^6$	—	400,000
Food-Processing Plant[3] - Discharge 001																
10-18	.07	15	2.2	7.5	29	58.2	3.94	.433	6.6	16.0	11.6	42	2,163	$2.1x10^6$	—	470,000
10-19	.12	14	7	7.4	22	58.7	4.62	.402	7.0	16.4	13.6	78	2,120	420,000	400,000	<200
10-20	.13	15	2.1	7.5	31	44.6	2.52	5.28	14.5	15.0	14.8	26	2,409	$1.7x10^6$	—	$2.5x10^6$
Food-Processing Plant[3] - Discharge 002																
10-18	.05	20	7.7	8.0	3.3	4.88	.025	.028	.6	.31	.231	31	1,049	—	8,600	12,000
10-19	.05	20	8.3	8.0	<2	5.71	.003	.134	.7	.39	.281	8	1,963	380	<2	26
10-20	.05	21	8.2	8.2	1.0	5.80	.003	.096	2.5	.35	.348	4	2,000	16	—	<2
Food-Processing Plant[3] - Discharge 004																
10-19	.003	14	9.2	7.7	1.6	2.17	.005	.012	<.01	.02	.001	<2	662	8,600	6	340
Rupert Sewage-Treatment Plant																
10-18	.02	13	2.8	7.3	133	.05	.302	11.6	29.6	13.4	8.67	181	1,472	$1.3x10^6$	240,000	340,000
10-19	.04	15	1.7	7.3	121	<.01	.134	10.8	40.2	17.1	10.3	86	1,413	$55x10^6$	—	860,000
10-20	.03	14	2.3	7.3	114	.09	.044	10.5	31.4	13.3	8.12	205	1,558	$130x10^6$	—	$11x10^6$
Burley Sewage-Treatment Plant																
10-18	.04	13	7.7	7.7	56	<.01	.133	7.40	10.7	4.64	4.10	26	1,359	26,000	2,600	60
10-19	.04	12	5.5	7.6	44	.01	.094	6.50	13.3	4.81	4.80	31	1,204	310,000	—	<2
10-20	.04	13	7.2	7.7	28	<.01	.093	5.89	12.9	5.38	3.74	31	1,262	350,000	—	100
Heyburn Sewage-Treatment Plant																
10-18	.01	19	4	7.3	218	.09	.008	21.7	30.0	10.3	6.83	96	1,493	15,000	330	11,000
10-19	.01	18	2.5	7.2	235	.02	.087	16.4	30.8	10.2	2.31	66	1,656	250	—	100
10-20	.01	18	2.0	7.8	198	<.01	.087	20.0	38.1	9.81	6.45	70	1,472	$63x10^6$	—	$1.5x10^6$

[1]Data collected and analyzed by the Idaho Department of Health and Welfare
[2]Plant No. 2 on figure 1
[3]Plant No. 5 on figure 1

Table B. Summary of chlorophyll a, seston, and carbon-uptake analyses in the Milner reach[1]

Site number	Chlorophyll a (mg/m³)	Ash-free weight seston (mg/L)	Autotrophic index	Seston (percent organic matter)	Primary productivity (mg C/m³/hr)
3-south shore[2]	6.9	15.5	2256	94	29
3-north shore	6.5	16.5	2535	95	11.0
4-south shore	6.1	14.7	2319	90	4.7
4-north shore	11.6	15.5	1336	88	8.4
7-mid-channel	9.3	12.0	1286	94	10.3
9-south shore	4.8	11.8	2439	69	9.8
9-north shore	7.8	11.5	1482	94	10.0
12-mid-channel	20.5	9.0	439	94	39.1
15-mid-channel	33.8	9.9	294	90	21.3

[1]Data collected and analyzed by University of Idaho
[2]Samples collected at about one-third of the channel width from shore

Table C. BOD analyses in the Milner reach, Snake River, Idaho, October 18-20, 1977

Site number	Date	Time	BOD_2 (mg/L)	[1]BOD_5 (mg/L)	[1]BOD_{10} (mg/L)	[1]BOD_{15} (mg/L)	[1]BOD_{20} (mg/L)
1	10-18-77	1500	0.8	1.5	1.7	2.6	2.8
	10-19-77	1430	1.1	1.7	2.1	3.0	4.0
3	10-18-77	1415		1.8			
	10-19-77	1430		1.4			
	10-20-77	1415		1.3			
4	10-18-77	1400		3.6			
	10-19-77	1430		3.4			
	10-20-77	1345		3.7			
8	10-18-77	1400		3.6			
	10-19-77	1500		2.7			
	10-20-77	1400		2.7			
9	10-18-77	1400	1.6	2.6	4.8	5.8	6.0
	10-19-77	1515	1.7	2.9	4.2	5.2	5.8
	10-20-77	1400		2.7			
15	10-18-77	1500	1.9	3.1	5.6	6.8	7.5
	10-19-77	1430	1.6	2.9	4.6	5.8	6.1
	10-20-77	1435		2.7			

[1]Concentrations include carbonaceous and nitrogenous demand

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 13--Snake River above PA Lateral near Milner				
10-18	1635	1/4	surface	12.8	8.6	588	8.4
			bottom	12.8	--	595	8.4
		1/2	surface	12.8	--	589	8.4
			bottom	12.8	--	597	8.4
		3/4	surface	12.8	8.8	589	8.4
			bottom	12.8	--	605	8.4
10-19	1005	1/4	surface	11.7	9.4	584	8.3
			bottom	11.7	--	590	8.3
		1/2	surface	11.7	9.5	571	8.3
			bottom	11.7	--	592	8.3
		3/4	surface	11.7	9.3	577	8.3
			bottom	11.7	--	586	8.4
10-19	1615	1/4	0.3	12.6	10.8	553	8.5
			3.0	12.3	10.4	--	--
			6.1	11.6	9.2	593	8.5
		1/2	.3	12.7	11.0	577	8.5
			3.0	11.8	9.6	--	--
			6.1	11.5	9.5	572	8.5

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 13--Snake River above PA Lateral near Milner (Continued)				
		3/4	.3	13.0	10.2	593	8.5
			3.0	12.0	9.6	--	--
			6.1	11.0	9.2	570	8.5
10-20	1620	1/4	0.3	12.4	10.2	602	--
			1.5	12.0	10.2	--	--
			3.0	11.7	9.9	--	--
			4.6	11.5	9.3	--	--
			bottom	11.4	8.9	601	8.3
		1/2	.3	12.0	10.2	614	--
			1.5	11.8	10.0	--	--
			3.0	11.7	9.9	--	--
			4.6	11.5	9.4	--	--
			6.1	11.4	8.9	--	--
			bottom	11.4	8.9	609	--
		3/4	.3	12.1	9.9	581	8.4
			1.5	11.9	9.8	--	--
			3.0	11.6	9.5	--	--
			4.6	11.4	9.4	--	--
			bottom	11.4	8.9	580	8.3

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 13--Snake River above PA Lateral near Milner (Continued)				
10-21	1400	1/4	0.3	11.2	9.8	603	8.5
			1.5	11.2	9.7	--	--
			3.0	11.2	9.7	--	--
			4.6	11.1	9.7	--	--
			bottom	11.1	9.7	613	8.5
		1/2	.3	11.1	9.8	590	8.5
			1.5	11.1	9.7	--	
			3.0	11.1	9.6	--	--
			4.6	11.1	9.6	--	--
			6.1	11.1	9.5	-	--
			bottom	11.1	9.3	615	8.5
		3/4	.3	11.0	10.2	606	8.5
			1.5	11.0	10.0	--	--
			3.0	11.0	9.8	--	--
			4.6	11.0	9.7	--	--
			bottom	11.0	9.6	620	8.5

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 15--Snake River above Milner Dam near Milner				
10-18	1000	1/4	surface	11.9	--	587	8.4
			bottom	11.9	--	586	8.4
		1/2	surface	11.8	--	576	8.5
			bottom	11.7	--	584	8.4
		3/4	surface	11.5	--	590	8.5
			bottom	11.5	--	589	8.5
10-18	1500	1/4	surface	12.5	9.4	590	8.4
			bottom	12.5	--	590	8.3
		1/2	surface	12.4	8.7	589	8.3
			bottom	12.4	--	585	8.3
		3/4	surface	12.4	8.5	589	8.4
			bottom	12.4	--	589	8.3
10-19	0835	1/4	surface	11.6	8.6	598	8.3
			bottom	11.6	--	594	8.3
		1/2	surface	11.5	8.5	598	8.3
			bottom	11.5	--	596	8.3

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 15--Snake River above Milner Dam near Milner (Continued)				
10-19	0835	3/4	surface	11.5	8.5	566	8.3
			bottom	11.5	--	569	8.3
10-19	1430	1/4	surface	13.1	10.4	613	8.6
			middle	11.5	8.8	--	--
			bottom	10.8	8.0	596	8.5
		1/2	surface	13.0	10.4	611	8.5
			middle	11.9	9.6	--	--
			bottom	11.0	8.2	619	8.4
		3/4	surface	13.2	10.2	594	8.6
			middle	11.9	10.1	--	--
			bottom	11.7	8.8	635	8.9
10-20	0900	1/4	0.3	11.8	10.6	586	8.5
			1.5	11.8	10.5	--	--
			3.0	11.8	10.5	--	--
			4.6	11.6	9.3	--	--
			6.1	11.6	8.8	--	--
			7.6	11.4	8.5	--	--
			9.1	11.0	8.1	--	--
			10.7	10.8	6.7	--	--
			bottom	10.8	6.0	591	8.4

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 15--Snake River above Milner Dam near Milner (Continued)				
10-20	0900	1/2	0.3	11.8	9.9	586	8.5
			1.5	11.8	9.8	--	--
			3.0	11.8	9.9	--	--
			4.6	11.6	9.0	--	--
			6.1	11.6	8.6	--	--
			7.6	11.5	8.2	--	--
			9.1	11.1	8.0	--	--
			10.7	10.8	6.6	--	--
			bottom	--	--	590	8.4
		3/4	.3	11.8	9.3	586	8.4
			1.5	11.8	9.2	--	--
			3.0	11.8	9.3	--	--
			4.6	11.8	9.2	--	--
			6.1	11.7	8.9	--	--
			7.6	11.6	8.5	--	--
			bottom	--	--	591	8.4
10-20	1435	1/4	.3	12.4	11.1	586	8.4
			1.5	12.1	10.9	--	--
			3.0	11.9	10.7	--	--
			4.6	11.7	10.0	--	--
			6.1	11.5	8.9	--	--
			7.6	11.2	8.1	--	--
			9.1	11.0	7.8	--	--
			bottom	10.7	6.2	584	8.3

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
			Site 15--Snake River above Milner Dam near Milner (Continued)				
10-20	1435	1/2	0.3	12.3	11.0	579	8.4
			1.5	12.0	10.9	--	--
			3.0	11.8	10.5	--	--
			4.6	11.7	9.8	--	--
			6.1	11.5	8.6	--	--
			7.6	11.3	8.2	--	--
			9.1	11.0	7.3	--	--
			bottom	10.7	5.9	586	8.3
		3/4	.3	12.2	10.1	604	8.7
			1.5	12.0	10.2	--	--
			3.0	11.8	9.8	--	--
			4.6	11.7	9.4	--	--
			6.1	11.6	9.0	--	--
			7.6	11.5	8.6	--	--
			bottom	11.5	8.3	618	8.5
10-20	0930	1/4	.3	11.6	10.7	610	8.6
			1.5	11.6	10.7	--	--
			3.0	11.5	10.5	--	--
			4.6	11.5	10.5	--	--
			6.1	11.4	8.8	--	--
			7.6	11.2	8.3	--	--
			9.1	11.0	7.7	--	--
			10.7	10.8	5.7	--	--
			bottom	10.8	5.2	604	8.5

Table D. Vertical-profile data for sites 13 and 15 in the Milner reach, Snake River, Idaho, October 18-21, 1977 (Continued)

Date	Time	Cross section (in quarters from left bank)	Depth (m)	Water temperature (°C)	Dissolved oxygen (mg/L)	Specific conductance (µmhos/cm at 25°C)	pH (units)
		Site 15--Snake River above Milner Dam near Milner (Continued)					
10-20	0930	1/2	0.3	11.4	10.5	578	8.6
			1.5	11.4	10.4	--	--
			3.0	11.4	10.4	--	--
			4.6	11.4	10.3	--	--
			6.1	11.4	9.0	--	--
			7.6	11.3	8.2	--	--
			9.1	11.0	7.8	--	--
			10.7	10.8	6.3	--	--
			bottom	10.8	5.6	593	8.6
		3/4	.3	11.4	10.6	595	8.7
			1.5	11.4	10.6	--	--
			3.0	11.4	10.6	--	--
			4.6	11.3	10.5	--	--
			6.1	11.3	9.9	--	--
			7.6	11.2	8.9	--	--
			bottom	11.0	8.0	585	8.9