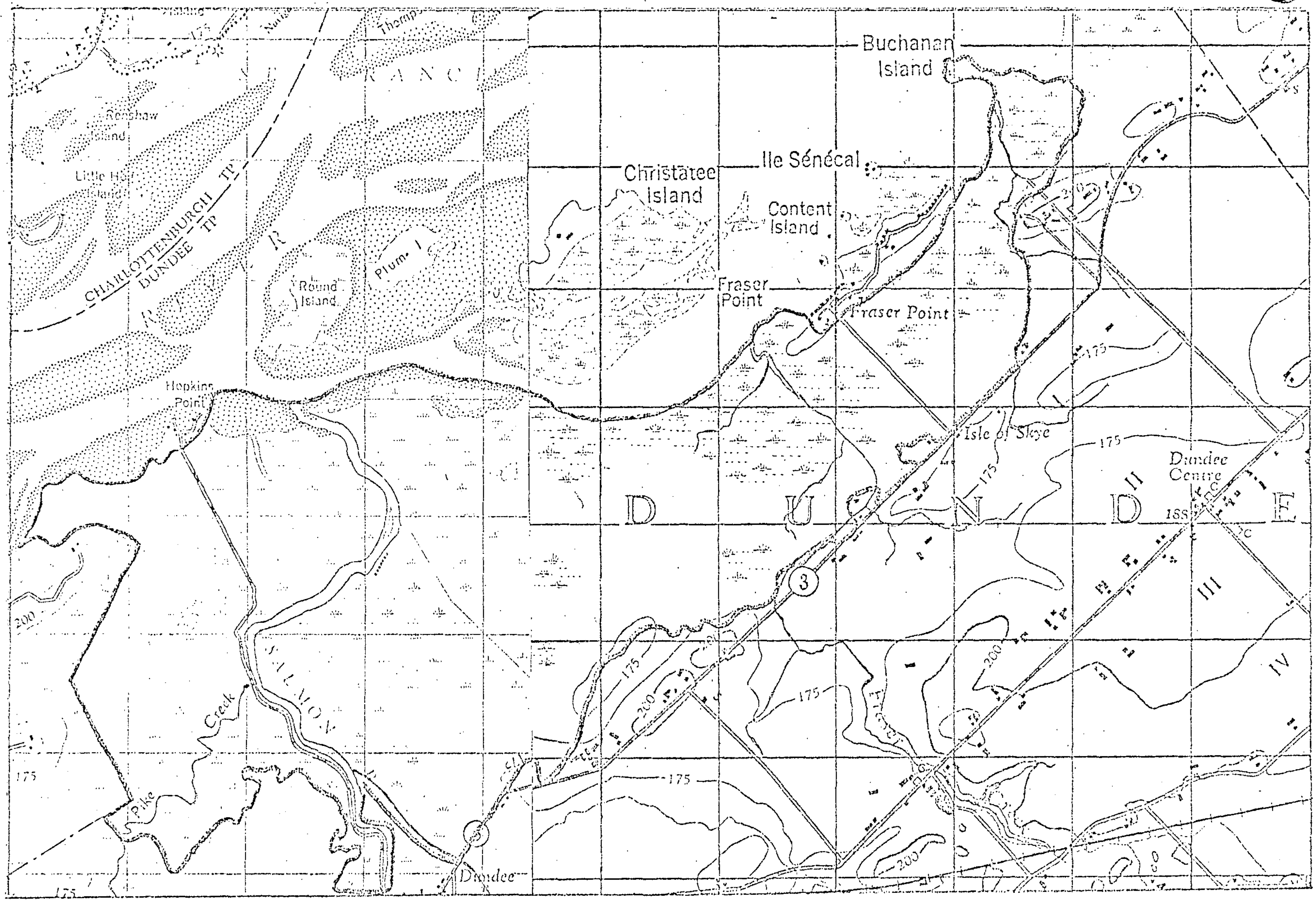
Dundee Marsh Studies, 1973

Introduction

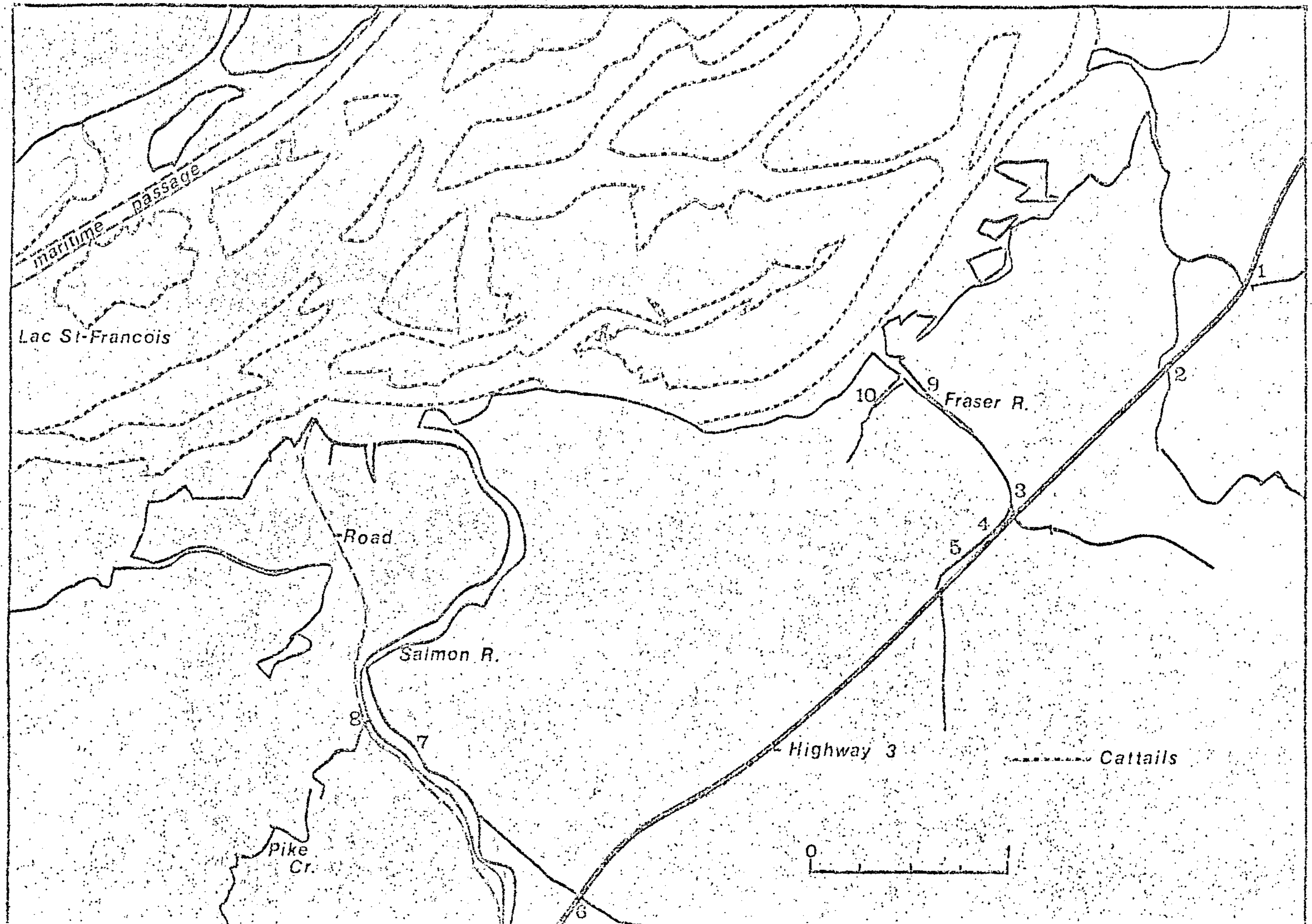
With the advice of Jean-Pierre Lamoureux ten sampling stations were established in the various drainages entering the marsh on the Dundee National Area at Dundee, Quebec (Map 1) for the purpose of evaluating the nutrient contribution of each to marsh productivity. Sampling stations are shown on Map 2. Of particular interest also was to detect whether or not fertilizers used by farmers in the area had any seasonal effects on the concentrations of dissolved solids in the various drainages entering the marsh from adjacent farms.

Methods

One-litre water samples were collected at each station five times during the summer and sent to the Burlington laboratories of the Inland Waters Directorate, Environment Canada, where standard analyses were carried out. Of all the measurements taken, the one which best reflects the total nutrient concentrations in the water samples is the specific conductivity measurement. That measurement allows us to compare the total load of dissolved solids in each sample with the dissolved solids contained in any or all other samples, but it does not identify the ions that contribute to the conductivity readings obtained. Specific conductance readings (standardized at 25 °C) have been used to compare the drainages tested. Summaries of the sampling results for each station have been compiled and are included in the appendix.



Map 1. Dundee National Wildlife Area, Dundee, Quebec. Scale: 1:50,000.



Map 2. Sampling Stations.

Results

Specific conductance readings are summarized in Table 1. There the sampling stations have been grouped according to the different drainages, and by specific conductance readings that show similarities. Waters from Sampling Stations 1 to 5 enter the eastern section of the reserve and have the highest readings. Waters from Stations 1 and 2 combine in the marsh to form one drainage, while waters from Stations 3, 4 and 5 combine inside the marsh to form another separate drainage, (the Fraser River). (Map 2, Sampling Station locations). Waters from Sampling Stations 6 and 8 have lower but somewhat similar readings so they were grouped as a unit. Waters from Sampling Stations 10 and 7 were different from any of the others and belong to none of the three groups mentioned.

Of some interest was the observation that the conductance readings from the Fraser River waters were always lower than the readings made from the waters of the three tributaries that combine to make up the river. (Readings from Stations 3 to 5 have been averaged in the table). From this it is concluded that waters seeping into the Fraser River from the marsh were lower in dissolved solids, and diluted the ion concentrations before Sampling Station 9 was reached. This is substantiated by the lower readings obtained at Station 10 in the east marsh creek. It has its origin in the marsh from seepage, probably from water coming from either or both the Salmon River or the St. Lawrence River.

Table 1. Specific Conductance Measurements (micromhos @ 25°C). Dundee Marsh, 1973.

	Sampling Stations										
			Fraser River Tributaries				Fraser R.		Pike Cr.	E. Marsh Cr.	Salmon R.
Sampling Dates	1	2	3	4	5	Av. 3 to 5	9	6	8	10	7
May 2	360	490	482	519	528	510	477	509	264	375	121
June 5	366	533	467	476	507	483	406	321	242	168	141
Aug. 7	430	306	390	409	409	403	340	160	149	265	115
Sept. 1	407	352	450	476	450	459	309	201	146	309	148
Sept. 26	542	370	452	447	580	493	468	289	252	230	127
Season Average	421	410	448	465	495	469	400	296	211	271	130

Except for one reading in May, the water samples from Station 6 compared more closely to the readings from Pike Creek (Station 8) than to readings in the more easterly streams. That would suggest that Pike Creek and the creek on which Station 6 is located originate in areas with a different soil type than the drainages farther east. Is is impossible to specify how much of the dissolved solids load comes from the use of fertilizers by farmers and how much from natural sources, but unusual exceptionally high readings such as the one of 509 at Station 6 in May suggests an ion contribution from some sources other than from normal drainage. Other periodic high readings in the other drainages might also signify contributions from farmers' fertilizing activities, but no specific pattern is discernable other than a trend for the average readings for all the first 5 Sampling Stations to be higher in the spring and fall than in mid-summer. This trend might arise from the use by farmers of fertilizers in spring and fall. However, it might also result from reduced precipitation and reduced runoff from farmers' fields in mid season.

Water in the east marsh creek appears to originate from seepages through the marsh from either or both the St. Lawrence and Salmon rivers. Since we had no samples of the St. Lawrence water its chemistry is unknown, and its contribution to the marsh water supply can only be surmised.

The Salmon River appears to be a separate drainage altogether with much lower and more uniform specific conductance readings than were obtained from the more local drainages. Possibly the waters from that river are responsible for the slight dilution of dissolved solids in the eastern part of the reserve because at the mouth the waters would tend to be diverted into the marsh by the St. Lawrence. The strong current of the latter was much in evidence whenever we travelled by boat to Sampling Stations 9 and 10.

Summaries of the analyses from each station are presented in the appendix. There is great variation between samples from the various stations and even among samples from the same station taken on different dates. All stations show great differences from sample to sample, even in such things as turbidity, pH, ion concentrations and colour. In all samples the dominant cation was calcium, followed by magnesium. The dominant anion was bicarbonate, but in some samples the sulfate ion rose to high levels in August and September. All samples showed good amounts of dissolved solids indicating moderately high productivity.

Discussion

The results of the water analyses do not demonstrate conclusively that fertilization of farmland is affecting the dissolved solids concentrations in the various drainages. However, there is some suggestion that might be so. More data are needed on the types of fertilizers used, the times when they are applied, precipitation patterns and a more thorough knowledge of the drainage basins themselves before any detailed evaluation could be made. There are apparently differences in the waters coming into the western half of the marsh compared to those entering the eastern half. The differences have come about from natural differences in the soil types of the two areas, or from differences in, or lack of, farming in the two western drainages compared to those in the east. Specific conductance measurements indicate that the Salmon River water is much less productive than any of the more local waters. Water from the Salmon River may dilute the concentration of dissolved solids in the marsh areas, particularly along the outer edges of the marsh adjacent to the St. Lawrence River. Because we have no analyses of water samples from the St. Lawrence the latter observation is only speculation. It could be verified by another summer of sampling which would include samples from the St. Lawrence River as well as from the stations already established. If time would allow more frequent sampling would also be desirable.

When plans are made for creating new bodies of water to encourage the nesting of waterfowl some thought might well be given to selecting sites which will take into account the potential productivity of waters filling the excavations. In general, potential productivity is good in the entire area. However, locations in the eastern half of the marsh that utilize waters sampled at Stations 1 to 5 could be expected to develop almost twice the quantities of food organisms as would locations in the western end of the marsh. If funds for engineering are limited, greater benefit to young developing waterfowl would be realized by concentrating the greatest effort in areas where potential productivity is highest.

Appendix. Analyses of water from sampling stations in the Dundee National Wildlife Area.

Appendix ctd.

Sampling Station #1 Date of Sampling, 1973

Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	50.0	70.0	50.0	10.0	10.0
Specific Conductance	360.0	366.0	430.0	407.0	542.0
Turbidity	28.0	47.0	86.0	22.0	4.7
p-H	8.0	7.6	7.6	7.9	8.1
Alkalinity - Total	168.0	163.0	95.6	159.0	212.0
Hardness - Total	186.0	195.0	212.0	201.0	274.0
Calcium	58.2	58.4	56.2	40.0	62.0
Magnesium	9.9	12.0	17.4	24.5	29.0
Potassium	0.9	1.1	1.7	3.1	1.4
Sodium	5.5	5.7	3.5	5.2	8.2
Bicarbonate	205.0	199.0	117.0	194.0	258.0
Chloride	6.7	8.7	5.2	3.6	9.2
Nitrogen - Total	0.07	0.26	0.8	0.48	0.02
Silica	4.3	7.3	6.6	5.5	5.3
Sulphate	20.0	22.0	110.0	56.0	67.0
Phosphorus - Total	0.085	0.1	0.015	0.034	0.033

Appendix ctd.

Sampling Station #2 — Dates of Sampling, 1973

Water analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	20.0	20.0	50.0	40.0	30.0
Specific Conductance	490.0	533.0	306.0	352.0	370.0
Turbidity	13.0	12.0	5.7	1.2	2.5
p-H	7.9	7.4	7.0	7.5	7.4
Alkalinity - Total	222.0	253.0	85.2	134.0	121.0
Hardness - Total	242.0	277.0	134.0	151.0	159.0
Calcium	67.7	73.2	42.5	36.0	38.0
Magnesium	17.7	22.9	6.8	14.8	15.5
Potassium	1.9	1.8	4.6	2.7	4.3
Sodium	10.9	11.7	6.8	10.0	11.0
Bicarbonate	271.0	309.0	104.0	163.0	148.0
Chloride	21.5	19.6	13.4	19.8	14.3
Nitrogen - Total	0.14	0.34	1.0	0.19	0.41
Silica	2.1	5.2	7.5	0.8	3.5
Sulphate	26.0	19.0	45.0	20.0	40.0
Phosphorus - Total	0.1	0.027	0.019	0.17	0.07

Appendix ctd.

Sampling Station #3	Date of Sampling, 1973				
Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	20.0	40.0	40.0	50.0	50.0
Specific conductance	482.0	467.0	390.0	450.0	452.0
Turbidity	6.6	33.0	14.0	1.9	2.1
p-H	8.0	7.7	7.4	7.4	7.4
Alkalinity - Total	238.0	225.0	158.0	197.0	175.0
Hardness - Total	255.0	251.0	193.0	230.0	215.0
Calcium	73.7	73.0	47.8	52.0	51.5
Magnesium	17.2	16.7	17.9	24.2	21.0
Potassium	1.4	1.7	3.2	3.1	3.8
Sodium	7.3	7.0	4.6	8.0	7.4
Bicarbonate	290.0	274.0	193.0	240.0	213.0
Chloride	10.0	8.5	8.3	12.7	11.5
Nitrogen - Total	0.09	0.9	0.42	0.3	0.36
Silica	2.3	4.0	6.7	2.4	5.8
Sulphate	21.0	25.0	35.0	31.5	50.5
Phosphorus - Total	0.034	0.17	0.014	0.37	0.14

Appendix ctd.

Sampling Station #4	Date of Sampling, 1973				
Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	30.0	40.0	30.0	40.0	60.0
Specific Conductance	519.0	476.0	409.0	476.0	447.0
Turbidity	10.0	30.0	13.0	0.6	2.4
p-H	8.0	7.4	7.3	7.4	7.4
Alkalinity - Total	247.0	230.0	160.0	223.0	171.0
Hardness - Total	271.0	158.0	197.0	224.0	215.0
Calcium	77.1	78.6	49.2	53.0	50.5
Magnesium	19.1	15.0	18.0	27.0	20.5
Potassium	1.8	2.1	4.0	3.5	3.5
Sodium	8.1	7.2	4.9	6.8	7.0
Bicarbonate	301.0	280.0	195.0	272.0	209.0
Chloride	9.7	7.8	10.4	10.0	11.1
Nitrogen - Total	0.15	0.46	1.15	0.15	0.34
Silica	3.0	5.3	6.0	2.3	6.1
Sulphate	33.0	27.0	36.0	25.0	46.5
Phosphorus - Total	0.068	0.037	0.010	0.44	0.21

Appendix ctd.

Sampling Station #5 Date of Sampling, 1973

Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	20.0	30.0	50.0	10.0	30.0
Specific conductance	528.0	507.0	409.0	450.0	580.0
Turbidity	15.0	25.0	4.7	0.6	2.5
p-H	8.1	7.7	7.2	8.2	7.7
Alkalinity - Total	254.0	247.0	94.6	211.0	210.0
Hardness - Total	278.0	276.0	181.0	234.0	284.0
Calcium	76.7	77.2	47.8	48.0	68.0
Magnesium	21.0	20.2	15.0	27.6	30.0
Potassium	2.1	2.2	4.0	3.6	4.2
Sodium	8.4	7.3	7.8	5.5	10.0
Bicarbonate	310.0	301.0	115.0	257.0	250.0
Chloride	10.2	8.3	13.7	6.9	12.8
Nitrogen - Total	0.18	0.44	3.6	0.17	0.39
Silica	3.1	5.5	8.5	1.8	7.6
Sulphate	34.0	28.0	61.0	29.0	74.0
Phosphorus - Total	0.063	0.055	0.012	0.053	0.06

Appendix ctd.

Sampling Station #6	Date of Sampling, 1973				
Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	30.0	50.0	30.0	30.0	50.0
Specific conductance	509.0	321.0	160.0	201.0	289.0
Turbidity	2.5	1.8	3.5	3.4	0.7
p-H	7.9	7.4	6.8	7.2	7.1
Alkalinity - Total	226.0	152.0	62.1	88.5	115.0
Hardness - Total	246.0	158.0	71.4	94.9	131.0
Calcium	70.9	55.9	19.8	23.5	24.0
Magnesium	16.8	4.5	5.3	8.8	11.2
Potassium	1.4	2.0	1.3	1.3	1.6
Sodium	15.0	9.1	2.9	3.9	7.3
Bicarbonate	276.0	185.0	75.7	108.0	140.0
Chloride	26.7	10.1	3.9	4.1	8.6
Nitrogen - Total	0.10	0.34	0.53	0.73	0.25
Silica	2.6	4.4	1.5	0.1	4.2
Sulphate	19.0	13.0	11.0	7.5	23.0
Phosphorus - Total	0.037	0.06	0.035	0.27	0.13

Appendix ctd.

Sampling Station #7 Salmon River Date of Sampling, 1973

Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	20.0	30.0	30.0	10.0	40.0
Specific conductance	121.0	141.0	115.0	148.0	127.0
Turbidity	1.7	2.6	2.2	1.8	1.1
p-H	7.5	7.4	6.7	7.6	7.2
Alkalinity - Total	43.6	49.4	42.7	57.8	39.3
Hardness - Total	53.3	60.8	58.1	65.1	51.0
Calcium	16.5	22.4	16.5	16.5	13.5
Magnesium	2.9	1.2	4.1	5.8	4.2
Potassium	0.7	0.9	1.5	1.0	0.8
Sodium	2.6	2.5	2.3	3.1	2.3
Bicarbonate	53.2	60.2	52.1	70.5	47.9
Chloride	2.7	2.4	2.6	3.0	2.2
Nitrogen - Total	0.16	0.41	0.53	0.16	0.17
Silica	5.6	5.4	6.9	6.0	7.8
Sulphate	10.0	12.0	15.0	11.0	17.5
Phosphorus - Total	0.017	0.017	0.047	0.044	0.012

Appendix ctd.

Sampling Station #8 Pike Creek Date of Sampling, 1973

Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	40.0	60.0	30.0	10.0	50.0
Specific conductance	264.0	242.0	149.0	146.0	252.0
Turbidity	3.3	3.2	7.9	1.1	1.9
p-H	7.8	7.4	7.4	7.5	7.2
Alkalinity - Total	128.0	110.0	54.6	57.6	89.0
Hardness - Total	136.0	118.0	65.9	65.1	117.0
Calcium	41.4	41.3	17.5	16.5	28.5
Magnesium	7.9	3.6	5.4	5.8	11.0
Potassium	0.6	0.9	1.3	1.0	2.0
Sodium	3.7	3.3	2.8	3.1	4.3
Bicarbonate	156.0	134.0	66.6	70.2	109.0
Chloride	2.3	2.2	3.7	3.0	5.7
Nitrogen - Total	0.08	0.19	0.29	0.14	0.08
Silica	2.5	4.0	5.0	5.3	4.6
Sulphate	11.0	12.0	14.0	12.5	31.5
Phosphorus - Total	0.033	0.03	0.029	0.022	0.07

Appendix ctd.

Sampling Station #9 Fraser River	Dates of Sampling, 1973				
Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	30.0	50.0	50.0	50.0	40.0
Specific conductance	477.0	406.0	340.0	309.0	468.0
Turbidity	7.5	14.0	3.8	0.5	0.6
p-H	7.9	7.6	7.0	7.5	7.2
Alkalinity - Total	225.0	193.0	133.0	85.2	177.0
Hardness - Total	246.0	217.0	153.0	120.0	232.0
Calcium	70.5	69.6	41.9	33.5	54.0
Magnesium	17.0	10.5	11.8	8.8	23.5
Potassium	1.7	1.1	2.8	1.2	4.0
Sodium	8.0	6.7	8.0	13.0	7.6
Bicarbonate	274.0	235.0	162.0	104.0	216.0
Chloride	12.0	7.9	17.0	25.8	12.0
Nitrogen - Total	0.15	0.31	0.18	0.01	0.35
Silica	3.0	3.8	5.8	0.6	6.2
Sulphate	24.0	21.0	17.0	28.0	57.0
Phosphorus - Total	0.055	0.039	0.015	0.028	0.06

Appendix ctd.

Sampling Station #10 East March Creek Date of Sampling, 1973

Water Analyses	May 2	June 5	Aug. 7	Sept. 1	Sept. 26
Colour	30.0	120.0	100.0	20.0	80.0
Specific conductance	375.0	168.0	265.0	309.0	230.0
Turbidity	2.0	0.6	0.8	0.2	0.4
p-H	7.9	7.1	6.7	7.3	7.1
Alkalinity - Total	158.0	63.0	89.7	95.2	68.0
Hardness - Total	179.0	79.5	110.0	123.0	93.7
Calcium	55.3	29.3	35.5	33.5	25.0
Magnesium	9.9	1.5	5.2	9.5	7.6
Potassium	1.2	4.9	1.2	1.0	1.6
Sodium	8.0	0.1	9.7	13.0	8.7
Bicarbonate	193.0	76.8	109.0	116.0	82.9
Chloride	13.5	8.3	22.6	25.9	20.6
Nitrogen - Total	0.09	0.08	0.12	0.01	0.02
Silica	1.7	0.1	6.3	1.2	4.7
Sulphate	21.0	14.0	11.0	23.5	18.0
Phosphorus - Total	0.024	0.011	0.021	0.023	0.055