DEPARTMENT OF THE ENVIRONMENT
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC REGION

PROGRESS REPORT NO. 3 - SEPTEMBER 1983
WATER QUALITY SAMPLING IN MYRA CREEK
AT WESTMIN RESOURCES LTD. MINE
ON VANCOUVER ISLAND

Regional Program Report 85 - 06

By

B. Godin
M. Ross
M. Jones

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1 INTRODUCTION

Westmin Resources Ltd., in August 1982, had installed a system of surface and groundwater collection and treatment systems for leachate and surface runoff. The water was found to be contaminated by zinc and copper and draining into Myra Creek.

The present study, third of a series of progress reports, focuses on the development of the water quality in Myra Creek as a result of the water collection system. The first survey done in December 1982, was reported by Kelso and Jones (1982). The second was conducted in May 1983 and published in 1984 by M. Ross. The comparison of the water quality will be based on the second report.

Evaluation of the receiving water quality of Myra Creek will be reviewed in a future report, once all installation works have been completed.

2 MATERIAL AND METHODS

Westmin Resources is located on Vancouver Island in Strathcona Provincial Park, southwest of Buttle Lake (Figure 1).

Conductivity and temperature were recorded in transects across Myra Creek with a Hydrolab digital 4041 indicator unit and 4021 sonde unit at sites above and below the Westmin treatment and collection works. The results of this initial conductivity survey were then used to determine water chemistry sampling sites (Figure 2).

Water chemistry data were collected from September 27 to September 29 inclusive. Each site was sampled in the morning and afternoon in order to determine if pollutant concentrations varied during the day. For three days, morning and afternoon, at each of the seven water chemistry sampling sites, conductivity and temperature were recorded with the Hydrolab unit and field pH was recorded with a Metrohm pH meter, Model E588. Replicated grab samples were collected using a modified version of a replicated grab sampler reported by Oguss and Erlebach (1976). Six, one litre samples were collected simultaneously at each site and three of these were individually analyzed for conductivity, turbidity, residues and sulphates. Each of the remaining three, one litre bottles were used to fill two 250 ml bottles. One 250 ml sample was analyzed for total metals and the other was analyzed for dissolved metals.

The conductivity, turbidity, residues and sulphate samples were kept cool with ice until analyzed. Total metal samples of 250 ml each were preserved on site with one ml of nitric acid. Dissolved metal samples of 100 ml each were filtered on site through a 0.45 micron cellulose nitrate filter and then preserved with 0.5 ml nitric acid. All samples were delivered to the Environmental Protection Service/Department of Fisheries and Oceans Laboratory in West Vancouver by September 30, 1983.

For analytical methods refer to the Environment Canada Pacific Region Environmental Laboratory Manual (Anon, 1979). Laboratory conductivity results are reported in Appendix II and served only as an instrument

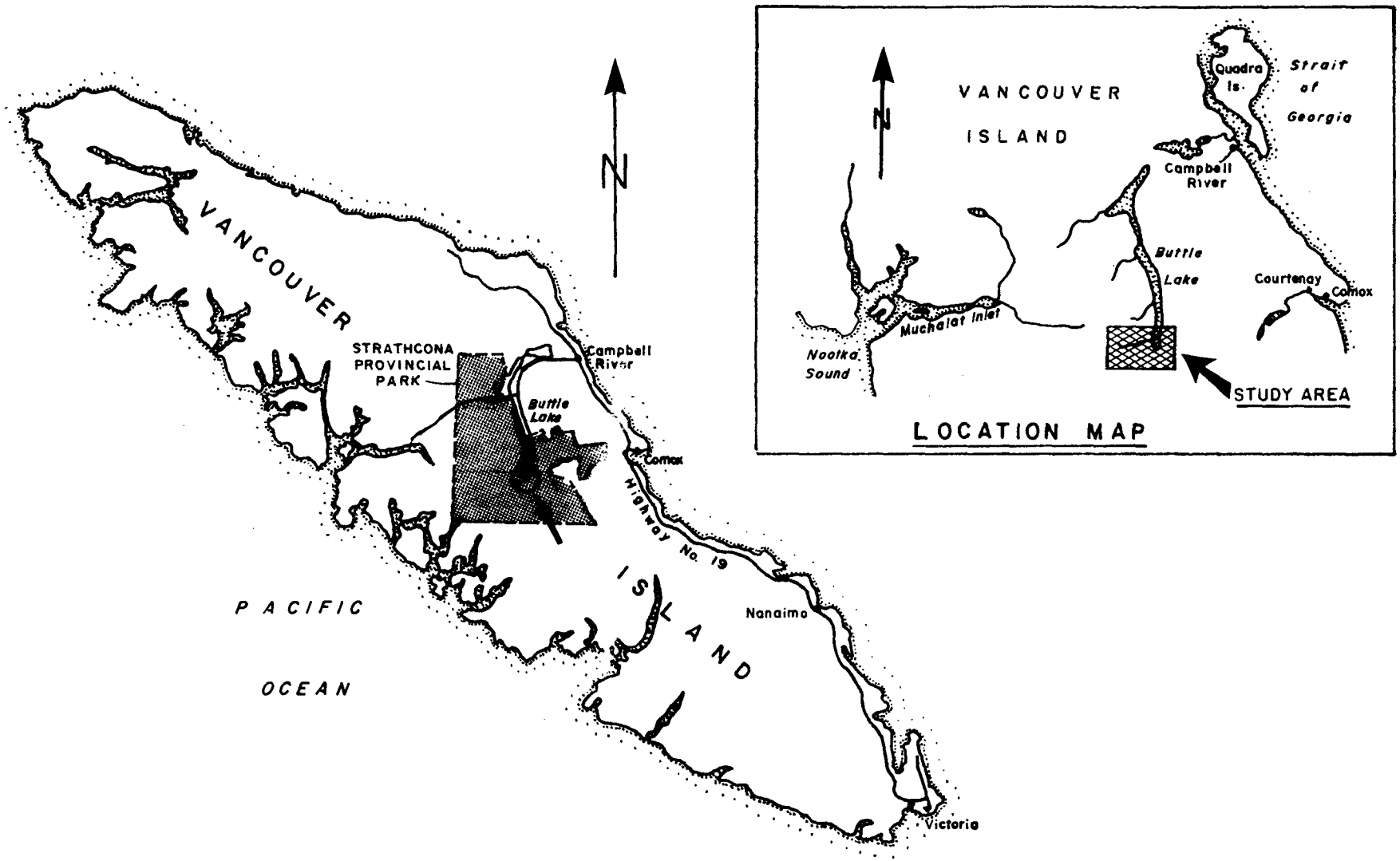

FIGURE 1 LOCATION OF WESTMIN RESOURCES LTD. MINING OPERATION

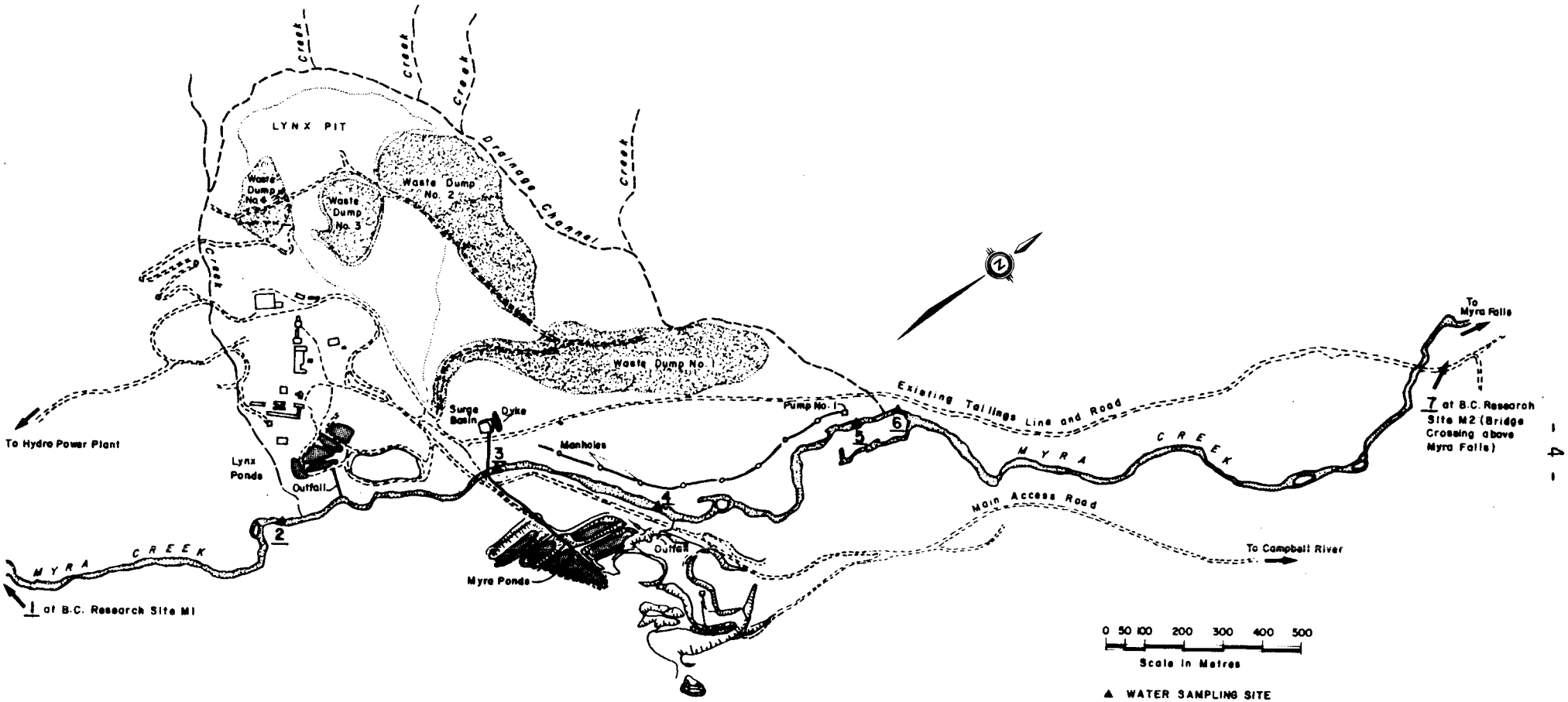

FIGURE 2 LOCATION OF WATER SAMPLING STATIONS IN MYRA CREEK - September 27 to September 29, 1983

check for the Hydrolab unit. The Inductively Coupled Argon Plasma or ICAP scan, an automated atomic emissions spectrophotometer, which gives a reading of twenty-six metals, was used for the total and dissolved metal analysis. If the copper, lead or cadmium readings were below the ICAP detection limit, the samples were rerun on the graphite furnace of the atomic absorption spectrophometer to obtain a lower detection limit.

From September 27 to September 29 inclusive, Sirco model #MK-7 sampler was set each morning to collect one sample per hour over a 24-hour period. On September 27 to 29, samples from three consecutive hours were combined, mixed and then split to provide three replicate samples for total metal analysis.

A grab sample was collected on September 18 along the south bank of site #4 to determine the chemical parameter responsible for high conductivity readings.

Replicated grab samples were collected from the Campbell River at the Gold River Bridge and from the Campbell River in Elk Falls Provincial Park on September 29, 1983 (Figure 3).

Flow measurements were performed with a Teledyne Gurley current meter #622.

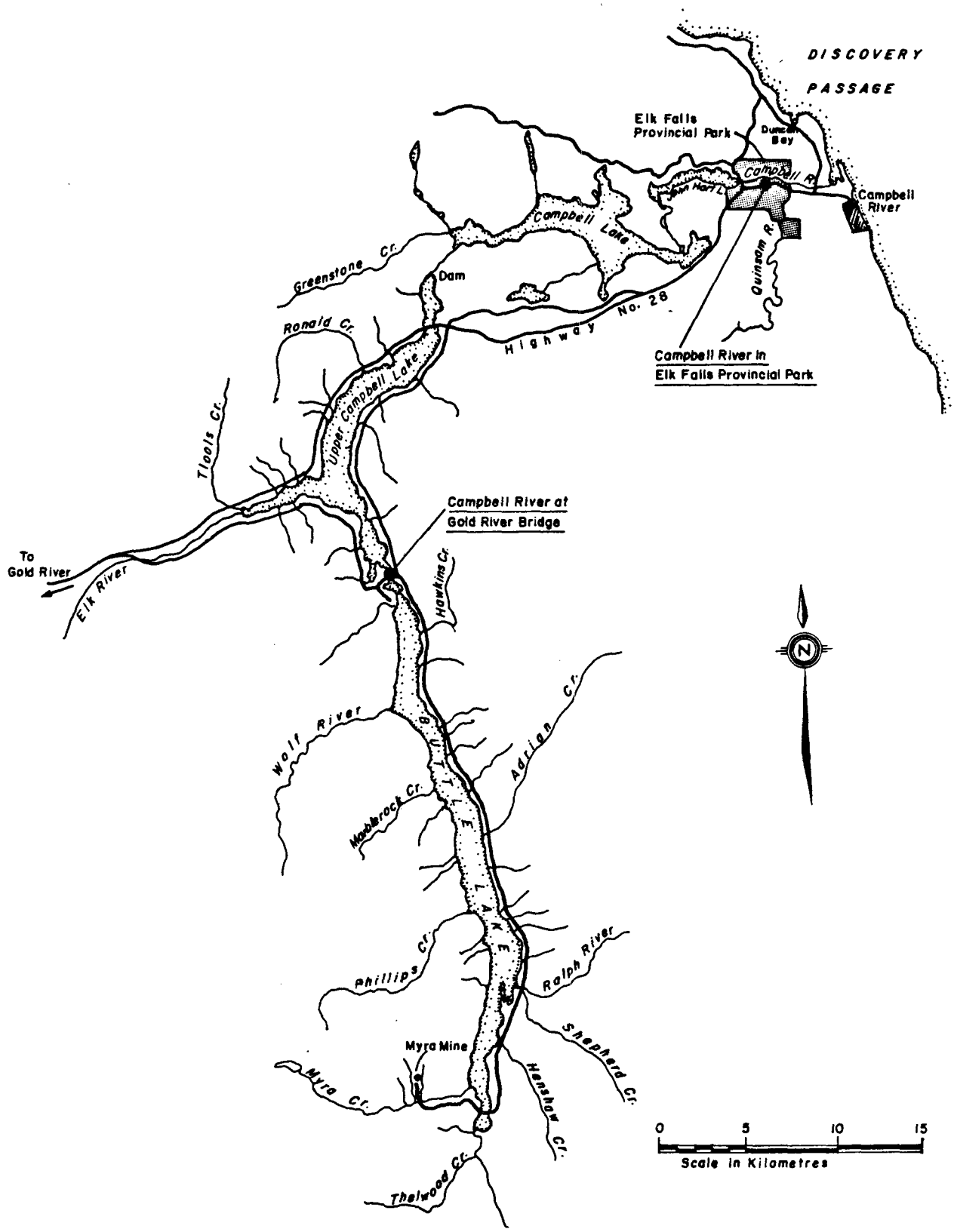

FIGURE 3 LOCATION OF CAMPBELL RIVER SITES

3 RESULTS

3.1 Water Chemistry Study - September 27-30, 1983

3.1.1 Conductivity. Conductivity readings increased from Stations 1 and 2, (above the mine) to Station 7 (Myra Falls) near Buttle Lake (Table 1). The values ranged from 24 uS/cm to 212 uS/cm on Myra Creek during the three day survey. Most of the change in conductivity occurred between Stations 2 and 3 where the levels rose from 24-26 uS/cm to 77-96 uS/cm; an increase of 3 to 4 times. The second major increase occurred between Stations 4 and 5 where the levels changed from 79-103 uS/cm to 162-196 uS/cm respectively. The Myra Pond effluent outlet is between the two stations where the increases occur. The conductivity increase is 5 to 6 times higher at Station 7 (170-212 uS/cm) than at Station 1 (33-39 uS/cm).

The September results are 2 to 3 times higher than those found in May 1983 (Ross 1983).

The conductivity taken on the south bank above Myra pond discharge shows high deviation from the other values of the stream transect. That value could be influenced by seepage from the Myra tailings pond or a back eddie of the Myra pond outfall.

3.1.2 Temperature. The temperature followed a constant increase from Station 1 to 7 (Table 1). The creek was 3°C to 4°C warmer than in May 1983 with temperature ranging from 5.1°C (Station 1) to 9.3°C (Station 7) within the three day survey.

3.1.3 Residues. The non-filterable residues were always below the detection limit of 5 mg/l (Table 2).

Filterable residue reached peak level on the afternoon of September 28 and decreased slowly, while Station 1 increased throughout the survey from 23 mg/l to 32 mg/l. Station 7 had, overall, 4 times more

TABLE 1 MEAN FIELD CONDUCTIVITY (uS/cm) AND TEMPERATURE (°C) READINGS ACROSS SEVEN MYRA CREEK STATIONS FROM NORTH SHORE TO SOUTH SHORE - SEPTEMBER 27 TO 29, 1983

SEPTEMBER 27, 1983														
	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion		7 M2	
Time	10:35		11:20		12:35		13:20		14:10		14:20		14:35	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
					77	8.0	77	8.5	163	9.3	163	9.2		
					77	7.9	80	8.4	162	9.0	165	9.0		
	33	6.3	24	7.6	77	7.9	80	8.3	162	8.9	160	9.0	170	9.3
					77	7.8	78	8.2	161	8.9	170	9.0		
					78	7.8	112	8.3	161	8.9	169	8.9		
$\bar{x}$	33		24		77		79*		162		165		170	

A = Field Conductivity North to South
B = Temperature North to South
*Not including elevated conductivity value from the south bank.
Note: Where Myra Pond effluent empties into Myra Creek, conductivity in the creek was 212 uS/cm.

CONTINUED...

TABLE 1 MEAN FIELD CONDUCTIVITY (uS/cm) AND TEMPERATURE (°C) READINGS ACROSS SEVEN MYRA CREEK STATIONS FROM NORTH SHORE TO SOUTH SHORE - SEPTEMBER 27 TO 29, 1983 (Continued)

SEPTEMBER 28, 1983														
	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion		7 M2	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Time	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
	33	5.3	26	7.0	97 96 95 94 95	8.0 7.3 7.3 7.3 7.3	95 101 102 104 147	8.0 7.8 7.7 7.6 7.9	197 196 196 196 197	9.7 8.4 8.3 8.3 8.3	200 200 200 199 201	8.3 8.3 8.3 8.2 8.2	205	8.3
$\bar{x}$	33		26		95		101*		196		200		205	
Time	14:10		14:30		15:20		15:30		16:00		16:10			
	36	5.6	25	7.6	87 88 88 88 88	7.9 7.8 7.7 7.7 7.7	90 95 93 98 146	8.1 8.0 8.0 7.9 8.1	182 183 183 184 192	8.7 8.6 8.5 8.5 8.5	205 208 207 207 207	8.6 8.6 8.6 8.6 8.6	212	8.8
$\bar{x}$	36		25		88		94*		185		207		212	

A = Field Conductivity North to South
B = Temperature North to South
*Not including elevated conductivity value from the south bank.

CONTINUED...

TABLE 1 MEAN FIELD CONDUCTIVITY (uS/cm) AND TEMPERATURE (°C) READINGS ACROSS SEVEN MYRA CREEK STATIONS FROM NORTH SHORE TO SOUTH SHORE - SEPTEMBER 27 TO 29, 1983 (Continued)

SEPTEMBER 29, 1983														
	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion		7 M2	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Time	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
	36	5.1	25	7.2	97 92 93 93 92	7.6 7.4 7.4 7.4 7.4	97 103 104 105 105	7.7 7.7 7.6 7.6 7.9	164 170 170 171 173	8.8 8.3 8.3 8.3 8.3	176 177 179 179 178	8.4 8.2 8.2 8.2 8.2	186	8.5
$\bar{x}$	36		25		93		103		170		178		186	
Time	14:45		15:10		15:30		15:45		15:55		16:15			
	39	5.5	26	7.9	98 94 92 93 93	8.2 8.0 8.0 8.0 8.0	94 99 103 106 182	8.4 8.3 8.3 8.2 8.4	177 177 176 176 176	8.9 8.7 8.7 8.7 8.7	182 182 181 181 182	8.9 8.8 8.8 8.8 8.8	185	8.9
$\bar{x}$	39		26		94		101*		176		182		185	

A = Field Conductivity North to South
B = Temperature North to South
*Not including elevated conductivity value from the south bank.

TABLE 2 MEAN RESIDUE CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS																				
	1 M1			2 Above Lynx Pond			3 Below Lynx Pond			4 Above Myra Ponds			5 Pumphouse			6 Below Diversion Ditches			7 M2		
	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.
Sept. 27, A.M.	10:35			11:20			12:35			13:20			14:10			14:20			15:35		
$\bar{x}$	23	< 5	23	19	< 5	19	49	< 5	49	48	< 5	48	100	< 5	100	95	< 5	95	97	< 5	97
s	2	0	2	4	0	4	1	0	1	1	0	1	4	0	4	4	0	4	4	1	4
Sept. 28, A.M.	10:10			10:45			11:35			12:00			12:35			12:50			13:30		
$\bar{x}$	23	< 5	25	10	< 5	10	50	< 5	50	54	< 5	54	110	< 5	110	106	< 5	106	114	< 5	116
s	5	1	3	3	0	3	2	0	2	1	0	1	1	0	1	3	0	3	2	0	3
Sept. 28, P.M.	14:10			14:50			15:20			15:20			16:00			16:10			17:00		
$\bar{x}$	23	< 5	26	20	< 5	21	60	< 5	60	58	< 5	60	112	< 5	116	123	< 5	123	125	< 5	125
s	2	3	2	2	1	2	3	0	3	2	2	2	6	1	6	2	0	2	1	0	1

CONTINUED...

TABLE 2 MEAN RESIDUE CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS																				
	1 M1			2 Above Lynx Pond			3 Below Lynx Pond			4 Above Myra Ponds			5 Pumphouse			6 Below Diversion Ditches			7 M2		
	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.	F.	NF.	T.
Sept. 29, A.M.	10:00			10:25			11:10			11:20			12:25			12:35			14:05		
$\bar{x}$	30	< 5	30	26	< 5	26	58	< 5	58	56	< 5	56	102	< 5	102	107	< 5	107	119	< 5	119
s	1	0	1	3	0	3	5	0	5	4	0	4	3	0	3	5	0	5	1	0	1
Sept. 29, P.M.	14:45			15:10			15:30			15:45			15:55			16:10			16:45		
$\bar{x}$	32	< 5	32	30	< 5	30	61	< 5	61	57	< 5	57	108	< 5	108	109	< 5	109	117	< 5	117
s	2	0	2	2	0	2	6	0	6	1	0	1	2	0	2	2	0	2	2	0	2
Overall																					
$\bar{x}$	26	< 5	27	21	< 5	21	56	< 5	56	55	< 5	55	106	< 5	107	108	< 5	108	114	< 5	115
s	4	1	4	7	0	7	6	0	6	4	1	4	6	1	7	10	0	10	10	0	9

F. = Filterable
NF. = Non-Filterable
T. = Total
s = Standard Deviation

Note: To calculate mean and standard deviation, one half the detection limit (2.5 mg/l) was used when sample concentrations were less than the detection limit (< 5 mg/l).

filtrate in solution with values ranging from 97 mg/l to 125 mg/l. The filterable residue increased sharply at two points between Stations 2 and 3, where the Lynx outfall is located, and Stations 4 and 5, where the Myra pond discharges. For both areas, the downstream station doubled the value of the immediate upstream station. The levels have increased since the May 1983 survey (Ross 1983) by 1.2 to 3.1 times overall.

3.1.4 Sulfate. The level of sulfate increased above the controls at each station during the three day survey and peaked on September 28 in the afternoon sampling (Table 3). The overall levels at Station 7 (50.4 mg/l) were 10 times higher than Station 1 (4.8 mg/l). The same pattern of increase as the conductivity and residue is noticed between Station 2 and 3 (3 times), as well as between Stations 4 and 5 (3 times).

When compared with the May 1983 overall results (Ross 1983), a small increase of 2.4 mg/l at Station 1 and 38.4 mg/l at Station 7, is found.

3.1.5 pH. The overall pH showed a drop of 0.3 pH unit between Stations 1 and 2 (Table 4). There was a slight increase at Station 3 of 0.2 pH unit; and the level was maintained on Myra Creek at the mine site at the 6.9 level. At Station 7, pH dropped 0.2 pH unit.

The pH was closer to neutrality than that seen in the May 1983 sampling survey (Ross 1983), where it was slightly more acidic.

3.1.6 Hardness. The hardness showed the same pattern fluctuation as conductivity, residue and sulfate. Peak values were seen on September 28 in the afternoon (Table 5). Hardness increased between Station 2 and 3, with an overall mean of 10.05 mg/l and 36.61 mg/l respectively. Stations 4 and 5, with an overall mean of 30.33 mg/l and 65.27 mg/l respectively, shows also the effect of the Myra pond effluent. The September hardness levels are higher, compared to May 1983 (Ross 1983). The overall levels ranged from 8.61 to 17.60 mg/l in May and 13.52 to 70.80 mg/l in September.

TABLE 3 MEAN SULPHATE CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27 THROUGH TO SEPTEMBER 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS						
	1 M1	2 Above Lynx Pond	3 Below Lynx Pond	4 Above Myra Pond Discharge	5 Pumphouse	6 Below Diversion Ditch	7 M2
Sept. 27, A.M.	10:35	11:20	12:35	13:20	14:10	14:20	15:35
$\bar{x}$	4.8	4.9	13.5	12.2	43.6	44.7	47.5
s	0.2	0.5	0.4	0.3	1.5	0.8	1.0
Sept. 28, A.M.	10:10	10:45	11:35	12:00	12:35	12:50	13:30
$\bar{x}$	4.3	3.9	15.6	15.8	51.4	53.0	53.2
s	0.7	1.4	0.6	0.3	1.8	0.9	1.0
Sept. 28, P.M.	14:10	14:50	15:20	15:20	16:00	16:10	17:00
$\bar{x}$	7.2	7.1	15.6	15.3	52.5	55.5	57.2
s	0.9	1.8	0.3	0.4	0.5	0.9	1.2
Sept. 29, A.M.	10:00	10:25	11:10	11:20	12:25	12:35	14:05
$\bar{x}$	3.9	3.8	15.3	15.0	44.7	45.3	45.3
s	0.2	0.4	0.2	0.1	0.3	1.2	1.4
Sept. 29, P.M.	14:45	15:10	15:30	15:45	15:55	16:10	16:45
$\bar{x}$	3.6	3.3	15.0	15.1	42.0	46.7	49.0
s	0.3	0.7	0.1	0.1	1.8	1.0	1.5
Overall							
$\bar{x}$	4.8	4.6	15.0	14.7	46.9	49.0	50.4
s	1.4	1.7	0.9	1.4	4.6	4.6	4.5

s = standard deviation

TABLE 4 MEAN FIELD PH (relative units) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27 THROUGH TO SEPTEMBER 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS						
	1 M1	2 Above Lynx Pond	3 Below Lynx Pond	4 Above Myra Pond Discharge	5 Pumphouse	6 Below Diversion Ditch	7 M2
Sept. 27, A.M. $\bar{x}$	10:35 7.0	11:20 7.1	12:35 7.0	13:20 7.1	14:10 7.2	14:20 7.1	15:35 7.1
Sept. 28, A.M. $\bar{x}$	10:10 7.0	10:45 6.5	11:35 7.2	12:00 7.0	12:35 6.9	12:50 6.8	13:30 6.7
Sept. 28, P.M. $\bar{x}$	14:10 6.9	14:50 6.7	15:20 6.7	15:20 6.7	16:00 6.8	16:10 6.8	17:00 6.7
Sept. 29, A.M. $\bar{x}$	10:00 7.1	10:25 6.8	11:1 6.5	11:20 6.7	12:25 6.8	12:35 6.9	14:05 6.7
Sept. 29, P.M. $\bar{x}$	14:45 7.3	15:10 7.0	15:30 7.2	15:45 6.9	15:55 6.9	16:10 6.9	16:45 6.7
Overall $\bar{x}$	7.0	6.7	6.9	6.9	6.9	6.9	6.7

$$\bar{x} = \log_{10} \frac{n}{\sum_{i=1}^{n} \frac{1}{10^{pH_i}}}$$

TABLE 5 MEAN HARDNESS CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Ponds		5 Pumphouse		6 Below Diversion Ditches		7 M2	
	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	11.67	11.70	9.63	9.73	27.03	27.23	26.07	26.23	58.23	58.60	60.10	60.67	63.93	64.60
s	0.06	0.10	0.04	0.05	0.38	0.38	0.06	0.12	0.15	0.10	0.36	0.38	0.47	0.46
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	13.33	13.43	9.96	10.13	32.40	32.70	31.77	31.93	70.06	70.50	72.43	73.10	73.87	74.73
s	0.15	0.15	0.03	0.06	0.36	0.36	0.06	0.12	0.25	0.26	0.12	0.10	0.31	0.25
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	13.40	13.53	10.15	10.25	30.13	30.37	30.70	30.83	71.57	72.17	74.30	75.10	76.17	77.07
s	0.10	0.06	0.07	0.05	0.06	0.06	0.17	0.12	0.25	0.25	0.36	0.36	0.32	0.32

CONTINUED...

TABLE 5 MEAN HARDNESS CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Ponds		5 Pumphouse		6 Below Diversion Ditches		7 M2	
	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total	Ca Mg	Total
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	14.23	14.40	9.87	10.00	31.43	31.67	30.93	31.13	60.60	62.07	63.73	64.30	68.27	69.07
s	0.06	0.10	0.05	0	0.23	0.21	0.06	0.06	0.10	0.15	0.45	0.50	0.23	0.23
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	14.40	14.53	10.03	10.20	31.00	31.23	31.33	31.53	62.60	63.00	64.70	65.27	67.80	68.53
s	0.10	0.15	0.06	0	0.17	0.21	0.06	0.06	0.26	0.26	0.10	0.06	0.52	0.55
Overall														
$\bar{x}$	13.41	13.52	9.91	10.05	30.40	30.61	30.16	30.33	64.81	65.27	67.05	67.69	70.01	70.80
s	1.01	1.05	0.18	0.20	1.91	1.92	2.15	2.16	5.32	5.38	5.61	5.69	4.59	4.67

s = Standard Deviation

3.1.7 Copper. At Stations 1 and 2, the copper levels were below detection limit of 0.001 mg/l, for both total and dissolved (Table 6). The first appearance of detectable copper was found below the Lynx pond (Station 3) with a level of 0.005 mg/l. A second increase in the total copper level was found between Stations 4 and 5 with an overall increase of 0.004 mg/l, and third one between Stations 5 and 6, with an overall increase of 0.003 mg/l. An overall dissolved concentration of 0.009 mg/l was found at Station 7. The total copper reading is 0.003 to 0.004 mg/l higher than the dissolved copper. The peak copper values occurred on the afternoon sampling September 28.

The comparison between grab sample and 72 hours sampling at Station 7 (Table 7), did not show significant differences. The average values ranged from 0.008 mg/l to 0.017 mg/l of total copper. The Sirco results showed more variability than the May 1983 Sirco results, with coefficient of variation from 7 to 40% in September, compared to 0 to 20% variation in May 1983 (Ross 1983).

3.1.8 Zinc. The average total zinc levels ranged from less than 0.002 to 0.231 mg/l (Table 8), corresponding to the increase from Station 2 to Station 7 respectively. The total mean zinc level increase, between Station 2 and 3, was 13 times from 0.003 to 0.039 mg/l. The concentration of zinc decreased to an overall average of 0.024 mg/l at Station 4. The Myra pond discharge below Station 4 contributed to an increased concentration of 0.109 mg/l of total zinc. Another increase occurred between Station 5 and 6 with 0.07 mg/l augmentation of the overall total concentration. The Lynx diversion channel contribution to the increase was small, with a mean value of 0.008 mg/l total zinc concentration, and a standard deviation of 0.003 (Keith Ferguson, personal communication). There was a significant increase of total and dissolved zinc concentrations between Station 5 and 7 ($p < 0.05$). Water-contaminated infiltration might have occurred since no direct effluents are found between those locations. The tailings line road, made of waste rock is suspected to be the cause of that

.E 6 MEAN COPPER CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
ept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.006	0.005	0.005	0.005	0.007	0.006	0.008	0.006	0.008	0.008
s	0	0	0	0	0	0.001	0	0	0.001	0	0.002	0.003	0	0
ept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.006	0.005	0.006	0.005	0.007	0.006	0.009	0.008	0.010	0.009
s	0.001	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0
ept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.007	0.005	0.005	0.005	0.012	0.007	0.015	0.009	0.017	0.010
s	0	0	0	0	0.004	0	0	0	0	0.001	0.001	0.001	0.002	0

CONTINUED...

TABLE 6 MEAN COPPER CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.005	0.005	0.005	0.005	0.008	0.005	0.013	0.008	0.014	0.010
s	0	0	0	0	0.003	0	0	0	0.004	0	0.001	0	0.001	0.002
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.001	< 0.001	0.001	< 0.001	0.0005	0.002	0.005	0.005	0.008	0.004	0.013	0.007	0.014	0.008
s	0.001	0	0.001	0	0.001	0.003	0	0.001	0.004	0.002	0.001	0.002	0	0.001
Overall														
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.006	0.005	0.005	0.005	0.009	0.006	0.012	0.008	0.013	0.009
s	0.001	0	0.0004	0	0.002	0.002	0.0004	0.0003	0.003	0.001	0.003	0.002	0.003	0.001

T. = Total
D. = Dissolved
s = Standard Deviation

Note: To calculate mean and standard deviation, one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l).

TABLE 7 MEAN TOTAL COPPER CONCENTRATIONS (mg/l) FROM SIRCO SAMPLES COLLECTED SEPTEMBER 28 THROUGH TO SEPTEMBER 30 AT STATION 7

DATE	TIME	$\bar{x}$	s
September 27	0925 - 1125	0.009	0.003
	1225 - 1425	0.008	0.001
	1525 - 1725	0.008	0.001
	1825 - 2025	0.010	0.002
	2125 - 2325	0.010	0.002
September 28	0025 - 0225	0.009	0.001
	0325 - 0525	0.010	0.002
	0625 - 0825	0.013	0.002
	0900 - 1100	0.009	0.002
	1200 - 1400	0.010	0.002
	1500 - 1700	0.011	0.004
	1800 - 2000	0.012	0.001
	2100 - 2300	0.013	0.001
September 29	2400 - 0200	0.015	0.002
	0300 - 0500	0.017	0.001
	0600 - 0800	0.014	0.001
	0900 - 1100	0.013	0.001
	1200 - 1400	0.015	0.006
	1500 - 1700	0.010	0.002
	1800 - 2000	0.012	0.001
	2100 - 2300	0.015	0.002
September 30	2400 - 0200	0.014	0.001
	0300 - 0500	0.014	0
	0600 - 0800	0.014	0

TABLE 8 MEAN ZINC CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.002	< 0.002	0.002	< 0.002	0.054	0.049	0.017	0.016	0.096	0.089	0.160	0.154	0.182	0.181
s	0.002	0	0.001	0.001	0.002	0.005	0	0	0.001	0.001	0.001	0.001	0.004	0.002
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.002	0.002	< 0.002	0.002	0.030	0.031	0.023	0.021	0.113	0.108	0.196	0.192	0.231	0.220
s	0	0.001	0	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.003	0	0.014	0.001
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.004	0.002	0.004	< 0.002	0.034	0.028	0.024	0.021	0.136	0.128	0.208	0.204	0.230	0.227
s	0.002	0.001	0.001	0	0.003	0.001	0.001	0	0.001	0.001	0.003	0.002	0.001	0.002

CONTINUED...

TABLE 8 MEAN ZINC CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.003	< 0.002	0.004	< 0.002	0.040	0.034	0.028	0.024	0.100	0.091	0.180	0.168	0.215	0.212
s	0.001	0	0.001	0	0.005	0.001	0.002	0.001	0.001	0.004	0.002	0.001	0.002	0.001
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.006	< 0.002	0.002	< 0.002	0.037	0.033	0.028	0.025	0.098	0.086	0.164	0.157	0.206	0.202
s	0.007	0	0.001	0	0.001	[illegible]	0.002	0.001	0.010	0.001	0.003	0.001	0.001	0.002
Overall														
$\bar{x}$	0.003	< 0.002	0.003	< 0.002	0.039	0.035	0.024	0.021	0.109	0.100	0.182	0.175	0.213	0.209
s	0.003	0.001	0.002	0.001	0.009	0.008	0.004	0.003	0.016	0.016	0.019	0.020	0.020	0.016

T. = Total
D. = Dissolved
s = Standard Deviation

Note: To calculate mean and standard deviation, one half the detection limit (0.001 mg/l) was used when sample concentrations were less than the detection limit (< 0.002 mg/l).

TABLE 9 MEAN TOTAL ZINC CONCENTRATIONS (mg/l) FROM SIRCO SAMPLES COLLECTED SEPTEMBER 27 THROUGH TO SEPTEMBER 30 AT STATION 7

DATE	TIME	$\bar{x}$	s
September 27	0925 - 1125	0.200	0.005
	1225 - 1425	0.190	0.004
	1525 - 1725	0.204	0.001
	1825 - 2025	0.196	0.003
	2125 - 2325	0.201	0.002
September 28	0025 - 0225	0.205	0.002
	0325 - 0525	0.213	0.003
	0625 - 0825	0.244	0.043
	0900 - 1100	0.227	0.005
	1200 - 1400	0.222	0.003
	1500 - 1700	0.236	0.002
	1800 - 2000	0.216	0.004
	2100 - 2300	0.235	0.002
September 29	2400 - 0200	0.246	0.002
	0300 - 0500	0.249	0.004
	0600 - 0800	0.248	0.001
	0900 - 1100	0.228	0.003
	1200 - 1400	0.213	0.003
	1500 - 1700	0.211	0.004
	1800 - 2000	0.219	0.001
	2100 - 2300	0.245	0.003
September 30	2400 - 0200	0.226	0.003
	0300 - 0500	0.223	0.008
	0600 - 0800	0.221	0.002

elevation of zinc in Myra Creek. Station 7 has 105 times more zinc concentration of zinc than Station 1, on a dissolved basis, and 70 more times on a total basis.

The Sirco continuous sampling results showed a similarity to the grab samples at Station 7 except for one value on September 27, at 15:35, where the value seemed to be lower than what would be expected (Table 9). The 72 h sampling period showed concentration always above 0.2 mg/l.

A comparison with the survey in May 1983 (Ross 1983) shows similar levels above the mine influence; but the levels at Station 7 were 6 times greater in September for dissolved zinc (0.035 mg/l in May 1983 and 0.209 mg/l in September 1983).

3.1.9 Cadmium. Generally total and dissolved cadmium were equal to, or less than, 0.0005 mg/l at all sampling sites during the three day survey (Table 10). The continuous sampling showed only one outstanding value on the morning of September 27 with 0.018 mg/l, and a standard deviation of 0.0009 (Table 11).

3.1.10 Lead. The lead level at the Myra Creek transects was generally below the detection limit (Table 12). Some replicates, however showed levels of 0.005 or 0.009 mg/l which increased the average. The apparent change in lead level in the September 29-30, 1983 continuous sampling at Station 7 was due to the change in the detection limit (Table 13). The low level detection analysis was not done at the laboratory.

The September level showed no increase over May 1983 results (Ross 1983).

3.1.11 Aluminum. The levels ranged from less than 0.05 mg/l to 0.08 mg/l (Table 14). Levels above the detection limit were first encountered at Station 5. The maximum variation for the continous sampling period was 0.06 mg/l (Table 15). There was no discrepancy between the transect monitoring and continuous sampling values at Station 7.

TABLE 10 MEAN CADMIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	0.0005
s	0	0	0	0	0	0	0	0	0	0	0	0	0.0002	0.0001
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0004	< 0.0005
s	0	0	0	0	0	0	0	0	0	0	0	0	0	.0001

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LE 10 MEAN CADMIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
s	0	0	0	0	0.0003	0	0	0	0	0	0	0	0	0
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0009	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
s	0	0	0	0	0	0	0	0	0.0011	0	0	0	0	0
Overall														
$\bar{x}$	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
s	0	0	0	0	0.0001	0	0	0	0.0005	0	0	0	0.0001	0.0001

T. = Total
D. = Dissolved
s = Standard Deviation

TABLE 11 MEAN TOTAL CADMIUM CONCENTRATIONS (mg/l) FROM SIRCO SAMPLES COLLECTED SEPTEMBER 27 THROUGH TO SEPTEMBER 30 AT STATION 7

DATE	TIME	$\bar{x}$	s
September 27	0925 - 1125	0.018	0.0009
	1225 - 1425	0.0006	0.0003
	1525 - 1725	< 0.0005	0.0001
	1825 - 2025	< 0.0005	0
	2125 - 2325	< 0.0005	0.0001
September 28	0025 - 0225	< 0.0005	0
	0325 - 0525	< 0.0005	0.0001
	0625 - 0825	0.0005	0.0002
September 28	0900 - 1100	0.0006	0.0001
	1200 - 1400	< 0.0005	0
	1500 - 1700	< 0.0005	0
	1800 - 2000	< 0.0005	0
	2100 - 2300	< 0.0005	0
September 29	2400 - 0200	< 0.0005	0.0001
	0300 - 0500	< 0.0005	0.0001
	0600 - 0800	< 0.0005	0.0002
	0900 - 1100	0.0006	0
	1200 - 1400	< 0.0005	0.0002
	1500 - 1700	0.0005	0.0004
	1800 - 2000	< 0.0005	0
	2100 - 2300	< 0.0005	0
September 30	2400 - 0200	< 0.0005	0.0002
	0300 - 0500	0.0005	0.0002
	0600 - 0800	0.0006	0.0001

TABLE 12 MEAN LEAD CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
s	0	0	0	0	0	0	0	0	0	0	0.001	0	0	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
s	0	0	0	0	0	0	0.005	0	0	0	0	0	0	0

CONTINUED...

TABLE 12 MEAN LEAD CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	< 0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
s	0	0	0	0	0.005	0	0	0	0	0	0	0	0	0
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
s	0	0	0	0	0	0	0	0	0.003	0	0	0	0	0
Overall														
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
s	0	0	0	0	0.002	0	0.001	0	0.002	0	0	0	0	0

T. = Total
D. = Dissolved
s = Standard Deviation

Note: To calculate mean and standard deviation one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l)

TABLE 13 MEAN TOTAL LEAD CONCENTRATIONS (mg/l) FROM SIRCO SAMPLES COLLECTED SEPTEMBER 27 THROUGH TO SEPTEMBER 30 AT STATION 7

DATE	TIME	$\bar{x}$	s
September 27	0925 - 1125	0.001	0.001
	1225 - 1425	0.001	0
	1525 - 1725	0.001	0
	1825 - 2025	0.001	0
	2125 - 2325	0.001	0.001
September 28	0025 - 0225	< 0.001	0
	0325 - 0525	0.001	0
	0625 - 0825	0.001	0
September 28	0900 - 1100	0.001	0.001
	1200 - 1400	< 0.001	0
	1500 - 1700	< 0.001	0
	1800 - 2000	< 0.001	0
	2100 - 2300	< 0.001	0
September 29	2400 - 0200	0.002	0.002
	0300 - 0500	< 0.001	0
	0600 - 0800	< 0.02	0
	0900 - 1100	< 0.02	0
	1200 - 1400	< 0.02	0
	1500 - 1700	< 0.02	0
	1800 - 2000	< 0.02	0
	2100 - 2300	< 0.02	0
September 30	2400 - 0200	< 0.02	0
	0300 - 0500	< 0.02	0
	0600 - 0800	< 0.02	0

TABLE 14 MEAN ALUMINUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	0.07	< 0.05	0.07	< 0.05
s	0.01	0	0	0	0	0	0	0	0.02	0	0.02	0	0.01	0.01
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.06	< 0.05	0.07	< 0.05	0.10	0.05
s	0	0	0	0	0	0	0	0	0.01	0	0.01	0	0.01	0.02
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	0.08	0.05	0.07	0.06
s	0	0	0	0	0	0	0	0	0.02	0	0.01	0.02	0.01	0.01

CONTINUED...

TABLE 14 MEAN ALUMINUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.08	0.06
s	0	0	0	0	0	0	0	0	0	0.02	0.01	0	0.01	0.01
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	0.06	< 0.05	0.08	0.05
s	0	0	0	0	0	0	0	0	0.02	0	0.01	0	0.01	0.01
Overall														
$\bar{x}$	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	0.06	< 0.05	0.08	0.05
s	0	0	0	0	0	0	0	0	0.02	0	0.02	0	0.01	0.01

T. = Total
D. = Dissolved
s = Standard Deviation

Note: To calculate mean and standard deviation one half the detection limit (0.025 mg/l) was used when sample concentrations were less than the detection limit (< 0.050 mg/l)

TABLE 15 MEAN TOTAL ALUMINUM CONCENTRATIONS (mg/l) FROM SIRCO SAMPLES COLLECTED SEPTEMBER 27 THROUGH TO SEPTEMBER 30 AT STATION 7

DATE	TIME	$\bar{x}$	s
September 27	0925 - 1125	< 0.05	0
	1225 - 1425	0.06	0.01
	1525 - 1725	0.06	0.01
	1825 - 2025	0.06	0.01
	2125 - 2325	0.06	0.01
September 28	0025 - 0225	0.06	0.01
	0325 - 0525	0.06	0.01
	0625 - 0825	0.08	0.01
September 28	0900 - 1100	0.07	0.01
	1200 - 1400	0.07	0.01
	1500 - 1700	0.11	0.01
	1800 - 2000	0.07	0.02
	2100 - 2300	0.08	0.01
September 29	2400 - 0200	0.08	0.01
	0300 - 0500	0.07	0.01
	0600 - 0800	0.09	0.01
	0900 - 1100	0.07	0.01
	1200 - 1400	0.07	0
	1500 - 1700	0.07	0.01
	1800 - 2000	0.06	0.01
	2100 - 2300	0.08	0.01
September 30	2400 - 0200	0.08	0.01
	0300 - 0500	0.08	0.01
	0600 - 0800	0.08	0.01

TABLE 16 MEAN IRON CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.006	< 0.0005	0.009	< 0.005	0.013	< 0.005	0.012	< 0.005	0.030	< 0.005	0.037	< 0.005	0.020	0.010
s	0.003	0	0.002	0	0.001	0	0.003	0.002	0.013	0.001	0.019	0.001	0.002	0.001
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	0.011	< 0.005	< 0.005	< 0.005	0.011	0.007	0.015	0.007	0.024	0.006	0.032	< 0.005	0.022	0.014
s	0.006	0	0	0	0.002	0.001	0.009	0.001	0.009	0.001	0.030	0.002	0.002	0.001
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.007	< 0.005	0.020	< 0.005	0.015	0.007	0.016	0.006	0.024	0.005	0.017	0.005	0.117	0.014
s	0.004	0	0.016	0	0.002	0.001	0.006	0.001	0.011	0.001	0.005	0.002	0.161	0.001

CONTINUED...

TABLE 16 MEAN IRON CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.016	< 0.005	0.007	< 0.005	0.030	0.007	0.027	< 0.005	0.023	0.017	0.018	< 0.005	0.024	0.014
s	0.008	0	0.004	0.001	0.009	0	0.010	0.002	0.004	0.022	0.002	0	0.001	0.001
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.013	< 0.005	0.005	< 0.005	0.011	0.006	0.010	0.006	0.067	0.007	0.015	0.006	0.015	0.013
s	0.011	0	0.005	0	0.003	0	0.002	0.003	0.095	0.002	0.008	0.003	0.004	0.003
Overall														
$\bar{x}$	0.010	< 0.005	0.009	< 0.005	0.016	0.006	0.016	0.005	0.034	0.008	0.024	< 0.005	0.039	0.013
s	0.007	0	0.009	0	0.008	0.002	0.008	0.002	0.041	0.010	0.017	0.002	0.073	0.002

T. = Total
D. = Dissolved
s = Standard Deviation

Note: To calculate mean and standard deviation one half the detection limit (0.0025 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l)

TABLE 17 MEAN TOTAL IRON CONCENTRATIONS (mg/l) FROM SIRCO SAMPLES COLLECTED SEPTEMBER 27 THROUGH TO SEPTEMBER 30 AT STATION 7

DATE	TIME	$\bar{x}$	s
September 27	0925 - 1125	0.015	0.002
	1225 - 1425	0.020	0.006
	1525 - 1725	0.039	0.035
	1825 - 2025	0.014	0.001
	2125 - 2325	0.217	0.342
September 28	0025 - 0225	0.018	0.004
	0325 - 0525	0.025	0.012
	0625 - 0825	0.026	0.001
	0900 - 1100	0.024	0.009
	1200 - 1400	0.030	0.014
	1500 - 1700	0.022	0.004
	1800 - 2000	0.021	0.001
	2100 - 2300	0.018	0.001
September 29	2400 - 0200	0.018	0.001
	0300 - 0500	0.014	0.019
	0600 - 0800	< 0.005	0
	0900 - 1100	< 0.005	0
	1200 - 1400	0.018	0.027
	1500 - 1700	< 0.005	0
	1800 - 2000	< 0.005	0
	2100 - 2300	< 0.005	0
September 30	2400 - 0200	< 0.005	0
	0300 - 0500	< 0.005	0
	0600 - 0800	< 0.005	0

3.1.12 Iron. Average values ranged from 0.005 to 0.117 mg/l of total iron, and less than 0.005 mg/l to 0.067 mg/l of dissolved iron (Table 16). The standard deviation of the total iron value was high. The overall coefficient of variation ranged from 0 to 187%. The total iron is 4 times greater at Station 7 than at Station 1. The major increase of iron can be found between Stations 2 and 3, as well as Stations 4 and 5. On September 28, at 7:00 p.m. at Station 7, a high value of 0.117 mg/l total iron was found in the sampling transect, but not on the continuous sampling (Table 17). The overall May results have an even higher coefficient of variation which makes the comparison less reliable.

3.1.13 Copper, Zinc and Sulfate Loading in Myra Creek. The September flow of Myra Creek was 3 times less than what was found in May 1983.

Natural loadings of heavy metal at Station 2 were very low. The actual loading cannot be calculated correctly because the concentrations were often below the detection limit (Table 18).

The creek loading of copper, zinc and sulfate at Station 3 are all less than average values calculated in May 1983. At Station 5 the loading of dissolved zinc had changed from 4.68 kg/day in May to an average of 18.16 kg/day in September. The sulfate loading in May was 5620 kg/day and in September 8531 kg/day. At Station 7, the average zinc loading was 2.0 times more than what was seen in May 1983, with a loading value of 41.14 kg/day of dissolved zinc.

The average sulfate loading was 10,202 kg/day in September as compared to 6902 kg/day in May, an increase of 3,300 kg/day of sulfate. It seems that seepage and/or drainage between Station 7 and Station 5 was responsible for that increase.

3.2 Additional Sampling Sites

3.2.1 South Bank of Station 4. The comparison of the south bank grab sample with the other transect sample at the same station reveals

TABLE 18 COMPARISON OF MEAN MAY 1983 AND SEPTEMBER 1983 RESULTS

CONCENTRATION (mg/l)	SITE #2 - ABOVE LYNX DISCHARGE				SITE #3 - BELOW LYNX DISCHARGE			
	May $\bar{x}$*	September 27	September 28	September 29	May $\bar{x}$*	September 27	September 28	September 29
T. Cu	< 0.001	< 0.001	< 0.001	< 0.001	0.004	0.006	0.007	0.005
D. Cu	< 0.001	< 0.001	< 0.001	< 0.001	0.003	0.005	0.005	0.004
T. Zn	< 0.002	0.002	0.002	0.003	0.029	0.054	0.032	0.039
D. Zn	< 0.002	< 0.001	< 0.002	< 0.002	0.015	0.049	0.030	0.033
SO_4	2.3	4.9	5.5	3.6	4.75	13.5	15.6	15.2
FLOW (m^3/S)	5.6	2.4	1.8	1.5	5.71	2.5	1.9	1.5
LOADINGS (kg/day)								
T. Cu	< 0.48	< 0.21	< 0.16	< 0.13	1.97	1.30	1.15	0.65
D. Cu	< 0.48	< 0.21	< 0.16	< 0.13	1.48	1.08	0.82	0.52
T. Zn	< 0.97	0.41	0.31	0.39	14.31	11.66	5.25	5.05
D. Zn	< 0.97	< 0.41	< 0.31	< 0.26	7.40	10.58	4.92	4.28
SO_4	1113	1016	855	467	2540	2916	2561	1970

CONCENTRATION (mg/l)	SITE #5 - PUMPHOUSE				SITE #7 - M2			
	May $\bar{x}$*	September 27	September 28	September 29	May $\bar{x}$*	September 27	September 28	September 29
T. Cu	0.003	0.007	0.010	0.008	0.005	0.008	0.014	0.009
D. Cu	0.002	0.006	0.006	0.005	0.005	0.008	0.010	0.002
T. Zn	0.024	0.096	0.124	0.099	0.052	0.182	0.231	0.210
D. Zn	0.009	0.089	0.118	0.089	0.035	0.181	0.223	0.207
SO_4	11.2	43.6	52.0	43.3	12.0	47.5	55.2	47.1
FLOW (m^3/S)	6.05	2.7	2.1	1.6	6.6	3.0	2.3	1.8
LOADINGS (kg/day)								
T. Cu	1.57	1.63	1.81	1.11	2.87	2.07	2.78	1.40
D. Cu	1.05	1.40	1.09	0.69	2.87	2.07	1.99	0.31
T. Zn	12.54	22.39	22.50	13.69	29.83	47.17	45.90	32.66
D. Zn	4.70	20.76	21.41	12.30	20.08	46.92	44.31	32.19
SO_4	5854	10171	9435	5986	6902	12312	10969	7325

*Results from Ross (1983)

higher levels for sulfate, filterable residues, hardness and conductivity (Table 19). All the other parameters taken on the south bank did not differ from the average value of Station 4.

3.2.2 Campbell River at Gold River Bridge and Campbell River in Elk Falls Provincial Park. For most of the chemical parameters, the concentrations were reduced from Gold River Bridge to Elk Falls Provincial Park, except for dissolved iron where the concentration rose from 0.007 mg/l to 0.018 mg/l (Table 20).

The Gold River Bridge zinc levels were high with 0.036 and 0.032 mg/l for the total and dissolved values respectively. At Elk Falls Park, which is approximately 75 km downstream of Myra Falls after the river passes through a series of lakes, the zinc level was 0.026 and 0.022 mg/l for total and dissolved concentrations. Nevertheless, the levels were reduced compared to May 1983 (Ross 1983).

TABLE 19 CHEMICAL MEASUREMENTS FROM A SINGLE GRAB SAMPLE COLLECTED ON THE SOUTH BANK OF STATION 4 ON SEPTEMBER 28, 1983

PARAMETER	
pH (relative units)	7.0
Turbidity (FTU)	< 0.1
Conductivity (lab) (umhos/cm)	128 @ 25°C
Conductivity (field) (umhos/cm)	147 @ 7.9°C
Filterable Residues	86
Non-Filterable Residues	< 5
Total Residues	86
Sulphates	32.8
Total Copper	0.005
Dissolved Copper	0.005
Total Zinc	0.019
Dissolved Zinc	0.021
Total Cadmium	< 0.0005
Dissolved Cadmium	< 0.0005
Total Lead	< 0.001
Dissolved Lead	< 0.001
Total Aluminum	< 0.05
Dissolved Aluminum	< 0.05
Total Iron	0.005
Dissolved Iron	0.007
Hardness Ca, Mg	49.0
Total Hardness	49.2

*All units mg/l except where indicated otherwise.

TABLE 20 CHEMICAL PARAMETERS FROM REPLICATED GRAB SAMPLES IN THE CAMPBELL RIVER ON SEPTEMBER 29, 1983

PARAMETERS*	AT GOLD RIVER BRIDGE		IN ELK FALLS PROVINCIAL PARK	
	$\bar{x}$	s	$\bar{x}$	s
pH (relative units)	7.1	-	7.1	-
Turbidity (FTU)	< 0.1	0	< 0.1	0
Conductivity (lab) (umhos/cm)	52.4	0	46.9	0
Filterable Residues	38.3	2.9	28.7	2.1
Non-Filterable Residues	< 5	0	< 5	0
Total Residues	38.3	2.9	28.7	2.1
Sulphates	4.5	0.3	4.0	0.3
Total Copper	0.005	0.007	0.002	0.001
Dissolved Copper	0.002	0.001	< 0.001	0
Total Zinc	0.036	0.006	0.026	0.002
Dissolved Zinc	0.032	0.002	0.022	0
Total Cadmium	< 0.0005	0	< 0.0005	0
Dissolved Cadmium	< 0.0005	0	< 0.0005	0
Total Lead	0.001	0	< 0.001	0
Dissolved Lead	< 0.001	0	< 0.001	0
Total Aluminum	< 0.05	0	< 0.05	0
Dissolved Aluminum	< 0.05	0	< 0.05	0
Total Iron	0.016	0.006	0.112	0.128
Dissolved Iron	0.007	0.001	0.018	0
Hardness Ca, Mg	24.2	0.3	21.2	0.1
Total Hardness	24.4	0.3	21.4	0.1

*All parameters in mg/l unless otherwise indicated.

4.0 SUMMARY AND CONCLUSIONS

A pattern of conductivity over the three day survey emerged. The first increase occurred below the Lynx pond discharge and the second below the Myra Pond discharge. These increases are reflected by an increase in total residues, sulfates, hardness, copper and zinc.

Copper and zinc were the only two significant heavy metals present in the water of Myra Creek. Levels of total copper and zinc at Station 7 increased to 0.013 mg/l and 0.213 mg/l respectively due to surface runoff, effluent and leachate from the wase rock site. Significant increases between Stations 5 and 7 suggest contaminated water infiltration which was especially high in zinc.

Concentrations of chemical parameters were somewhat similar or higher than those revealed by a survey in May 1983, but the flow rate was smaller in September 1983. The loading of zinc and sulfates were the only two parameters found to be significantly higher in September 1983, with an average, at Station 7 of 41.9 kg/day and 10,202 kg/day, respectively. The total copper load was less in September with an average of 1.5 kg/day compared to May 1983 with 2.9 kg/day.

Significant levels of zinc could be detected at the Gold River Bridge and Campbell River in Elk Falls Provincial Park.

It seems that the collection system of surface and groundwater on the mine site is not 100% effective. There was still a significant impact from zinc and sulfate in Myra Creek below the pumphouse during that low flow period.

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APPENDIX I

METAL CONCENTRATIONS IN MYRA CREEK

September 27-29, 1983

TABLE 1 HEAVY METALS THAT WERE BELOW THE DETECTION LIMIT (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

METAL	DETECTION LIMIT
Arsenic	0.05
Beryllium	0.001
Cobalt	0.005
Chromium	0.005
Molybdenum	0.005
Nickel	0.02
Phosphorus	0.05
Antimony	0.05
Selenium	0.05
Tin	0.01
Vanadium	0.01

TABLE 2 MEAN BORON CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.004	0.010	0.006	< 0.001	0.006	< 0.001	0.004	0.004	0.006	0.004	0.006	0.012	0.003	0.016
s	0.003	0.015	0	0	0	0	0.003	0.007	0	0.007	0	0	0.003	0.007
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.001	0.004	< 0.001	0.004	< 0.001	0.024	0.010	0.018	0.009	0.030	0.010	0.024	0.025	0.022
s	0	0.003	0	0.007	0	0	0.004	0.012	0.007	0	0.004	0.006	0	0.004
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.021	0.004	0.017	< 0.001	0.017	0.008	0.025	0.004	0.025	0.020	0.021	0.026	0.010	0.030
s	0.007	0.007	0.007	0	0.014	0.007	0	0.007	0	0.007	0.007	0.004	0.004	0

CONTINUED...

TABLE 2 MEAN BORON CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.004	0.010	0.004	0.002	0.015	0.026	0.020	< 0.001	0.020	< 0.001	0.016	< 0.001	0.025	0.010
s	0.007	0.007	0.007	0.003	0.004	0.013	0	0	0	0	0.004	0	0.010	0.004
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.023	0.011	0.005	< 0.001	0.032	0.019	0.034	0.012	0.037	0.023	0.034	0.025	0.026	0.025
s	0.010	0	0.004	0	0.011	0.006	0.007	0.011	0.006	0	0.012	0.004	0.007	0.007
Overall														
$\bar{x}$	0.011	0.008	0.007	0.002	0.014	0.016	0.019	0.008	0.019	0.016	0.017	0.018	0.018	0.021
s	0.011	0.008	0.007	0.003	0.013	0.012	0.011	0.010	0.012	0.012	0.012	0.011	0.011	0.008

Note: To calculate mean and standard deviation, one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l).

TABLE 3 MEAN BARIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.004	0.004	0.003	0.003	0.006	0.005	0.006	0.005	0.019	0.01	0.019	0.01	0.014	0.012
s	0	0.001	0.001	0	0.001	0	0	0	0.006	0	0.011	0	0.002	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	0.005	0.005	0.003	0.004	0.007	0.006	0.009	0.006	0.015	0.011	0.014	0.011	0.015	0.013
s	0	0	0.001	0.001	0.001	0	0.004	0	0.001	0.001	0	0	0	0.001
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.005	0.005	0.005	0.002	0.007	0.006	0.008	0.006	0.014	0.011	0.013	0.012	0.015	0.014
s	0.001	0	0.001	0.001	0	0	0.001	0	0	0	0.001	0	0	0

CONTINUED...

TABLE 3 MEAN BARIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:20		12:35		14:05	
$\bar{x}$	0.005	0.005	0.004	0.003	0.009	0.006	0.007	0.006	0.012	0.011	0.012	0.011	0.014	0.014
s	0	0	0	0.001	0.003	0	0	0	0	0	0	0	0.001	0.001
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.005	0.005	0.004	0.004	0.006	0.006	0.007	0.006	0.016	0.011	0.012	0.011	0.014	0.014
s	0.006	0	0.001	0	0	0	0	0	0.007	0	0.001	0.001	0	0.001
Overall														
$\bar{x}$	0.005	0.005	0.004	0.004	0.006	0.006	0.007	0.006	0.016	0.011	0.012	0.011	0.014	0.014
s	0.001	0	0.001	0.001	0	0	0	0	0.007	0	0.001	0.001	0	0.001

Note: To calculate mean and standard deviation, one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l).

BLE 4 MEAN CALCIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	4.3	4.4	3.5	3.6	10.7	10.2	10.5	10.0	21.2	21.1	21.8	21.6	22.5	22.9
s	0.1	0	0.1	0	0	0.1	0	0	0.1	0.1	0.1	0.1	0.5	0.2
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	5.7	5.0	4.6	3.7	12.9	12.3	12.9	12.1	24.4	25.2	25.5	25.8	26.0	26.3
s	0	0.1	0.1	0	0.1	0.2	0.1	0	1.0	0.1	0.2	0.1	0.1	0.1
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	5.9	5.0	4.7	3.8	12.0	11.4	12.2	11.7	25.5	25.6	25.9	26.4	26.4	27.0
s	0	0.1	0.1	0	0.1	0.1	0.1	0.1	0.2	0.1	0.4	0.2	0.1	0.1

CONTINUED...

TABLE 4 MEAN CALCIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	6.1	5.4	4.6	3.7	11.4	11.9	11.8	11.8	22.9	22.4	23.4	23.0	24.3	24.5
s	0.1	0	0.1	0	0.4	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	5.5	5.4	3.9	3.7	12.0	11.8	12.3	11.9	23.3	22.8	23.5	23.3	24.4	24.3
s	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0.2	0.1	0.1	0.1	0.2	0.2
Overall														
$\bar{x}$	5.5	5.1	4.2	3.7	11.8	11.5	11.9	11.5	23.5	23.4	24.0	24.0	24.8	25.0
s	0.7	0.4	0.5	0.1	0.8	0.7	0.8	0.8	1.5	1.8	1.6	1.9	1.5	1.5

Note: To calculate mean and standard deviation, one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l).

TABLE 5 MEAN MAGNESIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.2	0.2	0.2	0.1	0.4	0.4	0.2	0.3	1.3	1.4	1.5	1.5	1.6	1.7
s	0	0.1	0	0.1	0	0.1	0.1	0	0	0	0	0	0.1	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	0.1	0.2	0.1	0.2	0.3	0.4	0.4	0.4	1.7	1.7	1.9	1.9	2.0	2.0
s	0.1	0	0	0	0	0	0.1	0.1	0.1	0.1	0	0	0	0
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.2	0.2	0.1	0.2	0.3	0.4	0.3	0.4	1.8	1.9	2.0	2.0	2.0	2.1
s	0	0	0.1	0	0.1	0	0	0.1	0	0	0.1	0	0	0

CONTINUED...

TABLE 5 MEAN MAGNESIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.2	0.2	0.1	0.2	0.5	0.4	0.4	0.4	1.3	1.4	1.5	1.5	1.7	1.8
s	0	0	0	0	0.1	0	0	0	0.1	0.1	0.1	0.1	0	0.1
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.2	0.2	0.1	0.2	0.4	0.4	0.4	0.4	1.4	1.4	1.6	1.6	1.7	1.8
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Overall														
$\bar{x}$	0.2	0.2	0.1	0.2	0.4	0.4	0.3	0.4	1.5	1.6	1.7	1.7	1.8	1.9
s	0	0	0.1	0	0.1	0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2

Note: To calculate mean and standard devaition, one half the detection limit (0.05 mg/l) was used when sample concentrations were less than the detection limit (< 0.1 mg/l).

TABLE 6 MEAN MANGANESE CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.007	0.008	0.002	0.002	0.034	0.031	0.046	0.044	0.043	0.043
s	0	0	0	0	0.001	0.001	0	0	0.001	0.001	0.002	0.001	0.001	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.005	0.005	0.003	0.003	0.046	0.043	0.061	0.059	0.055	0.055
s	0	0	0	0	0	0	0	0	0.002	0.001	0.001	0.001	0	0
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.005	0.005	0.003	0.003	0.049	0.045	0.061	0.058	0.055	0.056
s	0	0	0	0	0	0	0	0	0.001	0	0.002	0.001	0	0

CONTINUED...

TABLE 6 MEAN MANGANESE CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.008	0.006	0.003	0.003	0.024	0.018	0.039	0.034	0.039	0.036
s	0	0	0	0	0.002	0	0	0	0	0.001	0	0.001	0	0.001
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.006	0.005	0.004	0.003	0.024	0.017	0.036	0.03	0.037	0.034
s	0	0	0	0	0	0.001	0.001	0	0.004	0	0.001	0.001	0	0.001
Overall														
$\bar{x}$	< 0.001	< 0.001	< 0.001	< 0.001	0.006	0.006	0.003	0.003	0.035	0.031	0.049	0.045	0.046	0.045
s	0	0	0	0	0.002	0.001	0.001	0.001	0.01	0.012	0.011	0.012	0.008	0.010

Note: To calculate mean and standard deviation one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l)

BLE 7 MEAN SODIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.6	0.6	0.5	0.5	1.7	1.7	1.6	1.7	2.1	2.0	2.0	2.1	2.0	2.1
s	0	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0	0.1	0.1	0.1	0.1
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	0.6	0.6	0.6	0.5	2.1	2.2	2.0	2.1	2.3	2.5	2.4	2.5	2.3	2.4
s	0.1	0	0.1	0.1	0	0	0.1	0	0.1	0	0	0	0	0
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.7	0.6	0.6	0.5	1.9	2.0	1.9	2.0	2.4	2.4	2.4	2.5	2.3	2.4
s	0.1	0	0	0	0	0	0	0	0	0.1	0	0.1	0.1	0.1

CONTINUED...

TABLE 7 MEAN SODIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.7	0.7	0.6	0.6	2.0	2.1	2.1	2.0	2.4	2.7	2.4	2.3	2.4	2.3
s	0	0	0.1	0.1	0.2	0	0	0.1	0	0.5	0	0	0	0.1
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.7	0.6	0.6	0.5	2.2	2.1	2.1	2.1	2.4	2.4	2.4	2.3	2.4	2.3
s	0	0.1	0	0.1	0	0	0.1	0	0.1	0.1	0	0	0.1	0
Overall														
$\bar{x}$	0.7	0.6	0.6	0.5	2.0	2.0	2.0	2.0	2.3	2.4	2.3	2.3	2.3	2.3
s	0.1	0.1	0	0.1	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.1

Note: To calculate mean and standard deviation, one half the detection limit (0.1 mg/l) was used when sample concentrations were less than the detection limit (< 0.2 mg/l).

TABLE 8 MEAN SILICA CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.8	0.9	0.7	0.8	0.7	0.8	0.7	0.8	0.9	1.0	1.0	1.0	1.1	1.2
s	0	0	0	0.1	0	0	0	0	0	0	0.1	0	0.1	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	0.8	1.0	0.7	0.8	0.7	0.8	0.7	0.8	0.9	1.0	1.0	1.1	1.1	1.2
s	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.9	1.0	0.7	0.6	0.7	0.8	0.7	0.8	1.0	1.1	1.0	1.1	1.1	1.3
s	0	0.1	0	0.4	0	0	0	0	0	0	0	0	0	0

CONTINUED...

TABLE 8 MEAN SILICA CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.9	1.0	0.7	0.7	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.1	1.2	1.3
s	0	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.9	1.0	0.7	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.1	1.2	1.2
s	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
Overall														
$\bar{x}$	0.9	1.0	0.7	0.7	0.7	0.8	0.7	0.8	1.0	1.0	1.0	1.1	1.1	1.2
s	0.1	0.1	0	0.2	0.1	0	0.1	0	0.1	0	0	0	0.1	0.1

Note: To calculate mean and standard deviation, one half the detection limit (0.05 mg/l) was used when sample concentrations were less than the detection limit (< 0.1 mg/l).

TABLE 9 MEAN STRONTIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	0.009	0.009	0.008	0.007	0.025	0.026	0.024	0.025	0.044	0.045	0.044	0.046	0.045	0.047
s	0.001	0	0.001	0	0	0.001	0	0	0	0.001	0.001	0.001	0.002	0
Sept. 28, A.M.	10:10		10:45		11:3[illegible]		12:00		12:35		12:50		13:10	
$\bar{x}$	0.01	0.01	0.008	0.008	0.032	0.032	0.032	0.033	0.051	0.056	0.054	0.056	0.053	0.055
s	0	0	0	0	0	0.001	0	0.001	0	0.001	0	0.001	0.001	0.001
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	0.01	0.01	0.008	0.006	0.03	0.032	0.03	0.032	0.054	0.057	0.053	0.058	0.053	0.057
s	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

CONTINUED...

TABLE 9 MEAN STRONTIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.011	0.011	0.008	0.008	0.035	0.034	0.033	0.033	0.05	0.05	0.051	0.051	0.05	0.053
s	0	0.001	0	0	0.004	0.001	0	0	0	0.001	0.001	0	0.001	0.001
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	0.012	0.012	0.008	0.008	0.034	0.034	0.034	0.034	0.05	0.051	0.051	0.052	0.05	0.052
s	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0	0.001	0.001
Overall														
$\bar{x}$	0.010	0.011	0.008	0.007	0.031	0.032	0.031	0.031	0.050	0.052	0.051	0.053	0.050	0.053
s	0.001	0.001	0	0.002	0.004	0.003	0.004	0.003	0.004	0.004	0.004	0.004	0.003	0.004

Note: To calculate mean and standard deviation, one half the detection limit (0.0005 mg/l) was used when sample concentrations were less than the detection limit (< 0.001 mg/l).

TABLE 10 MEAN TITANIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 27, A.M.	10:35		11:20		12:35		13:20		14:10		14:20		15:35	
$\bar{x}$	< 0.002	< 0.002	0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002	< 0.002	0.002	< 0.002	< 0.002	< 0.002
s	0	0	0.001	0	0	0	0	0	0.001	0	0.002	0	0	0
Sept. 28, A.M.	10:10		10:45		11:35		12:00		12:35		12:50		13:30	
$\bar{x}$	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
s	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sept. 28, P.M.	14:10		14:50		15:20		15:20		16:00		16:10		17:00	
$\bar{x}$	< 0.002	< 0.002	0.001	< 0.002	0.002	< 0.002	0.002	< 0.002	0.002	< 0.002	0.001	< 0.002	0.002	< 0.002
s	0	0	0.001	0	0.001	0	0.001	0	0	0	0.001	0	0.001	0

CONTINUED...

TABLE 10 MEAN TITANIUM CONCENTRATIONS (mg/l) FOR THE MORNING AND AFTERNOON OF SEPTEMBER 27, 28 AND 29, 1983 AT SEVEN MYRA CREEK STATIONS (Continued)

	STATIONS													
	1 M1		2 Above Lynx Pond		3 Below Lynx Pond		4 Above Myra Pond Discharge		5 Pumphouse		6 Below Diversion Ditch		7 M2	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Sept. 29, A.M.	10:00		10:25		11:10		11:20		12:25		12:35		14:05	
$\bar{x}$	0.002	< 0.002	< 0.016	< 0.002	< 0.002	< 0.002	< 0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
s	0	0	0.024	0	0.001	0	0.003	0	0	0	0	0	0	0
Sept. 29, P.M.	14:45		15:10		15:30		15:45		15:55		16:10		16:45	
$\bar{x}$	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.006
s	0	0	0	0	0	0	0	0	0.001	0	0	0	0	0
Overall														
$\bar{x}$	< 0.002	< 0.002	0.004	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
s	0	0	0.010	0	0.001	0	0.001	0	0	0	0.001	0	0	0

Note: To calculate mean and standard deviation one half the detection limit (0.001 mg/l) was used when sample concentrations were less than the detection limit (< 0.002 mg/l)