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DISSOLVED NITROGEN, DISSOLVED OXYGEN, AND RELATED WATER TEMPERATURES IN THE COLUMBIA AND LOWER SNAKE RIVERS, 1965-69

Kirk T. Beiningen, et al

National Marine Fisheries Service
Seattle, Washington

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DISSOLVED NITROGEN, DISSOLVED OXYGEN, AND RELATED WATER TEMPERATURES IN THE COLUMBIA AND LOWER SNAKE RIVERS, 1965-69

By

KIRK T. BEININGEN and WESLEY J. EBEL

Data Report 56

Seattle, Washington
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DISSOLVED NITROGEN, DISSOLVED OXYGEN, AND RELATED WATER TEMPERATURES IN THE COLUMBIA AND LOWER SNAKE RIVERS, 1965-69

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ABSTRACT

Data on the dissolved nitrogen, dissolved oxygen, and water temperatures in the Columbia and lower Snake Rivers from 1965 through 1969 are presented. The data were compiled from field observations and from laboratory analysis of water samples collected at 40 stations.

INTRODUCTION

A study of dissolved nitrogen supersaturation and its effect on salmon (genus Oncorhynchus) and steelhead trout (Salmo gairdneri) in the Columbia and lower Snake Rivers was begun in 1965. Earlier observations by Westgard (1964) and Pauley, Fujihara, and Nakatani (1966)[2/] had indicated the potential danger of this condition to indigenous salmon populations. Primary objectives of this study were (1) to establish causes of supersaturation of dissolved nitrogen, (2) to measure the seasonal changes in concentrations, and (3) to determine the effects of various dissolved nitrogen concentrations on adult and juvenile salmon and steelhead trout. Ebel (1969) established that spillway discharge over dams created extremely high nitrogen supersaturation during the spring and summer from Grand Coulee Dam to the estuary. Beiningen and Ebel (1970) described the near-calamitous effects of high nitrogen concentrations on fish in the Columbia River.

This report presents basic data of dissolved gas concentrations and related temperature observations from 1965 through 1969 in the Columbia and lower Snake Rivers. We also describe

1/ Present Address: Fish Commission of Oregon, Research Headquarters, Route 2, Box 31-A, Clackamas, Oreg. 97015.

2/ G. B. Pauley, M. P. Fujihara, and R. E. Nakatani. 1966. Salmon prespawning mortality studies at Rocky Reach Dam and Priest Rapids Dam, Washington, from Richland, Wash., 28 p. (Processed.)

in part some of the equipment and techniques used to fulfill the requirements of this study. A complete description of equipment currently used for analyzing dissolved gases in water will be given in a forthcoming review of techniques by Rucker3/.

MATERIALS AND METHODS

Field Procedures

Samples were collected from 40 different stations. Table 1 lists the sites in order according to river kilometer (measured upstream from the mouth); Figure 1 shows the geographic location of dams and other sampling sites. The use of aircraft enabled samples to be collected from all areas in one day.

All water samples were obtained with a Van Dorn water sampler and collected in standard 300-m/liter glass-stoppered bottles. Each bottle was flushed by at least a two-fold displacement of sample water with the discharge tube from the sampler extended to the bottom of the bottle. Care was taken to avoid trapping air as the stopper was inserted. Water temperature was recorded at the time the sample was taken with a calibrated 0.1 C-increment thermometer placed in the water sampler before withdrawing the sample. The bottle was immediately placed in an ice chest so that a reduced ambient temperature minimized any loss of dissolved gases. Sample bottle number, temperature, and depth from which the sample was taken were recorded for each station. When required, a duplicate sample was collected from the same cast of the sampler for later use in calibrating our analytical instruments.

Laboratory Procedures

All analyses were performed as quickly as possible (within 24 hr of arrival at laboratory) to lessen deterioration of water quality. When no more than six samples were obtained at one time, analysis was done with a Van Slyke-Neill manometric blood gas analyzer, modified for water determinations (Van Slyke and Neill, 1927).

Analysis of a large number of samples for dissolved nitrogen was done by the gas chromatographic technique described by Swinnerton, Linnenbom, and Cheek (1962) but with a modified Fisher blood gas analyzer (Ebel, 1969). Analysis required only 10 min per sample.

While collecting samples for a river survey we obtained duplicate samples from at least six stations representing a range of expected saturation values. The duplicate samples were used for two separate calibrations. Determination of dissolved oxygen content with the Alsterberg modification of the Winkler method provided a reliable check on dissolved oxygen values obtained with the Van Slyke apparatus. The Van Slyke values from three or more duplicate samples were then used to calibrate readings from the chromatographic gas partitioner.

3/ Robert R. Rucker, U.S. Fish and Wildl. Serv., Bur. Sport Fish and Wildl., Western Fish Disease Lab., Seattle, Wash., report in progress.

PRESENTATION OF DATA

Sampling dates are arranged chronologically in Table 2. The river surveys are given first for each year; surveys made at specific locations are arranged by river kilometer (in descending order) within each calendar year. Tables 3 through 6 show data for 1965, Table 7 through 26 for 1966, Tables 27 through 69 for 1967, Tables 70 through 81 for 1968, and Tables 82 through 94 for 1969.

Primary data are the dissolved nitrogen concentrations; dissolved oxygen concentrations, companion values obtained during analysis, are used as calibration factors. Dissolved gas concentrations, expressed in percentage saturation, are normally used in discussing gas bubble disease and are a function of temperature and barometric pressure on the parts per million (ppm) values. In this paper, values were calculated on a basis of 760 mm (sea level) pressure and no corrections were made for changes in barometric pressure from weather or changes in altitude. Tables used to calculate oxygen saturation values were from Elmore and Hayes (1960) and for nitrogen, from Rucker (footnote 2).

Spillway discharge and total river flow past the several dams in the survey areas are shown where applicable to correlate changes in gas concentrations with changes in spill volumes. River flow data were obtained from the U.S. Corp of Army Engineers, Seattle, Wash.

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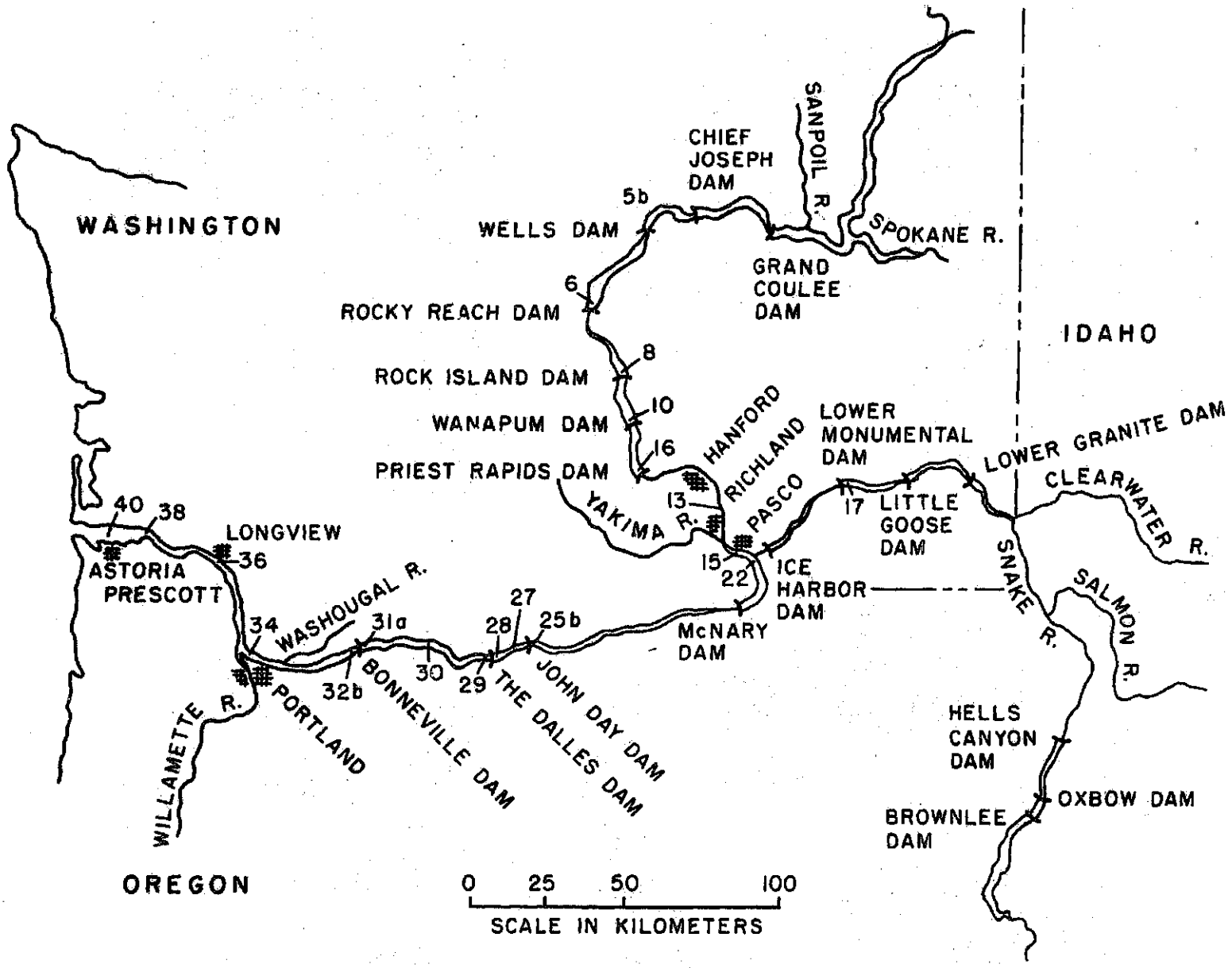

Figure 1. --Hydroelectric dams and other sampling sites on the Columbia and lower Snake Rivers; Table 1 identifies all sampling sites by river kilometers.

Table 1.--Location of sampling sites in the Columbia and Snake Rivers; representative sampling sites are shown by number in figure 1

Station code number	Sampling Site	River kilometer from Columbia River mouth
	(Columbia River)	
1a	Grand Coulee Dam--Forebay (Spillway side)	961.0
1b	Grand Coulee Dam--Forebay (Powerhouse side)	961.0
2a	Grand Coulee Dam--Tailrace (Powerhouse side)	960.0
2b	Grand Coulee Dam--Tailrace (Spillway side)	960.0
3a	Chief Joseph Dam--Forebay (Spillway side)	878.1
3b	Chief Joseph Dam--Forebay (Powerhouse side)	878.1
4a	Chief Joseph Dam--Tailrace (Powerhouse side)	
4b	Chief Joseph Dam--Tailrace (Spillway side)	877.1
5a	Columbia River at Wells Dam site (prior to 4/68)	831.7
5b	Wells Dam--Forebay	831.7
6	Rocky Reach Dam--Forebay	764.5
7	Rocky Reach Dam--Tailrace (Spillway side)	763.4
8	Rock Island Dam--Forebay	730.4
9	Rock Island Dam--Tailrace (Spillway side)	729.5
10	Wanapum Dam--Forebay	668.5
11a	Priest Rapids Dam--Forebay	639.7
11b	Priest Rapids Dam--(in Powerhouse Gatewell)	do
12	Priest Rapids Dam--Tailrace (Spillway side)	638.7
13	Columbia River--below Hanford (at Richland)	544.2
14a	Columbia River--above mouth of Yakima River	540.1
14b	In Yakima River mouth	539.0
15	Columbia River--at Pasco	528.4
16	Columbia River--above mouth of Snake River	524.1
	(Snake River)	
17	Lower Monumental Dam--Forebay	597.8
18	Lower Monumental Dam--Tailrace (Spillway side)	596.8
19a	Ice Harbor Dam--Forebay (Spillway side)	538.2
19b	Ice Harbor Dam--Forebay (Powerhouse side)	
20	Ice Harbor Dam--Tailrace (Spillway side)	537.2
21	In Snake River mouth	522.1
	(Columbia River)	
22	Columbia River--below Snake River mouth	520.7
23a	McNary Dam--Forebay (Spillway side)	470.6
23b	McNary Dam--Forebay (Powerhouse side)	470.6
23c	McNary Dam--Upstream End of North Fish Ladder	do
23d	McNary Dam--Downstream End of North Fish Ladder	do
23e	McNary Dam--Upstream End of South Fish Ladder	do
23f	McNary Dam--Downstream End of South Fish Ladder	do
24a	McNary Dam--Tailrace (Powerhouse side)	469.6
24b	McNary Dam--Tailrace (Spillway side)	469.6
25a	Columbia River at John Day Dam site (prior to 4/20/68 only)	
25b	John Day Dam--Forebay (Center)	347.6
25c	John Day Dam--Forebay (Spillway side)	347.6
25d	John Day Dam--Forebay (Powerhouse side)	347.6
25e	John Day Dam--Upstream End of North Fish Ladder	
25f	John Day Dam--Downstream End of North Fish Ladder	

Table 1.--Con.

Station code number	Sampling Site	River kilometer from Columbia River mouth
25g	John Day Dam--Upstream End of South Fish Ladder	
25h	John Day Dam--Downstream End of South Fish Ladder	
26a	John Day Dam--Tailrace (Powerhouse side)	346.6
26b	John Day Dam--Tailrace (Spillway side)	346.6
27	Columbia River--at Biggs Junction	334.9
28	The Dalles Dam--Forebay	308.8
29	The Dalles Dam--Tailrace (Spillway side)	307.8
30	Columbia River--at Hood River	272.7
31a	Bonneville Dam--Forebay (Spillway side)	235.7
31b	Bonneville Dam--Forebay (Powerhouse side)	235.7
31c	Bonneville Dam--Upstream End of North Fish Ladder	do
31d	Bonneville Dam--Downstream End of North Fish Ladder	do
31e	Bonneville Dam--Upstream End of Bradford Is. Fish Ladder	do
31f	Bonneville Dam--Downstream End of Bradford Is. Fish Ladder (Spillway side)	do
31g	Bonneville Dam--Downstream End of Bradford Is. Fish Ladder (Powerhouse side)	do
32a	Bonneville Dam--Tailrace (Powerhouse side)	234.2
32b	Bonneville Dam--Tailrace (Spillway side)	234.7
33a	Columbia River--at Washougal	195.9
33b	In Washougal River mouth	
33c	In Camas Slough	190.1
34	Columbia River--at Vancouver	171.5
35	Columbia River--at Prescott	115.0
36	Columbia River--at Longview	108.0
37	Columbia River--at Westport Slough (Jones Beach)	73.9
38	Columbia River--at Harrington Point (Estuary)	37.8
39	Columbia River--at Tongue Point	29.3
40	Columbia River--at Astoria Bridge	22.1

Table 2.--Chronological order of sampling dates

Year	River survey	Site surveys						
		Priest Rapids Dam	Snake River mouth	McNary Dam	John Day Dam	The Dalles Dam	Bonneville Dam	Other
1965	6/10						6/15	
	11/15							
	12/16							
1966	2/9						2/27-3/2	Grand Coulee Res. 5/4
	3/7						3/10-3/11	Grand Coulee Dam 4/27
	4/6							Chief Joseph Res. 5/2
	4/18							Chief Joseph Dam 4/28
								Snake River 5/23
	5/9							Ice Harbor Dam 5/16-5/1
	6/6							McNary Reservoir 6/8
	7/11							
	8/1							
	9/6							
	10/2							
	11/7							
1967							3/15	
	4/3	6/19	7/26	6/21			3/22	
	5/1	6/22	8/9	6/29			3/23	
	5/15	6/30	8/15	7/7			3/29	
	6/6	7/7	8/30	7/12			4/5	
	6/27	7/12		7/19			4/12	
	7/5	8/8		7/28			4/19	
	7/19			8/4			4/26	
	8/2			8/11			5/3	
	8/23							
	9/5			8/17			5/10	
	10/3			8/22			5/17	
				9/1			5/25	
				9/7			6/1	
				9/13			6/8	
1968	5/7		7/16	6/19	4/23	5/24	9/24	
	6/4		7/23	6/25		7/9		
	7/1		7/30	7/9	7/19	7/15		
	8/8		8/21	7/15	7/23	7/30		
				7/23				
					8/1			
				7/30	8/8			
				9/2	9/4	9/11		
					9/11	9/18		
					9/18	9/24		
					9/24			
1969	4/2			6/24				Middle Snake River 3/
	4/8			6/26				Washougal R. mouth
								6/5 and 17
	4/16							Estuary 5/20
	5/7							
	5/21							
	6/5							
	6/17							
	7/1							
	7/15							
	8/5							

Table 3.--Limnological data--Columbia River, June 10, 1965

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	12.5			-	101.9	-	98
3a	0	12.2			-	106.7	-	113
6	0	13.1			-	120.5	-	117
11a	0	12.9			-	116.9	-	130
19a	0	14.2			-	100.6	-	117
23a	0	16.6			-	115.1	-	118
28	0	15.1			-	110.8	-	116
31a	0	15.1			-	113.0	-	118

Table 4.--Limnological data--Columbia River, November 5, 1965

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	15.0			10.5	104.7	16.5	97
2b	0	14.3			9.5	93.2	16.6	97
3a	0	14.2			9.6	93.9	17.1	99
4b	0	14.1			9.5	92.8	16.9	98
6	0	13.7			9.7	93.9	17.5	101
7	0	13.7			11.2	108.4	16.9	97
11a	0	14.0			10.5	102.3	17.7	102
12	0	13.7			10.3	99.7	17.2	99
23a	0	15.0			10.5	104.7	17.5	103
28	0	13.9			10.2	99.2	17.7	102
31a	0	13.9			11.2	108.9	18.7	108

Table 5.--Limnological data--Columbia River, December 16, 1965

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	10.5			11.9	106.8	17.8	96
2b	0	9.6			12.0	105.4	18.0	96
3a	0	9.1			10.3	89.4	18.3	96
4b	0	9.3			10.7	93.3	17.4	92
6	0	8.9			11.3	97.6	18.4	96
7	0	8.9			12.5	107.9	18.5	97
11a	0	8.6			11.6	99.4	18.4	96
12	0	8.3			11.4	97.0	18.1	94

Table 6.--Limnological data--Bonneville Dam, June 15, 1965

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
31a	0	14.5			-	100.0	-	107
31b	0	14.5			-	104.5	-	111
32a	0	14.5			-	103.5	-	108
32b	0	14.2			-	105.0	-	111

Table 7.--Limnological data--Columbia River, February 9, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	2.7			12.4	91.2	21.0	96
1a	10	3.0			12.2	90.4	21.3	98
1a	29	4.0			12.2	92.9	21.4	101
1a	55	4.0			11.3	86.1	19.5	92
2b	0	3.2			12.2	90.9	20.9	97
3a	0	4.1			11.5	87.8	21.0	99
4a	0	4.2			11.5	88.1	21.3	101
5a	0	3.9			11.2	85.0	18.7	88
6	0	4.2			11.0	84.2	18.6	88
6	10	4.5			11.8	91.0	20.4	97
7	0	4.2			11.8	90.4	20.1	95
8	0	4.1			-	-	-	-
8	10	4.5			12.0	92.6	20.1	96
9	0	4.2			11.8	90.4	20.0	95
10	0	5.2			12.8	100.6	20.8	101
10	10	5.0			11.4	89.1	19.1	92
11a	0	4.5			12.7	98.0	20.8	99
11a	10	4.5			12.4	95.7	19.5	93
12	0	4.9			11.8	92.0	20.6	99
19a	0	4.0			11.1	84.5	19.5	92
20	0	4.0	0	8.9	12.2	92.9	20.2	95
20	3	4.0			12.2	92.9	20.2	95
23a	0	4.9			11.8	92.0	20.3	98
23a	10	4.9			12.2	95.2	20.3	98
23b	0	4.9			12.1	94.4	20.6	99
23b	3	4.9			12.2	95.2	19.9	96
24b	0	5.4	0	32.2	12.4	97.9	20.3	99
25a	0	5.0			12.5	97.7	20.2	97
28	0	5.0			12.7	99.3	20.3	98
28	10	5.0			12.7	99.3	21.0	101
29	0	4.9	0	33.8	13.2	103.0	20.0	96
31a	0	4.5			12.7	98.0	21.2	101
31a	10	4.6			11.8	91.3	19.5	93
32b	0	4.8	0	34.8	12.4	96.4	20.0	96
36	0	5.2			12.0	94.3	21.5	104
38	0	5.0			12.1	94.6	21.6	104

Table 8.--Limnological data--Columbia River, March 7, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	2.7			12.2	89.7	20.0	92
1a	10	2.7			12.2	89.7	20.3	93
2b	0	2.7			11.8	86.8	21.4	98
3a	0	2.8			12.1	89.2	20.9	96
3a	10	2.8			12.2	90.0	21.8	100
4a	0	2.8			-	-	21.1	97
5a	0	2.8			-	-	-	-
6	0	3.3			12.8	95.7	20.9	97
6	10	3.3			12.4	92.7	-	-
7	0	3.3			-	-	21.3	99
8	0	3.3			11.9	88.9	20.5	95
8	10	3.3			12.3	91.9	20.7	96
9	0	3.2			12.9	96.1	21.9	101
10	0	3.4			12.9	96.6	21.3	99
11a	0	3.7			13.0	98.2	20.1	94
11a	10	3.7			13.5	102.0	20.2	95
12	0	3.8			12.7	96.2	21.4	101
13	0	6.4			-	-	-	-
19a	0	4.2			11.8	90.4	20.2	96
19a	10	4.2			11.8	90.4	20.2	96
20	0	4.2	0	7.0	11.1	85.0	19.4	92
23a	0	4.6			12.2	94.4	20.3	97
23a	10	5.0			-	-	-	-
23b	0	4.9			-	-	-	-
23b	10	4.9			-	-	-	-
24a	0	4.9			12.5	97.5	20.3	98
24b	0	5.0	0	26.4	13.0	101.6	21.1	102
25a	0	5.2			-	-	-	-
28	0	5.6			12.6	100.1	19.1	93
28	10	5.5			12.1	95.9	20.0	98
29	0	5.2	0	27.1	12.4	97.5	20.2	98
31a	0	5.7			12.9	102.7	20.0	98
32b	0	6.0	0	24.3	14.6	117.2	23.2	114
36	0	5.8			12.1	96.6	20.3	100
38	0	5.8			11.8	94.2	-	-
40	0	5.9			11.7	93.7	20.7	102

Table 9.--Limnological data--Columbia River, April 6, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	7.4			12.8	106.5	21.5	109
1a	10	4.8			12.5	97.2	20.9	100
1a	76	4.5			21.1	93.4	22.3	106
2b	0	5.5			12.2	96.7	20.7	101
3a	0	5.7			12.7	101.1	20.1	98
3a	10	5.0			12.5	97.7	20.7	100
4b	0	5.3			13.0	102.4	21.1	102
5a	0	5.8			12.5	99.8	20.4	100
6	0	6.7			12.8	104.6	20.1	101
6	10	6.0			12.8	102.7	19.8	98
7	0	6.0			12.8	102.7	20.3	100
8	0	6.9			12.8	105.1	20.1	101
8	10	6.4			13.2	107.1	21.4	106
9	0	6.3			13.2	106.8	21.4	106
10	0	8.4			13.5	115.2	20.2	105
10	10	6.7			13.1	107.0	20.9	105
11a	0	8.5			13.5	115.4	20.3	106
11a	10	6.8			13.3	108.9	20.8	104
12	0	6.9			13.2	108.4	20.1	101
13	0	9.2			13.1	114.0	20.1	106
19a	0	9.4			11.3	98.8	19.7	104
19a	10	9.3			11.5	100.3	19.4	102
20	0	9.4	9.8	19.3	13.8	120.6	23.0	122
23a	0	13.2			12.0	114.8	19.8	113
23a	10	10.4			11.2	100.4	20.2	109
23b	0	14.2			-	-	20.1	117
23b	10	9.8			11.1	98.0	19.6	105
24a	0	10.5			11.7	105.0	19.6	106
24b	0	10.6	0	42.8	11.8	106.2	20.1	109
25a	0	10.9			11.3	102.4	19.2	105
28	0	10.8			21.1	109.4	18.8	102
28	10	10.7			11.3	102.0	19.5	106
29	0	10.8	0	46.3	11.0	99.5	19.6	107
31a	0	10.1			11.4	101.4	19.2	103
31a	10	10.0			-	-	-	-
32b	0	10.2	10.6	44.8	13.4	119.4	23.2	125
36	0	10.7			10.6	95.7	18.9	103

Table 10.--Limnological data--Columbia River, April 18, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	7.5			12.2	101.8	19.5	99
1a	10	6.8			12.6	103.2	20.0	100
1a	76	5.1			11.7	91.7	20.1	97
2b	0	5.8	0	18.9	11.9	95.0	21.5	105
3a	0	6.8			11.4	93.4	20.9	105
3a	10	6.3			12.3	99.5	19.5	97
4b	0	6.4	0	22.4	12.0	97.3	20.1	100
5a	0	6.5			11.9	96.7	22.0	110
6	0	7.5			12.1	100.9	19.9	101
6	10	7.2			11.8	97.7	20.3	103
7	0	7.3	0	24.3	12.3	102.1	21.9	111
8	0	8.1			13.0	110.1	19.6	101
8	10	7.8			12.7	106.7	20.2	103
9	0	7.3	0	24.7	12.8	106.2	19.6	99
10	0	8.3			12.6	107.2	19.9	103
10	10	7.8			-	-	-	-
11a	0	8.3			12.2	103.8	18.9	98
11a	10	8.4			12.6	107.5	19.9	103
12	0	8.3	17.0	41.7	12.6	107.2	19.9	103
13	0	10.3			12.2	109.0	19.4	105
19a	0	10.3			11.3	101.0	19.0	102
19a	0	10.1			10.9	97.0	18.8	101
23a	0	10.5			11.1	99.6	18.1	98
23a	10	10.5			12.8	114.9	21.2	115
23b	0	10.5			11.9	106.8	18.9	102
23b	10	10.5			11.1	99.6	19.4	105
24a	0	10.4			11.2	100.4	18.8	102
24b	0	10.4	0	33.9	11.1	99.5	18.6	100
25a	0	11.1			11.4	103.8	18.7	102
28	0	11.6			10.8	99.5	17.7	98
28	10	11.5			11.7	107.6	20.2	112
29	0	11.8	0	31.7	11.4	105.6	19.2	107
31a	0	11.5			11.0	101.2	18.7	103
31a	10	11.3			10.8	98.8	18.0	99
32b	0	11.6	2.6	36.1	12.9	118.9	21.1	117
36	0	11.0			10.6	96.4	18.8	103
38	0	11.2			10.5	95.9	19.4	106
38	10	11.2			9.2	84.0	18.8	103

Table 11.--Limnological data--Columbia River, May 9, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	15.3			10.6	106.3	16.5	98
1a	10	11.8			11.0	101.9	18.4	102
2b	0	8.8	27.8	47.2	13.3	114.6	22.7	119
3a	0	9.0			13.2	114.3	22.5	118
3a	10	8.5			13.5	115.4	23.1	120
4b	0	8.7	28.8	47.5	14.2	122.0	23.3	122
5a	0	9.2			13.0	113.1	21.6	114
6	0	9.6			12.7	111.6	21.5	114
6	10	9.3			13.6	118.6	23.0	122
7	0	9.5	0	51.9	13.3	116.6	21.6	115
8	0	9.7			-	-	-	-
8	10	9.5			14.2	124.5	23.6	125
9	0	9.6		57.6	13.6	119.5	21.3	113
10	0	11.4			12.4	113.8	21.5	118
10	10	10.2			12.8	114.1	19.9	107
11a	0	13.6			12.7	122.6	20.8	120
11a	10	10.8			12.9	116.6	20.8	113
12	0	10.9	21.9	56.1	13.3	120.6	20.9	114
13	0	12.3			12.5	117.2	20.3	114
19a	0	13.6			10.5	101.4	19.1	110
19a	10	12.5			10.2	96.0	18.6	105
20	0	12.8	19.3	31.0	12.2	115.6	19.4	110
23a	0	16.4			12.1	124.4	18.6	112
23b	0	14.1			12.0	117.2	22.3	129
24a	0	13.8			11.8	114.5	19.9	115
24b	0	14.0	50.7	92.1	12.6	122.8	21.7	126
25a	0	14.0			11.4	111.1	19.3	112
28	0	14.1			11.1	108.4	18.6	108
28	10	14.1			10.5	102.5	18.6	108
29	0	14.0	43.3	88.2	11.6	113.1	19.1	111
31a	0	13.8			11.4	110.6	19.6	113
32b	0	13.8	50.7	87.3	12.8	124.2	22.9	132
36	0	14.4			10.1	99.3	19.0	111

Table 12.--Limnological data--Columbia River, June 6, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	12.5			10.9	102.6	19.6	110
1a	10	10.7			11.4	102.9	20.2	110
2b	0	10.8	55.1	74.6	12.7	114.8	22.4	122
3a	0	11.7			13.2	122.2	23.0	127
3a	10	10.3			12.7	113.5	22.6	122
4b	0	11.3	60.3	77.8	12.7	116.2	23.0	126
5a	0	11.6			11.5	106.0	21.6	119
6	0	11.9			12.0	111.4	19.8	110
6	10	11.5			-	-	22.4	124
7	0	11.7		78.1	13.0	120.1	22.9	127
8	0	11.9			12.9	119.8	22.5	125
8	10	11.7			12.5	115.5	22.6	125
9	0	11.8		83.5	13.0	120.4	23.8	132
10	0	13.3			12.5	119.8	22.6	129
10	10	11.7			13.1	121.1	23.0	125
11a	0	12.3			12.8	120.0	23.0	129
11a	10	11.7			12.8	118.3	22.6	125
12	0	11.9	46.8	81.3	12.8	118.8	22.1	123
13	0	13.0			12.3	117.1	21.4	122
19a	0	15.1			9.2	91.9	17.0	100
19a	10	13.7			9.8	94.9	18.3	105
20	0	13.7	7.4	18.6	9.5	92.0	17.9	103
23a	0	16.0			11.3	115.1	21.6	129
23a	10	13.2			10.8	103.3	19.6	112
23b	0	14.2			10.7	104.7	19.1	111
23b	10	13.2			11.1	106.2	19.7	112
23a	0	13.6			11.6	112.0	19.5	112
24b	10	13.6	50.1	99.7	12.4	119.7	21.6	124
25a	0	13.5			11.3	108.9	19.6	112
28	0	13.8			11.5	111.5	21.0	121
28	10	13.7			10.2	98.7	20.8	120
29	0	13.8	56.3	100.3	11.4	110.6	21.1	122
31a	0	14.2			10.9	106.7	19.6	114
31a	10	14.2			11.2	109.6	19.9	116
32b	0	14.2	67.8	102.0	12.6	123.3	23.7	138
36	0	14.4			10.9	107.2	20.7	121
36	10	14.2			-	-	21.2	123
38	0	14.2			10.9	106.7	19.9	116
38	0	14.0			10.5	102.3	20.1	116

Table 13.--Limnological data--Columbia River, July 11, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	14.7			11.3	111.9	19.2	113
1a	10	14.1			10.8	105.5	18.2	106
1a	76	12.7			10.4	98.4	19.4	110
2b	0	13.5	49.7	66.2	13.0	125.2	22.3	128
3a	0	13.8			13.0	126.1	23.1	133
3a	10	13.6			12.4	119.7	22.2	128
4b	0	13.7	48.1	71.0	13.0	125.8	22.2	128
5	0	13.8			12.4	120.3	22.0	127
6	0	14.7			11.2	110.9	20.8	122
6	10	14.5			11.9	117.2	21.0	123
7	0	14.5		68.5	12.0	118.2	21.7	127
8	0	14.5			12.0	118.2	21.9	128
8	10	14.4			12.2	120.0	21.6	126
9	0	14.5		73.2	12.8	126.1	22.5	131
10	0	15.3			11.7	117.4	21.4	127
10	10	14.8			11.7	116.1	22.4	132
11a	0	15.4			11.8	118.6	22.1	131
11a	10	15.0			12.4	123.6	21.8	129
12	0	15.3	36.3	70.2	11.7	117.4	20.8	123
14b	0	15.8			11.9	120.7	20.1	120
19a	0	22.8			8.7	102.0	16.3	109
19a	10	20.8			8.1	91.2	16.0	104
20	0	20.6	0	7.2	8.1	90.9	15.1	98
23a	0	18.8			10.7	115.7	17.3	102
23a	10	16.6			10.1	104.2	17.1	104
23b	0	18.6			10.2	109.8	17.6	110
23b	10	16.5			11.1	114.3	18.7	113
24a	0	16.9			11.8	122.5	21.1	129
24b	0	17.0	47.7	79.1	11.4	118.6	20.7	126
25a	0	17.3			10.2	106.9	18.8	115
28	0	17.3			10.3	108.0	17.3	106
28	10	17.3			10.0	104.8	17.8	109
29	0	17.0	42.1	77.7	10.3	107.2	19.1	117
31a	0	17.0			-	-	18.8	115
31a	10	17.0			11.3	117.6	19.6	120
32b	0	17.0	45.9	80.1	11.9	123.8	20.3	124
36	0	17.4			10.4	109.2	20.2	124
36	10	17.4			11.5	120.8	19.7	121
38	0	17.3			10.9	114.3	19.8	121
38	10	17.3			10.0	104.8	19.2	118

Table 14.--Limnological data--Columbia River, August 1, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	17.8			11.1	117.6	17.1	106
1a	10	17.2			10.5	109.8	18.8	115
1a	76	14.8			9.3	92.3	20.0	117
3a	0	16.2			10.7	109.5	20.4	123
3a	10	15.6			10.8	109.1	21.8	130
4b	0	15.8	20.7	41.3	11.6	117.6	21.7	130
5	0	16.2			10.6	108.5	20.8	125
6	0	16.9			10.8	112.1	21.8	133
6	10	16.9			10.4	107.3	19.7	119
7	0	16.7	0	43.6	11.1	114.8	19.8	120
8	0	17.2			12.1	126.6	20.9	128
8	10	16.7			11.1	114.8	21.1	128
9	0	17.0	0	45.3	11.2	116.5	20.0	122
10	0	19.9			10.4	115.0	20.5	131
10	10	17.2			10.5	109.8	19.9	122
11a	0	19.2			10.3	112.3	20.8	132
11a	10	17.2			10.8	113.0	18.7	115
12	0	17.5	3.6	44.2	9.7	102.1	18.2	112
14a	0	18.2			10.8	115.4	18.6	116
19a	0	25.5			7.2	88.9	14.8	103
19a	10	23.3			6.4	75.7	14.9	100
20	0	23.2	0	5.9	7.0	82.7	14.6	98
23a	0	20.8			9.2	103.6	16.7	108
23a	10	19.1			10.1	109.9	16.6	105
23b	0	21.7			10.5	120.4	17.2	113
23b	10	18.7			9.3	100.3	17.6	104
24a	0	19.2			9.3	101.4	17.3	109
24b	0	19.2	11.1	54.1	10.8	117.8	20.2	128
25a	0	19.5			9.8	107.5	17.6	112
28	0	19.2			8.9	97.1	17.3	109
28	10	19.2			8.0	87.2	16.7	106
29	0	19.3	11.5	57.5	10.0	109.3	16.3	103
31a	0	19.2			10.2	111.2	-	-
31a	10	19.2			9.0	98.1	16.6	105
32b	0	19.2	23.6	56.5	11.0	120.0	20.9	132
36	0	20.0			9.2	102.0	19.4	124
38	0	20.0			7.5	83.1	17.8	114
38	10	20.0			8.8	97.6	19.3	124

Table 15.--Limnological data--Columbia River, September 6, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	20.5			7.6	85.1	16.3	105
1a	76	16.3			8.2	84.1	17.0	102
2b	0	16.4	0	19.5	9.0	92.5	18.2	110
3a	0	17.6			8.9	93.9	17.7	109
3a	10	16.7			8.6	88.9	18.1	110
5a	0	16.8			8.0	82.9	17.5	106
6	0	17.9			8.7	92.4	16.5	102
6	10	17.1			8.9	92.9	17.5	107
7	0	17.3	0	22.0	9.1	95.4	17.6	108
8	0	17.5			8.0	84.2	16.4	101
8	10	17.2			8.9	93.1	16.8	103
9	0	17.5		22.3	9.2	96.8	16.4	101
10	0	18.0			9.2	97.9	16.0	99
10	10	17.8			9.4	99.6	17.1	106
11a	0	19.0			9.0	97.7	15.8	100
11a	10	17.6			9.7	102.3	18.2	112
12	0	17.8		23.2	-	-	17.0	105
13	0	21.6			9.7	111.0	15.8	104
19a	0	22.6			8.9	104.0	13.8	92
19a	10	21.1			7.4	83.9	15.9	104
20	0	20.9	0	6.2	6.5	73.4	14.0	91
23a	0	21.5			10.7	122.3	15.4	101
23a	10	20.1			9.8	108.9	15.7	101
23b	0	21.8			11.0	126.4	15.3	101
23b	10	20.4			9.9	110.6	15.9	103
24a	0	20.1			9.1	101.1	16.4	105
24b	0	20.0	0.2	24.6	9.4	104.2	16.4	105
25a	0	20.4			9.4	105.0	-	-
28	0	20.4			-	-	15.7	101
28	10	20.4			9.1	101.7	15.1	97
29	0	20.4	0	26.7	8.9	99.4	15.5	100
31a	0	19.6			9.2	101.1	15.4	98
31a	10	19.6			8.9	97.8	14.6	93
32b	0	19.6	0.7	27.8	9.2	101.1	16.9	108
36	0	19.5			8.3	91.0	15.0	95
38	0	19.8			7.1	78.4	15.0	96
38	10	19.8			7.8	86.1	14.6	93

Table 16.--Limnological data--Columbia River, October 2, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	17.7			8.4	88.8	15.0	93
1a	10	18.1			8.3	88.5	15.2	94
1a	76	16.4			7.9	81.2	15.2	92
2b	0	16.6	0	21.1	8.3	85.7	15.9	96
3a	0	16.5			7.7	79.3	14.2	86
3a	10	16.2			8.2	83.9	14.9	90
4b	0	16.2	0	20.6	8.3	85.0	15.4	93
5a	0	16.1			8.2	83.8	15.5	93
6	0	16.5			8.2	84.4	15.4	93
6	10	16.3			8.4	86.2	14.9	90
7	0	16.5	0	20.1	8.5	87.5	14.3	87
8	0	16.7			8.5	87.9	15.2	92
8	10	16.5			8.5	87.5	14.8	90
9	0	16.6	0	20.5	9.1	93.9	15.3	93
10	0	17.6			8.5	89.7	16.6	102
10	10	17.0			8.5	88.4	15.0	92
11a	0	17.3			9.0	94.3	14.3	88
11a	10	17.0			8.8	91.6	15.2	93
12	0	17.0	0	23.6	8.7	90.5	15.4	94
14a	0	18.8			8.8	95.1	14.3	90
19a	0	20.5			6.8	76.1	13.4	87
19a	10	19.2			7.4	80.7	15.0	95
20	0	19.7	0	5.9	7.0	77.1	14.4	92
23a	0	19.7			9.5	104.6	15.3	98
23a	10	18.6			8.6	92.6	14.3	90
23b	0	19.6			9.0	98.9	15.0	96
23b	10	18.6			-	-	-	-
24a	0	18.6			8.7	93.6	14.5	91
24b	0	18.8	0	24.9	8.8	95.1	14.5	91
25a	0	18.2			8.3	88.7	14.2	88
28	0	18.0			8.4	89.4	14.9	92
29	0	18.2	0	28.6	8.2	87.6	15.4	96
31a	0	18.2			9.5	101.5	15.8	98
31a	10	18.2			8.7	92.9	14.6	91
32b	0	18.2	0.7	29.6	9.1	97.2	15.8	98
36	0	18.0			8.0	85.1	14.8	92
38	0	18.3			7.8	83.5	14.6	91
38	10	18.3			7.7	82.4	14.8	92

Table 17.--Limnological data--Columbia River, November 7, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	14.5			8.5	83.7	16.8	98
1a	10	14.8			8.1	80.4	15.1	89
2b	0	14.6	0	18.4	7.9	78.1	15.4	90
3a	0	14.9			7.9	78.5	15.5	91
3a	10	14.5			8.6	84.7	16.9	99
4b	0	14.6	0	16.5	8.9	87.9	16.8	98
5a	0	14.4			8.5	83.6	16.3	95
6	0	14.4			8.8	86.5	16.5	96
6	10	14.0			8.5	82.8	15.5	90
7	0	14.0	0	17.5	8.3	80.9	15.6	90
8	0	14.0			9.1	88.7	15.4	89
8	10	13.7			8.4	81.3	15.2	87
9	0	13.7	0	17.5	9.2	89.1	15.2	87
10	0	13.8			9.0	87.3	15.4	89
10	10	13.3			9.1	87.2	15.3	87
11a	0	13.5			8.7	83.8	16.3	93
11a	10	13.0			8.5	81.0	15.5	88
12	0	13.2	0	21.5	8.6	82.3	15.6	89
14a	0	15.5			8.8	88.7	15.5	92
19a	0	12.1			8.7	81.2	16.1	90
19a	10	11.9			9.3	86.4	17.6	98
20	0	11.9	0	6.1	9.5	88.2	16.2	90
23a	0	13.4			10.5	101.0	18.8	108
23a	10	12.9			10.1	96.0	17.6	100
23b	0	13.4			10.7	102.9	17.0	97
23b	10	12.9			9.3	88.4	17.6	100
24a	0	12.9			9.7	92.2	17.8	101
24b	0	13.0	0	25.7	9.9	94.3	17.7	101
25a	0	12.3			10.6	99.3	17.9	100
28	0	12.2			10.1	94.4	18.3	102
28	10	12.2			10.1	94.4	17.8	100
29	0	12.3	0	26.2	9.9	92.8	17.9	100
31a	0	12.4			11.0	103.3	17.7	99
31a	10	12.4			10.2	95.8	18.2	102
32b	0	12.5	0	26.6	11.1	104.5	-	-
36	0	11.7			9.7	89.6	18.7	104
38	0	11.7			9.4	86.9	18.4	102
38	10	11.7			9.6	88.7	18.2	101

Table 18.--Limnological data--Grand Coulee (Roosevelt) Reservoir, May 4, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1/ 1g	0	9.1			12.1	105.0	20.2	106
2/ 1f	0	12.2			12.4	115.9	19.5	109
1f	10	8.9			12.4	104.1	19.9	104
3/ 1e	0	10.7			12.6	113.7	19.1	104
1e	10	8.6			12.2	104.5	19.3	101
4/ 1d	0	12.4			12.8	120.2	18.7	105
1d	10	9.2			12.2	106.2	19.9	105
5/ 1c	0	12.4			12.2	114.6	18.4	103
1c	10	8.9			11.9	102.8	19.8	104
1a	0	14.5			9.4	92.6	18.2	106
1a	10	10.3			10.3	92.0	19.3	104
2b	0	7.9			14.0	117.9	22.1	113

1/ 1g - at Northport (River km 1, 181.9).
2/ 1f - Kettle Falls (River km 1, 124.8).
3/ 1e - at Daisy (River km 1, 078.7).
4/ 1d - at Spokane River mouth (River km 1, 035.2).
5/ 1c - at Sanpoil River mouth (River km 991.8).

Table 19.--Limnological data--Grand Coulee Dam, April 27, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
1a	0	8.7			11.8	101.4	19.9	104
1a	10	7.8			12.4	104.2	21.4	110
1b	0	8.3			12.4	105.5	20.1	104
1b	10	7.8			12.5	105.0	20.4	104
2a	0	7.2			12.0	99.3	20.6	104
2b	0	6.7	6.7	24.9	15.6	127.5	25.5	128
1/ 2c	0	7.2			15.1	125.0	25.1	127

1/ 0.5 kilometer downstream.

Table 20.--Limnological data--Chief Joseph Reservoir, May 2, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
1a	0	11.6			12.9	118.9	18.6	103
2b	0	7.8	6.7		14.7	123.5	24.0	123
1/ 2c	0	8.2			14.9	126.5	23.3	120
2c	5	7.6			14.6	122.1	23.2	118
2/ 2d	0	7.9			14.7	123.8	24.0	123
2d	10	7.8			14.8	124.4	22.3	114
3/ 2e	0	8.6			14.8	126.8	21.9	114
2e	10	8.1			-	-	22.2	114
4/ 2f	0	9.1			14.8	128.5	24.2	127
2f	10	8.9			14.6	126.1	23.3	122

1/ 2c-14.5 kilometers downstream (River km 945.5).
2/ 2d-29.0 km downstream (River km 931.0).
3/ 2c-35.4 km downstream (River km 924.6).
4/ 2f-51.5 km downstream (River km 908.5).

Table 21.--Limnological data--Chief Joseph Dam, April 28, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
3a	0	7.7			13.8	115.7	19.5	100
3a	10	7.3			13.1	108.7	22.0	112
3b	0	7.4			14.0	116.5	23.2	118
3b	10	7.3			13.5	112.0	23.4	119
4a	0	7.5			13.8	115.1	22.4	114
4b	0	7.4	1.3		13.6	113.1	23.3	118
1/ 4c	0	7.5			13.2	110.1	22.9	117
2/ 4d	0	7.6			13.5	112.9	22.7	116
3/ 4e	0	7.7			13.6	114.0	22.6	116

1/ 4c 1.6 kilometers downstream.
2/ 4d 4.0 kilometers downstream.
3/ 4e 8.1 kilometers downstream.

Table 22.--Limnological data--Snake River, May 23, 1966

Sampling site	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
Brownlee Dam Forebay	0	17.4		3.5	7.8	81.9	15.4	95
	10	15.4			8.6	86.4	16.0	95
Oxbow Dam	0	16.7		1.8	9.0	93.1	16.6	101
	10	15.2			9.2	92.1	17.8	105
Mouth of Grand Ronde River	0	12.8			9.0	85.3	17.6	100
Lewiston	0	14.0			9.0	87.7	17.1	99
Lower Granite Dam site	0	12.4			10.0	93.9	19.1	107
Little Goose Dam site	0	12.8			10.2	96.7	19.0	108
Lower Monumental Dam site	0	13.5			10.0	96.3	17.8	102
Ice Harbor Dam Forebay	0	13.7			9.8	94.9	17.6	101
	10	13.2			9.3	89.0	18.9	108
Ice Harbor Dam Tailrace	0	13.2	5.1	11.3	11.3	108.1	20.2	115

Table 23.--Limnological data--Ice Harbor Dam, May 16 and 18, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			May 16, 1966					
19a	0	10.9			10.5	95.2	19.6	107
19b	0	10.7			10.4	93.9	19.4	105
20	0	11.1	7.5	18.9	12.3	112.0	21.3	117
1/ 20a	0	11.0	11.3	-	10.7	97.3	18.8	103
			May 18, 1966					
19a	0	11.1			10.8	98.4	19.5	107
19b	0	11.0			10.7	97.3	19.3	106
20	0	11.2	5.1	16.2	12.1	110.5	21.1	116
1/ 20a	0	10.9	11.1	-	10.9	98.8	19.9	109

1/ 20a - Tailrace (Powerhouse side).

Table 24.--Limnological data--McNary Reservoir, June 8, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	13.1			11.8	112.6	21.5	122
16	6	12.9			11.6	110.3	22.0	125
21	0	14.8			10.6	105.2	19.4	114
21	6	14.8			10.2	101.2	21.4	126
1/ 22a	0	13.8			11.9	115.4	20.9	121
22a	10	13.8			11.3	109.6	20.4	118
2/ 22b	0	13.2			11.7	112.0	22.8	130
22b	10	13.0			12.4	118.1	21.8	124
3/ 22c	0	15.9			10.3	104.7	21.0	126
22c	10	13.9			11.1	108.0	20.9	121
4/ 22d	0	14.2			11.5	112.5	22.0	128
22d	10	13.5			11.0	106.0	21.7	124
5/ 22e	0	15.5			-	-	-	-
22e	8	14.0			10.0	97.5	21.3	123
6/ 22f	0	16.8			11.4	118.1	21.0	128
22f	10	13.8			11.1	107.7	21.8	126
7/ 22g	0	14.1			-	-	-	-
22g	10	13.8			10.9	105.7	21.8	126
8/ 22h	0	14.8			12.1	120.0	22.2	130
22h	10	13.8			12.0	116.4	22.5	130
23b	0	14.8			12.1	120.0	21.7	125
23b	10	13.9			-	-	-	-
23a	0	14.8			-	-	-	-
23a	10	13.8			11.4	110.6	21.0	121

1/ 22a - East side (River km 511.6).
2/ 22b - West side (River km 511.6).
3/ 22c - West side (River km 489.1).
4/ 22d - West side (River km 489.1).
5/ 22e - Oregon side (River km 485.1).
6/ 22f - Washington side (River km 485.1).
7/ 22g - Oregon side (River km 477.8).
8/ 22h - Washington side (River km 477.8).

Table 25.--Limnological data--Bonneville Dam, March 10 and 11, 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			March 10					
31a	0		28.2			101.4	-	104.1
32b	0		28.2			129.0		124.4
31b	0		28.2			100.0		93.3
32a	0		28.2			101.4		99.2
31f	0		28.2			124.4		126.4
			Bonneville Dam Survey, March 11					
31a	0		42.4			101.1		98.0
32b	0		42.4			123.1		123.6
31b	0		42.4			100.0		93.0
32a	0		42.4			99.5		94.7
31f	0		42.4			124.4		126.4

Table 26.--Limnological data--The Dalles, February and March 1966

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			February 27					
28	0	6.0	0	-	12.6	101.1	20.2	99.7
29	0	6.2	0	-	12.6	100.8	20.2	99.4
			February 28					
28	0	6.2	9.9	-	12.7	102.4	20.8	103.1
29	0	6.7	9.9	-	12.5	102.6	20.8	101.1
28	0	6.2	0	-	12.6	101.6	20.7	102.4
29	0	6.6	0	-	12.6	102.6	20.2	10[illegible]
			March 1					
28	0	6.6	28.2	-	12.4	101.0	[illegible].3	100.6
29	0	6.5	28.2	-	12.8	104.0	20.6	102.8
28	0	6.2	0	-	12.4	100.0	20.3	100.6
29	0	6.8	0	-	12.6	101.6	20.6	100.1
			March 2					
28	0	5.8	33.6	-	12.6	100.6	20.7	101.6
29	0	6.8	33.6	-	13.0	106.4	20.9	105.0

Table 27.--Limnological data--Columbia River April 3, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
14b	0	10.8			9.1	82.3	18.7	102
19a	0	8.9			11.4	98.4	20.5	107
19a	10	8.1			11.2	94.8	19.8	102
20	0	8.0	0	11.6	10.9	92.1	21.4	110
23a	0	9.1			11.6	100.7	22.3	117
23a	10	7.7			11.8	98.9	21.3	109
23b	0	9.5			12.0	105.2	21.0	111
23b	10	7.6			-	-	20.9	107
24a	0	7.7			11.5	96.4	20.0	102
24b	0	7.8	0	40.5	12.2	102.5	20.5	105
25a	0	8.5			11.9	101.7	20.1	104
28	0	8.8			11.2	96.5	19.7	103
28	10	8.7			11.4	97.9	20.1	105
29	0	8.8	0	41.0	11.8	101.6	21.6	113
31a	0	8.7			12.0	103.1	20.2	105
31a	10	8.1			11.4	96.5	20.2	104
32b	0	8.2	1.8	40.0	13.2	112.1	23.2	120
36	0	8.7			11.0	94.5	20.3	106

Table 28.--Limnological data--Columbia River May 1, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
14a	0	9.8			13.1	115.6	23.3	124
19a	0	10.5			10.9	97.8	18.9	102
20	0	10.7	0.8	13.2	10.6	95.7	18.9	103
23a	0	10.2			13.2	117.6	20.6	111
23a	10	9.4			12.8	111.9	20.2	114
23b	0	9.8			12.8	113.0	20.2	108
23b	10	9.1			12.5	108.5	20.6	108
24a	0	9.4			12.3	107.5	-	-
24b	0	9.6	0	34.7	12.9	113.4	19.9	106
25a	0	9.8			12.3	108.6	19.8	106
28	0	9.8			12.3	108.6	19.3	103
28	10	9.3			12.2	106.4	20.2	107
29	0	9.8	0	35.3	12.0	105.9	19.9	106
31a	0	10.0			11.6	102.9	18.3	98
31a	10	10.0			12.0	106.5	19.2	103
32b	0	10.1	1.5	38.2	11.7	104.1	19.9	107
36	0	10.8			11.3	102.2	19.5	106

Table 29.--Limnological data--Columbia River, May 15, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
14a	0	13.2			12.1	115.8	19.2	109
19a	0	10.9			10.5	95.2	19.4	106
19a	10	10.3			11.2	100.1	20.4	110
20	0	10.5	10.6	23.7	11.3	101.4	20.9	113
23a	0	14.2			13.6	133.1	19.9	116
23a	10	12.4			13.4	125.8	21.1	119
23b	0	13.3			13.6	130.4	20.2	115
23b	10	11.3			-	-	21.0	115
24a	0	11.8			12.4	114.8	20.2	112
24b	0	12.0	5.3	44.1	12.5	116.3	20.8	116
25a	0	13.0			12.3	117.1	19.8	113
28	0	13.3			11.5	110.3	18.5	106
28	10	13.0			11.7	111.4	18.5	105
29	0	13.3	14.5	52.7	11.8	113.1	19.6	112
31a	0	13.0			11.7	111.4	19.1	109
31a	10	13.0			11.5	109.5	19.2	109
32b	0	13.0	17.4	51.1	11.6	110.5	19.6	111
36	0	13.5			10.9	105.0	19.4	111

Table 30.--Limnological data--Columbia River, June 6, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
14a	0	13.2			12.8	122.5	22.4	128
19a	0	12.1			11.2	104.5	19.4	108
19a	10	11.8			11.1	102.8	20.6	114
20	0	12.2	24.5	37.1	12.1	113.1	22.2	124
23a	0	13.7			12.5	121.0	21.5	124
23a	10	13.6			12.2	117.8	22.0	126
23b	0	13.2			12.0	114.8	21.9	125
23b	10	13.0			12.0	114.3	22.2	126
24a	0	13.3			12.5	119.8	22.7	130
24b	0	13.8	86.0	150.9	13.9	134.8	24.8	143
25a	0	14.0			11.7	114.0	21.9	127
29	0	14.1	86.1	144.7	12.7	124.0	22.6	131
31a	0	13.9			11.9	115.8	21.2	122
32b	0	13.9	107.9	148.1	11.8	114.8	20.8	120
36	0	14.5			11.7	115.3	22.8	133

Table 31.--Limnological data--Columbia River, June 27, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	14.2			13.8	135.0	24.1	140
11a	10	14.1			13.7	133.8	24.2	140
12	0	14.6	96.9		12.9	127.5	22.7	133
14a	10	14.3			12.4	121.7	21.8	127
21	3	16.3			10.8	110.8	19.9	120
23a	-	15.2			11.8	118.1	21.2	125
24b	-	15.6	113.1	168.3	12.9	130.3	23.7	141
25a	0	15.6			11.1	112.1	20.7	123
28	2	15.9			11.3	114.8	20.8	125
31a	2	16.0			11.1	113.0	20.7	124
36	10	16.8			11.1	115.0	21.7	132

Table 32.--Limnological data--Columbia River, July 5, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	15.7			13.1	132.6	23.6	141
11a	10	15.7			13.3	134.6	23.8	142
14a	0	16.6			11.2	115.6	20.9	127
19a	0	19.7			9.1	100.2	16.6	106
19a	10	19.3			9.3	101.6	17.1	108
20	0	19.4	0.5	6.6	8.7	95.3	17.4	110
23a	0	17.7			10.7	113.1	19.5	120
23a	10	17.2			11.8	123.4	20.0	122
23b	0	17.4			11.4	119.7	19.5	120
23b	10	17.1			11.1	115.9	20.6	126
24a	0	17.2			10.9	114.0	17.9	110
24b	0	17.2	83.0	129.0	12.2	127.6	22.3	137
25a	0	17.5			11.0	115.8	20.6	127
28	0	17.6			10.9	115.0	18.9	116
29	0	17.7	103.7	137.6	11.1	117.3	20.6	127
31a	0	17.5			10.2	107.4	19.3	119
31a	10	17.5			11.0	115.8	20.2	124
32b	0	17.7	97.4	135.2	12.2	129.0	23.2	143
36	0	18.2			10.4	111.1	20.3	126

Table 33.--Limnological data--Columbia River, July 19, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	16.2			12.6	129.0	21.8	131
11a	10	16.2			12.4	126.9	22.3	134
14a	10	17.0			11.5	119.7	20.2	123
21	0	22.2			10.1	117.0	18.9	125
23a	0	18.7			-	-	19.4	122
23a	10	18.3			11.4	122.1	19.7	123
23b	3	18.9			11.1	120.3	18.8	118
24a	0	18.7			10.7	115.4	-	-
24b	0	18.4	42.0	84.3	12.0	128.8	21.2	132
25a	0	18.2			10.4	111.1	17.1	106
28	10	18.4			10.4	111.6	17.9	112
31a	0	18.5			10.7	115.1	17.3	108
36	10	19.1			10.5	114.3	19.4	123

Table 34.--Limnological data--Columbia River, August 2, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	18.7			12.2	131.6	19.5	122
11a	10	17.7			11.8	124.7	20.0	123
14a	0	19.1			-	-	-	-
16	0	19.1			11.5	125.1	18.5	117
19a	0	24.7			8.4	102.2	15.6	107
19a	10	23.5			7.3	86.7	15.3	103
21	0	23.7			6.9	82.3	16.0	108
23a	0	22.2			-	-	-	-
23a	10	20.4			11.5	128.5	18.0	116
23b	0	21.5			-	-	-	-
23b	10	19.9			10.7	118.4	18.3	117
24a	0	20.0			10.6	117.5	18.1	116
24b	0	20.6	23.7	60.3	11.3	126.8	19.8	128
25a	0	20.5			-	-	-	-
28	0	20.2			-	-	-	-
28	10	20.1			10.4	115.6	17.3	111
29	0	20.3	8.6	51.1	10.0	111.5	17.9	115
31a	0	19.9			-	-	-	-
31a	10	19.9			9.8	108.4	17.4	111
32b	0	20.0	16.4	57.4	11.2	124.2	20.6	132
36	0	20.4			9.3	103.9	18.3	118

Table 35.--Limnological data--Columbia River, August 23, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	20.8			9.8	110.4	14.7	95
16	8	20.6			8.9	99.9	15.2	98
21	0	24.5			5.2	63.0	13.2	90
21	6	23.1			6.3	74.3	13.4	90
23a	0	22.5			9.0	104.9	14.8	98
23a	10	22.8			8.9	104.3	14.8	99
23d	0	22.7			9.3	108.8	16.5	110
23f	0	22.9			8.5	99.8	15.9	106
24b	0	22.6	0	34.1	9.3	108.6	16.7	111
25a	0	22.6			8.4	98.1	14.1	94
31a	0	22.3			7.6	88.2	14.1	94
31a	10	22.3			7.9	91.6	13.9	92
36	0	22.5			8.2	95.6	14.4	96

Table 36.--Limnological data--Columbia River, September 5, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
11a	0	19.6			10.9	119.8	17.1	109
11a	10	18.7			10.9	117.6	17.7	111
14a	0	21.6			10.3	117.8	16.3	107
16	0	21.2			9.2	104.4	-	-
16	10	21.2			-	-	16.5	108
19a	0	23.8			6.9	82.4	14.6	99
19a	10	23.7			7.6	90.7	15.3	104
21	0	23.3			6.2	73.4	15.3	103
23a	0	22.0			9.4	108.4	15.6	103
23a	10	21.0			8.9	100.7	16.5	107
23b	0	22.4			9.2	107.0	15.8	105
23b	10	21.5			9.3	106.3	17.2	113
24a	0	21.4			9.2	104.9	16.6	109
24b	0	21.2	0	24.6	9.4	106.7	17.0	111
25a	0	21.8			9.8	112.6	16.0	105
28	0	21.1			8.7	98.6	16.2	106
28	10	21.2			7.3	82.9	-	-
29	0	21.4	0	26.1	8.8	100.3	16.1	105
31a	0	21.5			7.9	90.3	14.4	94
31a	10	21.5			8.5	97.1	15.6	102
32b	0	21.6	0.7	28.4	8.7	99.5	16.2	106
36	0	22.1			8.0	92.5	16.1	107

Table 37.--Limnological data--Columbia River, October 3, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
14a	0	16.8			9.0	93.3	15.3	93
16	0	16.4			9.4	96.6	16.7	101
16	10	16.4			9.8	100.7	17.3	105
19a	0	20.0			7.9	87.6	15.7	101
21	0	19.5			8.2	89.9	14.7	93
23a	0	20.0			8.9	98.7	15.9	102
23b	0	20.0			8.7	96.5	16.0	103
24b	0	18.4	0	27.3	9.0	96.6	15.9	99
25a	0	17.7			8.8	93.0	15.9	98
28	0	17.6			9.4	99.2	16.0	99
28	10	17.6			9.5	100.2	15.6	96
29	0	17.9	0	32.4	9.0	95.5	16.3	101
36	0	17.6			8.3	87.6	15.4	95

Table 38.--Limnological data--Priest Rapids Dam, June 19, 22, 30, July 7, 12, and August 8, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			June 6					
11a	0	14.2			13.2	129.2	23.3	135
11a	10	13.9			12.4	120.6	22.0	127
11b	0	14.7			12.5	123.8	21.6	127
			June 22					
12	0	13.9	74.9	106.9	12.5	121.6	22.4	129
12	5	13.9			12.6	122.6	22.7	131
12	11	14.2			12.4	121.3	22.9	133
			June 30					
11a	0	15.0			12.6	125.6	22.9	135
11a	10	14.5			12.4	122.2	23.2	135
11b	0	15.3			12.2	122.4	23.0	136
			July 7					
11a	0	16.1			11.9	121.6	21.6	130
11a	10	15.3			12.2	122.4	22.1	131
11b	0	15.8			9.9	100.4	18.5	111
			July 12					
11a	0	16.7			12.8	132.4	22.3	135
11a	10	16.1			12.4	126.7	22.6	136
			August 8					
11a	0	18.9			11.6	125.7	18.4	116
11a	10	17.8			11.7	123.9	18.5	114

Table 39.--Limnological data--Snake River Mouth, July 26, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	18.6			11.8	127.0	18.6	117
16	10	18.1			11.6	123.7	19.1	119
21	0	23.0			7.8	91.8	16.2	109
21	10	22.9			7.5	88.0	15.9	106
1/ 22a	0	22.0			8.5	98.0	16.5	109
22a	10	19.1			11.2	121.9	18.5	117
2/ 22b	0	20.1			10.3	114.4	18.0	116
22b	10	18.3			11.6	124.2	19.1	119
3/ 22c	0	18.2			11.6	123.9	19.1	119
22c	10	18.1			11.6	123.7	19.1	119

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 40.--Limnological data--Snake River Mouth, August 9, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	19.6			11.5	126.4	18.1	115
16	10	18.9			11.1	120.3	18.3	115
21	0	25.0			6.7	81.9	15.3	105
21	10	23.6			6.5	77.4	15.0	101
1/ 22a	0	23.9			7.8	93.4	17.4	118
22a	10	19.7			10.9	120.0	18.0	115
2/ 22b	0	24.0			7.3	87.6	15.5	105
22b	10	19.5			10.7	117.3	18.0	114
3/ 22c	0	19.4			11.2	122.7	18.1	115
22c	10	19.3			11.2	122.4	18.0	114

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 41.--Limnological data--Snake River Mouth, August 15, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	21.0			10.9	123.3	17.7	115
16	10	20.9			10.8	121.9	17.4	113
21	0	24.7			6.9	83.9	15.1	104
21	10	24.5			6.8	82.4	14.9	102
1/ 22a	0	24.1			7.1	85.3	15.7	107
22a	10	21.4			10.7	122.0	17.2	113
2/ 22b	0	23.4			8.3	98.5	15.9	107
22b	10	21.2			10.5	119.2	17.0	111
3/ 22c	0	21.1			10.8	122.4	17.9	117
22c	10	21.1			11.0	124.7	17.6	115

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 42.--Limnological data--Snake River Mouth, August 30, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	20.5			10.6	118.7	17.2	111
16	10	20.2			10.6	118.0	18.7	120
21	0	23.4			5.6	66.4	15.0	101
21	10	23.5			5.7	67.7	14.9	101
1/ 22a	0	23.4			6.8	80.7	15.2	102
22a	8	21.5			8.8	100.6	16.4	108
2/ 22b	0	22.1			8.3	96.0	16.2	107
22b	10	20.4			10.5	117.3	17.6	113
3/ 22c	0	20.6			10.6	119.0	18.6	120
22c	10	20.6			11.0	123.5	18.4	119

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 43.--Limnological data--McNary Dam, June 21, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23a	3	16.0			11.7	119.1	21.0	126
23b	3	15.9			11.5	116.9	20.6	123
23c	0	16.3			11.7	120.0	20.6	124
23d	0	18.0			11.3	120.2	20.4	127
23e	0	16.3			11.6	119.0	20.8	125
23f	0	16.3			9.9	101.5	18.1	109
24a	0	15.8			11.6	117.6	20.4	122
24b	2	17.1	107.5	167.6	12.0	125.3	20.2	123

Table 44.--Limnological data--McNary Dam, June 29, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23a	3	16.5			11.6	119.5	21.2	128
23b	3	16.3			11.4	116.9	21.2	128
23c	0	17.1			11.2	116.9	21.2	130
23d	0	16.9			11.5	119.4	20.4	124
23e	0	16.5			11.2	115.3	21.1	128
23f	0	17.0			9.8	102.0	18.2	111
24a	0	16.3			11.3	115.9	20.8	125
24b	0	16.7	108.6	163.0	12.1	125.1	22.7	138

Table 45.--Limnological data--McNary Dam, July 7, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23c	0	18.9			11.0	119.2	19.9	125
23d	0	18.0			11.0	117.0	19.8	123
23e	0	18.0			10.8	114.9	20.0	124
23f	0	17.9			9.5	100.8	17.7	110
24b	0	18.1	77.4	131.7	11.9	126.9	22.4	139

Table 46.--Limnological data--McNary Dam, July 12, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
23a	3	17.1			11.8	123.2	19.8	121
23b	3	17.0			11.5	119.7	20.0	122
23c	0	17.5			11.7	123.2	20.3	125
23d	0	17.4			11.3	118.7	19.6	120
23e	0	17.2			11.4	119.2	19.9	122
23f	0	17.2			10.7	111.9	19.1	117
24a	0	17.4			11.2	117.6	20.2	124
24b	0	17.6	50.6	101.1	12.1	127.6	21.5	132

Table 47.--Limnological data--McNary Dam, July 19, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
23c	0	18.9			10.9	118.1	19.0	120
23d	0	18.6			10.7	115.2	18.2	114
23e	0	18.8			10.9	117.8	18.4	116
23f	0	18.8			9.6	103.8	17.5	110

Table 48.--Limnological data--McNary Dam, July 28, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
23a	3	19.3			11.0	120.0	18.0	114
23b	3	19.5			10.5	115.1	18.1	115
23c	0	19.7			11.4	125.6	-	-
23d	0	19.5			10.5	115.1	17.3	110
23e	0	19.3			10.5	114.8	-	-
23f	0	19.5			9.4	103.1	17.2	109
24a	0	19.1			10.8	117.5	17.9	113
24b	0	19.3	34.0	70.4	11.5	125.7	20.2	128

Table 49.--Limnological data--McNary Dam, August 4, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23c	0	21.4			11.3	128.8	17.6	115
23d	0	20.9			10.8	121.9	17.4	113
23e	0	21.0			10.5	118.8	17.7	115
23f	0	20.9			9.1	102.7	16.6	108

Table 50.--Limnological data--McNary Dam, August 11, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23a	3	20.8			10.4	117.1	17.2	112
23b	3	21.3			10.2	116.0	17.2	112
23c	0	20.9			10.4	117.4	17.2	112
23d	0	20.8			9.8	110.4	16.7	108
23e	0	21.1			10.1	114.5	16.9	110
23f	0	21.6			9.2	105.3	16.3	107
24a	0	20.5			9.6	107.5	17.0	110
24b	0	21.0	1.0	36.8	10.0	113.1	17.0	111

Table 51.--Limnological data--McNary Dam, August 17, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23a	3	23.2			10.9	128.8	16.7	112
23b	3	22.1			10.2	117.9	17.0	113
23d	0	22.7			9.9	115.8	16.0	107
23f	0	22.3			8.9	103.2	16.1	107
24a	0	22.3			10.0	116.0	15.2	101
24b	0	22.2	0	39.6	9.9	114.7	17.0	113

Table 52.--Limnological data--McNary Dam, August 22, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
23a	3	22.6			9.6	112.1	15.9	106
23b	3	22.9			8.8	103.3	16.0	107
23c	0	22.9			9.7	113.8	16.4	110
23d	0	22.7			9.3	108.8	16.5	110
23e	0	22.7			8.6	100.6	17.0	113
23f	0	22.9			8.5	99.8	15.9	106
24a	0	22.3			8.6	99.8	16.5	109
24b	0	22.6	0	43.2	9.3	108.7	16.7	111

Table 53.--Limnological data--McNary Dam September 1, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
23a	3	22.1			9.8	113.3	16.2	107
23b	3	23.0			9.4	110.6	16.1	108
23c	0	22.5			9.9	115.4	16.3	108
23d	0	22.1			9.0	104.0	15.8	105
23e	0	22.6			9.4	109.8	16.1	107
23f	0	22.5			8.8	102.6	16.2	108
24a	0	21.8			9.1	104.6	16.4	108
24b	0	22.2	0	32.5	9.3	107.8	16.1	107

Table 54.--Limnological data--McNary Dam, September 7, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
23c	0	21.5			9.2	105.1	16.3	107
23d	0	21.2			9.1	103.3	16.0	105
23e	0	21.9			9.2	106.0	15.9	105
23f	0	21.9			9.0	103.7	16.5	109

Table 55.--Limnological data--McNary Dam, September 13, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
23a	3	20.0			8.8	97.6	16.3	104
23b	3	20.2			8.7	96.9	16.3	105
23c	0	20.1			9.0	100.0	16.8	108
23d	0	20.1			8.9	98.9	16.3	105
23e	0	19.8			8.6	94.9	16.1	103
23f	0	20.1			9.4	104.4	17.1	110
24a	0	20.1			8.8	97.8	16.5	106
24b	0	20.0	0	33.7	8.8	97.6	16.5	106

Table 56.--Limnological data--Bonneville Dam, March 15, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31c	0	6.8			12.0	98.3	20.0	100
31c	2	7.2			12.0	99.3	19.3	98
32b	0	7.2	2.5	39.1	13.2	109.3	22.4	113

Table 57.--Limnological data--Bonneville Dam, March 22, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31a	0	8.1			12.2	103.3	20.0	103
31b	0	8.1			12.1	102.5	19.9	103
31e	0	8.1			12.2	103.3	19.9	103
32a	0	8.3			11.5	97.9	19.9	103
32b	0	7.8	0	39.6	12.7	106.7	23.0	118

Table 58.--Limnological data--Bonneville Dam, March 23, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31d	0	7.2			12.1	100.2	20.4	103
31f	0	7.5			12.1	100.9	21.5	109
31g	0	7.5	0.3	42.1	12.2	101.8	20.4	104

Table 59.--Limnological Data--Bonneville Dam, March 29, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	0	7.8			11.7	98.3	20.2	103
31c	0	7.8			11.8	99.2	19.8	101
31c	2	7.8			11.8	99.2	19.9	102
31e	0	7.5			11.6	96.7	21.2	108
31f	0	7.8			12.0	100.8	20.6	105
31g	0	7.8			12.1	101.7	20.2	103
32a	0	7.8			11.7	98.3	20.4	104
32b	0	7.8	0.7	39.9	12.7	106.7	22.1	113

Table 60.--Limnological data--Bonneville Dam, April 5, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	0	8.9			11.4	98.4	20.0	105
31b	3	8.9			11.6	100.2	19.7	103
31c	2	8.9			11.1	95.9	-	-
31d	0	9.2			11.7	101.8	20.9	110
31e	0	9.0			11.5	99.6	19.1	100
31f	0	9.2			11.8	102.7	20.0	105
31g	0	9.1			11.7	101.6	20.2	106
32a	0	8.9			11.4	98.4	19.8	104
32b	0	8.2	0.7	39.1	13.2	112.1	23.2	120

Table 61.--Limnological data--Bonneville Dam, April 12, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
31b	0	9.8			11.4	100.6	19.1	102
31b	3	9.8			11.5	101.5	20.4	109
31c	0	10.0			11.5	102.0	19.1	102
31c	2	9.9			11.4	100.9	19.3	103
31d	0	9.9			11.5	101.8	19.8	106
31e	0	9.9			11.6	102.6	19.4	104
31f	0	10.0			11.5	102.0	19.8	106
31g	0	9.8			11.6	102.4	20.0	107
32a	0	9.8			11.4	100.6	19.2	102
32b	0	10.0	1.9	38.5	12.4	110.0	21.0	113

Table 62.--Limnological data--Bonneville Dam, April 19, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
31b	0	10.2			11.7	104.3	19.6	105
31b	3	9.9			11.9	105.3	19.3	103
31c	0	10.2			11.8	105.2	19.3	104
31c	2	10.0			11.9	105.6	19.4	104
31d	0	9.9			11.7	103.5	19.9	106
31e	0	10.2			11.8	105.2	19.6	105
31f	0	10.2			11.5	102.5	19.5	105
31g	0	10.2			11.4	101.6	19.5	105
32a	0	10.1			11.9	105.9	19.5	105
32b	0	10.0	7.9	50.1	13.7	121.6	23.8	128

Table 63.--Limnological data--Bonneville Dam, April 26, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
31b	0	10.9			12.7	115.1	19.4	106
31b	3	10.8			12.1	109.4	19.3	105
31c	0	10.7			12.2	110.1	19.1	104
31c	2	10.7			11.9	107.4	19.0	103
31d	0	10.7			11.2	101.1	19.8	108
31e	0	10.8			11.9	107.6	19.4	106
31f	0	10.8			11.9	107.6	19.9	108
31g	0	11.0			11.8	107.3	19.8	108
32a	0	10.8			12.1	109.4	21.1	115
32b	0	10.7	9.3	48.0	12.2	110.1	20.8	113

Table 64.--Limnological data[1]--Bonneville Dam, May 3, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	3	10.6			11.8	106.2	19.5	106
31c	2	10.6			11.8	106.2	19.1	104
31d	0	10.9			11.5	104.3	20.1	110
31e	0	10.8			11.8	106.7	19.6	107
31f	0	10.7			12.1	109.2	21.0	108
31g	0	10.8			11.3	102.2	19.8	108
32a	0	11.4			11.7	107.3	19.4	107

Table 65.--Limnological data[1]--Bonneville Dam, May 10, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	3	12.4			10.8	101.4	-	-
31c	2	12.4			10.0	103.3	18.3	103
31d	0	12.4			10.9	102.3	18.8	106
31e	0	12.4			10.9	102.3	19.2	108
31f	0	12.3			10.9	102.2	18.9	106
31g	0	12.4			10.7	100.5	18.6	104
32a	0	12.3			10.9	102.2	18.5	104
32b	0	12.4	3.5	49.6	11.7	109.9	20.1	113

Table 66.--Limnological data[1]--Bonneville Dam, May 17, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	3	14.3			11.8	115.8	19.4	113
31c	2	14.2			11.9	116.4	19.9	116
31d	0	14.5			11.2	110.3	18.9	110
31e	0	14.4			11.7	115.0	18.7	109
31f	0	14.3			11.3	110.9	19.7	115
31g	0	14.4			10.5	103.2	18.9	110
32a	0	14.2			11.7	114.5	18.9	110
32b	0	14.4	15.2	58.6	12.0	118.0	20.6	120

Table 67.--Limnological data--Bonneville Dam, May 25, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	3	14.3			11.4	111.9	19.9	116
31c	2	14.4			11.4	112.1	20.4	119
31d	0	14.6			11.1	109.7	19.6	115
31e	0	14.3			11.2	109.9	20.0	116
31f	0	14.3			11.1	108.9	19.9	116
31g	0	14.3			11.4	111.9	20.5	119
32a	0	14.2			12.3	120.4	21.5	125
32b	0	14.3	78.2	126.7	11.7	114.8	20.8	121

Table 68. Limnological data--Bonneville Dam, June 1, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	3	13.2			11.9	113.9	21.4	122
31c	2	13.0			11.9	113.3	21.5	122
31d	0	12.9			11.7	111.2	20.9	118
31e	0	13.0			11.9	113.3	21.2	120
31f	0	13.2			11.7	112.0	20.7	118
31g	0	13.1			11.9	113.5	20.9	119
32a	0	13.0			11.9	113.3	21.2	120
32b	0	13.1	83.4	122.7	12.4	118.3	21.8	124

Table 69.--Limnological data--Bonneville Dam, June 8, 1967

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
31b	3	13.9			11.4	110.9	21.1	122
31b	0	14.0			11.1	108.2	20.2	117
31e	0	13.9			11.5	111.9	20.8	120
31f	0	13.9			11.5	111.9	20.5	118
31g	0	13.9			11.5	111.9	20.5	118
32a	0	13.9			11.4	110.9	20.8	120
32b	0	13.9	119.8	163.6	12.5	121.6	23.2	134

Table 70.--Limnological data--Columbia River, May 7, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	10.1			11.9	105.9	19.3	104
11a	10	9.8			11.3	99.7	19.0	101
12	0	9.9	0		11.5	101.8	19.7	105
14a	0	11.1			11.2	102.0	18.5	101
19a	10	12.0			10.5	97.7	18.3	102
20	0	12.2	0	10.7	9.9	92.5	17.7	99
23a	0	12.7			10.4	98.4	18.3	103
23a	10	12.0			10.0	93.0	18.0	100
23b	0	12.5			10.8	101.7	18.3	103
23b	10	12.0			10.7	99.5	18.4	103
24a	0	12.0			11.0	102.3	19.1	106
24b	0	12.2	0	38.1	11.0	102.8	18.6	104
25a	0	12.4			11.0	103.3	18.4	103
25b	10	11.4			11.3	103.7	19.8	109
26b	0	11.6	44.0	44.0	13.5	124.4	24.0	133
28	0	11.5			12.6	115.9	23.1	128
28	10	11.5			12.8	117.8	22.5	124
31a	0	11.3			10.6	97.0	20.1	111
31a	10	11.3			11.0	100.6	20.7	114
36	0	11.3			11.3	103.4	20.9	115
38	0	12.5			10.7	100.8	19.9	112

Table 71.--Limnological data--Columbia River, June 4, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	13.4			12.3	118.3	21.8	125
11a	10	13.0			12.8	121.9	22.0	125
12	0	13.4	11.3		12.1	116.3	22.4	128
14a	0	13.8			11.7	113.5	20.9	121
19a	10	13.1			10.1	96.4	18.3	104
20	0	13.4	23.5	35.1	12.2	117.3	22.3	128
23a	0	15.8			11.4	115.6	19.9	119
23a	10	14.5			11.8	116.3	21.3	124
23b	0	16.8			11.1	115.0	20.3	123
23b	10	13.9			-	-	19.9	115
24a	0	14.2			11.5	112.5	21.0	122
24b	0	14.6	48.4	82.3	13.4	132.4	23.2	136
25b	0	15.5			10.8	108.9	20.3	121
25b	10	14.5			11.4	112.3	20.2	118
26b	0	14.7	89.5	89.5	13.4	132.7	23.8	140
28	0	14.6			13.7	135.4	23.2	136
28	10	14.7			12.8	126.7	23.5	138
29	0	14.7	45.1	79.9	11.8	116.8	22.5	132
31a	0	14.8			12.1	120.0	22.1	130
31a	10	14.7			11.8	116.8	21.6	127
32b	0	14.7	53.0	87.4	11.9	117.8	21.1	124
36	0	15.4			10.6	106.5	21.0	125
38	0	15.2			10.6	106.1	20.2	119

Table 72.--Limnological data--Columbia River, July 1, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
11a	0	14.2			12.8	125.2	23.2	135
11a	10	13.8			12.5	121.2	22.8	131
12	0	14.0	34.3		12.8	124.8	22.2	128
14a	0	15.9			12.1	123.0	20.5	123
19a	10	17.0			9.1	94.7	17.0	104
20	0	17.2	3.3	14.3	9.7	101.5	17.6	108
23a	0	15.6			11.6	117.2	19.4	116
23a	10	15.7			11.8	119.4	19.1	114
23b	0	15.6			11.3	114.1	18.3	109
23b	10	15.4			11.6	116.6	18.5	110
24a	0	15.6			11.0	111.3	-	-
24b	0	15.7	57.4	92.8	13.0	131.6	22.2	132
25b	0	17.2			10.1	105.6	17.7	108
25b	10	16.4			10.4	106.9	17.4	105
26b	0	16.8	92.4	93.6	13.4	138.9	23.3	142
28	0	16.6			12.5	129.0	21.9	133
28	10	16.3			13.4	137.4	23.2	140
29	0	16.8	56.3	89.8	12.3	127.5	20.7	126
31a	0	17.5			12.1	127.4	19.8	122
31a	10	16.6			12.3	126.9	20.2	122
32b	0	18.3	66.5	91.5	12.9	138.1	23.0	143
36	0	19.4			11.6	127.1	20.2	128
38	0	20.0			11.5	127.5	19.9	128

Table 73.--Limnological data--Columbia River, August 8, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
11a	0	18.1			11.1	118.3	18.4	114
11a	10	17.9			10.0	106.2	18.8	116
12	0	18.0	0		10.8	114.9	19.1	119
14a	0	18.6			10.3	110.9	18.4	115
16	0	19.0			11.2	121.6	17.1	108
16	10	18.9			10.7	115.9	18.6	117
21	0	23.2			7.0	82.7	-	-
21	4	23.2			7.0	82.7	15.7	106
23a	0	21.2			-	-	15.8	103
23a	10	20.4			10.3	115.1	17.1	110
23b	0	21.1			10.5	119.0	16.6	108
23b	10	19.8			9.4	103.8	17.6	112
24a	0	20.2			9.5	105.8	15.8	102
24b	0	20.4	0	44.2	9.8	109.5	16.7	108
25b	0	21.1			8.4	95.2	15.4	100
25b	10	20.8			9.7	109.2	17.7	115
26b	0	20.8	50.4	54.1	11.3	127.3	20.4	132
28	0	20.7			10.5	118.0	19.9	129
28	10	20.5			10.9	122.1	20.1	130
29	0	20.6	0	53.2	10.4	116.7	20.7	134
31a	0	20.4			10.2	114.0	18.0	116
31a	10	20.2			10.2	113.6	18.1	116
32b	0	20.2	10.5	50.9	10.3	114.7	19.3	122
36	0	20.6			10.0	112.2	17.2	111
38	0	21.3			9.6	109.2	17.1	112

Table 74.--Limnological data--Snake River Mouth, July 16, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	15.9			11.6	117.9	-	-
21	0	22.0			8.6	99.2	-	-
1/ 22a	0	15.9			11.6	117.9	-	-
2/ 22b	0	15.9			11.6	117.9	-	-
3/ 22c	0	17.7			9.7	102.5	-	-

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 75.--Limnological data--Snake River Mouth, July 23, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	16.9			11.3	117.3	-	115
21	0	21.2			7.7	87.4	-	109
21	10	21.3			7.8	88.7	-	109
1/ 22a	0	17.2			11.2	117.2	-	115
2/ 22b	0	19.4			9.3	101.9	-	112
22b	10	17.1			10.9	113.8	-	114
3/ 22c	0	21.3			8.4	95.6	-	111
22c	10	18.6			10.0	107.6	-	113

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 76.--Limnological data--Snake River Mouth, July 30, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	19.1			10.6	115.3	17.7	112
21	0	22.0			6.9	79.6	15.9	105
21	10	22.1			6.7	77.5	-	-
1/ 22a	0	19.4			10.6	116.1	-	-
22a	10	19.4			10.7	117.2	-	-
2/ 22b	0	20.5			9.2	103.0	-	-
22b	10	19.3			10.6	115.8	-	-
3/ 22c	0	22.7			7.5	87.7	-	-
22c	10	21.3			8.2	93.3	16.4	107

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 77.--Limnological data--Snake River Mouth, August 21, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	18.5			10.8	116.1	-	-
16	10	18.4			10.7	114.8	17.0	106
21	0	20.4			8.7	97.2	-	-
21	10	20.3			9.1	101.4	16.1	104
1/ 22a	0	18.5			10.7	115.1	-	-
22a	10	18.5			10.6	114.0	-	-
2/ 22b	0	20.1			8.2	91.1	-	-
22b	10	18.8			10.4	112.4	-	-
3/ 22c	0	20.7			8.3	93.3	-	-
22c	10	20.0			7.7	85.4	15.4	99

1/ East Bank Columbia River (River km 520.7).
2/ Midstream Columbia River (River km 520.7).
3/ West Bank Columbia River (River km 520.7).

Table 78.--Limnological data--McNary Dam, June 19, 25, July 9, 15, 23, 30, and September 2, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			June 19					
23a	3	15.1			12.2	121.9	20.8	123
23b	3	15.5			11.8	119.0	21.4	127
			June 25					
23a	3	15.8			11.4	115.6	20.8	124
23b	3	15.8			11.2	113.6	20.9	125
			July 9					
23a	3	17.8			11.4	120.8	19.8	123
23b	3	17.5			10.8	113.7	19.5	120
			July 15					
23b	0	17.5			10.8	113.7	17.8	110
			July 23					
23a	3	18.3			11.4	122.1	-	-
23b	3	17.8			10.7	113.3	-	-
			July 30					
23a	3	20.8			10.9	122.7	17.1	111
23b	3	20.9			10.4	117.4	17.6	114
			September 2					
23a	3	19.4			10.9	119.4	17.3	110
23b	3	19.2			10.8	117.8	17.2	109

Table 79.--Limnological data--John Day-The Dalles, April 23, May 24, July 9, 15, 19, 23, 30, and August 1, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			April 23					
25b	0	10.3			12.6	112.6	18.8	101
			May 24					
28	3	15.2			12.5	125.1	21.7	128
			July 9					
28	3	18.6			11.5	123.8	20.5	129
			July 15					
28	0	18.7			11.6	125.1	20.6	129
			July 19					
25d	0	18.2			10.3	110.0	18.1	113
26a	0	18.2			10.5	112.2	19.8	123
			July 23					
25c	0	19.6			10.8	118.7	18.1	115
25f	0	19.0			11.5	124.9	21.5	136
25h	3	19.0			10.0	108.6	18.9	119
26a	3	19.2			10.1	110.1	18.7	118
			July 30					
28	3	20.1			10.7	118.9	18.7	120
			August 1					
25c	1	21.0			10.0	113.1	-	-
25d	1	21.1			10.0	113.4	-	-
25f	1	20.7			9.1	102.2	16.6	108
25h	1	20.9			9.2	103.8	-	-
26a	0	20.1			9.8	108.9	17.8	114
26b	0	20.5	37.3	41.5	11.4	127.7	20.4	132

Table 80.--Limnological data--John Day-The Dalles, August 8, September 4, 11, and 18, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			August 8					
25b	0	21.1			8.4	95.2	15.4	100
25b	10	20.8			9.7	109.2	17.7	115
25f	0	21.2			9.1	103.3	17.1	112
25h	0	21.1			9.2	104.3	15.8	103
26a	0	20.9			8.9	100.5	16.5	107
26b	0	20.8	50.4	54.1	11.3	127.3	20.4	132
			September 4					
25d	3	20.8			10.0	112.6	-	-
25h	0	20.5			9.4	105.3	-	-
26a	3	19.6			8.9	97.8	-	-
			September 11					
25c	3	19.9			9.7	107.3	16.8	107
25f	0	20.0			11.0	122.0	19.0	122
25h	0	20.0			9.7	107.5	16.5	106
26a	3	19.9			9.9	109.5	18.3	117
28	3	19.8			10.9	120.3	18.9	121
			September 18					
25c	3	19.0			8.8	95.5	-	-
25f	0	19.0			9.9	107.5	-	-
26a	3	19.1			9.0	97.9	-	-
28	3	18.8			10.7	115.7	-	-

Table 81.--Limnological data--John Day-The Dalles, September 24, 1968

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
25c	0	18.7			10.2	110.0	15.0	94
25c	10	18.4			10.0	107.3	15.3	96
25d	0	20.0			9.1	100.9	15.0	96
25d	10	17.8			8.9	94.3	16.3	101
25f	0	18.7			10.0	107.9	16.7	105
25h	0	18.3			10.2	109.2	16.9	105
26a	0	17.9			9.1	96.6	15.3	95
26a	10	17.8			9.1	96.4	16.8	104
27	0	18.4			11.0	118.0	18.9	118
28	0	18.7			12.2	131.6	19.6	123
31a	0	19.2			10.3	112.3	17.8	113

Table 82.--Limnological data--Columbia River, April 2, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
16	0	8.9			13.7	118.3	21.8	114
17	10	8.3			11.8	100.4	20.3	105
18	0	8.9	35.9	35.9	14.0	120.9	23.3	122
19a	10	8.3			14.9	126.8	24.9	129
20	0	8.3	23.8	36.5	15.0	127.7	24.5	127
31a	3	7.5			14.7	122.6	23.4	119
32b	0	7.4	62.1	102.0	15.0	124.8	24.8	126

Table 83.--Limnological data--Columbia River, April 8, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
25b	3	9.0			13.1	113.4	-	-
28	3	9.0			14.9	129.0	-	-
30	0	9.0			13.1	113.4	23.2	122
36	0	8.5			12.3	105.1	22.5	117

Table 84.--Limnological data--Columbia River, April 16, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
17	0	10.0			11.1	98.5	20.3	109
17	10	9.4			11.2	97.9	20.1	106
18	0	10.0	33.8	33.8	13.3	118.0	22.4	120
19a	0	10.6			13.6	122.4	24.9	135
19a	10	10.6			13.5	121.5	24.1	131
20	0	10.0	23.2	33.4	13.0	115.4	21.8	117
23b	0	14.4			12.9	126.8	21.8	127
25b	3	10.1			12.7	113.0	22.7	122
27	0	9.3			14.0	122.1	25.2	133
28	3	9.7			14.5	127.8	26.0	138
31a	3	9.6			13.7	120.4	24.0	128
32b	0	9.6	79.2	108.9	13.8	121.3	25.1	133
36	0	9.7			12.6	111.0	23.3	124
38	0	9.2			12.5	108.8	23.2	122

Table 85.--Limnological data--Columbia River, May 7, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
15	0	10.6			11.8	106.2	21.1	114
17	0	12.8			10.8	102.4	19.0	108
17	10	12.2			10.4	97.2	17.8	100
18	0	12.8	28.9	28.9	13.6	128.9	24.3	138
19a	0	12.2			13.6	127.1	24.3	136
19a	10	12.2			13.7	128.0	25.9	145
20	0	11.1	16.1	28.8	13.3	121.1	23.9	131
25b	3	12.5			12.5	117.7	22.9	129
28	3	11.2			14.1	128.8	26.2	144
31a	3	11.3			13.3	121.7	23.3	128
37	0	10.8			12.1	109.4	22.3	121

Table 86.--Limnological data--Columbia River, May 21, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
15	0	14.5			11.5	113.3	19.7	115
17	0	12.2			10.7	100.0	19.5	109
17	10	11.7			10.6	98.0	19.0	105
19a	0	12.8			12.6	119.4	24.6	139
19a	10	12.2			12.9	120.6	24.4	136
20	0	12.8	38.1	50.9	12.4	117.5	22.6	128
28	0	13.1			13.4	127.9	24.2	138
28	10	13.2			13.6	130.1	25.1	143
31a	0	13.5			12.5	120.4	21.5	123
31a	10	13.5			12.6	121.4	22.1	127
32a	0	13.7			12.6	122.0	22.1	127
35	0	13.2			11.5	110.0	21.7	124
37	0	13.8			11.4	110.6	21.7	125
37	10	13.8			11.3	109.6	22.6	130
39	0	13.9			11.3	109.9	22.0	127
39	10	13.9			11.3	109.9	21.7	125
40	0	14.0			11.0	107.2	21.0	122
40	10	13.9			11.2	108.9	21.5	124

Table 87.--Limnological data--Columbia River, June 5, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
15	0	14.8			11.9	118.1	21.4	126
17	0	15.0			9.6	95.7	18.6	110
17	10	15.0			10.2	101.7	19.5	115
18	0	15.1	25.7	31.2	13.0	129.9	23.1	136
19a	0	14.8			12.2	121.1	23.7	139
19a	10	14.6			12.8	126.5	23.0	135
20	0	14.8	17.2	29.7	12.7	126.0	22.0	129
23a	0	15.8			11.8	119.7	20.8	124
23a	10	15.3			11.3	113.3	20.9	124
23b	0	15.2			11.6	116.1	22.0	130
23b	10	15.0			11.9	118.6	21.6	127
24a	0	15.2			11.8	118.1	22.1	131
24b	0	15.3	59.9	100.9	12.6	126.4	23.7	140
25b	0	16.2			11.6	118.7	21.3	128
25b	10	15.6			11.7	118.2	22.1	132
26b	0	15.4	65.6	105.1	13.4	134.7	24.1	143
28	0	15.4			11.6	116.6	23.2	138
28	10	15.4			12.9	129.6	23.3	138
29	0	15.4	66.0	101.3	12.6	126.6	23.3	138
31a	0	15.8			11.3	114.6	20.3	121
31a	10	15.6			11.3	114.1	20.8	124
32b	0	15.7	67.0	105.5	13.0	131.6	23.2	138
36	0	16.5			11.1	114.3	20.4	123
38	0	16.2			10.7	109.5	20.3	122

Table 88.--Limnological data--Columbia River, June 17, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
15	0	15.6			11.6	117.2	20.0	119
17	0	17.9			9.3	98.7	16.7	103
17	10	17.7			8.8	93.0	16.0	99
18	0	17.8	17.2	22.6	11.2	118.6	20.6	127
19a	0	18.0			11.4	121.3	20.8	129
19a	0	17.4			11.4	119.7	20.8	128
20	0	17.6	9.7	22.2	11.0	116.0	21.0	129
23a	0	17.8			11.5	121.8	19.8	123
23a	10	17.1			11.2	116.9	20.3	124
23b	0	17.7			10.9	115.2	19.8	122
23b	10	17.4			11.3	118.7	19.3	119
24a	0	17.0			10.6	110.3	18.9	115
24b	0	16.9	44.7	93.4	13.5	140.2	24.1	147
25b	0	18.4			11.8	126.6	21.2	132
25b	10	17.6			11.7	123.4	20.9	129
26b	0	17.8	64.9	100.0	11.8	125.0	22.6	140
28	0	17.6			12.2	128.7	21.8	134
28	10	17.6			12.6	132.9	22.5	139
29	0	17.6	32.7	91.7	11.5	121.3	21.5	132
31a	0	17.8			12.1	128.2	21.6	134
31b	10	18.0			12.1	128.7	21.4	133
32b	0	18.0	61.4	96.6	12.3	130.9	22.4	139
36	0	19.2			10.4	113.4	19.9	126
38	0	19.5			10.2	111.8	18.9	120

Table 89.--Limnological data--Columbia River, July 1, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
15	0	16.0			11.6	118.1	21.1	127
17	0	17.0			10.4	108.2	16.9	103
17	10	16.0			10.1	102.9	16.8	101
18	0	16.2	11.6	17.3	13.0	133.1	23.1	139
19a	0	17.2			12.2	127.6	19.7	121
19a	10	16.8			11.5	119.2	20.3	123
20	0	17.1	4.9	17.1	11.9	124.2	20.1	123
23a	0	18.1			11.8	125.8	19.2	119
23a	10	17.6			-	-	19.5	120
23b	0	17.5			11.5	121.1	20.1	124
23b	10	17.0			11.5	119.7	20.0	122
24a	0	17.3			11.2	117.4	19.3	118
24b	0	17.4	37.7	89.8	12.7	133.4	22.8	140
25b	0	18.4			10.6	113.7	18.4	115
25b	10	17.6			10.7	112.9	18.7	115
26b	0	17.6	54.5	90.1	12.8	135.0	23.9	147
28	0	17.8			12.5	132.4	21.8	135
28	10	17.5			12.6	132.6	22.2	137
29	0	17.4	39.1	87.4	11.8	123.9	21.0	129
31a	0	17.4			-	-	20.8	128
31a	10	17.8			11.8	125.0	20.9	129
32b	0	17.5	54.1	91.9	12.9	135.8	22.0	135
36	0	18.7			11.5	124.1	19.3	121
38	0	17.6			11.1	117.1	19.1	118

Table 90.--Limnological data--Columbia River, July 15, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen[2] P.p.m.	Oxygen[2] Percent	Nitrogen[2] P.p.m.	Nitrogen[2] Percent
17	0	20.4			9.2	103.4	17.8	115
	10	20.3			8.0	89.2	15.8	102
18	0	20.4	4.5	9.6	10.4	116.2	18.4	119
19	0	20.6			9.4	106.1	16.8	109
	10	20.0			9.5	105.3	18.9	121
20	0	19.9	2.2	9.3	9.4	104.0	17.1	109
15	0	17.6			10.9	115.0	19.1	117
23a	0	19.4			11.3	124.3	18.8	119
	10	18.5			10.7	115.6	18.0	113
23b	0	19.0			10.9	118.9	19.1	121
	10	18.4			10.4	111.6	18.1	113
24a	0	18.5			10.5	113.4	18.4	115
24b	0	18.8	23.7	67.7	12.0	129.7	20.7	130
25a	0	20.0			9.9	110.3	16.1	103
	10	19.4			9.7	106.2	17.5	111
26b	0	18.9	36.8	71.0	12.7	138.1	22.4	141
28	0	18.9			11.7	127.3	20.3	128
	10	18.9			11.4	123.5	20.0	126
29	0	18.9	28.8	68.6	11.1	120.3	19.3	122
31a	0	18.9			11.1	120.3	19.5	123
	10	18.9			10.4	113.2	18.5	116
32a	0	18.9			11.9	129.5	22.7	143
32b	0	18.9	31.6	68.9	10.7	115.9	18.0	113
33a	0	19.2			11.5	125.4	21.0	133
34	0	19.4			11.7	128.1	19.8	126
36	0	19.4			11.3	123.8	18.0	115
38	0	20.0			10.2	113.1	18.4	118

Table 91.--Limnological data--Columbia River, August 5, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen[2] P.p.m.	Oxygen[2] Percent	Nitrogen[2] P.p.m.	Nitrogen[2] Percent
17	0	22.4			7.2	83.7	14.7	98
	10	22.4			7.5	87.2	15.0	100
	38	22.4			7.2	83.7	-	-
18	0	22.4	0.4	6.1	7.7	89.5	15.0	100
19	0	22.6			7.8	91.7	15.6	104
	10	22.5			6.8	79.8	-	-
	33	22.4			6.7	77.9	-	-
20	0	22.5		5.5	7.8	90.9	14.7	98
15	0	18.6			10.3	110.9	17.2	108
23a	0	20.2			9.2	103.0	16.1	104
	10	20.0			9.4	104.2	16.8	108
23b	0	20.2			9.4	104.7	16.3	105
	10	20.1			-	-	-	-
24a	0	20.2			9.4	104.7	17.0	109
24b	0	20.3		30.2	9.6	107.0	16.7	108
25a	0	20.6			8.7	97.6	-	-
	10	20.6			-	-	14.7	95
26b	0	20.6	0.3	38.3	8.6	96.5	16.4	106
28	0	20.2			8.6	95.8	16.0	103
	10	20.2			8.1	90.8	15.5	100
29	0	20.2		41.6	8.7	96.9	16.9	109
31a	0	19.8			8.7	96.8	15.3	98
	10	19.6			8.7	96.2	15.3	97
32a	0	19.5			9.0	98.7	16.0	102
32b	0	19.5	0.7	34.5	9.4	103.1	17.7	113
36	0	20.3			8.5	94.8	16.0	103
38	0	19.8			7.6	83.9	16.1	103

Table 92.--Limnological data--McNary Dam - Split-leaf Spill Test, June 24 and 26, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
			June 24					
15	3	16.1			11.2	114.4	18.9	114
21	3	18.6			10.7	115.2	17.6	110
23a	0	16.7			10.8	111.7	17.8	108
	10	16.7			10.9	112.7	-	-
23b	0	16.7			10.4	107.5	-	-
	10	16.7			10.5	108.6	17.8	108
24a	0	-			-	-	-	-
24b	0	16.7	34.7	79.3	13.2	136.9	21.7	132
	3	16.7			13.0	134.4	-	-
			June 26					
23a	0	17.2			10.5	109.8	17.4	107
	10	16.9			10.3	107.0	17.5	107
23b	0	16.7			10.2	105.5	17.9	109
	10	16.7			9.8	101.3	17.5	106
24a	0	17.2			10.2	106.7	18.6	114
	3	17.2			10.2	106.7	18.9	116
24b	0	17.5	35.5	78.8	12.4	130.5	22.1	136
	3	17.5			12.3	129.5	22.3	137

Table 93.--Limnological data--Middle Snake River, March 29, 1969

Sampling site	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen		Nitrogen	
					P.p.m.	Percent	P.p.m.	Percent
Brownlee Dam Forebay	3	8.0			9.8	82.8	18.5	95
Oxbow Dam Forebay	9	7.6			13.6	113.7	22.4	114
Oxbow Dam Tailrace	0	8.0			13.7	115.8	22.7	117
Hells Canyon Dam Forebay	0	7.4			13.3	110.6	22.8	116
Snake River above Mouth of Grande Ronde River	0	7.7			12.3	103.1	20.5	105

Table 94.--Limnological data--Washougal River Mouth, June 5 and 17, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
				June 5				
33a	0	17.0			12.9	134.2	23.3	142
33b	0	18.8			9.3	100.5	17.4	109
33c	0	16.9			12.9	134.0	23.6	144
				June 17				
33a	0	19.0			11.9	129.2	21.9	138
33b	0	23.5			8.7	103.3	15.8	107
33c	0	19.0			12.0	130.3	21.8	138

Table 95.--Limnological data--Estuary Columbia River, May 20, 1969

Station code number	Depth M.	Temp. °C.	Spill 100 c.m.s.	Total flow 100 c.m.s.	Oxygen P.p.m.	Oxygen Percent	Nitrogen P.p.m.	Nitrogen Percent
35	0	13.2			11.5	110.0	21.7	124
37	0	13.8			11.4	110.6	21.7	125
37	10	13.8			11.3	109.6	22.6	130
39	0	13.9			13.9	109.9	22.0	127
39	10	13.9			11.3	109.9	21.7	125
40	0	14.0			11.0	107.2	21.0	122
40	10	13.9			11.2	108.9	21.5	124