ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC AND YUKON REGION

QUINSAM COAL DEVELOPMENT

A DATA REPORT ON RECEIVING WATER QUALITY - 1984 -

Regional Data Report DR86-03

By

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1 INTRODUCTION

Quinsam Coal Company a joint venture of Weldwood of Canada Ltd. and Luscar Ltd., in 1976 proposed to construct and operate an open pit coal mine in the vicinity of Middle Quinsam Lake, 20 km southwest of Campbell River, British Columbia, Figure 1. More recently, September 1981, Brinco Mining Ltd. replaced Luscar Ltd. and joined Weldwood in a similar joint venture, Quinsam Coal Ltd. The Quinsam Coal property contains surface and underground coal, 17 million tonnes would be extracted using surface mining methods over a period of 15 years. However, the potential exists for the life of the mine to continue beyond the 15 year life expectancy for surface mining methods.

Quinsam Coal Company began conducting environmental monitoring studies in 1978 to provide baseline data required to assess the potential impacts associated with coal mine development and operation phases. A federal intergovernmental Quinsam Coal Task Force, was established in 1978, and reviewed project developments parallel to the staged provincial review process. Stage I and II reviews by the Federal Quinsam Coal Task Force in 1979 and 1981 respectively, outlined the following areas of concern; acid generation, heavy metals, nutrient enrichment and sedimentation. The Quinsam Coal Task Force in 1981 recommended that Stage II approval-in-principle not be given "...pending satisfactory resolution of the many outstanding issues...". The concerns of the Federal Task Force were raised before a provincially appointed commission holding a Public Inquiry into the Quinsam Coal Project, in the fall of 1983. In their report to the British Columbia Minister of Environment the Commission agreed with the issues raised by the Federal Task Force and that insufficient data was available to make a proper assessment of the potential impact.

To supplement the data collected by the company, Environment Canda in 1984 conducted an investigation of four lakes and five stream reaches that could be affected by the development and operation of the mine (Figure 1). This report presents additional physical, chemical and biological data collected by the Environmental Protection Service (EPS) from March to October 1984. Biological data collected in June 1983 is presented in Appendix I. The water quality data collected by EPS in 1983 is reported by Sneddon and Kelso (1983).

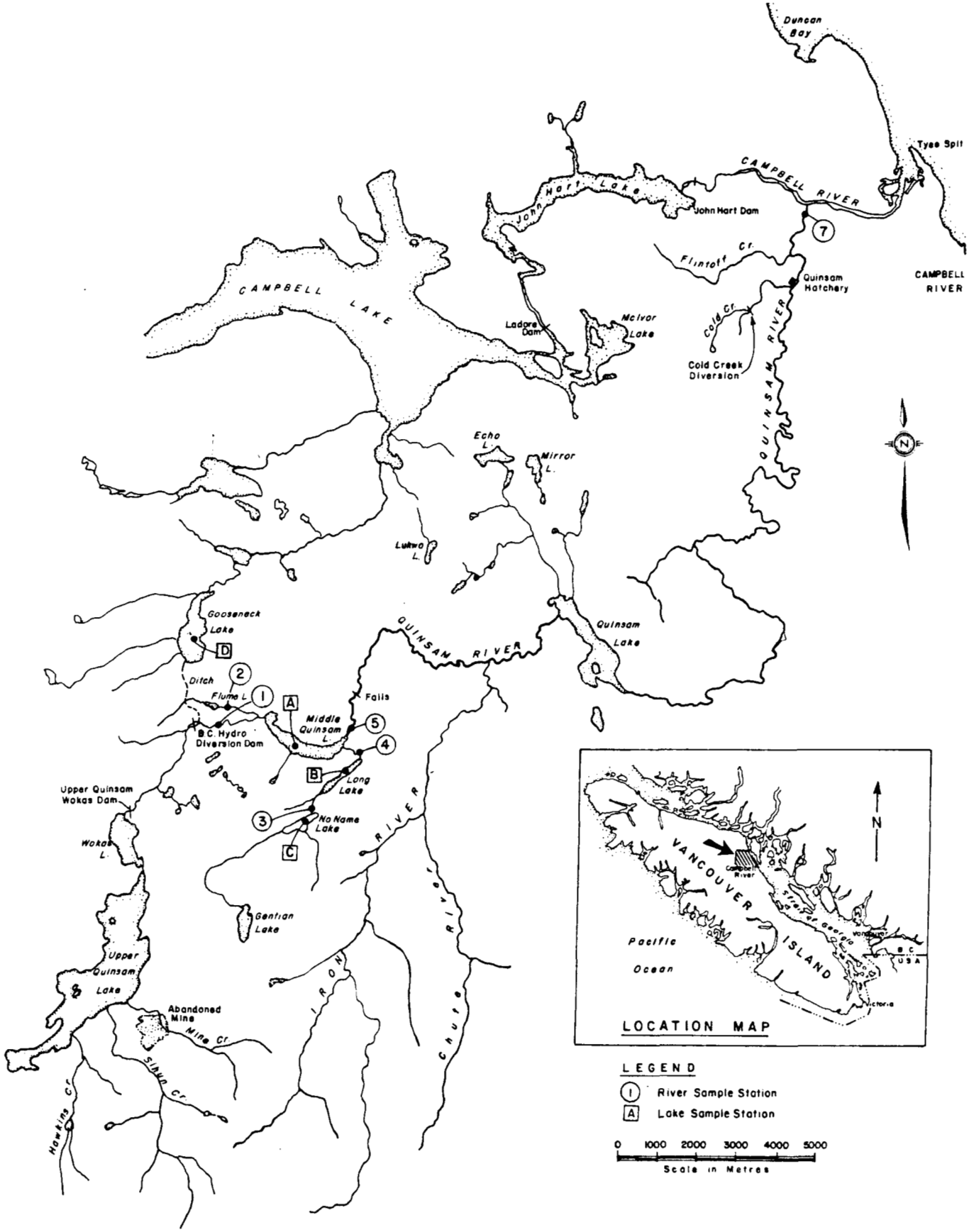

FIGURE 1 QUINSAM DRAINAGE BASIN - STREAM AND LAKE SAMPLING LOCATIONS, 1984

2 STUDY AREA

The Quinsam drainage is located in the coastal-Douglas fir biogeoclimatic zone on the eastern slopes of Vancouver Island and covers an area of 210 km^2. The Quinsam River flows northeast, joining the Campbell River three km upstream of its estuary (Figure 1). The study area is located in the upper half of the Quinsam drainage at an elevation of 300 m, approximately 20 km southwest of the Quinsam-Campbell confluence. The Quinsam drainage, having been logged in the 1950's, has a well established second growth. Annual precipitation is estimated at 100-150 cm and is concentrated in the fall and winter months (October to March).

Flows in the Quinsam River are regulated and diverted by British Columbia Hydro dams located at the outlet of Upper Quinsam and Wokas lakes and 1.9 km upstream of Middle Quinsam Lake. Minimum flows of 0.3 and 1.7 cms are maintained upstream of Middle Quinsam Lake and at the outlet of Lower Quinsam Lake. The remaining flow is diverted via Gooseneck Lake into the Campbell system where it is used for hydroelectric generation. All other flows are not regulated.

Station locations are shown in Figure 1. Lake stations were established at maximum depths in Middle Quinsam Lake (A), Long Lake (B) and No Name Lake (C). A control station on Gooseneck Lake (D), established by consultants for Quinsam Coal Limited, was continued by EPS in order to have comparable control data. Stream Stations (1-5) were established in the vicinity of the proposed mine developments in tributaries to and outflows from the above mentioned lakes. In addition Station 7 was established on the Quinsam River 50 m upstream from its confluence with the Campbell River.

3 METHODS AND MATERIALS

All stations were sampled during the growing season on four occassions in 1984 at approximately two month intervals. Table 1 summarizes the field methods, sample preparation and preservation, parameters and laboratory. All samples were kept cool and dark until further preparation or when delivered to the respective laboratories. Survey dates are listed below, but will be referred to throughout the report by the month in which the first day of the survey occurred.

March 13 - 16
May 28 - June 1
July 24 - 28
September 9 - 12

A one-day survey (October 10) involved sampling stream and river stations during high flows for residues (filterable and non-filterable), turbidity and specific conductivity was conducted.

3.1 Water Chemistry Sampling

Triplicate grab samples were collected at all stream and river stations. Temperature, pH, conductivity and D.O. were either measured in situ with a Hydrolab Model 4041 or in the field laboratory within 4 hours. All other samples were preserved and delivered to the respective labs.

Lake stations were located with a Furuno FM-21 Echo Sounder and geographic markers. Depth-temperature-pH conductivity and dissolved oxygen profiles were recorded to the bottom at 1 m intervals using a Hydrolab 4041. Sample depths were located 1 m below the surface, at the top of the thermocline, at the bottom of the thermocline and 1-2 m from the bottom. Discrete water samples were collected in a 6 l Van-Dorn water bottle, distributed to the various sample containers and preserved for shipment. All samples were kept cool until delivered to the respective laboratories.

TABLE 1 SUMMARY OF PARAMETERS, LABORATORIES, INSTRUMENTS AND SAMPLE PRESERVATION

PARAMETER	INSTRUMENT/ LABORATORY	FIELD PREPARATION
Temperature	Hydrolab 4041	- in situ measurement
Conductivity	Hydrolab 4041	- in situ measurement
Dissolved Oxygen	Hydrolab 4041	- in situ measurement
	EPS/DOE Lab	- manganese sulphate and alkaline-iodine
	Hydrolab 4041	azide solutions; Winkler titration
pH	Hydrolab 4041	- in situ measurement
Turbidity	EPS/DOE Lab	- in situ measurement
Alkalinity	EPS/DOE Lab	
Residues	EPS/DOE Lab	
Sulphate	EPS/DOE Lab	
Nitrate	EPS/DOE Lab	
	IWD Lab	
Nitrite	EPS/DOE Lab	
Ammonia	EPS/DOE Lab	
	IWD Lab	
Total Dissolved Nitrogen	EPS/DOE Lab	- filter through Whatman GF-F glass
	IWD Lab	fibre filters
Particulate Carbon	EPS/DOE Lab)	- filter onto Whatman GF-F glass fibre
	IWD Lab)	filters, freeze and desicate filters
Particulate Nitrogen	EPS/DOE Lab)	
	IWD Lab)	
Total Phosphorus	EPS/DOE Lab	
Total Dissolved Phosphorus	EPS/DOE Lab	- filter through 0.45 u Sartorius
		cellulose acetate filters
Total Metals	EPS/DOE Lab	
Dissolved Metals	EPS/DOE Lab	- filter through 0.45 u Sartorius
		cellulose acetate filters
Chlorophyll a	EPS/DOE Lab	- filter onto Whatman GF-C glass
		filters, freeze and desicate filters
Fluorescence	Turner Design	- in situ measurment
	Model 10-005R	

3.2 Biological Sampling

Profiles of fluorescing organic matter in the water column were recorded at each lake station and date. Measurements were recorded at one meter intervals from the surface to a depth of constant fluorescence. Water was pumped to the surface, using a submersible pump, where a Turner Design Fluorometer (Model 10-005R) was used to measure fluorescence.

Chlorophyll a and phytoplankton sample depths were chosen after examining the fluorescence profile and included the depth of maximum fluorescence when a peak was present. Triplicate chlorophyll a samples were taken at five or six depths while a single phytoplankton grab sample was taken from each of three depths. Chlorophyll a samples were stored cool and in the dark for a maximum of four hours prior to being filtered onto Whatman glass fibre filters. Residues on the filters were filter dried, frozen and stored in the dark prior to being analysed. Phytoplankton samples were preserved with Lugol's solution and stored in the dark prior to being analysed.

Triplicate zooplankton samples were obtained from each lake station and date using a 25 cm diameter, 20 mesh Wisconsin net. Vertical hauls, 1.5 m from the bottom to the surface, were pulled at a rate of 1 m/sec. For each haul the net was washed a minimum of three times and the sample preserved with buffered formalin.

4 RESULTS

4.1 Physical and Chemical

TABLE 2(a)	GOOSENECK LAKE
TABLE 2(b)	LONG LAKE
TABLE 2(c)	MIDDLE QUINSAM LAKE
TABLE 2(d)	NO NAME LAKE
TABLE 2(e)	STREAMS

TABLE 2(a) GOOSENECK LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Mar.	0	5.5	38	-	-	-	-	-	-	-	-	-	-
	1	5.4	38	7.3	11.2	95	18.0	15.5	1.9	< .1	< 5	39	39
	2	5.4	36	-	-	-	-	-	-	-	-	-	-
	3	5.4	36	7.4	11.1	95	18.0	16.0	2.0	< .1	< 5	40	40
	4	5.3	35	-	-	-	-	-	-	-	-	-	-
	5	4.9	35	-	-	-	-	-	-	-	-	-	-
	6	4.7	34	-	-	-	-	-	-	-	-	-	-
	7	4.5	34	-	-	-	-	-	-	-	-	-	-
	8	4.3	33	7.3	11.1	92	18.0	16.5	1.9	< .1	< 5	37	37
	9	4.1	32	-	-	-	-	-	-	-	-	-	-
	10	4.0	30	-	-	-	-	-	-	-	-	-	-
	11*	3.9	28	-	-	-	-	-	-	-	-	-	-
	12	3.9	28	7.6	10.9	89	19.0	15.0	1.9	< .1	< 5	38	38
May	0	14.0	39	-	-	-	-	-	-	-	-	-	-
	1	13.8	38	7.5	9.7	101	18.6	16.0	2.0	< .1	< 5	41	41
	2	13.7	38	-	-	-	-	-	-	-	-	-	-
	3	13.0	38	-	-	-	-	-	-	-	-	-	-
	4	12.4	38	7.6	10.0	101	18.5	16.0	3.0	< .1	< 5	45	45
	5	12.0	37	-	-	-	-	-	-	-	-	-	-
	6	11.6	37	-	-	-	-	-	-	-	-	-	-
	7	11.2	36	-	-	-	-	-	-	-	-	-	-
	8	10.2	35	7.6	10.0	96	18.4	16.0	2.0	< .1	5	46	51
	9	9.2	36	-	-	-	-	-	-	-	-	-	-
	10*	8.0	34	-	-	-	-	-	-	-	-	-	-
	11	7.2	33	-	-	-	-	-	-	-	-	-	-
	12	6.6	32	7.3	9.8	86	17.9	15.0	2.0	< .1	6	61	67

CONTINUED...

TABLE 2(a) GOOSENECK LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
July	0	21.5	17	-	8.7	105	-	-	-	-	-	-	-
	1	21.6	43	7.2	8.6	104	21.0	18.0	1.0	< .1	< 5	35	35
	2	21.6	41	-	8.6	104	-	-	-	-	-	-	-
	3	21.2	40	-	8.7	105	-	-	-	-	-	-	-
	4	20.7	39	-	8.7	104	-	-	-	-	-	-	-
	5	20.0	39	-	8.7	103	-	-	-	-	-	-	-
	6	18.4	43	7.5	9.7	111	20.5	18.0	2.0	< .1	< 5	38	38
	7	16.2	35	-	9.8	107	-	-	-	-	-	-	-
	8	13.8	32	-	10.5	109	-	-	-	-	-	-	-
	9	12.5	30	-	10.1	102	-	-	-	-	-	-	-
	10	10.2	31	7.1	9.8	94	18.6	16.0	2.0	< .1	< 5	35	35
	11*	8.9	30	-	9.4	87	-	-	-	-	-	-	-
	12	8.3	29	7.0	9.5	87	18.1	16.0	2.0	< .1	< 5	35	35
	13	7.9	24	-	9.2	83	-	-	-	-	-	-	-
Sept.	0	16.0	51	6.7	9.7	106	-	-	-	-	-	-	-
	1	16.0	50	6.9	9.5	104	20.6	18.0	2.0	< .1	< 5	35	35
	2	16.0	50	6.9	9.4	103	-	-	-	-	-	-	-
	3	16.0	51	7.0	9.3	101	-	-	-	-	-	-	-
	4	16.0	51	7.1	9.3	101	-	-	-	-	-	-	-
	5	16.0	51	7.1	9.3	101	-	-	-	-	-	-	-
	6	16.0	51	7.2	9.2	100	-	-	-	-	-	-	-
	7	16.0	50	7.1	9.2	100	20.3	18.0	2.0	< .1	< 5	35	35
	8	14.8	47	7.0	9.9	105	-	-	-	-	-	-	-
	9	11.8	49	7.0	10.0	99	-	-	-	-	-	-	-
	10	10.4	49	7.0	10.0	96	18.8	16.0	4.0	< .1	< 5	35	35
	11*	9.1	50	6.9	9.4	88	-	-	-	-	-	-	-
	12	8.4	50	6.8	8.9	82	-	-	-	-	-	-	-
	13	7.8	50	6.7	8.7	79	-	-	-	-	-	-	-
	14	7.5	50	6.7	8.3	74	18.5	17.0	2.0	< .1	< 5	39	39

* Secchi Depth

TABLE 2(b) LONG LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Mar.	0	4.6	13	-	-	-	-	-	-	-	-	-	-
	1	4.6	13	7.2	10.8	90	10.0	9.0	1.6	< .1	< 5	42	42
	2	4.6	11	-	-	-	-	-	-	-	-	-	-
	3	4.5	11	-	-	-	-	-	-	-	-	-	-
	4	4.5	11	7.2	11.3	94	10.0	9.0	1.8	< .1	< 5	37	37
	5	4.5	11	-	-	-	-	-	-	-	-	-	-
	6*	4.2	11	-	-	-	-	-	-	-	-	-	-
	7	4.2	11	-	-	-	-	-	-	-	-	-	-
	8	4.2	11	-	-	-	-	-	-	-	-	-	-
	9	4.1	11	-	-	-	-	-	-	-	-	-	-
	10	4.1	11	7.4	10.0	82	10.0	9.0	1.8	< .1	< 5	36	36
	11	4.0	10	-	-	-	-	-	-	-	-	-	-
	12	4.0	9	-	-	-	-	-	-	-	-	-	-
	13	4.0	10	-	-	-	-	-	-	-	-	-	-
	14	4.0	9	-	-	-	-	-	-	-	-	-	-
	15	3.9	9	-	-	-	-	-	-	-	-	-	-
	16	3.8	9	7.4	9.5	77	10.0	10.0	1.9	< .1	< 5	41	41
	17	3.8	7	-	-	-	-	-	-	-	-	-	-
May	0	14.0	24	-	-	-	-	-	-	-	-	-	-
	1	14.0	23	7.0	8.6	90	11.9	11.0	2.0	< .1	< 5	37	37
	2	13.9	23	-	-	-	-	-	-	-	-	-	-
	3	13.6	23	-	-	-	-	-	-	-	-	-	-
	4	12.0	23	7.0	9.5	95	11.9	11.0	2.0	< .1	< 5	35	35
	5	11.1	21	-	-	-	-	-	-	-	-	-	-
	6*	9.4	20	-	-	-	-	-	-	-	-	-	-
	7	8.4	17	-	-	-	-	-	-	-	-	-	-

CONTINUED...

TABLE 2(b) LONG LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
May	8	7.3	16	-	-	-	-	-	-	-	-	-	-
	9	6.8	15	-	-	-	-	-	-	-	-	-	-
	10	6.7	14	6.8	9.1	80	11.0	9.0	2.0	< .1	5	34	39
	11	6.6	14	-	-	-	-	-	-	-	-	-	-
	12	6.5	12	-	-	-	-	-	-	-	-	-	-
	13	6.4	12	-	-	-	-	-	-	-	-	-	-
	14	6.3	11	-	-	-	-	-	-	-	-	-	-
	15	6.2	11	6.7	8.6	75	11.1	9.0	2.0	< .1	< 5	37	37
	16	6.2	10	-	-	-	-	-	-	-	-	-	-
July	0	21.9	33	-	8.5	103	-	-	-	-	-	-	-
	1	21.8	32	7.3	8.6	104	14.8	12.0	2.0	< .1	< 5	36	36
	2	21.8	30	-	8.5	103	-	-	-	-	-	-	-
	3	20.9	30	-	8.6	103	-	-	-	-	-	-	-
	4	19.4	32	-	8.9	103	-	-	-	-	-	-	-
	5	15.2	25	7.0	9.5	102	13.4	12.0	< 1.0	< .1	< 5	36	36
	6	11.5	24	-	9.0	89	-	-	-	-	-	-	-
	7*	10.1	23	-	8.7	83	-	-	-	-	-	-	-
	8	8.9	21	-	8.2	76	-	-	-	-	-	-	-
	9	8.3	19	-	8.3	76	-	-	-	-	-	-	-
	10	7.8	19	6.5	7.9	71	11.5	10.0	2.0	< .1	< 5	31	31
	11	7.6	18	-	7.6	68	-	-	-	-	-	-	-
	12	7.4	16	-	7.9	71	-	-	-	-	-	-	-
	13	7.2	15	-	7.4	66	-	-	-	-	-	-	-
	14	7.0	15	-	6.9	61	-	-	-	-	-	-	-
	15	6.9	15	-	6.3	56	-	-	-	-	-	-	-
	16	6.8	14	6.5	6.3	55	11.9	9.0	2.0	< .1	< 5	26	26
	17	6.8	11	-	6.3	55	-	-	-	-	-	-	-

CONTINUED...

TABLE 2(b) LONG LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPER-ATURE (°C)	SPECIFIC CONDUC-TIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Sept.	0	15.7	38	6.6	9.7	105	-	-	-	-	-	-	-
	1	15.7	38	6.8	9.5	103	13.7	13.0	1.0	< .1	< 5	32	32
	2	15.7	38	6.8	9.5	103	-	-	-	-	-	-	-
	3	15.7	38	6.9	9.4	102	-	-	-	-	-	-	-
	4	15.7	38	7.0	9.4	102	-	-	-	-	-	-	-
	5	15.6	38	7.0	9.4	101	-	-	-	-	-	-	-
	6	14.5	34	7.0	9.4	99	13.2	14.0	2.0	< .1	< 5	33	33
	7*	10.9	32	6.7	8.9	87	-	-	-	-	-	-	-
	8	8.6	32	6.5	8.2	75	-	-	-	-	-	-	-
	9	7.8	32	6.4	7.8	70	-	-	-	-	-	-	-
	10	7.5	32	6.3	7.3	65	-	-	-	-	-	-	-
	11	7.2	33	6.2	7.1	63	-	-	-	-	-	-	-
	12	7.0	32	6.2	7.0	62	10.9	10.0	2.0	< .1	< 5	32	32
	13	6.9	32	6.2	6.8	60	-	-	-	-	-	-	-
	14	6.8	33	6.1	6.6	58	-	-	-	-	-	-	-
	15	6.6	33	6.1	6.0	52	-	-	-	-	-	-	-
	16	6.5	33	6.1	5.3	46	-	-	-	-	-	-	-
	17	6.4	34	6.0	4.7	41	-	-	-	-	-	-	-
	18	6.4	35	6.0	4.2	37	12.2	11.0	2.0	< .1	< 5	33	33
	19	6.4	35	6.0	3.8	33	-	-	-	-	-	-	-

* Secchi Depth

TABLE 2(c) MIDDLE QUINSAM LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Mar.	0	6.6	36	-	-	-	-	-	-	-	-	-	-
	1	6.3	36	7.5	11.0	95	16.0	15.0	1.8	.1	< 5	39	39
	2	6.3	36	7.3	11.1	96	16.0	15.0	1.9	< .1	< 5	37	37
	3	5.6	34	-	-	-	-	-	-	-	-	-	-
	4	5.4	33	-	-	-	-	-	-	-	-	-	-
	5	5.3	34	-	-	-	-	-	-	-	-	-	-
	6*	5.1	33	-	-	-	-	-	-	-	-	-	-
	7	5.0	32	7.4	11.1	93	16.0	14.0	1.8	.1	< 5	40	40
	8	4.9	31	-	-	-	-	-	-	-	-	-	-
	9	4.9	31	-	-	-	-	-	-	-	-	-	-
	10	4.8	30	7.2	11.2	93	16.0	14.5	1.8	< .1	< 5	36	36
	11	4.8	30	-	-	-	-	-	-	-	-	-	-
	12	4.7	30	-	-	-	-	-	-	-	-	-	-
May	0	15.8	36	-	-	-	-	-	-	-	-	-	-
	1	15.0	36	7.6	9.7	103	16.9	15.0	2.0	< .1	< 5	48	48
	2	14.7	35	-	-	-	-	-	-	-	-	-	-
	3	14.2	34	-	-	-	-	-	-	-	-	-	-
	4	13.5	34	7.6	9.8	101	16.9	15.0	2.0	< .1	6	41	47
	5	13.0	34	-	-	-	-	-	-	-	-	-	-
	6	12.6	32	-	-	-	-	-	-	-	-	-	-
	7	12.4	33	-	-	-	-	-	-	-	-	-	-
	8	12.2	33	-	-	-	-	-	-	-	-	-	-
	9	12.0	33	7.5	9.7	96	16.9	16.0	2.0	< .1	< 5	37	37
	10*	11.8	32	-	-	-	-	-	-	-	-	-	-
	11	11.5	32	-	-	-	-	-	-	-	-	-	-
	12	11.2	32	-	-	-	-	-	-	-	-	-	-

CONTINUED...

TABLE 2(c) MIDDLE QUINSAM LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
May	13	10.7	33	7.7	9.1	88	17.0	14.0	2.0	< .1	6	39	45
	14	10.3	34	-	-	-	-	-	-	-	-	-	-
July	0	23.1	44	-	8.8	109	-	-	-	-	-	-	-
	1	22.5	43	7.1	8.7	107	20.8	17.0	2.0	< .1	< 5	40	40
	2	22.3	42	-	8.8	108	-	-	-	-	-	-	-
	3	21.9	41	-	8.9	108	-	-	-	-	-	-	-
	4	21.6	40	-	8.9	108	-	-	-	-	-	-	-
	5	20.6	40	6.7	9.1	107	21.1	17.0	1.0	< .1	< 5	35	35
	6	18.9	38	-	9.7	111	-	-	-	-	-	-	-
	7	17.4	37	-	10.0	112	-	-	-	-	-	-	-
	8	15.1	36	6.7	9.5	101	18.1	15.0	3.0	< .1	< 5	34	34
	9	14.3	35	-	9.1	96	-	-	-	-	-	-	-
	10*	13.3	36	6.8	8.1	83	18.3	15.0	2.0	< .1	< 5	36	36
	11	12.3	38	-	6.5	65	-	-	-	-	-	-	-
Sept.	0	15.4	53	6.6	10.0	107	-	-	-	-	-	-	-
	1	15.4	53	6.9	9.7	104	20.5	19.0	2.0	.2	< 5	36	36
	2	15.4	53	7.0	9.7	104	-	-	-	-	-	-	-
	3	15.4	53	7.0	9.7	104	-	-	-	-	-	-	-
	4	15.4	53	7.1	9.6	103	-	-	-	-	-	-	-
	5	15.4	53	7.1	9.5	102	-	-	-	-	-	-	-
	6	15.3	53	7.1	9.5	102	20.5	19.0	2.0	.1	< 5	37	37
	7	15.3	53	7.2	9.5	102	-	-	-	-	-	-	-
	8	15.0	53	7.1	9.3	99	-	-	-	-	-	-	-
	9	14.8	54	7.1	9.2	97	-	-	-	-	-	-	-
	10*	14.2	55	7.0	8.0	84	-	-	-	-	-	-	-

CONTINUED...

TABLE 2(c) MIDDLE QUINSAM LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPER-ATURE (°C)	SPECIFIC CONDUC-TIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Sept.	11	13.1	60	6.8	6.3	64	19.3	17.0	2.0	.2	< 5	32	32
	12	12.4	64	6.7	5.4	54	-	-	-	-	-	-	-
	13	12.1	67	6.6	4.4	44	-	-	-	-	-	-	-
	14	11.9	69	6.5	3.8	38	-	-	-	-	-	-	-
	15	11.9	70	6.5	3.5	35	20.8	17.0	2.0	1.1	< 5	39	39

* Secchi Depth

TABLE 2(d) NO NAME LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Mar.	0	4.9	17	-	-	-	-	-	-	-	-	-	-
	1	4.9	15	7.5	10.7	90	11.0	8.5	1.4	< .1	< 5	35	35
	2	4.9	15	-	-	-	-	-	-	-	-	-	-
	3	4.9	14	-	-	-	-	-	-	-	-	-	-
	4	4.8	13	7.0	10.7	90	10.0	9.0	1.5	< .1	< 5	34	34
	5*	4.7	11	-	-	-	-	-	-	-	-	-	-
	6	4.6	11	-	-	-	-	-	-	-	-	-	-
	7	4.5	11	-	-	-	-	-	-	-	-	-	-
	8	4.5	11	-	-	-	-	-	-	-	-	-	-
	9	4.5	10	-	-	-	-	-	-	-	-	-	-
	10	4.4	10	6.9	9.7	80	10.0	9.0	1.5	< .1	< 5	39	39
	11	4.4	10	-	-	-	-	-	-	-	-	-	-
	12	4.3	10	-	-	-	-	-	-	-	-	-	-
	13	4.3	10	-	-	-	-	-	-	-	-	-	-
	14	4.2	11	-	-	-	-	-	-	-	-	-	-
	15	4.1	11	-	-	-	-	-	-	-	-	-	-
	16	4.1	11	7.2	7.9	65	12.0	10.0	1.8	< .1	< 5	39	39
	17	4.1	11	-	-	-	-	-	-	-	-	-	-
	18	4.1	11	-	-	-	-	-	-	-	-	-	-
May	0	14.1	21	-	-	-	-	-	-	-	-	-	-
	1	13.6	20	7.0	9.4	97	11.5	11.0	2.0	< .1	< 5	32	32
	2	13.0	20	-	-	-	-	-	-	-	-	-	-
	3	12.2	19	6.8	9.6	96	11.6	10.0	2.0	.2	< 5	32	32
	4	11.1	18	-	-	-	-	-	-	-	-	-	-
	5*	10.8	17	-	-	-	-	-	-	-	-	-	-
	6	9.4	16	-	-	-	-	-	-	-	-	-	-

CONTINUED...

TABLE 2(d) NO NAME LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPERATURE (°C)	SPECIFIC CONDUCTIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
May	7	8.8	13	-	-	-	-	-	-	-	-	-	-
	8	7.9	12	-	-	-	-	-	-	-	-	-	-
	9	7.7	11	-	-	-	-	-	-	-	-	-	-
	10	7.6	11	6.9	8.5	76	10.9	11.0	2.0	.2	< 5	34	34
	11	7.6	11	-	-	-	-	-	-	-	-	-	-
	12	7.4	10	-	-	-	-	-	-	-	-	-	-
	13	7.3	10	-	-	-	-	-	-	-	-	-	-
	14	7.2	8	-	-	-	-	-	-	-	-	-	-
	15	7.1	8	6.8	7.8	69	11.0	10.0	2.0	.3	< 5	30	30
July	0	23.3	31	-	8.3	104	-	-	-	-	-	-	-
	1	22.6	31	7.3	8.3	102	14.5	12.0	2.0	< .1	< 5	37	37
	2	22.2	31	-	8.4	103	-	-	-	-	-	-	-
	3	21.6	30	-	8.4	102	-	-	-	-	-	-	-
	4	19.2	28	-	8.9	103	-	-	-	-	-	-	-
	5	15.0	24	-	9.8	105	-	-	-	-	-	-	-
	6	12.3	24	7.0	9.1	92	13.3	11.0	3.0	< .1	< 5	34	34
	7	10.9	21	-	8.4	82	-	-	-	-	-	-	-
	8	9.7	18	-	7.7	73	-	-	-	-	-	-	-
	9*	9.1	16	-	7.2	67	-	-	-	-	-	-	-
	10	8.7	16	-	7.0	65	-	-	-	-	-	-	-
	11	8.6	16	6.5	6.9	64	11.4	9.0	2.0	< .1	< 5	32	32
	12	8.5	16	-	6.9	63	-	-	-	-	-	-	-
	13	8.4	16	-	7.0	64	-	-	-	-	-	-	-
	13	8.2	16	-	6.7	61	-	-	-	-	-	-	-
	12	7.9	12	6.4	5.8	53	12.3	9.0	2.0	< .1	< 5	33	33
	9	7.7	9	-	5.1	46	-	-	-	-	-	-	-

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TABLE 2(d) NO NAME LAKE. PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	TEMPER-ATURE (°C)	SPECIFIC CONDUC-TIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS	TOTAL ALKALINITY	SULFATE	TURBIDITY (FTU)	RESIDUE		
					Diss.	% Satn.					Non-Filterable	Filterable	Total
Sept.	0	16.1	36	6.7	9.3	102	-	-	-	-	-	-	-
	1	16.2	36	6.9	9.5	104	14.0	14.0	1.0	< .1	< 5	31	31
	2	16.0	36	7.0	9.5	104	-	-	-	-	-	-	-
	3	15.9	36	7.0	9.5	103	-	-	-	-	-	-	-
	4	15.9	36	7.0	9.6	104	-	-	-	-	-	-	-
	5	15.9	36	7.0	9.5	103	-	-	-	-	-	-	-
	6	14.4	30	6.9	9.8	104	12.8	12.0	1.0	< .1	< 5	30	30
	7	11.4	30	6.6	8.6	85	-	-	-	-	-	-	-
	8*	9.7	30	6.4	7.4	70	-	-	-	-	-	-	-
	9	8.8	31	6.2	6.6	61	-	-	-	-	-	-	-
	10	8.5	31	6.2	6.2	57	-	-	-	-	-	-	-
	11	8.3	31	6.1	6.0	55	-	-	-	-	-	-	-
	12	8.2	31	6.1	5.9	54	11.6	10.0	2.0	< .1	< 5	28	28
	13	8.0	31	6.1	5.6	51	-	-	-	-	-	-	-
	14	7.8	31	6.1	5.3	48	-	-	-	-	-	-	-
	15	7.6	33	6.1	4.0	36	-	-	-	-	-	-	-
	16	7.4	33	6.0	3.4	30	-	-	-	-	-	-	-
	17	7.3	34	6.0	2.5	22	13.3	11.0	2.0	1.0	< 5	34	34
	18	7.2	36	6.0	1.2	11	-	-	-	-	-	-	-

* Secchi Depth

QUINSAM COAL DEVELOPMENT

TABLE 2(e) STREAM PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE

STATION	DATE	TEMP. (°C)	SPECIFIC CONDUC-TIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS * $\bar{x}$ (SD)	TOTAL ALKALINITY * $\bar{x}$ (SD)	SULFATE * $\bar{x}$ (SD)	TURBIDITY * (FTU) $\bar{x}$ (SD)	RESIDUE*		
					Diss.	% Satn.					Non-Filt. $\bar{x}$ (SD)	Filt. $\bar{x}$ (SD)	Total $\bar{x}$ (SD)
1	May	12.9	39	7.0	9.6	98	19.1 (0.1)	17.3 (0.6)	2.0 (0)	< 0.1 (0)	5.3 (0.6)	49 (15)	51 (13)
	July	21.4	43	7.7	7.8	94	22.2 (0.1)	18.3 (0.6)	2.0 (0)	< 0.1 (0)	< 5 (0)	38 (2)	38 (2)
	Sept.	15.2	47	6.8	9.7	104	20.4 (0.2)	18.3 (0.6)	2.0 (0)	0.1 (0)	< 5 (0)	39 (1)	39 (1)
	Oct.	-	35	-	-	-	-	-	-	< 0.1 (0)	< 5 (0)	36 (2)	36 (2)
2	May	15.1	40	6.9	8.3	89	17.8 (0.1)	16.3 (0.6)	2.0 (0)	< 0.1 (0)	5.3 (0.6)	48 (1)	50 (3)
	July	20.8	53	7.1	6.3	75	24.3 (0.3)	21.0 (0)	2.0 (0)	0.2 (0)	< 5 (0)	44 (1)	44 (1)
	Sept.	13.6	59	6.4	8.3	86	24.5 (0.1)	22.3 (0.6)	2.0 (0)	0.7 (0)	< 5 (0)	43 (4)	43 (4)
3	May	15.0	18	7.3	9.4	100	11.4 (0)	10.3 (0.6)	1.7 (0.6)	0.13 (0.06)	< 5 (0)	31 (2)	31 (2)
	July	21.1	35	7.2	7.8	94	14.6 (0.4)	12.7 (0.6)	2.3 (0.6)	< 0.1 (0)	< 5 (0)	41 (4)	41 (4)
	Sept.	16.8	30	6.6	10.1	112	13.6 (0.2)	13.0 (0)	1.7 (0.6)	< 0.1 (0)	< 5 (0)	30 (2)	30 (2)

CONTINUE...

TABLE 2(e) STREAM PHYSICAL AND CHEMICAL RESULTS (units in mg/l unless otherwise stated) - 1984 BASELINE (Continued)

STATION	DATE	TEMP. (°C)	SPECIFIC CONDUC-TIVITY (uS/cm)	pH	OXYGEN		TOTAL HARDNESS *	TOTAL ALKALINITY *	SULFATE *	TURBIDITY *	RESIDUE*		
					Diss.	% Satn.	$\bar{x}$ (SD)	$\bar{x}$ (SD)	$\bar{x}$ (SD)	(FTU) $\bar{x}$ (SD)	Non-Filt. $\bar{x}$ (SD)	Filt. $\bar{x}$ (SD)	Total $\bar{x}$ (SD)
4	May	14.2	22	7.4	9.5	100	12.0 (0.1)	11.0 (1)	2.0 (0)	0.13 (0.06)	5.3 (0.6)	36 (2)	41 (2)
	July	21.3	35	7.1	7.4	89	14.5 (0.2)	13.0 (0)	2.0 (0)	< 0.1 (0)	< 5 (0)	34 (3)	34 (3)
	Sept.	14.9	33	6.5	8.8	94	14.2 (0.2)	14.0 (0)	1.0 (0)	< 0.1 (0)	< 5 (0)	34 (3)	34 (3)
5	Mar.	5.0	53	7.3	-	-	15.3 (0.6)	13.0 (0)	1.8 (0)	0.1 (0)	< 5 (0)	38 (2)	38 (2)
	May	14.4	32	7.4	9.7	102	15.4 (0.1)	14.0 (0)	2.0 (0)	< 0.1 (0)	7.3 (2.5)	48 (2)	54 (7)
	July	23.0	43	6.9	8.7	108	20.4 (0.6)	18.0 (1)	2.0 (0)	< 0.1 (0)	< 5 (0)	37 (2)	37 (2)
	Sept.	15.7	48	6.9	9.7	105	20.2 (0.3)	18.3 (0.6)	2.0 (0)	0.1 (0)	< 5 (0)	35 (6)	35 (6)
	Oct.	-	39	-	-	-	-	-	-	0.2 (0.1)	< 5 (0)	33 (1)	33 (1)
7	May	11.4	73	7.6	10.0	95	27.0 (0.1)	24.0 (0)	2.0 (0)	0.8 (0)	7.7 (1.2)	64 (3)	72 (3)
	July	17.5	104	8.3	10.1	109	43.6 (0.1)	38.3 (0.6)	2.7 (1.2)	< 0.1 (0)	< 5 (0)	72 (2)	72 (2)
	Sept.	13.5	90	7.5	10.5	105	33.3 (0.3)	30.3 (0.6)	2.0 (0)	0.3 (0)	< 5 (0)	56 (2)	56 (2)
	Oct.	-	53	-	-	-	-	-	-	7.0 (0)	36 (3)	48 (1)	84 (2)

* mean of three replicates

4.2 Nutrients

TABLE 3(a)	GOOSENECK LAKE
TABLE 3(b)	LONG LAKE
TABLE 3(c)	MIDDLE QUINSAM LAKE
TABLE 3(d)	NO NAME LAKE
TABLE 3(e)	STREAMS

QUINSAM COAL DEVELOPMENT

TABLE 3(a) GOOSENECK LAKE. NUTRIENT RESULTS (units in ug/l) - 1984 BASELINE

DATE	DEPTH	TOTAL DISSOLVED PHOSPHATE	TOTAL PHOSPHATE	NITRATE	NITRITE	AMMONIA	TOTAL DISSOLVED NITROGEN	PARTICULATE NITROGEN*	PARTICULATE CARBON*
Mar.	1	3	4	11	< 5	< 5	67	< 10	191
	3	3	4	11	< 5	< 5	70	< 10	192
	8	3	4	11	< 5	< 5	78	< 10	148
	12	5	4	12	< 5	< 5	66	< 10	136
May	1	< 2	< 2	< 2	< 5	5	70	4	102
	4	< 2	< 2	< 2	< 5	< 5	60	10	132
	8	< 2	< 2	< 2	< 5	< 5	60	< 10	152
	12	< 2	< 2	5	< 5	7	70	< 10	146
July	1	3/0.7+	3	12	< 2	3	70	< 10	105
	6	< 2/0.7+	2	< 5	< 2	3	70	< 10	88
	10	< 2/0.7+	< 2	< 5	< 2	< 2	60	< 10	147
	12	< 2/0.8+	4	< 5	< 2	< 2	130	7	173
Sept.	1	2	6	< 10	< 5	< 5	100	17	205
	7	< 2	6	< 10	< 5	< 5	90	11	146
	10	5	3	< 10	< 5	< 5	80	22	201
	14	2	5	< 10	< 5	< 5	70	16	196

+Soluble Reactive Phosphate
*analysed by Inland Waters Directorate Laboratory

TABLE 3(b) LONG LAKE. NUTRIENT RESULTS (units in ug/l) - 1984 BASELINE

DATE	DEPTH	TOTAL DISSOLVED PHOSPHATE	TOTAL PHOSPHATE	NITRATE	NITRITE	AMMONIA	TOTAL DISSOLVED NITROGEN	PARTICULATE NITROGEN*	PARTICULATE CARBON*
Mar.	1	4	5	12	< 5	5	131	4	147
	4	5	7	11	< 5	8	118	< 10	203
	10	4	6	13	< 5	7	125	< 10	141
	16	5	7	15	< 5	13	130	< 10	212
May	1	< 2	< 2	< 2	< 5	< 5	100	12	210
	4	< 2	< 2	< 2	< 5	< 5	110	13	232
	10	< 2	< 2	< 2	< 5	< 5	80	< 10	192
	15	< 2	< 2	< 2	< 5	8	100	6	268
July	1	< 2/1.5+	4	< 5	< 2	8	140	< 10	127
	5	< 2/1.0+	3	< 5	< 2	3	130	< 10	144
	10	< 2/1.2+	3	5	< 2	4	110	< 10	116
	16	< 2/1.3+	2	29	< 2	10	100	< 10	146
Sept.	1	2	2	< 10	< 5	10	-	11	176
	6	2	3	< 10	< 5	10	120	15	191
	12	2	2	< 10	< 5	9	90	< 10	144
	18	5	5	30	< 5	14	130	14	208

+Soluble Reactive Phosphate
*analysed by Inland Waters Directorate Laboratory

TABLE 3(c) MIDDLE QUINSAM LAKE. NUTRIENT RESULTS (units in ug/l) - 1984 BASELINE

DATE	DEPTH	TOTAL DISSOLVED PHOSPHATE	TOTAL PHOSPHATE	NITRATE	NITRITE	AMMONIA	TOTAL DISSOLVED NITROGEN	PARTICULATE NITROGEN*	PARTICULATE CARBON*
Mar.	1	3	4	11	< 5	< 5	115	< 10	163
	2	3	5	11	< 5	< 5	105	< 10	175
	7	3	4	12	< 5	< 5	71	< 10	211
	10	3	4	13	< 5	< 5	81	< 10	214
May	1	< 2	< 2	< 2	< 5	< 5	60	< 10	158
	4	< 2	< 2	< 2	< 5	5	70	< 10	130
	9	< 2	< 2	< 2	< 5	5	70	8	183
	13	< 2	< 2	4	< 5	8	70	8	17
July	1	< 2/2.2+	< 2	5	< 2	3	110	38	407
	5	< 2/1.0+	2	< 5	< 2	6	110	19	259
	8	< 2/1.3+	2	< 5	< 2	5	80	20	225
	10	< 2/1.5+	2	7	< 2	10	110	12	193
Sept.	1	2	4	< 10	< 5	10	100	< 10	148
	6	2	5	< 10	< 5	10	80	< 10	124
	11	< 2	6	< 10	< 5	19	90	13	163
	15	3	6	30	< 5	105	190	< 10	113

+Soluble Reactive Phosphate
*analysed by Inland Waters Directorate Laboratory

QUINSAM COAL DEVELOPMENT

TABLE 3(d) NO NAME LAKE. NUTRIENT RESULTS (units in ug/l) - 1984 BASELINE

DATE	DEPTH	TOTAL DISSOLVED PHOSPHATE	TOTAL PHOSPHATE	NITRATE	NITRITE	AMMONIA	TOTAL DISSOLVED NITROGEN	PARTICULATE NITROGEN*	PARTICULATE CARBON*
Mar.	1	4	6	13	< 5	10	97	11	203
	4	4	5	13	< 5	< 5	100	14	228
	10	5	5	14	< 5	7	100	9	220
	16	5	6	20	< 5	19	130	9	266
May	1	< 2	< 2	< 2	< 5	< 5	110	12	234
	3	< 2	< 2	< 2	< 5	< 5	140	30	350
	10	< 2	4	4	< 5	5	100	18	298
	15	2	4	< 2	< 5	12	110	10	361
July	1	< 2/1.0+	< 2	7	< 2	2	150	< 10	148
	6	< 2/1.0+	4	< 5	< 2	3	140	< 10	< 10
	11	< 2/1.3+	< 2	6	< 2	8	120	< 10	92
	15	< 2/1.5+	3	41	< 2	3	250	12	129
Sept.	1	< 2	2	< 10	< 5	9	130	14	222
	6	< 2	5	< 10	< 5	6	160	33	330
	12	< 2	5	10	< 5	< 5	120	15	190
	17	5	9	110	< 5	6	230	14	371

+Soluble Reactive Phosphate
*analysed by Inland Waters Directorate Laboratory

QUINSAM COAL DEVELOPMENT

TABLE 3(e) STREAM NUTRIENT RESULTS (mean of three replicates, units in ug/l) - 1984 BASELINE

STATION	DATE	TOTAL DISSOLVED PHOSPHATE $\bar{x}$ (SD)	TOTAL PHOSPHATE $\bar{x}$ (SD)	NITRATE $\bar{x}$ (SD)	NITRITE $\bar{x}$ (SD)	AMMONIA $\bar{x}$ (SD)	TOTAL DISSOLVED NITROGEN $\bar{x}$ (SD)	PARTICULATE NITROGEN* $\bar{x}$ (SD)	PARTICULATE CARBON* $\bar{x}$ (SD)
1	May	< 2 (0)	2.7 (1.1)	12 (0)	< 5 (0)	< 5 (0) < 2 (0)*	60 (0) 62 (8)*	< 10 (0)	92 (7)
	July	< 2 (0) 1.7 (0.3)+	2 (0)	32 (6)	< 2 (0)	< 2 (0)	97 (6) 99 (61)*	< 6 (0)	74 (6)
	Sept.	< 2 (0)	3 (1)	< 10 (0)	< 5 (0)	10 (0.6)	80 (10) 60 (6)*	9.7 (0.6)	152 (52)
2	May	2 (0)	5.7 (0.6)	6.3 (1.5)	< 5 (0)	< 5 (0) 5.7 (1.5)*	97 (12) 85 (10)*	6.3 (3.2)	173 (48)
	July	< 2 (0) 1.1 (0.4)+	3 (1.0)	< 5 (0)	< 2 (0)	< 2 (0)	93 (6) 82 (13)*	9.3 (1.2)	214 (56)
	Sept.	3 (0)	9.7 (2.1)	< 10 (0)	< 5 (0)	9 (0)	123 (6) 89 (2)*	26 (1)	401 (34)
3	May	< 2 (0)	< 2 (0)	< 2 (0)	< 5 (0)	< 5 (0) 3 (1.7)*	100 (10) 79 (2)*	< 17 (0)	274 (41)
	July	< 2 (0) 1.7 (0.4)+	4.7 (0.6)	13 (0)	< 2 (0)	6.3 (0.6)	117 (49) 97 (31)*	9 (1)	138 (8)
	Sept.	< 2 (0)	2.7 (0.6)	< 10 (0)	< 5 (0)	5.3 (0.6)	130 (17) 108 (12)*	17 (6)	220 (29)

CONTINUED...

TABLE 3(e) STREAM NUTRIENT RESULTS (mean of three replicates, units in ug/l) - 1984 BASELINE (Continued)

STATION	DATE	TOTAL DISSOLVED PHOSPHATE $\bar{x}$ (SD)	TOTAL PHOSPHATE $\bar{x}$ (SD)	NITRATE $\bar{x}$ (SD)	NITRITE $\bar{x}$ (SD)	AMMONIA $\bar{x}$ (SD)	TOTAL DISSOLVED NITROGEN $\bar{x}$ (SD)	PARTICULATE NITROGEN* $\bar{x}$ (SD)	PARTICULATE CARBON* $\bar{x}$ (SD)
4	May	< 2 (0)	< 2 (0)	< 2 (0)	< 5 (0)	< 5 (0) 4 (2.6)*	103 (6) 87 (2)*	11 (2)	225 (57)
	July	< 2 (0) 1.3 (0.3)+	4.7 (0.6)	6.7 (0.6)	< 2 (0)	5.7 (0.6)	150 (0) 121 (12)*	12 (5)	170 (22)
	Sept.	4.3 (0.6)	2.3 (0.6)	< 10 (0)	< 5 (0)	10 (2)	120 (10) 100 (6)*	11 (1)	167 (11)
5	Mar.	3.3 (0.6)	3.7 (0.6)	14 (0)	< 5 (0)	< 5 (0)	--	--	--
	May	< 2 (0)	< 2 (0)	< 2 (0)	< 5 (0)	< 5 (0) < 2 (0)*	77 (6) 72 (2)*	9.3 (1.2)	141 (30)
	July	< 2 (0) 1.4 (0.4)+	3.7 (2.9)	5 (0)	< 2 (0)	5.3 (0.6)	90 (0) 94 (20)*	17 (1)	207 (19)
	Sept.	< 2 (0)	4.7 (1.2)	< 10 (0)	< 5 (0)	12 (1)	97 (6) 81 (5)*	15 (4)	172 (19)
7	May	7.7 (0.6)	15 (1)	57 (1)	< 5 (0)	16 (1) 10 (2)*	123 (46) 116 (3)*	11 (2)	176 (44)
	July	13 (1) 11 (0.3)+	17 (1)	19 (3)	< 2 (0)	5.7 (0.6)	90 (10) 72 (11)*	17 (1)	174 (21)
	Sept.	11 (2)	11 (0.6)	20 (0)	< 5 (0)	8.3 (0.6)	113 (6) 93 (10)*	10 (0)	156 (29)

+ Soluble Reactive Phosphate
* analysed by Inland Waters Directorate Laboratory

4.3 Heavy Metals in Water

TABLE 4	HEAVY METALS IN WATER AT OR BELOW DETECTION LIMITS
TABLE 5(a)	GOOSENECK LAKE
TABLE 5(b)	LONG LAKE
TABLE 5(c)	MIDDLE QUINSAM LAKE
TABLE 5(d)	NO NAME LAKE
TABLE 5(e)	STREAMS

QUINSAM COAL DEVELOPMENT

TABLE 4 HEAVY METALS IN WATER AT OR BELOW THE DETECTION LIMITS (units in mg/l) - 1984 BASELINE

METAL	DETECTION LIMITS		
	ICAP	ATOMIC ABSROPTION	
	Dissolved / Extractable / Total	Dissolved	Total
Aluminum (Al)	0.05		
Antimony (Sb)	0.05		
Arsenic (As)	0.05		
Beryllium (Be)	0.001		
Cadmium (Cd)	0.002	0.0005	0.0006
Chromium (Cr)	0.005		
Cobalt (Co)	0.005		
Copper (Cu)	0.005	0.001	0.001
Lead (Pb)	0.02		0.001
Mercury (Hg)	--		0.00005
Molybdenum (Mo)	0.005		
Nickel (Ni)	0.02		
Selenium (Se)	0.05		
Titanium (Ti)	0.002		
Vanadium (V)	0.01 or 0.005 (Sept.)		

TABLE 5(a) GOOSENECK LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE

DATE	DEPTH (m)	BORON		BARIUM		MANGANESE		TIN	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	0.019		0.001		0.002		< 0.01	
	4	0.014		0.002		0.002		< 0.01	
	8	0.019		0.002		0.002		< 0.01	
	12	0.009		0.002		0.002		0.02	
July	1	< 0.001	0.021	0.001	0.001	0.003	0.003	< 0.01	< 0.01
	6	< 0.001	0.023	0.001	0.001	< 0.001	0.002	< 0.01	< 0.01
	10	< 0.001	< 0.001	0.002	0.001	0.001	0.002	< 0.01	< 0.01
	12	< 0.001	0.016	0.001	0.001	0.002	0.003	< 0.01	< 0.01
Sept.	1	0.002		0.001		0.005		< 0.01	
	7	0.002		0.001		< 0.001		< 0.01	
	10	0.007		0.001		0.001		< 0.01	
	14	0.016		0.002		0.003		< 0.01	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(a) GOOSENECK LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	STRONTIUM		ZINC		IRON		SILICON	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
Mar.	1							2.0	
	3							2.0	
	8							2.0	
	12							2.0	
May	1	0.013		< 0.002		0.009		1.8	
	4	0.012		< 0.002		0.008		1.8	
	8	0.012		< 0.002		0.007		1.8	
	12	0.012		0.006		0.008		1.9	
July	1	0.012	0.012	0.004	< 0.002	0.028	0.022	1.8	1.7
	6	0.012	0.012	< 0.002	< 0.002	0.010	0.018	1.7	1.7
	10	0.011	0.012	0.002	< 0.002	0.011	< 0.005	1.7	1.6
	12	0.011	0.012	< 0.002	< 0.002	0.010	0.008	1.8	1.7
Sept.	1	0.012		< 0.002		0.023		1.7	
	7	0.012		< 0.002		0.006		1.7	
	10	0.012		< 0.002		0.008		1.5	
	14	0.012		< 0.002		0.019		1.8	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(a) GOOSENECK LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	CALCIUM		SODIUM		MAGNESIUM	
		Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	6.3		0.8		0.7	
	4	6.2		0.7		0.7	
	8	6.2		0.7		0.7	
	12	6.0		0.7		0.7	
July	1	6.7	7.1	0.7	0.7	0.8	0.8
	6	6.3	6.9	0.7	0.7	0.7	0.8
	10	6.0	6.4	0.7	0.6	0.7	0.7
	12	5.9	6.2	0.7	0.8	0.7	0.7
Sept.	1	6.8		0.7		0.8	
	7	6.8		0.7		0.8	
	10	6.3		0.7		0.7	
	14	6.2		0.7		0.7	

* Dissolved metals were analysed in July

TABLE 5(b) LONG LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE

DATE	DEPTH (m)	BORON		BARIUM		MANGANESE		TIN	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	0.028		0.002		0.002		< 0.01	
	4	0.026		0.002		0.003		< 0.01	
	10	0.028		0.002		0.003		< 0.01	
	15	0.028		0.002		0.004		< 0.01	
July	1	0.018	0.028	0.002	0.002	0.001	0.003	< 0.01	< 0.01
	5	0.015	0.026	0.002	0.002	< 0.001	0.004	< 0.01	< 0.01
	10	0.018	0.035	0.002	0.002	0.002	0.002	< 0.01	< 0.01
	16	0.022	0.028	0.002	0.002	0.013	0.016	< 0.01	< 0.01
Sept.	1	0.027		0.002		< 0.001		0.01	
	6	0.025		0.002		0.001		< 0.01	
	12	0.018		0.002		0.004		< 0.01	
	18	0.011		0.002		0.014		< 0.01	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(b) LONG LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	STRONTIUM		ZINC		IRON		SILICON	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
Mar.								3.1	
								3.1	
								3.2	
								3.4	
May	1	0.013		< 0.002		0.028		2.8	
	4	0.013		< 0.002		0.029		2.8	
	10	0.012		< 0.002		0.035		3.0	
	15	0.012		0.007		0.047		3.1	
July	1	0.015	0.015	0.007	0.003	0.020	0.039	2.6	2.5
	5	0.013	0.014	0.002	< 0.002	0.020	0.037	2.6	2.4
	10	0.011	0.012	< 0.002	< 0.002	0.030	0.023	3.1	2.9
	16	0.012	0.012	0.002	< 0.002	0.058	0.110	3.3	3.0
Sept.	1	0.015		< 0.002		< 0.005		2.5	
	6	0.015		< 0.002		< 0.005		2.5	
	12	0.011		< 0.002		0.010		3.1	
	18	0.013		< 0.002		0.103		3.6	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(b) LONG LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	CALCIUM		SODIUM		MAGNESIUM	
		Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	3.5		1.2		0.7	
	4	3.5		1.2		0.7	
	10	3.3		1.2		0.7	
	15	3.2		1.2		0.7	
July	1	4.0	4.4	1.3	1.3	0.8	0.9
	5	3.6	4.0	1.3	1.2	0.7	0.8
	10	3.2	3.4	1.2	1.1	0.7	0.7
	16	3.2	3.4	1.2	1.1	0.7	0.7
Sept.	1	4.2		1.4		0.8	
	6	4.0		1.3		0.8	
	12	3.3		1.1		0.7	
	18	3.5		1.2		0.7	

* Dissolved metals were analysed in July

TABLE 5(c) MIDDLE QUINSAM LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE

DATE	DEPTH (m)	BORON		BARIUM		MANGANESE		TIN	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	0.028		0.001		0.002		< 0.01	
	4	0.023		0.001		0.001		< 0.01	
	9	0.028		0.001		0.001		< 0.01	
	13	0.023		0.002		0.003		0.01	
July	1	< 0.001	0.018	0.001	0.001	0.002	0.004	< 0.01	< 0.01
	5	< 0.001	0.031	0.001	< 0.001	0.003	0.005	0.01	< 0.01
	8	0.006	0.027	0.002	0.002	0.004	0.006	< 0.01	< 0.01
	10	0.010	0.028	0.002	0.002	0.009	0.007	< 0.01	< 0.01
Sept.	1	< 0.001		< 0.001		0.005		< 0.01	
	6	< 0.001		< 0.001		0.007		0.06	
	11	< 0.001		0.001		0.030		< 0.01	
	15	0.009		0.003		0.236		0.04	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(c) MIDDLE QUINSAM LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	STRONTIUM		ZINC		IRON		SILICON	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
Mar.	1							2.2	
	2							2.2	
	7							2.3	
	10							2.3	
May	1	0.012		< 0.002		0.021		1.7	
	4	0.012		< 0.002		0.020		1.8	
	9	0.012		< 0.002		0.021		1.8	
	13	0.013		< 0.002		0.026		1.8	
July	1	0.014	0.014	0.002	< 0.002	0.015	0.305	1.5	1.4
	5	0.014	0.015	0.005	< 0.002	0.047	0.054	1.5	1.4
	8	0.013	0.013	0.010	< 0.002	0.020	0.035	1.5	1.4
	10	0.013	0.014	0.018	0.004	0.060	0.094	1.7	1.5
Sept.	1	0.013		0.007		0.035		1.6	
	6	0.014		0.006		0.037		1.7	
	11	0.013		0.003		0.033		1.6	
	15	0.018		0.005		0.421		2.1	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(c) MIDDLE QUINSAM LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	CALCIUM		SODIUM		MAGNESIUM	
		Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	5.6		1.1		0.7	
	4	5.6		1.1		0.7	
	9	5.6		1.1		0.7	
	13	5.6		1.3		0.7	
July	1	6.3	6.7	1.0	1.0	0.8	0.8
	5	6.4	6.9	1.1	1.0	0.8	0.9
	8	5.6	6.0	1.3	1.2	0.7	0.7
	10	5.8	6.0	1.8	1.6	0.8	0.7
Sept.	1	6.8		1.0		0.8	
	6	7.0		0.9		0.8	
	11	6.4		1.4		0.8	
	15	6.7		2.8		0.8	

* Dissolved metals were analysed in July

TABLE 5(d) NO NAME LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE

DATE	DEPTH (m)	BORON		BARIUM		MANGANESE		TIN	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	0.019		< 0.001		0.002		< 0.01	
	3	0.019		< 0.001		0.002		< 0.01	
	10	0.009		0.001		0.004		< 0.01	
	15	0.028		0.001		0.010		0.01	
July	1	0.021	0.028	0.001	0.001	0.002	0.003	< 0.01	< 0.01
	5	0.003	0.023	< 0.001	0.002	0.001	0.004	< 0.01	< 0.01
	10	< 0.001	0.010	< 0.001	0.001	0.003	0.005	< 0.01	< 0.01
	15	< 0.001	0.022	0.001	0.001	0.021	0.026	< 0.01	< 0.01
Sept.	1	0.014		0.001		< 0.001		< 0.01	
	6	0.014		0.001		0.002		< 0.01	
	12	0.009		0.001		0.007		< 0.01	
	17	0.009		0.002		0.055		< 0.01	

*Dissolved metals were analysed in July

CONTINUED...

TABLE 5(d) NO NAME LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	STRONTIUM		ZINC		IRON		SILICON	
		Extractable*	Total	Extractable*	Total	Extractable*	Total	Extractable*	Total
Mar.	1							3.1	
	4							3.1	
	10							3.2	
	16							3.5	
May	1	0.011		< 0.002		0.035		2.8	
	3	0.011		< 0.002		0.038		2.8	
	10	0.010		< 0.002		0.093		2.9	
	15	0.010		< 0.002		0.248		3.0	
July	1	0.013	0.013	< 0.002	< 0.002	0.053	0.083	2.8	2.5
	5	0.011	0.012	< 0.002	< 0.002	0.026	0.234	2.7	2.5
	10	0.010	0.010	< 0.002	< 0.002	0.053	0.165	3.0	2.8
	15	0.010	0.011	< 0.002	< 0.002	0.020	0.333	3.2	3.0
Sept.	1	0.013		< 0.002		0.019		2.5	
	6	0.012		< 0.002		0.009		2.5	
	12	0.011		0.008		0.053		3.1	
	17	0.011		0.049		0.761		3.5	

* Dissolved metals were analysed in July

CONTINUED...

TABLE 5(d) NO NAME LAKE. HEAVY METALS IN WATER COLUMN (units in mg/l) - 1984 BASELINE (Continued)

DATE	DEPTH (m)	CALCIUM		SODIUM		MAGNESIUM	
		Extractable*	Total	Extractable*	Total	Extractable*	Total
May	1	3.3		1.0		0.7	
	3	3.3		1.0		0.7	
	10	3.1		1.0		0.7	
	15	3.0		0.9		0.7	
July	1	4.0	4.2	1.2	1.1	1.0	0.9
	5	3.4	3.7	1.1	1.0	0.8	0.9
	10	3.1	3.2	1.0	0.9	0.7	0.7
	15	3.1	3.4	1.0	1.0	0.7	0.8
Sept.	1	4.0		1.2		1.0	
	6	3.6		1.1		0.9	
	12	3.2		1.0		0.8	
	17	3.4		1.0		0.8	

* Dissolved metals were analysed in July

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TABLE 5(e) STREAM HEAVY METALS (units in mg/l) - 1984 BASELINE

METAL	MAY	JULY		SEPTEMBER
	Extractable $\bar{x}$ (SD)	Dissolved $\bar{x}$ (SD)	Total $\bar{x}$ (SD)	Extractable $\bar{x}$ (SD)
STATION 1				
Boron (B)	0.007 (0.006)	< 0.001 (0)	0.021 (0.01)	< 0.001 (0)
Barium (Ba)	0.001 (0)	0.001 (0)	< 0.001 (0)	< 0.001 (0)
Manganese (Mn)	< 0.001 (0)	0.001 (0)	0.002 (0)	0.004 (0.001)
Tin (Sn)	0.010 (0)	0.013 (0.006)	0.010 (0)	0.017 (0.012)
Strontium (Sr)	0.012 (0)	0.012 (0)	0.012 (0)	0.011 (0)
Zinc (Zn)	< 0.002 (0)	0.002 (0.001)	< 0.002 (0)	< 0.002 (0)
Iron (Fe)	0.005 (0.001)	0.019 (0.008)	0.052 (0.04)	0.025 (0.001)
Silicon (Si)	1.9 (0)	1.8 (0)	1.7 (0.06)	1.7 (0.06)
Calcium (Ca)	6.4 (0.06)	7.0 (0)	7.5 (0.06)	6.9 (0.06)
Sodium (Na)	0.7 (0)	0.7 (0.06)	0.6 (0.06	0.7 (0.06)
Magnesium (Mg)	0.7 (0)	0.8 (0)	0.8 (0)	0.8 (0)
STATION 2				
Boron (B)	0.009 (0)	0.005 (0)	0.019 (0.002)	< 0.001 (0)
Barium (Ba)	0.005 (0.001)	0.006 (0)	0.006 (0)	0.007 (0)
Manganese (Mn)	0.003 (0)	0.014 (0.001)	0.015 (0)	0.020 (0)
Tin (Sn)	< 0.010 (0)	0.013 (0.006)	< 0.010 (0)	0.057 (0.015)
Strontium (Sr)	0.017 (0.001)	0.021 (0.001)	0.021 (0)	0.021 (0.001)
Zinc (Zn)	0.007 (0.008)	0.005 (0.005)	< 0.002 (0)	0.002 (0.001)
Iron (Fe)	0.042 (0.001)	0.100 (0.004)	0.218 (0.06)	0.395 (0.004)
Silicon (Si)	2.1 (0.06)	2.2 (0.06)	2.1 (0.06)	2.1 (0.06)
Calcium (Ca)	5.8 (0)	7.7 (0.1)	8.1 (0.06)	7.8 (0.06)
Sodium (Na)	1.1 (0)	1.1 (0.1)	1.0 (0.1)	1.1 (0)
Magnesium (Mg)	0.8 (0)	1.0 (0)	1.0 (0.06)	1.0 (0)
STATION 3				
Boron (B)	0.024 (0.007)	0.016 (0.003)	0.028 (0.003)	0.007 (0.007)
Barium (Ba)	0.001 (0)	0.001 (0)	0.001 (0)	< 0.001 (0)
Manganese (Mn)	0.003 (0.001)	0.009 (0)	0.014 (0)	0.001 (0)
Tin (Sn)	< 0.010 (0)	0.010 (0)	0.010 (0)	< 0.010 (0)
Strontium (Sr)	0.011 (0)	0.013 (0)	0.014 (0)	0.013 (0)
Zinc (Zn)	< 0.002 (0)	< 0.002 (0)	0.002 (0.001)	< 0.002 (0)
Iron (Fe)	0.031 (0.001)	0.063 (0.004)	0.098 (0.003)	0.010 (0.005)
Silicon (Si)	2.8 (0)	2.7 (0)	2.5 (0)	2.5 (0)
Calcium (Ca)	3.3 (0)	4.0 (0)	4.2 (0.06)	3.9 (0.06)
Sodium (Na)	0.9 (0)	1.2 (0.06)	1.1 (0)	1.1 (0)
Magnesium (Mg)	0.7 (0)	1.0 (0)	0.9 (0.06)	0.9 (0)

CONTINUED..

TABLE 5(e) STREAM HEAVY METALS (units in mg/l) - 1984 BASELINE (Continued)

METAL	MAY	JULY		SEPTEMBER
	Extractable $\bar{x}$ (SD)	Dissolved $\bar{x}$ (SD)	Total $\bar{x}$ (SD)	Extractable $\bar{x}$ (SD)
STATION 4				
Boron (B)	0.028 (0)	0.025 (0.001)	0.020 (0.003)	0.023 (0.003)
Barium (Ba)	0.002 (0)	0.002 (0)	0.001 (0.001)	0.002 (0)
Manganese (Mn)	0.003 (0.001)	0.007 (0.001)	0.008 (0)	0.005 (0.001)
Tin (Sn)	< 0.010 (0)	< 0.010 (0)	< 0.010 (0)	< 0.010 (0)
Strontium (Sr)	0.013 (0)	0.015 (0)	0.015 (0.001)	0.015 (0.001)
Zinc (Zn)	< 0.002 (0)	0.003 (0.002)	< 0.002 (0)	< 0.002 (0)
Iron (Fe)	0.030 (0.002)	0.048 (0.001)	0.139 (0.160)	0.028 (0.002)
Silicon (Si)	2.8 (0)	2.5 (0)	1.5 (0)	2.5 (0)
Calcium (Ca)	3.5 (0)	4.1 (0.06)	6.7 (0.1)	4.1 (0.1)
Sodium (Na)	1.2 (0.06)	1.4 (0)	1.0 (0)	1.4 (0)
Magnesium (Mg)	0.7 (0)	0.9 (0)	0.8 (0)	0.9 (0)
STATION 5				
Boron (B)	0.009 (0.005)	0.017 (0.010)	0.019 (0.002)	0.028 (0.002)
Barium (Ba)	0.002 (0)	0.001 (0.001)	0.006 (0)	< 0.001 (0)
Manganese (Mn)	0.001 (0)	0.003 (0.001)	0.015 (0)	0.006 (0)
Tin (Sn)	< 0.010 (0)	0.010 (0)	< 0.010 (0)	0.023 (0.012)
Strontium (Sr)	0.013 (0.001)	0.014 (0.001)	0.021 (0)	0.013 (0.001)
Zinc (Zn)	< 0.002 (0)	0.005 (0.003)	< 0.002 (0)	< 0.002 (0)
Iron (Fe)	0.022 (0)	0.020 (0.006)	0.218 (0.06)	0.035 (0.001)
Silicon (Si)	2.0 (0)	1.6 (0)	2.1 (0.06)	1.6 (0)
Calcium (Ca)	4.9 (0.06)	6.4 (0)	8.1 (0.06)	6.8 (0.1)
Sodium (Na)	1.1 (0)	1.1 (0)	1.0 (0.1)	0.9 (0)
Magnesium (Mg)	0.7 (0)	0.8 (0)	1.0 (0.06)	0.8 (0)
STATION 7				
Boron (B)	0.021 (0.006)	0.021 (0.005)	0.028 (0)	0.009 (0.003)
Barium (Ba)	0.002 (0)	0.002 (0)	0.001 (0.001)	0.002 (0)
Manganese (Mn)	0.003 (0.001)	0.005 (0.001)	0.007 (0.001)	0.006 (0.001)
Tin (Sn)	0.013 (0.006)	0.017 (0.012)	< 0.010 (0)	0.010 (0)
Strontium (Sr)	0.022 (0)	0.026 (0)	0.027 (0)	0.026 (0.001)
Zinc (Zn)	< 0.002 (0)	0.004 (0.003)	< 0.002 (0)	< 0.002 (0)
Iron (Fe)	0.099 (0.003)	0.073 (0.014)	0.134 (0.007)	0.063 (0.009)
Silicon (Si)	3.5 (0.06)	4.8 (0)	4.5 (0)	3.6 (0)
Calcium (Ca)	8.2 (0.06)	12.2 (0.1)	12.7 (0.06)	10.0 (0.06)
Sodium (Na)	2.1 (0.06)	2.8 (0)	2.6 (0.06)	2.2 (0)
Magnesium (Mg)	1.5 (0)	2.8 (0)	2.8 (0)	2.0 (0.06)

4.4 Phytoplankton

4.4.1 Biovolume.

4.4.2 Abundance.

4.4.3 Dominance.

4.4.4 Chlorophyll a and Phaeophytin.

TABLE 6 PHYTOPLANKTON SPECIES LIST AND OCCURRENCE - 1984 BASELINE

PHYLA	STATION/DATE															
	GOOSENECK LAKE				LONG LAKE				MIDDLE QUINSAM LAKE				NO NAME LAKE			
	Mar	May	Jul	Sep	Mar	May	Jul	Sep	Mar	May	Jul	Sep	Mar	May	Jul	Sep
1) BACILLARIOPHYCEAE																
Achnanthes minutissima	X		X		X	X			X	X	X	X	X	X		
Achnanthes microcephala									X	X						
Anomoeneis vitrea									X	X	X					
Asterionella formosa							X	X			X	X				
Cyclotella glomerata						X		X			X					
Cyclotella ocellata									X							
Cyclotella stelligera		X														
Cyclotella sp. B	X	X		X			X	X	X	X	X	X	X	X	X	X
Cymbella caespitosa											X		X			
Cymbella sp						X										
Diploneis decipiens											X					
Eunotia pectinalis					X				X							
Eunotia sp											X		X	X		
Fragilaria capucina	X						X					X				
Fragilaria crotonensis					X	X			X					X		
Fragilaria vaucheriae	X			X	X	X			X					X		
Frustulia rhomboides													X			
Gomphonema sp	X												X			
Melosira granulata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Navicula salinarum var intermedia									X			X				
Navicula tripunctata													X			
Navicula sp	X	X							X		X		X			
Nitzschia linearis											X					

CONTINUED...

TABLE 6 PHYTOPLANKTON SPECIES LIST AND OCCURRENCE - 1984 BASELINE (Continued)

PHYLA	STATION/DATE															
	GOOSENECK LAKE				LONG LAKE				MIDDLE QUINSAM LAKE				NO NAME LAKE			
	Mar	May	Jul	Sep	Mar	May	Jul	Sep	Mar	May	Jul	Sep	Mar	May	Jul	Sep
1) BACILLARIOPHYCEAE (con't.)																
Nitzschia palea									X			X		X		
Rhopalodia gibba									X							
Stephanodiscus astrea										X						
Synedra sp									X	X						
Synedra ulna	X				X				X	X	X		X			
Tabellaria fenestrata					X	X			X		X					
2) CHLOROPHYTA																
Ankistrodesmus sp			X							X						
Chlamydomonas sp					X				X	X			X			
Elakatothrix sp	X	X	X	X			X				X	X			X	X
Oocystis sp		X	X	X						X	X	X				X
Scenedesmus sp									X							
Crucigenia tetrapedia							X	X				X				
3) CYANOPHYTA																
Gloecapsa sp			X	X				X						X		
Merismopedia sp								X		X				X	X	X
Aphanocapsa sp							X	X								X
Gloeothece sp																X
Rhabdoderma lineare								X								

CONTINUED...

TABLE 6 PHYTOPLANKTON SPECIES LIST AND OCCURRENCE - 1984 BASELINE
(Continued)

PHYLA	STATION/DATE															
	GOOSENECK LAKE				LONG LAKE				MIDDLE QUINSAM LAKE				NO NAME LAKE			
	Mar	May	Jul	Sep	Mar	May	Jul	Sep	Mar	May	Jul	Sep	Mar	May	Jul	Sep
4) CHRYSOPHYTA																
Diceras sp		X			X			X		X	X			X	X	X
Dinobryon bavaricum	X				X	X	X	X					X	X		X
Dinobryon sertularia	X		X	X	X	X			X		X	X	X	X	X	X
Mallamonas sp				X												
Ochromonas sp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chrysochromulina sp									X							
5) PYRRHOPHYTA																
Ceratium sp				X							X					
Gymnodinium sp					X	X										
Peridinium sp			X		X	X	X						X	X		X
6) CRYPTOPHYTA																
Cryptomonas borealis	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Chroomonas acuta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chroomonas sp									X	X						
Cryptomonas sp										X						

TABLE 7(a) GOOSENECK LAKE. PHYTOPLANTKON BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	3	6.39	0.05	0	11.0	0	2.11	19.6
	6	8.22	0	0	12.6	0	4.31	25.1
	9	13.8	0	0	12.6	0	12.2	38.6
	$\bar{x}$ (SD)	9.47 (4)	0.02 (0.03)	0 (0)	12.1 (1)	0 (0)	6.21 (5)	27.8
May	4	4.24	2.85	0	3.30	0	19.5	29.9
	8	23.7	1.46	0	2.95	0	20.0	48.1
	10	16.6	0	0	1.82	0	5.59	24.0
	$\bar{x}$ (SD)	14.8 (10)	1.44 (1)	0 (0)	2.69 (1)	0 (0)	15.0 (8)	34.0
July	4	17.9	1.67	0	22.5	0	32.5	74.6
	7	51.0	2.13	9.80	154	42.6	89.3	349.
	12	26.0	2.50	0	88.3	0	71.8	189.
	$\bar{x}$ (SD)	31.6 (17)	2.10 (0.4)	3.27 (6)	88.3 (66)	14.2 (25)	64.5 (29)	204.
Sept.	3	12.2	0.43	3.00	33.4	0	54.2	103.
	6	5.75	0	2.53	17.7	163	6.89	196.
	9	6.70	3.62	5.70	13.7	0	8.15	37.9
	$\bar{x}$ (SD)	8.22 (3)	1.35 (2)	3.74 (2)	21.6 (10)	54.3 (94)	23.1 (27)	112.

TABLE 7(b) LONG LAKE. PHYTOPLANTKON BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	1	24.8	1.82	0	513	0	27.4	567
	3	13.6	0	0	336	15.5	16.6	381
	5	21.2	0	0	345	145	11.8	523
	$\bar{x}$ (SD)	19.9 (6)	0.61 (1)	0 (0)	398 (100)	53.5 (80)	18.6 (8)	491
May	3	20.5	0	0	45.0	511	33.5	610
	6	16.8	0.07	0	27.1	0	82.7	126
	9	0.80	0	0	52.4	26.7	63.7	144
	$\bar{x}$ (SD)	12.7 (10)	0.02 (0.04)	0 (0)	41.5 (13)	179 (288)	60.0 (25)	293
July	6	81.0	1.42	1.98	221	35.4	69.5	410
	10	36.2	0	0.48	30.6	0	18.4	85.7
	13	81.1	0.32	0	5.84	0	14.8	102
	$\bar{x}$ (SD)	66.1 (26)	0.58 (.7)	0.82 (1)	85.9 (118)	11.8 (20)	34.2 (31)	199
Sept.	4	33.7	0	21.7	14.2	0	47.7	117
	6	14.6	0	27.1	9.52	0	76.9	128
	9	38.5	0	9.35	6.30	0	7.08	61.2
	$\bar{x}$ (SD)	28.9 (13)	0 (0)	19.4 (9)	10.0 (4)	0 (0)	43.9 (35)	102

TABLE 7(c) MIDDLE QUINSAM LAKE. PHYTOPLANKTON BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	3	200	0	0	182	0	0	382
	5	118	0	0	367	0	0.31	485
	8	95.9	1.46	0	220	0	12.0	329
	$\bar{x}$ (SD)	138 (55)	0.49 (.8)	0 (0)	256 (98)	0 (0)	4.10 (7)	399
May	3	48.5	0.31	0	0.88	0	2.61	52.3
	5	98.1	6.19	0	3.07	0	27.5	135
	8	90.0	1.04	0.28	1.91	0	19.7	113
	$\bar{x}$ (SD)	78.9 (27)	2.51 (3)	0.09 (.2)	1.95	0 (0)	16.6 (13)	100
July	4	90.3	0.82	0	43.6	0	11.7	146
	8	278	5.71	0	197	0	66.2	547
	12	66.4	0	0	41.9	0	22.9	131
	$\bar{x}$ (SD)	145 (116)	2.18 (3)	0 (0)	94.2 (89)	0 (0)	33.6 (29)	274
Sept.	4	47.5	1.07	0	60.3	119	60.1	288
	8	40.9	3.20	0	128	0	45.4	217
	11	165	0.29	0	11.1	0	47.5	224
	$\bar{x}$ (SD)	84.5 (70)	1.52 (2)	0 (0)	66.5 (59)	39.7 (69)	51.0 (8)	243

TABLE 7(d) NO NAME LAKE. PHYTOPLANKTON BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	3	41.7	0	0	492	19.1	27.7	581
	5	85.3	0	0	441	0	21.9	548
	7	82.0	3.55	0	759	0	77.0	922
	$\bar{x}$ (SD)	69.7 (24)	1.18 (2)	0 (0)	564 (171)	6.37 (11)	42.2 (30)	683
May	4	15.8	0	0.61	247	30.4	3.01	297
	6	41.4	0	0	413	0	2.43	457
	9	43.0	0	0	352	175	1.73	572
	$\bar{x}$ (SD)	33.4 (15)	0 (0)	0.20 (.4)	337 (84)	68.5 (94)	2.39 (0.6)	442
July	3	26.1	0.58	16.3	5.94	0	14.1	63
	7	26.0	0	1.64	6.41	0	0	34.1
	14	19.0	0	2.03	1.38	0	19.7	42.1
	$\bar{x}$ (SD)	23.7 (4)	0.19 (0.3)	6.66 (8)	4.57 (3)	0 (0)	11.3 (10)	46.4
Sept.	4	20.9	0.47	12.5	58.4	0	14.7	107
	6	50.9	1.50	5.60	45.9	0	100	204
	9	105	1.63	2.61	21.4	61.2	30.5	222
	$\bar{x}$ (SD)	58.9 (43)	1.20 (.6)	6.90 (5)	41.9 (19)	20.4 (35)	48.4 (45)	178

TABLE 8(a) GOOSENECK LAKE. PHYTOPLANTKON ABUNDANCE (cells/ml) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	3	6	1	0	111	0	5	123
	6	11	0	0	100	0	11	122
	9	14	0	0	137	0	18	168
	$\bar{x}$ (SD)	10 (4)	0 (0.6)	0 (0)	116 (19)	0 (0)	11 (7)	138
May	4	4	30	0	109	0	43	186
	8	34	15	0	121	0	62	231
	10	19	0	0	91	0	39	149
	$\bar{x}$ (SD)	19 (15)	15 (15)	0 (0)	107 (15)	0 (0)	48 (12)	189
July	4	25	28	0	173	0	67	294
	7	45	38	98	319	4	141	639
	12	28	25	0	260	0	103	416
	$\bar{x}$ (SD)	33 (11)	30 (7)	33 (57)	251 (73)	1 (2)	103 (37)	450
Sept.	3	11	9	30	183	0	89	321
	6	6	0	303	187	2	46	543
	9	7	43	543	179	0	54	827
	$\bar{x}$ (SD)	8 (3)	17 (23)	292 (257)	183 (4)	1 (1)	63 (23)	564

TABLE 8(b) LONG LAKE. PHYTOPLANTKON ABUNDANCE (cells/ml) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	1	13	5	0	598	0	200	816
	3	9	0	0	389	2	60	460
	5	13	0	0	392	2	98	505
	$\bar{x}$ (SD)	12 (2)	2 (3)	0 (0)	460 (120)	1 (1)	119 (72)	594
May	3	38	0	0	278	10	60	386
	6	11	4	0	222	0	63	300
	9	1	0	0	206	3	67	276
	$\bar{x}$ (SD)	17 (19)	1 (2)	0 (0)	235 (38)	4 (5)	63 (4)	321
July	6	89	28	396	315	4	276	1108
	10	34	0	95	124	0	124	377
	13	72	16	0	74	0	125	287
	$\bar{x}$ (SD)	65 (28)	15 (14)	164 (207)	171 (121)	1 (2)	175 (87)	591
Sept.	4	40	0	1365	200	0	94	1699
	6	18	0	1330	168	0	154	1669
	9	43	0	315	98	0	79	535
	$\bar{x}$ (SD)	34 (14)	0 (0)	1003 (596)	155 (52)	0 (0)	109 (40)	1301

TABLE 8(c) MIDDLE QUINSAM LAKE. PHYTOPLANKTON ABUNDANCE (cells/ml) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	3	142	0	0	155	0	0	296
	5	73	0	0	267	0	3	343
	8	95	7	0	156	0	21	279
	$\bar{x}$ (SD)	103 (35)	2 (4)	0 (0)	193 (64)	0 (0)	8 (11)	306
May	3	57	3	0	44	0	29	133
	5	71	19	0	82	0	46	218
	8	102	10	28	96	0	52	288
	$\bar{x}$ (SD)	77 (23)	11 (8)	9 (16)	74 (27)	0 (0)	42 (12)	213
July	4	106	16	0	148	0	27	298
	8	307	57	0	233	0	117	714
	12	85	0	0	229	0	136	450
	$\bar{x}$ (SD)	166 (123)	24 (29)	0 (0)	203 (48)	0 (0)	93 (58)	487
Sept.	4	77	53	0	159	1	69	359
	8	59	72	0	313	0	84	529
	11	219	6	0	154	0	64	442
	$\bar{x}$ (SD)	118 (88)	44 (34)	0 (0)	209 (90)	0 (0.6)	72 (10)	443

TABLE 8(d) NO NAME LAKE. PHYTOPLANKTON ABUNDANCE (cells/ml) - 1984 BASELINE

DATE	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Mar.	3	52	0	0	441	2	78	573
	5	79	0	0	520	0	104	703
	7	115	10	0	821	0	112	1058
	$\bar{x}$ (SD)	82 (32)	3 (6)	0 (0)	594 (201)	1 (1)	98 (18)	778
May	4	20	0	61	339	3	33	456
	6	54	0	0	531	0	27	612
	9	53	0	7	436	18	19	532
	$\bar{x}$ (SD)	42 (19)	0 (0)	23 (33)	435 (96)	7 (10)	26 (7)	533
July	3	26	12	1630	192	0	41	1900
	7	23	0	164	162	0	0	349
	14	19	0	204	69	0	28	319
	$\bar{x}$ (SD)	23 (4)	4 (7)	666 (835)	141 (64)	0 (0)	23 (21)	856
Sept.	4	21	9	764	179	0	117	1090
	6	48	20	320	210	0	163	760
	9	94	33	131	218	6	135	616
	$\bar{x}$ (SD)	54 (37)	21 (12)	405 (325)	202 (21)	2 (3)	138 (23)	822

TABLE 9(a) DOMINANT PHYTOPLANKTON SPECIES, RANKED WITH RESPECT TO BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - 1984 BASELINE

DATE	STATION							
	GOOSENECK LAKE		LONG LAKE		MIDDLE QUINSAM LAKE		NO NAME LAKE	
	Species	Biovol	Species	Biovol	Species	Biovol	Species	Biovol
Mar.	Dinobryon sertularia	9.32	Dinobryon sertularia	393	Dinobryon sertularia	256	Dinobryon sertularia	559
	Melosira granulata	5.50	Gymnodinium sp.	48.3	Synedra ulna	74.5	Cryptomonas borealis	35.0
	Cryptomonas borelis	5.44	Synedra ulna	12.1	Tabellaria fenestrata	18.5	Synedra ulna	18.8
	Ochromonas sp.	2.17	Chroomonas acuta	10.4	Fragilaria crotonensis	10.0	Navicula tripunctata	14.7
May	Melosira granulata	11.4	Gymnodinium sp.	153	Melosira granulata	47.9	Dinobryon sertularia	323
	Cryptomonas borealis	11.3	Cryptomonas borealis	57.0	Stephanodiscus astrea	10.7	Peridinium sp.	68.5
	Chroomonas acuta	3.81	Dinobryon sertularia	33.9	Synedra ulna	9.40	Melosira granulata	16.8
	Ochromonas sp.	2.08	Peridinium sp.	26.2	Cryptomonas borealis	8.16	Dinobryon bavaricum	9.69
July	Dinobryon sertularia	84.6	Dinobryon bavaricum	84.4	Dinobryon sertularia	91.0	Melosira granulata	20.1
	Cryptomonas borealis	58.0	Melosira granulata	55.1	Cyclotella sp. B	77.5	Cryptomonas borealis	9.68
	Melosira granulata	31.0	Cryptomonas borealis	19.4	Melosira granulata	27.1	Merismopedia sp.	6.66
	Peridinium sp.	14.2	Chroomonas acuta	14.8	Cryptomonas borealis	26.5	Cyclotella sp. B	3.57
Sept.	Ceratium sp.	54.5	Cryptomonas borealis	35.8	Dinobryon sertularia	63.2	Melosira granulata	54.6
	Cryptomonas borealis	18.3	Melosira granulata	23.8	Cryptomonas borealis	46.7	Cryptomonas borealis	37.8
	Dinobryon sertularia	17.8	Rhabdoderma lineare	9.26	Cyclotella sp. B	43.2	Dinobryon sertularia	34.1
	Melosira granulata	7.19	Chroomonas acuta	8.11	Ceratium sp.	39.5	Peridinium sp.	20.4

TABLE 9(b) DOMINANT PHYTOPLANKTON SPECIES, RANKED WITH RESPECT TO ABUNDANCE (cells/ml) - 1984 BASELINE

DATE	STATION							
	GOOSENECK LAKE		LONG LAKE		MIDDLE QUINSAM LAKE		NO NAME LAKE	
	Species	No.	Species	No.	Species	No.	Species	No.
Mar.	Ochromonas sp.	109	Dinobryon sertularia	279	Dinobryon sertularia	181	Dinobryon sertularia	397
	Chroomonas acuta	9	Ochromonas sp.	179	Achnanthes minutissima	25	Ochromonas sp.	197
	Dinobryon sertularia	7	Chroomonas acuta	115	Synedra ulna	18	Chroomonas acuta	80
	Melosira granulata	5	Cryptomonas borealis	4	Navicula sp.	13	Achnanthes minutissima	32
May	Ochromonas sp.	104	Ochromonas sp.	207	Ochromonas sp.	71	Dinobryon sertularia	229
	Chroomonas acuta	42	Chroomonas acuta	33	Melosira granulata	42	Ochromonas sp.	190
	Oocystis sp.	14	Cryptomonas borealis	30	Chroomonas acuta	25	Chroomonas acuta	27
	Melosira granulata	10	Dinobryon sertularia	24	Chroomonas sp.	11	Merismopedia sp.	20
July	Ochromonas sp.	191	Chroomonas acuta	165	Ochromonas sp.	138	Merismopedia sp.	666
	Chroomonas acuta	73	Aphanocapsa sp.	164	Cyclotella sp. B.	109	Ochromonas sp.	136
	Dinobryon sertularia	60	Dinobryon bavaricum	94	Chroomonas acuta	79	Melosira granulata	18
	Gloeocapsa sp A.	33	Ochromonas sp.	77	Dinobryon sertularia	65	Chroomonas acuta	17
Sept.	Aphanocapsa sp.	258	Merismopedia sp.	445	Ochromonas sp.	164	Merismopedia sp.	357
	Ochromonas sp.	170	Aphanocapsa sp.	430	Cyclotella sp. B.	61	Ochromonas sp.	173
	Chroomonas acuta	53	Ochromonas sp.	147	Chroomonas acuta	47	Chroomonas acuta	118
	Chroococcus sp.	36	Rhabdoderma lineare	93	Dinogryon sertularia	45	Melosira granulata	48

TABLE 10(a) GOOSENECK LAKE. CHLOROPHYLL A AND PHAEOPHYTIN (ug/l) - 1984 BASELINE

DATE	DEPTH (m)	CHLOROPHYLL A		PHAEOPHYTIN		FLUOROMETRIC VALUES ($\times 10^{-4}$)
		$\bar{x}$	SD	$\bar{x}$	SD	
March	1	0.69	0.25	1.16	0.59	31
	3	0.69	0.22	1.12	0.10	36
	6	0.58	0.10	0.92	0.32	34
	9	0.60	0.12	1.39	0.97	30
	11	0.49	0.14	1.66	0.44	28
May	1	0.16	0.05	1.35	0.24	2
	4	0.30	0.08	1.04	0.27	5
	8	0.46	0.26	1.82	0.77	17
	10	0.83	0.25	1.61	0.40	21
	12	0.66	0.08	2.01	0.48	20
July	1	0.27	0.06	1.19	0.27	18
	4	0.36	0.06	1.17	0.37	22
	7	0.55	0.08	2.29	1.34	34
	10	0.46	0.03	1.28	0.26	50
	12	0.54	0.09	1.11	0.02	58
September	1	0.55	0.08	0.91	0.09	23
	3	0.57	0.08	0.69	0.14	25
	6	0.62	0.14	0.82	0.04	24
	9	0.68	0.20	1.22	0.42	34
	12	0.71	0.06	1.32	0.13	33

TABLE 10(b) LONG LAKE. CHLOROPHYLL A AND PHAEOPHYTIN (ug/l) - 1984 BASELINE

DATE	DEPTH (m)	CHLOROPHYLL A		PHAEOPHYTIN		FLUOROMETRIC VALUES (X 10^{-4})
		$\bar{x}$	SD	$\bar{x}$	SD	
March	1	1.20*	-	2.49	-	68
	3	1.02	0.04	2.28	1.06	69
	5	1.05	0.17	1.99	0.75	71
	8	0.76	0.03	1.40	0.29	65
	12	0.63	0.27	1.55	0.69	59
May	1	0.15	0.00	2.78	0.53	4
	3	1.07	0.19	1.73	0.65	12
	6	1.80	0.87	2.90	1.67	26
	9	0.63	0.12	2.12	0.30	16
	12	0.50*	-	3.11	-	11
July	1	0.50	0.03	1.86	0.39	39
	4	1.18	0.09	1.49	0.36	79
	6	1.21	0.08	1.43	0.31	104
	10	0.52	0.08	1.27	0.06	94
	13	0.25	0.20	1.00	0.22	95
	16	0.14	0.08	1.19	0.08	95
September	1	0.87	0.38	1.71	0.84	44
	4	1.16	0.03	1.30	0.12	47
	6	1.20	0.03	1.52	0.13	69
	9	0.37	0.06	1.60	0.12	53
	12	0.12	0.08	1.15	0.19	51
	15	0.20	0.06	0.90	0.08	50

*Remove chlorophyll a values when absorption ratio is significantly different

QUINSAM COAL DEVELOPMENT

TABLE 10(c) MIDDLE QUINSAM LAKE. CHLOROPHYLL A AND PHAEOPHYTIN (ug/l) - 1984 BASELINE

DATE	DEPTH (m)	CHLOROPHYLL A		PHAEOPHYTIN		FLUOROMETRIC VALUES (X 10^{-4})
		$\bar{x}$	SD	$\bar{x}$	SD	
March	1	0.51	0.03	0.99	0.18	35
	2	0.65	0.16	0.74	0.33	40
	3	0.85	0.16	2.13	1.16	42
	5	0.87	0.00	2.36	0.93	46
	8	0.67	0.07	1.90	0.64	39
May	1	0.35	0.03	1.58	0.25	5
	3	0.41	0.13	1.40	0.90	7
	5	0.66	0.14	1.55	0.40	16
	9	0.59	0.11	1.82	0.11	15
	12	0.71	0.30	1.52	0.59	11
July	1	0.43	0.11	1.16	0.27	22
	4	0.62	0.11	2.26	1.09	32
	8	1.05	0.16	2.21	0.77	53
	12	0.44	0.08	1.48	0.48	35
	15	0.32	0.05	1.61	0.46	33
September	1	0.64	0.05	0.78	0.15	29
	4	0.69	0.06	0.81	0.08	31
	8	0.46	0.03	1.05	0.13	24
	11	1.71	0.11	1.23	0.13	47
	14	0.37	0.00	1.07	0.14	31

QUINSAM COAL DEVELOPMENT

TABLE 10(d) NO NAME LAKE. CHLOROPHYLL A AND PHAEOPHYTIN (ug/l) - 1984 BASELINE

DATE	DEPTH (m)	CHLOROPHYLL A		PHAEOPHYTIN		FLUOROMETRIC VALUES (X 10^{-4})
		$\bar{x}$	SD	$\bar{x}$	SD	
March	1	0.89	0.04	2.16	0.38	63
	3	0.81*	0.19	2.24	0.92	73
	5	0.72	0.04	3.03	1.36	76
	7	0.74	0.07	3.65	0.84	65
	12	0.76	0.24	2.17	0.34	60
May	1	0.83	0.31	1.46	0.08	11
	4	1.42	1.11	3.65	3.28	30
	6	2.81*	0.07	2.93	0.30	54
	9	1.52	0.06	2.50	0.25	27
	14	0.85	0.25	1.79	1.35	14
July	1	0.59	0.09	0.96	0.20	39
	3	0.71	0.03	1.28	0.14	47
	5	1.41	0.16	1.78	0.19	77
	7	0.55	0.11	1.11	0.26	78
	10	0.27	0.06	1.38	0.08	81
	14	0.18	0.03	1.39	0.25	83
September	1	0.82	0.12	1.71	0.37	45
	4	1.03	0.06	1.52	0.30	49
	6	1.46	0.08	1.87	0.07	150
	9	1.21	0.06	2.35	0.48	58
	12	1.14	0.03	0.86	0.19	49
	15	0.45	0.37	1.60	0.34	47

*Remove chlorophyll a values when absorption ratio is significantly different

4.5 Zooplankton Abundance

TABLE 11(a)	GOOSENECK LAKE
TABLE 11(b)	LONG LAKE
TABLE 11(c)	MIDDLE QUINSAM LAKE
TABLE 11(d)	NO NAME LAKE

TABLE 11(a) GOOSENECK LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Rotifera								
Ploima								
Branchionidae								
Kellicottia	285	35	11800	6490	13100	7780	2170	1290
Keratella	20	35	204	235	679	407		
unknown rotifers							362	430
Crustacea								
Cladocera								
Holopedidae								
Holopedium	41	35			2110	944	6110	2150
Siddae								
Diaphanosoma			136	235	4980	2420	5570	1990
Daphnidae								
Daphnia	693	398	7510	6420	45300	7590	58000	15600
Bosminidae								
Eubosmina	407	215	29600	12400	2130	1150	679	815
Polyphemidae								
Polyphemus	20	20			102	41	68	31
Leptodoridae								
Leptodora					20	20	14	12
cladoceran juveniles	20	35	136	235	543	333		

CONTINUED...

TABLE 11(a) GOOSENECK LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE (Continued)

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Crustacea								
Eucopepoda								
Diaptomidae								
Diaptomus	7920	927	8500	6220	25800	9520	19700	3540
Cyclopidae								
Cyclops	4070	832	5950	2570	9780	3510	8600	1780
Macrocyclops							7	12
copepod namplii			29700	6560	3620	1360	45	136
Arachnoidea								
Acari					27	12		
Unionicolidae								
Unionicola					27	12		
Pionidae								
Forelia					20	20	14	12

TABLE 11(b) LONG LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Rotifera								
Ploima								
Branchionidae								
Kellicottia	1900	2240	49700	13300	47400	19600	2670	1100
Keratella			45	136				
unknown rotifers			951	611	181	296		
Crustacea								
Cladocera								
Holopedidae								
Holopedium			14300	6140	5030	1830	1540	835
Siddae								
Diaphanosoma			1450	1020	13300	2570	15500	5410
Daphnidae								
Daphnia	317	340	7830	2430	73600	15300	77600	19400
Bosminidae								
Eubosmina	679	576	3440	2250	4480	1750	3170	1170
Chydoridae								
Eurycercus	7	12	7	12				
Polyphemidae								
Polyphemus					41	20	48	12

CONTINUED...

TABLE 11(b) LONG LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE (Continued)

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Crustacea								
Cladocera								
Leptodoridae								
Leptodora					14	12		
cladoceran juveniles	46	136	1680	1230	680	456	906	883
Eucopepoda								
Diaptomidae								
Diaptomus	770	475	3850	1810	21100	5680	28200	5880
Cyclopidae								
Cyclops	8380	2920	19200	3580	8960	2460	3610	1890
Macrocyclops								
copepod namplii	11400	4670	6970	3190	65100	15200	2900	1390
Arachnoidea								
Acari	27	31	20	20	41	20	20	20
Unionicolidae								
Unionicola	7	12	7	12	14	24	48	31
Pionidae								
Forelia	27	24	7	12	68	12		
Insecta								
Diptera								
Culicidae								
Chaoborus					7	12		

TABLE 11(c) MIDDLE QUINSAM LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Rotifera								
Ploima								
Branchionidae								
Kellicottia	190	65	543	941	1460	980	3120	2440
Keratella	27	31	136	235	68	235	136	288
unknown rotifers	109	31	1090	622	1120	836	407	456
Crustacea								
Cladocera								
Holopedidae								
Holopedium	34	42	25400	23400	3970	1540		
Siddae								
Diaphanosoma					6720	2710	3670	977
Daphnidae								
Daphnia	326	54	7740	8140	78500	12400	38500	4250
Bosminidae								
Eubosmina	149	96	23200	5880	18300	4130	1630	865
Chydoridae								
Eurycercus							7	12
cladoceran juveniles							1630	934

CONTINUED...

TABLE 11(c) MIDDLE QUINSAM LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE (Continued)

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Crustacea								
Eucopepoda								
Diaptomidae								
Diaptomus	1280	250	3800	3290	25900	5590	39000	6580
Cyclopidae								
Cyclops	2240	582	4620	2950	2850	1090	272	353
Macrocyclops							34	42
copepod nauplii	41	71	1220	815	1430	1740	860	378
Arachnoidea								
Acari	27	12	41	-	36	20	7	12
Unionicolidae								
Unionicola			20	-	10	20	7	12
Pionidae								
Forelia	20	20			36	59		
Insecta								
Diptera								
Culicidae								
Chaoborus					10	12		
Chironomidae							7	12

TABLE 11(d) NO NAME LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Rotifera								
Ploima								
Branchionidae								
Kellicottia	8740	4260	14600	7280	32600	6520	13200	6150
unknown rotifers							136	288
Crustacea								
Cladocera								
Holopedidae								
Holopedium					5810	3700	996	615
Siddae								
Diaphanosoma					11900	15900	7560	2090
Daphnidae								
Daphnia	453	592	226	461	40600	55900	77300	8930
Bosminidae								
Eubosmina	724	445	46	136	6400	4220	4570	1680
cladoceran juveniles	272	353	45	136				

CONTINUED...

TABLE 11(d) NO NAME LAKE. ZOOPLANKTON ABUNDANCE (individuals/m^2) - 1984 BASELINE (Continued)

CLASS ORDER FAMILY GENUS	MARCH		MAY		JULY		SEPTEMBER	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Crustacea								
Eucopepoda								
Diaptomidae								
Diaptomus	3120	2360	453	801	2850	1870	11800	4490
Cyclopidae								
Cyclops	38600	7390	126000	19300	31600	14100	13900	3320
Macrocyclops								
copepod nauplii	32500	7320	5250	4410	326000	125000	187000	47500
Arachnoidea								
Acari							88	51
Unionicolidae								
Unionicola							88	31
Insecta								
Diptera								
Chironomidae			7	12				

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2. Sneddon, H. and B.W. Kelso, 1983. A Data Report on Water Quality of the Receiving Waters of the Area Around the Proposed Quinsam Coal Development. D.O.E., Environmental Protection Service, Pacific and Yukon Region.

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APPENDIX I

BIOLOGICAL DATA - 1983 BASELINE

APPENDIX I BIOLOGICAL DATA - 1983 BASELINE

Biological samples collected in June 1983 were not completely analysed prior to the publication of the September 1982, "A Data Report on Water Quality of the Receiving Waters of the Area Around the Proposed Quinsam Coal Development", by H. Sneddon and B.W. Kelso. Biological data obtained from this survey is presented in Appendix I.

A) Phytoplankton

B) Zooplankton

QUINSAM COAL DEVELOPMENT

TABLE A1 PHYTOPLANKTON SPECIES LIST AND OCCURRENCE - JUNE 1983 BASELINE

PHYLA	STATION			
	GOOSENECK LAKE	LONG LAKE	MIDDLE QUINSAM LAKE	NO NAME LAKE
1) BACILLARIOPHYCEAE				
Asterionella formosa	X			
Cyclotella sp. A	X	X	X	X
Diatoma tenue var elongatum	X			
Gomphonema germinatum			X	
Melosira granulata	X	X	X	X
Melosira granulata var augustissima		X		X
Navicula sp	X			
Nitzschia palea	X		X	
Synedra ulna	X			
Tabellaria fenestrata	X			
2) CHLOROPHYTA				
Staurastrum sp			X	
Chlorogonium sp	X	X	X	
Elakatothrix sp	X	X		X
Oocystis sp	X	X		X
Scenedesmus sp			X	
Crucigenia tetrapedia	X	X		X
Cosmarium sp				X
Closterium sp		X		
3) CYANOPHYTA				
Gloecapsa sp	X	X	X	
Merismopedia sp		X		X
Aphanocapsa sp				X

CONTINUED...

TABLE A1 PHYTOPLANKTON SPECIES LIST AND OCCURRENCE - JUNE 1983 BASELINE (Continued)

PHYLA	STATION			
	GOOSENECK LAKE	LONG LAKE	MIDDLE QUINSAM LAKE	NO NAME LAKE
3) CYANOPHYTA (continued)				
Gloeothece sp				X
unidentified sp		X		X
Chrococcus sp	X	X		
4) CHRYSOPHYTA				
Diceras sp			X	
Dinobryon bavaricum		X		
Dinobryon sertularia	X		X	
Mallamonas sp		X	X	X
Ochromonas sp	X	X	X	X
Chrysochromulina sp		X		X
Chrysosphaerella sp		X		
5) PYRRHOPHYTA				
Ceratium sp			X	
6) CRYPTOPHYTA				
Cryptomonas borealis	X		X	X
Chroomonas acuta	X	X	X	X

QUINSAM COAL DEVELOPMENT

TABLE A2 PHYTOPLANTKON BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - JUNE 1983 BASELINE

STATION	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Gooseneck Lake	4	28.8	1.53	1.61	68.8	0	18.2	119
	5	35.2	0.66	0.18	123	0	11.2	170
	6	29.0	0.43	0.53	45.0	0	24.7	99.6
	$\bar{x}$ (SD)	31.0 (3.6)	0.87 (0.58)	0.77 (0.75)	78.9 (40)	0 (0)	18.0 (6.8)	130 (36)
Long Lake	2	121	19.4	4.86	22.1	0	3.14	171
	4	277	3.13	7.50	74.5	0	3.73	366
	5	81.0	0.57	22.4	2.49	0	5.30	112
	$\bar{x}$ (SD)	160 (104)	7.70 (10)	11.6 (9.5)	33.0 (37)	0 (0)	4.06 (1.1)	216 (133)
Middle Quinsam Lake	1	40.4	0	1.74	169	65.4	12.7	290
	3	49.6	6.04	1.61	26.4	87.6	20.0	191
	7	43.1	1.81	0	3.92	0	86.7	135
	$\bar{x}$ (SD)	44.4 (4.7)	2.62 (3.1)	1.12 (0.97)	66.4 (90)	51.0 (46)	39.8 (41)	205 (78)
No Name Lake	1	116	1.48	2.05	47.3	0	19.2	186
	4	74.6	3.64	2.88	66.1	0	5.49	153
	$\bar{x}$ (SD)	95.3 (29)	2.56 (1.5)	2.47 (0.59)	56.7 (13)	0 (0)	12.3 (9.7)	170 (23)

QUINSAM COAL DEVELOPMENT

TABLE A3 PHYTOPLANKTON ABUNDANCE (cells/ml) - JUNE 1983 BASELINE

STATION	DEPTH (m)	BACILLARIOPHYCEAE	CHLOROPHYTA	CYANOPHYTA	CHRYSOPHYTA	PYRRHOPHYTA	CRYPTOPHYTA	TOTAL
Gooseneck Lake	4	25	3	22	142	0	27	219
	5	31	11	3	163	0	23	231
	6	28	8	9	109	0	43	196
	$\bar{x}$ (SD)	28 (3.0)	7.3 (4.0)	11.3 (9.7)	138 (27)	0 (0)	31 (11)	215 (18)
Long Lake	2	135	37	556	198	0	35	961
	4	303	61	591	264	0	41	1260
	5	92	20	1820	124	0	59	2120
	$\bar{x}$ (SD)	177 (112)	39.3 (21)	989 (720)	195 (70)	0 (0)	45 (12)	1450 (601)
Middle Quinsam Lake	1	44	0	17	234	1	32	328
	3	55	1	16	137	1	32	242
	7	30	4	0	81	0	61	175
	$\bar{x}$ (SD)	43.0 (13)	1.67 (2.1)	11.0 (9.5)	151 (77)	0.67 (0.58)	41.7 (16.7)	248 (77)
No Name Lake	1	109	28	5220	85	0	37	5480
	4	65	11	6400	48	0	19	6540
	$\bar{x}$ (SD)	87.0 (31)	19.5 (12)	5810 (830)	66.5 (26)	0 (0)	28.0 (13)	6010 (750)

TABLE A4(a) DOMINANT PHYTOPLANKTON SPECIES, RANKED WITH RESPECT TO BIOVOLUME ($cm^3/m^3 \times 10^{-3}$) - JUNE 1983 BASELINE

GOOSENECK LAKE		LONG LAKE		MIDDLE QUINSAM LAKE		NO NAME LAKE	
Species	Biovol	Species	Biovol	Species	Biovol	Species	Biovol
Dinobryon sertularia	77.3	Melosira granulata	109	Dinobryon sertularia	94.3	Melosira granulata	89.5
Melosira granulata	23.6	Melosira granulata var augustissima	45.2	Ceratium hirundinella	76.5	Merismopedia sp	53.1
Cryptomonas borealis	16.0	Chyrsosphaerella sp	33.8	Cryptomonas borealis	37.8	Cryptomonas borealis	10.3
Tabellaria fenestrata	5.84	Closterium sp	17.8	Cyclotella sp A	23.0	Melosira granulata var augustissima	7.98

(b) DOMINANT PHYTOPLANKTON SPECIES, RANKED WITH RESPECT TO ABUNDANCE (cells/ml) - JUNE 1983 BASELINE

GOOSENECK LAKE		LONG LAKE		MIDDLE QUINSAM LAKE		NO NAME LAKE	
Species	No.	Species	No.	Species	No.	Species	No.
Ochromonas sp	83	Merismopedia sp	682	Ochromonas sp	103	Merismopedia sp	5310
Dinobryon sertularia	55	Aphanocapsa sp	288	Dinobryon sertularia	67	Aphanocapsa sp	985
Chroomonas acuta	22	Ochromonas sp	161	Cyclotella sp A	28	Melosira granulata	78
Melosira granulata	21	Melosira granulata	95	Chroomonas acuta	22	Ochromonas sp	59

QUINSAM COAL DEVELOPMENT

TABLE A5 CHLOROPHYLL A AND PHAEOPHYTIN (ug/l) - JUNE 1983 BASELINE

STATION	DEPTH (m)	CHLOROPHYLL A		PHAEOPHYTIN	
		$\bar{x}$	SD	$\bar{x}$	SD
Gooseneck Lake	2	0	0	< 1.07	0
	4	0.54	0.71	1.46	0.70
	5	0.80	0.47	1.09	1.03
	6	0.62	0.67	1.25	0.95
	11	0.62	0.67	1.31	0.87
	14	0.62	0.67	1.31	0.87
Long Lake	1	0.53	0.27	1.28	0.63
	2	0.80	0	0.51	0.19
	4	0.53	0	1.71	1.17
	5	1.07	0	1.24	0.28
	9	0.27	0.27	0.71	0.34
	12	0.09	0.16	1.08	0.23
Middle Quinsam Lake	1	0.71	0.16	1.03	0.43
	3	0.98	0.16	1.14	0.19
	4	0.53	0	1.40	0.47
	6	0.44	0.15	0.74	0.06
	7	0.89	0.16	0.92	0.06
	9	0.62	0.16	1.62	0.70
No Name Lake	0	1.60	-	0.83	-
	1	1.60	-	0.83	-
	3	1.60	-	1.39	-
	4	1.87	-	0.75	-
	5	2.41	-	1.34	-
	8	2.67	-	2.00	-

TABLE B1 ZOOPLANKTON ABUNDANCE (individuals/m^2) - JUNE 1983 BASELINE

CLASS ORDER FAMILY GENUS	GOOSENECK LAKE		LONG LAKE		MIDDLE QUINSAM LAKE		NO NAME LAKE	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Rotifera								
Ploima								
Branchionidae								
Kellicottia	8060	3100	32800	7000	3330	2100	25500	5200
Keratella	2430	1000	1590	1000	215	460	360	580
Gastropodidae								
Ascomorpha	2430	2500	12800	4000	20600	2600	72	220
Floscullariacea								
Conochilidae								
Conochilus	3260	2300	40900	16400	41500	18600	77300	27300
unknown rotifers	845	570	505	630	725	890	870	730
Crustacea								
Cladocera								
Holopedidae								
Holopedium	1180	3700	20700	6000	1520	1200	8040	2700
Siddae								
Diaphanosoma	865	2300	16000	3500	650	860	20500	5800

CONTINUED...

TABLE B1 ZOOPLANKTON ABUNDANCE (individuals/m^2) - JUNE 1983 BASELINE (Continued)

CLASS ORDER FAMILY GENUS	GOOSENECK LAKE		LONG LAKE		MIDDLE QUINSAM LAKE		NO NAME LAKE	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Crustacea								
Daphnidae								
Daphnia longiremus			3840	2700			15900	3900
D. rosea	16400	4500	6230	2600	6230	2400	13500	2400
Bosminidae								
Eubosmina	7410	3300	7530	2700	650	650	9240	3000
cladoceran juveniles	535	820	3190	950	870	800	1160	910
Eucopepoda								
Diaptomidae								
Diaptomus	10000	2600	22200	3900	32500	6000	37100	5600
Cyclopidae								
Cyclops	11000	3700	1590	1600	6740	1800	51000	9400
copepod nauplii	164000	39000	89800	20400	99700	13500	28900	8800
Insecta								
Baetidae	120	260						
Phytoplankton								
Pyrrhophyta	102000	59000	68400	14400	1880000	252000	457000	76600