

Middle Snake River Water Quality
for
Kanaka and Boulder Rapids

Submitted to

L.B. Industries

by

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INTRODUCTION

This report covers water quality data collected by the University of Idaho at Kanaka and Boulder Rapids located in the Middle Snake River. The Middle Snake River flows through an incised canyon from Milner Dam to King Hill. The present location and configuration of the river is the result of ancient canyon filling processes and erosion and sedimentation during the Pleistocene Bonneville flood (Malde, 1968). Kanaka and Boulder Rapids of the Middle Snake River are located approximately in the middle of the reach, north and northeast of Buhl, Idaho at river miles 592 and 597. Upstream of the rapids the Snake Plain aquifer partially discharges into the river at Crystal Springs and Nigera Springs. The purpose of the water quality study was to document the water quality of the Middle Snake River at the rapids prior to development of several run-of-the-river hydropower facilities by L.B. Industries.

Water Quality Sampling Stations

The river was sampled at two locations: Kanaka Rapids and Boulder Rapids. These two stations bracketed a water quality monitoring station, (Clear Lakes Bridge) for the Middle Snake River Water Quality Study conducted by the University of Idaho for the Department of Health and Welfare - Division of Environmental Quality (Brockway and Robison, 1992). The Kanaka Rapids station was located immediately downstream of Kanaka Rapids on the south bank at river mile 592.2 (USGS topographic maps). The elevation of the station was estimated to be 2900 ft. The latitude and longitude of the site was estimated to be 42° 39' 51" north and 114° 48' 9" west from USGS topographic maps. The river was sampled immediately downstream of the rapids from the south bank by throwing a bucket out into the main stream. The Boulder Rapids sampling location was immediately downstream of the rapids on the south bank at river mile 597 (USGS topographic maps). The site elevation was estimated to be 2960 from USGS topographic map for the area as well as the latitude and longitude of 42° 40' 2" north and 114° 42' 28" west. The Clear Lakes Bridge sampling station was at river mile 594.6, approximately half the distance between the Kanaka and Boulder Rapids stations.

PROCEDURES

Water Quality Parameters

The water quality parameter package for each station was selected to be the same as that for the DEQ study and consisted of seventeen parameters. The field parameters collected were:

Air Temperature	°C
Water Temperature	°C
Dissolved Oxygen	mg/l
Electrical Conductivity	µmho

pH	
Transparency, Secchi Disk	(feet)
The chemical, biological, and bacterial parameters sampled for were:	
Total Suspended Solids	mg/l
Turbidity	NTU
Nitrogen as Ammonia	NH ₃ -N mg/l
Nitrogen as Nitrate and Nitrite	NO ₂ +NO ₃ -N mg/l
Total Kjeldahl Nitrogen	N mg/l
Total Phosphorus	P mg/l
Ortho Phosphate	PO ₄ -P mg/l
Fecal Coliform Bacteria	colonies/100 ml
Fecal Strep Bacteria	colonies/100 ml
Five day Biochemical Oxygen Demand	mg/l
Chlorophyll-A	µg/l

Sampling Equipment

The water quality data were collected using standard methods and procedures. Field parameters were measured with portable electronic instruments. These instruments were calibrated each morning of sampling according to the manufacturers specifications. If a field observation appeared to be in error, the instrument was re-calibrated in the field using standard solutions and procedures. The electrical conductivity was measured with a Hanna Model 0661-30 DiST 3 ATC. This instrument has a range of 10 - 1990 µmhos with an accuracy of 30 µmhos. The field pH was measured using a Hanna Model 0624-00 pHep - pH dip stick. The instrument has a pH range of 0.0 to 14.0 with a resolution of 0.1 and an accuracy of 0.2. The dissolved oxygen was measured with a Hanna Model HI8543 Dissolved Oxygen wand. The wand has a range of 0.0 to 19.9 mg/l O₂ with a resolution of 0.1 mg/l. The temperatures were measured with electronic thermometers which were within 0.2 °C of a glass standard thermometer in laboratory tests. Samples for laboratory analysis were collected in 1 quart plastic cubiconainers, 15 ml tissue culture tubes (plastic), and 47 mm membrane filters.

Sampling Methods

The following procedures were used in collecting the water quality samples from each station. Upon arrival at each station, all sampling tools (buckets, dipper, churn, ...) were triple rinsed with water from the station downstream of the sampling point. After rinsing the equipment, water was collected by tossing a bucket attached to a rope into the middle of the river and retrieving the bucket through the water. The sample was placed in a 6 gallon churn splitter. A minimum of 3 to a maximum of 5 gallons of sample was obtained by throwing the bucket out repeatedly. The following procedures were performed by the sampling personnel:

- | Event | Description: |
|-------|---|
| 1. | Arrive at station, collect forms, sample containers, and tools. |
| 2. | Observe local weather conditions and environment. |

3. Triple rinse all collection tools in typical water from stream downstream of sampling site.
4. Collect sample volume and place in churn.
5. Quickly churn sample and extract 1 liter for field parameters.
6. Churn sample and extract 250 ml bacteria sample.
7. Churn sample and extract 1 liter TSS and turbidity sample.
8. Churn sample and extract 1 liter Nitrogen series sample.
9. Churn sample, extract, and filter ortho phosphate sample.
10. Churn sample and extract biological oxygen demand sample.
11. Churn sample and extract Chlorophyll-A sample for filtration at center.
12. Record field instrument readings.
13. Record all sample container numbers.
14. Place sample containers on ice in cooler.
15. Collect and store sampling equipment, make log book entries.

Sample Handling and Laboratory Analysis

After collection, the samples were placed on ice in coolers. Upon arrival at the research center, the samples were removed from the coolers, checked in, and transferred to shipping coolers packed with fresh ice. The Chlorophyll-A samples were filtered and the filter paper with volume filtered where placed in a 60 mm petri dish, which was wrapped with aluminum foil. The samples were shipped via courier to the Idaho Department of Health and Welfare Bureau of Laboratories for analysis. The laboratory analysis codes and minimum detection levels are shown in Table 1. The minimum detection level of Chlorophyll-A is dependent on the filtered sample volume.

Analysis	STORET Analysis Code	Minimum Detection Level
Total Suspended Solids	00530	2.0 mg/l
Turbidity	00076	0.1 NTU
Ammonia Nitrogen	00610	0.005 mg-N/l
Nitrate+Nitrite Nitrogen	00630	0.005 mg-N/l
Total Kjeldahl Nitrogen	00625	0.05 mg-N/l
Total Phosphorus	00665	0.05 mg-P/l
Ortho Phosphate	70507	0.005 mg-P/l
BOD ₅	00310	
Chlorophyll-A	32211	0.4 µg/(filtered volume)
Fecal Coliform Bacteria	31616	
Fecal Strep Bacteria	31679	

Data Analysis Procedures

Field data, sample container numbers, and comments recorded on the field data sheets (and log books) were entered into a relational data base the day following sampling. After receipt of the laboratory analysis data, the data was also entered into the relational data

base. In addition to several scans by project personnel for keyboard errors during data entry, the data were examined for outliers using Chauvenet's outlier procedure (Kennedy, 1976). The data points identified were again reviewed with the field sheets and laboratory analysis reports and rejected or retained.

Quality Control and Assurance

For the two stations no water quality sampling quality control and assurance procedures were implemented. The Middle Snake Water Quality Project - Phase 1 project was still in progress at the time. The sampling procedures and methods were the same, and those quality control and assurance program results were transferable to these stations. In the Mid Snake River Water Quality Project four sampling stations served as control stations. Blank, duplicate, spiked samples were taken and analyzed. The quality control and assurance program results are summarized in the following table 2.

Table 2. Mid Snake Water Quality Survey Quality Control and Assurance Sampling Results (Brockway and Robison, 1992)

Parameter	Duplicate Samples Relative Range	Spiked Samples Percent Recovery
Total Suspended Solids	17.7	97.1
Turbidity	12.5	-NA-
Ammonia Nitrogen	25.9	97.1
Nitrate+Nitrite Nitrogen	4.7	94.0
Total Kjeldahl Nitrogen	18.0	92.2
Ortho Phosphate	10.6	98.3
Total Phosphorus	15.4	95.0
Biochemical Oxygen Demand	21.9	-NA-
Chlorophyll - A	39.4	-NA-

RESULTS

Kanaka Rapids

The water quality data for Kanaka Rapids is shown in Table 3 for the thirteen observations from June 4, 1991 to January 15, 1992. Water temperature ranged from 7.5°C to 20.1°C for the six month period. Dissolved oxygen during midmorning to late afternoon ranged from 8.1 to 12.4 mg/l for the six month period. Average nitrogen levels were 0.128, 0.39, and 1.71 mg/l-N for Ammonia, Total Kjeldahl, and Nitrate+Nitrite, respectively. Ortho-phosphate and Total Phosphorus levels averaged 0.114 and 0.14 mg/l-P respectively. Chlorophyll-A measured at the station range from 1.3 to 41.8 µg/l.

Boulder Rapids

The water quality data for Boulder Rapids is shown in Table 4 for thirteen observations from June 1991 to December 1991. Similar ranges for the various parameters were seen

at this site as were for the Kanaka Rapids site. Daytime dissolved oxygen ranged from 7.3 to 11.8 mg/l with water temperatures ranging from 8.4°C to 19.9°C. Nitrogen levels ranged from 0.075 mg/l-N of Ammonia to 2.84 mg/l-N of Nitrate+Nitrite nitrogen. Similar phosphorus levels were also observed.

Clear Lakes Bridge

During the sampling period for Kanaka Rapids and Boulder Rapids, the Clear Lakes Bridge station was also sampled under the Middle Snake River Water Quality Study. Table 5 contains the water quality data collected at Clear Lakes Bridge for the period June 4, 1991 through July 16, 1991 when both sampling programs overlapped. Again similar water quality was observed for all stations.

Table 3. Measured Water Quality for Kanaka Rapids Monitoring Station (IS55S).

Date	Temperature		Secchi Disk		Electrical Conductivity umho/cm	Dissolved Oxygen ppm	BOD 5 - Day mg/l	Non-Filterable Residue mg/l	Turbidity NTU	Total Ammonia mg/l-N	Nitrogen			Ortho Phosphate mg/l-P	Total Phosphorus mg/l-P	Fecal Bacteria		Chlorophyll A ug/l
	Air °C	Water °C	Transparency ft	pH							Kjeldhal mg/l-N	NO2+NO3 mg/l-N	Coliform #/100ml			Strep #/100ml		
6/4/91	17.2	16.9	3.0	8.2	520	8.8	1.8	4	-NA-	0.426	0.38	1.81	0.106	0.11	21	20	1.5	
6/19/91	24.8	17.3	3.5	8.0	550	8.5	1.7	5	0.0	0.141	0.81	1.53	0.102	0.19	23	24	1.3	
7/3/91	27.7	18.9	5.0	7.9	510	8.2	1.5	5	3.0	0.095	0.52	1.53	0.107	0.11	23	9	1.5	
7/17/91	25.9	19.7	3.0	8.1	510	8.3	2.2	1	3.0	0.134	0.32	1.57	0.095	0.10	30	15	1.5	
7/31/91	31.4	20.1	3.0	8.1	520	8.1	1.0	8	5.0	0.074	0.45	1.48	0.084	0.13	60	11	1.7	
8/14/91	24.5	19.3	2.5	8.1	580	8.5	<1.0	7	5.7	0.096	0.39	1.37	0.111	0.13	43	10	4.6	
8/27/91	29.0	19.9	3.6	8.2	600	8.4	1.0	33	28.0	0.091	0.51	1.48	0.108	0.16	18	40	2.7	
9/11/91	15.4	16.1	2.0	8.4	590	8.8	2.0	10	6.0	0.120	0.46	1.59	0.122	0.17	240	900	3.2	
9/25/91	25.0	15.7	3.0	8.2	600	9.4	2.0	8	3.0	0.061	0.36	1.83	0.125	0.13	17	80	13.7	
10/9/91	21.6	14.8	4.0	8.1	700	9.3	3.0	2	3.0	0.079	0.29	1.91	0.075	0.12	16	170	15.1	
11/6/91	12.0	10.7	3.2	8.4	610	10.6	2.0	6	3.0	0.105	0.10	1.93	0.192	0.17	36	27	3.1	
12/18/91	8.2	7.5	3.5	7.0	590	10.6	3.0	3	2.0	0.148	<0.05	2.35	0.150	0.18	-NA-	-NA-	1.8	
1/15/92	7.8	7.5	3.0	8.5	590	12.4	4.0	9	4.0	0.090	0.44	1.88	0.105	0.15	-NA-	-NA-	41.8	
Average	20.8	15.7	3.3	8.1	575	9.2	2.0	8	5.5	0.128	0.39	1.71	0.114	0.14	48	119	7.2	
Minimum	7.8	7.5	2.0	7.0	510	8.1	<1.0	1	0.0	0.061	<0.05	1.37	0.075	0.10	16	9	1.3	
Maximum	31.4	20.1	5.0	8.5	700	12.4	4.0	33	28.0	0.426	0.81	2.35	0.192	0.19	240	900	41.8	

Table 4. Measured Water Quality for Boulder Rapids Monitoring Station (IS54S)

Date	Temperature		Secchi Disk		Electrical Conductivity umho/cm	Dissolved Oxygen ppm	BOD 5 - Day mg/l	Non-Filterable Residue mg/l	Turbidity NTU	Total Ammonia mg/l-N	Nitrogen			Ortho Phosphate mg/l-P	Total Phosphorus mg/l-P	Fecal Bacteria		Chlorophyll A ug/l
	Air °C	Water °C	Transparency ft	pH							Kjeldhal mg/l-N	NO2+NO3 mg/l-N	Coliform #/100ml			Strep #/100ml		
6/4/91	16.5	16.5	3.0	8.2	550	7.6	1.5	9	-NA-	0.130	0.98	1.59	0.095	0.08	67	56	2.7	
6/19/91	20.8	17.1	3.0	8.0	600	7.3	3.3	12	4.0	0.172	1.46	2.84	0.105	0.17	45	80	1.4	
7/3/91	28.6	18.8	4.0	7.9	540	7.3	1.6	8	4.0	0.090	0.73	1.56	0.111	0.13	49	24	2.9	
7/17/91	24.9	19.9	2.5	8.0	500	7.4	2.3	7	5.0	0.102	0.69	1.63	0.103	0.11	44	16	3.5	
7/31/91	26.0	19.8	1.5	8.1	520	7.5	0.9	15	8.0	0.078	0.33	1.47	0.075	0.11	82	56	3.2	
8/14/91	22.1	19.1	2.0	8.2	600	7.8	2.0	13	8.5	0.080	1.33	1.40	0.109	0.16	64	95	6.4	
8/27/91	27.9	19.5	2.5	8.4	620	8.1	2.0	36	23.0	0.087	0.54	1.48	0.109	0.13	11	11	2.8	
9/11/91	14.8	16.1	2.5	8.5	620	8.1	2.0	20	9.0	0.100	0.37	1.64	0.109	0.15	350	2000	7.1	
9/25/91	14.8	14.4	3.0	8.2	610	8.5	2.0	12	4.0	0.124	0.67	1.89	0.120	0.13	23	370	5.1	
10/9/91	16.7	13.9	3.2	8.1	730	8.7	3.0	6	4.0	0.075	0.51	1.98	0.054	0.11	60	550	14.4	
11/6/91	10.0	10.1	4.4	8.4	640	10.3	2.0	6	3.0	0.112	0.15	2.05	0.190	0.15	8	52	5.8	
11/20/91	7.1	9.9	4.0	8.1	650	9.9	2.0	3	2.0	0.117	0.36	2.37	0.194	0.15	<1	99	5.6	
12/4/91	11.7	8.4	4.0	7.4	660	11.8	2.0	2	2.0	0.110	0.32	2.46	0.132	0.17	4	29	<0.7	
Average	18.6	15.7	3.0	8.1	603	8.5	2.0	11	6.4	0.106	0.65	1.87	0.116	0.13	62	264	4.7	
Minimum	7.1	8.4	1.5	7.4	500	7.3	0.9	2	2.0	0.075	0.15	1.40	0.054	0.08	<1	11	<0.7	
Maximum	28.6	19.9	4.4	8.5	730	11.8	3.3	36	23.0	0.172	1.46	2.84	0.194	0.17	350	2000	14.4	

Table 5. Measured Water Quality for Snake River at Clear Lakes Bridge Monitoring Station.

Date	Temperature		Secchi Disk		Electrical Conductivity umho/cm	Dissolved Oxygen ppm	BOD 5 - Day mg/l	Non-Filterable Residue mg/l	Turbidity NTU	Nitrogen			Ortho Phosphate mg/l-P	Total Phosphorus mg/l-P	Fecal Bacteria		Chlorophyll A ug/l
	Air °C	Water °C	Transparency ft	pH						Total Ammonia mg/l-N	Total Kjeldhal mg/l-N	Total NO2+NO3 mg/l-N			Coliform #/100ml	Strep #/100ml	
6/4/91	17.3	16.9	4.0	8.2	550	8.2	1.3	-NA-	-NA-	0.046	0.65	1.78	0.109	0.12	43	30	4.3
6/19/91	22.2	17.1	3.5	8.2	600	8.0	1.7	10	5.0	0.074	0.65	0.69	0.095	0.11	49	62	3.0
7/2/91	30.0	18.2	4.0	8.1	610	8.1	1.9	8	4.0	0.061	0.44	1.63	0.107	0.14	38	54	3.0
7/16/91	28.1	20.1	2.5	8.0	550	7.9	1.5	10	5.0	0.109	0.44	1.60	0.085	0.16	190	84	3.1
Average	24.4	18.1	3.5	8.1	578	8.1	1.6	9	4.7	0.073	0.55	1.43	0.099	0.13	80	58	3.4
Minimum	17.3	16.9	2.5	8.0	550	7.9	1.3	8	4.0	0.046	0.44	0.69	0.085	0.11	38	30	3.0
Maximum	30.0	20.1	4.0	8.2	610	8.2	1.9	10	5.0	0.109	0.65	1.78	0.109	0.16	190	84	4.3
July 1990 through July 1991																	
Average	18.3	13.8	3.4	8.1	590	9.1	2.6	10	3.9	0.109	0.47	1.99	0.120	0.13	47	79	4.7
Minimum	-1.7	4.4	2.5	7.6	440	7.9	1.3	2	2.2	0.022	0.91	2.56	0.176	0.19	2	13	0.2
Maximum	36.0	20.6	5.0	8.6	670	13.1	5.1	20	6.0	0.267	0.27	0.69	0.085	0.05	360	800	10.5

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