Appendix 5

- **Fisheries Assessment of Streams and Lakes in the Ulu Project Area, RL&L Environmental Services Ltd., November 1996.**

FISHERIES ASSESSMENT OF STREAMS AND LAKES IN THE ULU PROJECT AREA, NUNAVUT

RL&L
Environmental Services Ltd.

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FISHERIES ASSESSMENT OF STREAMS AND LAKES IN THE ULU PROJECT AREA, NUNAVUT

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EXECUTIVE SUMMARY

The Ulu Deposit, located approximately 155 km north of the Lupin gold mine, has been purchased by Echo Bay Mines Ltd. In order to access the site and transport ore for processing, a winter road extending from Lupin is required. The proposed road will consist of overland sections and ice sections on frozen lakes and rivers. Four alternative routes are being evaluated on the basis of engineering and environmental criteria. Fish and fish habitat in streams that have the potential to be crossed by the proposed winter routes was assessed during the 1996 open water season.

The Ulu Project encompasses a study area of 3200 km^2. The area anticipated to be directly affected by the mine development and a winter road is approximately 122 ha. The four proposed routes for the winter road traverse a rugged landscape of bedrock, boulders and relic glacial features. These features have contributed to the formation of streams which generally can not support resident fish populations. The majority of the streams that are crossed by the proposed routes are small (often less than 1 m across), shallow (frequently less than 20 cm deep), and contain very little instream habitat that is suitable for supporting fish.

A total of 75 streams and portions of the Hood River were assessed during the June and August 1996 stream surveys, including: 43 streams along Route 1, 12 streams along Route 2, 3 on Route 3 and 17 on Route 4. Fish were captured or observed in only 14 (18%) of the streams (Table ES1). Species encountered included Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindricum*) and slimy sculpin (*Cottus cognatus*). Catch per unit effort (CPUE) was very low ranging from 0 to 1.73 fish per minute of electrofishing.

Overwintering habitat appears to limit the distribution of fish in the study area. As most streams and many of the lakes freeze to the bottom, deep water refugias are critical habitat features. During the winter ice can reach thicknesses of 2.4 to 2.7 m, therefore lakes must have water depths in excess of 3 m for fish to overwinter. Ice of this thickness not only prevents self-sustaining populations from becoming established, but also forms barriers to the upstream passage of fish, particularly Arctic grayling, prior to spring break up.

Surveys of four lakes in the vicinity of new infrastructure at the Ulu site were conducted in July 1996. Analysis of the water samples obtained from the four lakes during the July 1996 field program indicate that all four of the lakes are oligotrophic. Analysis of sediment and water samples collected in July 1996, provides an indication of the background concentrations of nutrients, metals and hydrocarbons in the four lakes sampled.

Fish were captured in all four lakes. Lake trout were present in all of the lakes sampled. Only in Reno Lake North were species other than lake trout encountered, these included round whitefish and Arctic charr (*S. alpinus*). The CPUE was very low in all of the lakes, ranging from 0.21 to 1.09 fish/hour of net set time/100 m^2 of net.

Table ES.1 Probability of encounter fish in streams along the proposed winter road alignments.

Route	Stream Number	Probability of Encountering Fish			
		Negligible	Low	Medium	High
1	4.6		✓		
	5.5		✓		
	7.0	✓			
	13.8		✓		
	14.2	✓			
	18.0				✓
	20.4/22.5				✓
	29.6	✓			
	30.9		✓		
	31.5	✓			
	32.2	✓			
	34.2		✓		
	35.8		✓		
	37.0				✓
	39.0	✓			
	39.3			✓	
	39.8	✓			
	42.1			✓	
	43.3		✓		
	43.6		✓		
	44.7	✓			
	46.8	✓			
	49.2	✓			
	51.1E				✓
	51.4W	✓			
	52.0W				✓
	52.1W				✓
	53.5				✓
	55.2	✓			
	56.5	✓			
	56.9	✓			
	58.2	✓			
	59.7	✓			
	62.2	✓			
	65.2	✓			
	66.2	✓			
	68.2	✓			
	69.7	✓			
	71.8		✓		
	71.9 (Hood River)		✓		
	74.8	✓			
	76.9	✓			
	83.2	✓			

Cont'd. . . .

Table ES.1 Cont'd.

Route	Stream Number	Probability of Encountering Fish			
		Negligible	Low	Medium	High
2	36.8	✓			
	37.4				✓
	40.7				✓
	42.5				✓
	43.2	✓			
	45.3	✓			
	46.9	✓			
	48.6	✓			
	70.8	✓			
	71.7		✓		
	73.2	✓			
	74.4			✓	
3	48.0				✓
	51.5				✓
	59.3				✓
4	1.0W				✓
	3.5E				✓
	3.7E				✓
	7.6				✓
	10.8		✓		
	12.0		✓		
	14.6				✓
	16.1	✓			
	16.9	✓			
	19.5	✓			
	21.0	✓			
	21.3	✓			
	23.2	✓			
	23.7				✓
	26.3		✓		
	28.3	✓			
	30.9	✓			

TABLE OF CONTENTS

Page #

LIST OF TABLES

Page #

LIST OF FIGURES

Page #

1.0 INTRODUCTION

Echo Bay Mines Ltd. has been operating a gold mine and processing facility at Lupin, N.W.T. since 1982. Echo Bay purchased the Ulu Deposit from BHP Minerals Ltd. in 1995. Plans call for ore extracted at Ulu to be stockpiled during the summer and trucked, via a winter road, to Lupin for processing.

Ulu is approximately 155 km north of Lupin and 510 km northeast of Yellowknife, N.W.T., at 66° 54'30"N, 110° 58'W (Figure 1.1). In order to access the Ulu Project Area, a winter road approximately 180 km in length, extending north from Contwoyto Lake is required.

The winter road will consist of overland sections and ice sections on frozen rivers and lakes. In this region the snow pack is light and there are large bedrock outcroppings and boulder fields that must be traversed. Depending upon the terrain conditions along the final route, select portions of the overland sections will have to be built up with gravel. The proposed road alignments attempt to maximize the use of rivers and lakes in order to minimize the overland portions. This approach has several benefits including the minimization of:

- environmental impacts to the terrestrial environment,
- construction costs, and
- maintenance costs.

There are however, limitations to the use of ice sections that must be considered during route selection. These limitations include the following:

- ice must reach a thickness of at least 2.4 m,
- there can not be flowing water under the ice (such a condition can result in flooding of the road and vehicles becoming mired in slush),
- large, non-ice covered boulders in the stream channel can cause difficulties preparing and maintaining a winter road, as well as require reduced travelling speeds, and
- potential impacts to fish and fish habitat.

Four proposed winter road routes are being evaluated on the basis of engineering and environmental criteria. Echo Bay Mines Ltd. contracted R.L. & L. Environmental Services Ltd. to conduct an assessment of the aquatic habitat at each stream crossing along the proposed winter road routes as well as the fish use of these streams. In addition to the stream assessments, R.L. & L. Environmental Services Ltd. has been requested to conduct preliminary limnological and fisheries surveys of four lakes. These lakes have the potential to be impacted by the daily activities at the Ulu Camp, the mine and ore storage facility.

R.L.& L. ENVIRONMENTAL SERVICES LTD.

Figure 1.1 Location of Ulu deposit

1.1 STUDY AREA

The Ulu Project area and proposed winter road alignments encompassed a study area of approximately 3200 km^2. The boundaries of the study area included Kathawachaga Lake to the south and the Ulu mine site to the north. The eastern boundary of the study area was approximately 115° 15'W and to the west at 111°30'W. The project is anticipated to disturb only 122ha within the study area.

The physiography of this area was typical of the treeless tundra, with numerous bedrock outcroppings and relic glacial features in the form of large sand and gravel eskers and ancient boulder filled stream channels. Vegetation consisted mainly of grass, moss, and lichen, although small willows were established in protected areas along some of the streams (D. Hamilton, personal observation, 1996). In some areas substantial deposits of peat have developed. The continuous permafrost in the study area, has resulted in the development of unique stream channel formations (refer to Section 3.1).

The study area includes a myriad of small lakes and streams. The northern portion of the study area is located in the Hood River and Wright River (a tributary of the Hood River) drainages. The southern quarter of the study area lies in the Cracroft and Burnside river drainages.

The only large river system in the study area to be crossed by the proposed winter road was the Hood River. The Hood River is approximately 210 km in length and drains an area of 11 914 km^2. Upstream fish movements from Bathurst Inlet are blocked by Wilberforce Falls, a twin set of 60-75 m waterfalls located approximately 5 km upstream from the inlet (Stewart and MacDonald 1978).

The climate in the study area is typical of the Arctic environment. Mean January air temperature is -32°C and mean July air temperature is 10°C. The annual total precipitation is approximately 200 mm. The study area receives between 80 and 120 cm of snow annually, with the heaviest snowfalls occurring in the southern portion of the study area. Large rivers are ice-free by the middle of June and freeze-up occurs by the beginning of October (Fisheries and Environment Canada 1978).

Many of the streams in the study are ephemeral and are initially fed by snow melt in the spring. During the late summer many streams cease to flow, while others continue to flow as a result of groundwater inputs and early snowfall meltwater (D. Hamilton, personal observation, 1996).

The Ulu site and associated road are located in an area where very little hunting or trapping activity has been reported. No domestic fishery has been reported on the Hood River or in the vicinity of the Ulu exploration area, although some has been reported to the south on Kathawachaga Lake (Nunavut Atlas 1992).

Stewart and MacDonald (1978) reported the results of gillnetting that was conducted upstream and downstream of the proposed crossing location on the Hood River. These authors documented the presence of lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindricum*), and slimy sculpin (*Cottus cognatus*). Other species reported in the Hood River, below Wilberforce Falls, include Arctic grayling (*Thymallus arcticus*) and broad whitefish (*Coregonus nasus*).

The proposed mine site is situated on a ridge between two lakes. Ulu Lake, on the east side of the ridge, has the potential to receive discharges of mine water and septic waste from the camp via East Lake and Discharge Creek (local names). West Lake, located on the west side of the ridge near the site of the Ulu camp, will be the source of potable water for the camp.

Located south of the camp and the Ulu mine is the main fuel storage area with a combined capacity of 3 185 000 L of fuel. This fuel storage is situated on the top of a sand and gravel esker between Reno Lake North and Reno Lake South.

1.2 OBJECTIVES

The objectives of the 1996 sampling programs included the following:

- assess at an overview level the fish habitat in streams to be crossed by the proposed road,
- determine stream discharges during peak and baseflows at each stream crossing,
- determine fish species presence, relative abundance, and critical life history functions (e.g., spawning, rearing, etc.) in streams to be crossed by the road,
- describe the water and sediment chemical characteristics of lakes in the Ulu Lake study area,
- describe the seasonal abundance, distribution, and biological characteristics of fish found in waterbodies in the study area, as well as habitat used by the fish, and
- assess the importance of waterbodies with the potential to be impacted by the development to fish populations residing in, immediately downstream, or upstream of the development.

2.0 METHODS

2.1 WINTER ROAD STREAM CROSSINGS

There were four proposed winter road routes examined during the 1996 field season. Routes were given a numeric designation (e.g., Route 1, Route 2, Route 3, and Route 4). Streams that were to be crossed by the proposed road along each route were also assigned a unique identification number based on distance (in kilometres) from Kathawachaga Lake. For example, along Route 1, Stream 4.6 was located 4.6 km north of Km 0 on the north shore of Kathawachaga Lake.

2.1.1 Physical Habitat Assessment

Stream order, a measure of the degree of stream branching and size, was determined using the Strahler numbering system as outlined by Newbury and Gaboury (1993).

Physical habitat was assessed within 100 m upstream and up to 300 m downstream of each proposed crossing. Habitat type, instream cover, and substrate composition were classified according to the R.L. & L. Habitat Classification System outlined in Appendix A; Table A1. The length and wetted channel width of each discrete habitat unit were measured. The availability of instream cover was assessed as a percentage of the total area of the habitat unit. This percentage was then used to calculate the areal cover in square metres. Similarly, bank instability (i.e., slumping, erosion, etc.) was recorded as a percentage of the total bank length for each discrete habitat unit.

In addition to the overall physical habitat assessment, cross section transects were made to assess the water depth, velocity, substrate characteristics, and silt depth in three areas of representative habitats. At each transect site, measurements were carried out at locations corresponding to ¼, ½, and ¾ of the stream's channel width.

Discharge was determined in all streams that had measurable flow. Velocity was measured using a Swoffer Model 2100 digital flow meter ($\pm$0.005 m/s) and water depths were measured using either a metre stick ($\pm$0.5 cm) or the flow meter wading rod. Water depth and mean velocity measurements were taken at intervals along a tag line positioned perpendicular to the flow. On very small streams, measurements were taken at 0.2 m intervals. Discharge was calculated according to the methods outlined by Bovee and Cochnauer (1977).

Water conductivity was measured with an Oakton TDS Testr1 conductivity meter (0-1990 μS cm^{-1}; $\pm$0.5 μScm). Water temperatures were measured with a alcohol pocket thermometer ($\pm$0.5°C).

Stream bank slopes at the crossing (i.e., between the water's edge and flood plain) and the slopes of the approach (from the flood plain out) were measured with a Silva clinometer (±0.5°). Bank cover (e.g., vegetation) and bank material were estimated in the field as a percentage of the total bank area.

A Garmin 45 Global Positioning System (GPS) was used to determine the Universal Transverse Mercator (UTM) coordinates of the RoW stream crossing as well as to assist navigation to several of the sites. The UTM coordinates were calculated using the NAD83 datum. Photographs were taken at each stream crossing site using a Nikon FE2 35 mm camera.

2.1.2 Fish Capture and Assessment

A Smith-Root Model XII Programmable Output Waveform (POW) backpack electrofisher was utilized to capture fish at each assessed stream crossing. The electrofisher operator waded upstream and sampled in the immediate vicinity of suspected fish holding sites (e.g., overhanging branches, undercut banks, boulders, etc.). The netter, who was positioned immediately downstream of the electrofisher operator, collected the stunned fish and placed them in a live-holding bucket.

Portions of the Hood River were sampled using a Smith Root Type VI electrofisher mounted in an Avon river raft, with a twin boom mode array. The raft requires one person to row the raft and to operate the electrofisher and a second person situated in the bow to act as the netter.

All captured fish were identified to species, weighed, and measured (fork length). Non-lethal aging structures were collected from sportfish species only and archived. All fish were released near their collection point.

Fork lengths (to the nearest millimeter) were determined using a measuring board. Weights were determined using a top loading electronic balance (±0.5 g). Fish identifications were confirmed using keys provided in the Freshwater Fishes of Canada (Scott and Crossman 1973).

All of the fish data were analysed and processed on a 586-66 MHZ computer utilizing Lotus 123 (V.5) and Freelance Graphics (V.2) software. The relative abundance was calculated in terms of catch-per-unit-effort (CPUE) based on the number of fish captured per minute of electrofishing sampling time. Fish observed but not captured were not included in the CPUE calculations.

2.2 LAKE SURVEYS

Fisheries assessments were conducted on the four lakes that have the potential to be impacted by the mine or camp operations. Fisheries surveys were conducted using a variety of methods including test-gangs of gill nets, Gee minnow traps, and angling. The test-gangs consisted of 15.2 m (50 ft) long panels of 19 mm, 38 mm, 70 mm,

89 mm, 114 mm, and 140 mm (¾, 1½, 2¾, 3½, 4½, and 5½ inch) stretched mesh size. As the main emphasis of the study program was to determine species present and relative abundance, the duration of gill net sets was generally limited to two to four hours in order to minimize capture mortalities.

Another objective of the 1996 study was to gather bathymetric data for each of the four study lakes to produce accurate bathymetric maps. A Trimble Pro XL GPS and data logger combined with a MD-100 sonar was to be used to collect georeferenced depth data. A second Trimble Pro XL GPS and data logger was used as a reference base station in order to provide the necessary data required to correct the positioning information and obtain submetre accuracy for the geographic positioning data. The bathymetric data could not be obtained due to sonar malfunctions.

At the profundal zone sampling station, water temperature and conductivity profiles were measured with a Hydrolab Conductivity/Temperature meter equipped with a 30 m cable.

Sediment and water samples were collected from the profundal zone of each of the four lakes. Collection of sediment samples proved to be difficult due to the nature of the lake sediments (i.e., light flocculent material and boulders). Samples were preserved and shipped to Norwest Labs in Edmonton where a variety of analytical tests were performed (Table 2.1). Several samples were damaged during shipping (i.e., the bottles were broken); consequently, there was an insufficient volume of material to conduct all of the tests for several sites.

Table 2.1 Analytical parameters for water and sediment analysis.

Parameter	Sediment	Water
Total Metals[1]	✓	✓
Major Cations (Ca, Mg, Na, K)	✓	✓
Alkalinity		✓
Particle Size	✓	
Nutrients		
Ammonia		✓
Nitrate-Nitrogen		✓
Nitrate + Nitrite--Nitrogen		✓
Total Kjeldahl Nitrogen		✓
Total Phosphorous	✓	✓
Total Dissolved Phosphorous		✓
Total Organic Carbon	✓	
Total Dissolved Solids		✓
Oil and Grease	✓	✓
Total extractable and purgeable hydrocarbons including BTEX	✓	✓

[1]Total metals - 31 elements: Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, P, K, Se, Si, Ag, Na, Sr, S, Tl, Ti, V, Zn.
[2]BTEX includes benzene, toluene, ethylbenzene and the three forms of xylene.

3.0 STREAM CROSSING SURVEYS

Assessments of the winter road stream crossings were scheduled for the spring freshet period and again in the late summer or early fall under baseflow conditions. Initial planning called for only one winter road route (Route 1) to be surveyed and this route was surveyed during June 1996. By mid July 1996, two additional routes were proposed (Routes 2 and 3) and in August a fourth alternative route had been added (Figure 3.1). These additional routes were surveyed during August 1996.

Early snowfall followed by warm weather combined with heavy rains resulted in water levels 15 to 25 cm higher than normal in August. Due to these unusually high flows, it was not possible to observe the streams under baseflow conditions.

3.1 ROUTE 1

Route 1 was surveyed from 14 - 21 June 1996. This route contains 38 stream crossings between Kathawachaga Lake and the Ulu mine site (Figure 3.1). An additional five streams situated to the east and west of the route were also surveyed in order to provide some flexibility to the final road placement. Table 3.1 provides an overview of the streams surveyed along Route 1.

The streams crossed by Route 1 ranged in size from streams less than one metre wide to the Hood River, which was 100 m wide at the crossing point used in early 1996. The flow conditions encountered during the June sampling trip ranged from zero flow in some small stream channels to spring freshet in the Hood River, which had water levels approximately 2.5 m higher than baseflow conditions. Several streams marked on the 1:50 000 NTS maps were relic, boulder filled, glacial melt channels; consequently, some streams were either dry at the time of sampling or had snow melt water flowing through the boulders but no defined stream channel (e.g., Stream 65.2).

Instream habitat features were generally dominated by boulder or cobble riffles and runs. Instream cover in the majority of the streams was provided by the "pocket water" behind large boulders, although in several streams overhanging willows also provided a limited amount of cover habitat.

The probability of encountering fish was assessed at each crossing based on habitat features at the crossing as well as upstream and downstream, results of fish sampling effort, and professional judgement. The probability of encounter fish ranged from negligible to high; where

- negligible indicates that due to the absence of fish habitat, fish would not be encountered in the stream,
- low indicates a small probability of encountering fish under unusual conditions (i.e., unusually high water levels) as there may be suitable overwintering habitat downstream of the site,
- medium indicates that fish may seasonally use the stream as there is suitable overwintering habitat near the crossing location; and
- high indicates that fish were captured at the site and there is suitable overwintering habitat near the crossing location.

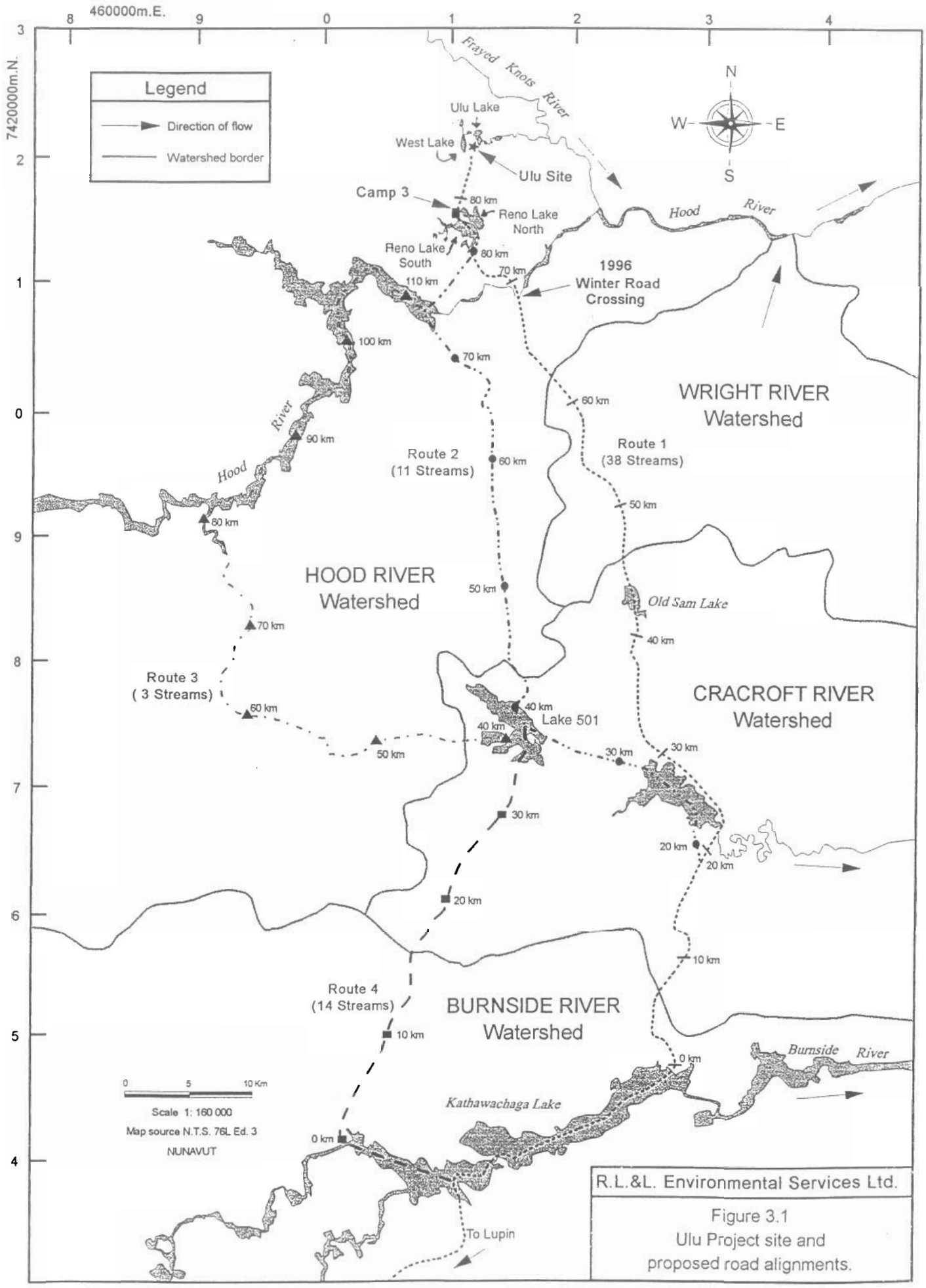
460000m.E.
7420000m.N.
Legend
Direction of flow
Watershed border
Frayed Knois River
Ulu Lake
West Lake
Ulu Site
Camp 3
Reno Lake North
Reno Lake South
Hood River
1996 Winter Road Crossing
WRIGHT RIVER Watershed
Route 1 (38 Streams)
Route 2 (11 Streams)
HOOD RIVER Watershed
Old Sam Lake
Route 3 (3 Streams)
CRACROFT RIVER Watershed
Lake 501
Route 4 (14 Streams)
BURNSIDE RIVER Watershed
Burnside River
Kathawachaga Lake
To Lupin
Scale 1: 160 000
Map source N.T.S. 76L Ed. 3
NUNAVUT
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Figure 3.1
Ulu Project site and
proposed road alignments.

Table 3.1 Summary of streams crossed by proposed Route 1

Stream No.	Stream Order	Watershed	Habitat Type	Fish Captured	Probability of Encountering Fish[1]
4.6	1	Burnside River	overflow	not sampled (n.s.)[2]	low
5.5	1	Burnside River	riffle/boulder garden and shallow runs	none	low
7.0	1	Burnside River	pools and underground flow through boulder field	n.s.	negligible
13.8	1	Cracroft River	overflow	n.s.	low
14.2	2	Cracroft River	bog, no stream channel	n.s.	negligible
18.0	2	Cracroft River	series of riffles, runs (R1&R2)[3] and pools (P1) with some overflow between pools	round whitefish	high
20.4/22.5	3	Cracroft River	series of riffles and runs (R2), with overhanging vegetation and boulders for instream cover	lake trout, round whitefish	high
29.6	1	Cracroft River	poorly defined channel flowing through a bog	n.s.	negligible
30.9	1	Cracroft River	riffle, runs (R2 & R3) and pools (P2); gravel and sand substrate with some cobble	none	low
31.5	1	Cracroft River	stream flows through wide bog, no defined banks; intermittent	n.s.	negligible
32.2	1	Cracroft River	bog with no channel; intermittent	n.s.	negligible
34.2	2	Cracroft River	riffle boulder garden with shallow runs (R3)	none	low
35.8	2	Cracroft River	pools (P1) and runs (R1 & R2) separated by small channels or sections of overflow	none	low
37.0	2	Cracroft River	shallow run and boulder garden	round whitefish	high
39.0	2	Cracroft River	no defined channel	n.s.	negligible
39.3	3	Cracroft River	riffle boulder garden between two lakes	none	moderate
39.8	1	Cracroft River	no defined channel, in an area of peat and boulders	n.s.	negligible
42.1	1	Cracroft River	moderately deep pools (P2), and runs (R2&R3), with some overflow	observed four unidentified fish in lake at upstream end of site.	moderate
43.3	3	Cracroft River	narrow channel with many deep holes behind boulders	none	low
43.6	2	Cracroft River	stream originates from bog and has a narrow channel, with overflow	n.s.	low
44.7	2	Cracroft River	surface flow through boulder field, no defined channel	n.s.	negligible
46.8	1	Cracroft River	isolated pockets of water, no flow	n.s.	negligible
49.2	1	Wright River	intermittent stream, with shallow runs (R3)	none	negligible
51.1E	2	Wright River	series of braided channels with shallow runs (R3)	lake trout and slimy sculpin	high
51.4W	1	Wright River	dry at time of sampling	n.s.	negligible
52.0W	3	Wright River	series of runs separated by riffle/boulder gardens	lake trout and slimy sculpin	high
52.1W	1	Wright River	series of ledges and pools formed by boulders	lake trout and slimy sculpin	high

Cont'd...

Table 3.1 Cont'd.

Stream No.	Stream Order	Watershed	Habitat Type	Fish Captured	Probability of Encountering Fish[1]
53.5	3	Wright River	wide channel, flowing through boulder garden	none	high
55.2	2	Wright River	series of shallow runs (R3) separated by sections of underground or undersnow flow	burbot captured at lake margin	negligible
56.5	2	Wright River	narrow channel with several wide pools, gradient downstream towards lake >20%, areas of underground flow	n.s.	negligible
56.9	1	Wright River	narrow channel with shallow run habitat (R3)	n.s.	negligible
58.2	1	Wright River	stream originates from lake and flows through boulder field	none	negligible
59.7	3	Wright River	channel braided, sections of shallow run (R3) separated by riffle boulder gardens	none	negligible
62.2	2	Wright River	intermittent stream, flowing overland through a boulder garden	n.s.	negligible
65.2	1	Hood River	intermittent stream, with only small pools left in boulder field	n.s.	negligible
66.2	2	Hood River	intermittent stream with overflow	n.s.	negligible
68.2	1	Hood River	small intermittent stream with a poorly defined channel, very little flow	n.s.	negligible
69.7	3	Hood River	intermittent stream with mainly shallow runs (R3) and riffle boulder gardens and flows underground below crossing point	none	negligible
71.8	3	Hood River	series of deep runs (R1) and riffles with boulder and cobble substrate	none	low
71.9 (Hood River)		Hood River	series of deep runs (>3 m) separated by rapids; substrate mainly sand, with boulders and cobbles near Stream 71.8	none	low
74.8	1	Hood River	intermittent stream with narrow channel; below crossing point stream disperses in a flat boggy area.	none	negligible
76.9	1	Hood River	narrow channel, with small pools (P3) and areas of overflow	none	negligible
83.2	1	Hood River	originates from lake via underground flow through a boulder field and disperses into a bog	none	negligible

[1]Negligible indicates absence of habitat; low indicates fish may be present under unusual circumstances; medium indicates that potential seasonal use of the stream; and high indicates that fish were captured (refer to Section 3.1 for more details of these terms).
[2]Not sampled due to the lack of water or absence of habitat.
[3]Refer to Appendix A, Table A1 for definitions.

Fish were captured in only seven of the 43 streams surveyed and observed in one (42.1). Fish species included burbot, lake trout, round whitefish, and slimy sculpin (Table 3.2). Fish use of the streams at the time of the survey was generally limited to the first 75 to 100 m immediately upstream from lakes which appeared to be of sufficient depth to provide overwintering habitat. Fish encountered were either juveniles that were thought to be utilizing the streams for rearing.

Table 3.2 Fish species observed or captured in streams along Route 1 by backpack electrofishing, June 1996.

Stream	Species	*n*	Fork Length Range (mm)	Weight Range (g)	CPUE[1]	
					Species	Site
18.0	Round Whitefish	1	126	28	0.17	0.17
20.4	Round Whitefish	6	57-126	<10-28	0.50	0.50
37.0	Round Whitefish	1	155	30	0.14	0.14
42.1	Lake Trout	1*				
	Slimy Sculpin	3*				
51.0E	Lake Trout	1	55	<10	0.17	
	Slimy Sculpin	4	54-68	<10	0.67	0.84
52.0W	Lake Trout	5	53-63	<10	0.36	
	Slimy Sculpin	14	33-92	<10	1.00	1.36
52.1W	Lake Trout	2	52-63	<10	0.19	
	Slimy Sculpin	16	44-72	<10	1.54	1.73
55.2	Burbot	1	275	126	0.9	0.90

[1] Catch per unit effort (CPUE)=number of fish captured per minute of electrofishing.
* observed

3.1.1 Stream Descriptions

The following discussions provide an overview of the habitat features at each site. More detailed habitat information has been included in Appendix A1.

STREAM 4.6 **UTM: 12W 0516700 7350600** **PLATE 1**

The stream channel at the proposed road crossing is a boulder field in a low-lying bog. There is a short section of braided channel immediately upstream of a small lake to the east of the crossing. The braided channel had some water in it at the time of sampling. The channel was well vegetated with grass, which indicated that after the completion of the snow melt runoff, the stream channel would be dry. Due to the stream channel conditions and very shallow water, Stream 4.6 was not sampled for fish.

The lake which Stream 4.6 discharges into is too shallow to provide overwintering habitat; however, as the lake is connected to the Kathawachaga Lake via a small stream and another lake (where Camp 2 was situated), it may be possible during periods of exceptionally high spring discharge for fish (Arctic grayling in particular) to move into the lake immediately below Stream 4.6. Therefore, there is a low probability of encountering fish near the stream mouth.

STREAM 5.5 **UTM: 12W 0517105 7351145** **PLATE 2**

The stream habitat consisted of a series of shallow runs (R3) separated by riffles and a long section (125 m) of riffle/boulder garden (RF/BG). The channel was braided with small elevated areas of boulders and willows separating the channels at the stream mouth. The center portion of the surveyed area was steep (gradient of 4%) with boulder cascade habitat. Above the boulder cascade, the stream flowed through a low gradient area of boulders and willows. Water depths varied from 10 to 44 cm in depth; however, the submerged lichen on the rocks indicated that water levels would be very low during baseflow periods.

Where the stream consisted of a single channel, the wetted stream width was between 3.8 and 6.4 m and the substrate was almost entirely boulders. Instream cover habitat was provide mostly by boulders, although there were areas where overhanging vegetation contributed to the available cover.

As with Stream 4.6, there is the potential to encounter fish in the lower part of the stream during high water years.

STREAM 7.0 **UTM: 12W 0516714 7352850** **PLATE 3**

This stream originates from a boulder field, flows overland for approximately 30 m, and then flows underground through a boulder field before reaching the lake. The portion of the stream that flows aboveground has terrestrial grass in the stream channel, which indicates that the stream flows only during the period of spring snow melt runoff or heavy rain.

STREAM 13.8 **UTM: 12W 0518500 7362488** **PLATE 4**

Stream 13.8 consisted of a series of shallow, braided channels with the water flowing over terrestrial vegetation. The substrate in all of the channels consisted of organic material (underlain by permafrost) covered with grasses. There is a low probability of encountering fish near the stream mouth.

STREAM 14.2 **UTM: 12W 0518300 7358900**

Although marked on the NTS map (#76L/7), this stream exhibited only a boggy area with no visible stream channel.

STREAM 18.0 **UTM: 12W 0520051 7362499** **PLATE 5**

The habitat in this stream consisted mainly of moderately deep (R2) and shallow (R3) runs separating pools which were greater than 1 m in depth (P1; Plate 5). There were also areas with no defined channel, where there was overflow from one run to the next. Substrate was predominantly organic material and grass, with sections of gravel and cobble.

A single juvenile round whitefish was captured at this site (CPUE of 0.17 fish/min). Based on an examination of the stream, the study team believed that this individual may have moved upstream from Stream 22.5. Therefore, there is a high probability of encountering fish during the spring and summer in Stream 18.0 between the sampling site and Stream 22.5. Fish may also move upstream because habitat similar to that observed at the crossing site continued upstream.

STREAM 20.4/22.5 **UTM: 12W 0521834 7364210** **PLATES 6 - 8**

Stream 22.5 was the second largest watercourse surveyed in June. The stream originates from a large unnamed lake and flows south for approximately 3 km before it turns east at a gap in the large esker that confines the eastern bank of the stream. The stream then follows a meandering path to the northeast and eventually joins with the

Cracroft River, which ultimately flows into the Burnside River, approximately 5 km downstream of the Bellanca Rapids. A large, deep (>2 m) back eddy has been created by the confluence of Stream 18.0 and Stream 22.5 at the gap in the esker.

Due to its size, depth, and velocity the stream could not be safely sampled at the crossing point. Habitat measurements and backpack electrofishing were conducted immediately downstream of the gap in the esker (approximately 3 km downstream of the proposed crossing). This site was designated Stream 20.4.

The habitat at this location consisted of a long deep run (R1), followed by a boulder/cobble riffle and a deep pool (P1) below the riffle (Plates 6 and 7). The substrate in the run and riffle was almost entirely boulder, although cobble was present in some areas. The substrate in the pools was sand and gravel, with some silt in back eddys. Instream cover was limited to the pocket water of boulders and small areas of overhanging willows.

At the upstream crossing location the habitat consisted of boulder rapids and deep runs (R1). Instream cover was provided by the pocket water of boulders (Plate 8).

Backpack electrofishing was conducted in the downstream sampling area. A total of six round whitefish (CPUE 0.50 fish/min) were captured in the riffle (Table 3.2). The majority of these fish were found to be associated with lower velocity areas along stream banks and under overhanging willows. Angling of the pool below the riffle (2 anglers fishing for 0.75 h) resulted in the capture of one lake trout (694 mm in length and >2300 g). Other large fish (likely lake trout) were subsequently observed in larger pools and runs approximately 1 km downstream during an overflight on 19 June 1996.

Angling was also conducted in the rapid section at the proposed stream crossing site (Stream 22.5). A single lake trout (654 mm in length and >2300 g) was captured with a combined effort of 1.0 h of angling (2 anglers for 0.5 h). This individual was captured holding in the pocket water of a large boulder in the rapids.

Based on the results of this sampling there is a high probability of encountering fish throughout Stream 22.5. In addition, there is also a high probability that fish are overwintering in the lake from which Stream 22.5 originates and that juvenile lake trout and whitefish may utilize other tributaries of the lake for rearing habitat.

STREAM 29.6 **UTM: 12W 0521834 7364210** **PLATE 9**

At the time of sampling (mid-June) Stream 29.6 had no defined channel and consisted of snow melt runoff flowing over a wide meadow. The substrate was predominantly decomposing organic material and grass). The stream had no fish habitat value and would be dry when spring runoff was complete.

STREAM 30.9 **UTM: 12W 0516444 7373092** **PLATE 10**

The habitat in Stream 30.9 consisted of a series of shallow runs (R3), riffles/boulder gardens(RF/BG), moderately deep pools (P2), and deep pools (P1). Substrate was a mixture of sand, gravel cobble and boulders. Instream cover was limited to the pocket water of boulders. The stream banks above the crossing location were unstable as the stream cuts through a sand esker. Portions of the right upstream bank (RUB) in this area were covered by an ice and snow shelf. The stream channel was generally very narrow (2 m wide), although at its widest the stream was 6 m across. One of the most unique features about this stream was that the substrate and stream banks were frozen (Plate 10).

Although the stream provided potentially suitable fish habitat (i.e., deep pools and spawning substrate), backpack electrofishing for 310 s did not yield any fish. Many of the lakes downstream of the proposed crossing location freeze completely in the winter, thus likely making it impossible for Arctic grayling to move upstream in the very early spring. In addition, the size of the stream channel and grass in the channel indicate that water levels are considerably lower during baseflow periods. The probability of encountering fish in Stream 30.9 is considered to be low.

STREAM 31.5 **UTM: 12W 0516296 7373260** **PLATE 11**

This stream originates from a small lake located at the base of an esker. This intermittent stream was flowing at the time of sampling (mid-June) due to the snow melt runoff. The stream had no defined banks; rather, it was flowing through a slight depression in a peat bog. There was not enough water in the stream to permit backpack electrofishing, therefore the stream was not sampled for fish.

As the lake from which the steam originates freezes to the bottom during the winter (as evidenced by the shallow depth and ice cover), there was no available overwintering habitat for fish. Given that Stream 31.5 is intermittent, downstream lakes freeze to the bottom, and the boggy terrain downstream (resulting in poorly defined stream channels), it is unlikely that fish could move in from downstream areas. The probability of encountering fish is considered to be negligible at the Stream 31.5 crossing.

STREAM 32.2 **UTM: 12W 0516144 7374478** **PLATE 12**

At the time of sampling (mid-June), the stream was nearly dry. There were no defined banks and the stream was classed as intermittent. The probability of encountering fish at the Stream 32.2 crossing is considered to be negligible.

STREAM 34.2 **UTM: 12W 0514875 7375739** **PLATE 13**

The instream habitat consisted of long (>100 m) sections of shallow runs (R3) and riffle/boulder gardens (RF/BG). Substrate was boulders with a small amount of cobble. Water depths varied from 16 to 32 cm; however, lichen growth on the rocks indicated that water levels would be approximately 5 to 10 cm lower during baseflow conditions. Instream cover was limited to the pocket water of large boulders.

Backpack electrofishing (288 s) was conducted throughout the area of the proposed crossing with no fish captured or observed. As was evident throughout the study area, many of the lakes downstream of this site will freeze to the bottom during the winter. It is unlikely that fish are present at this site; however, the potential does exist for fish to migrate upstream during periods of unusually high flows. Therefore, the probability of encountering fish at this location is considered to be low.

STREAM 35.8 **UTM: 12W 0515063 7377450** **PLATE 14**

Stream 35.8 had the most complex arrangement of habitat types of the streams surveyed during the June and August field programs. The instream habitat features consisted of a series of deep pools (P1) or deep runs (R1) separated by either shallow runs (R3) or overflow. The pools were large, several were 20 m long and 8 m wide, with vertical sides that caused the water depth to change abruptly. The maximum depth in some pools exceeded 3 m. The areas of overflow were long (5 to 10 m) and covered with grass, indicating that under baseflow conditions the large pools become isolated. Instream cover habitat was very limited as the substrate consisted entirely of frozen peat polygons.

There were no fish captured or observed during 215 s of backpack electrofishing. The nature of the pools (i.e., rapid changes in depth and depths too great for wading) made it difficult for the sampling crew to effectively sample large areas of the pools. It is possible that fish could have been holding in the large ponds and were not observed. Due to the presence of large areas of overflow, the probability of encountering fish in this stream is considered to be low.

STREAM 37.0 **UTM: 12W 0514827 7378491** **PLATE 15**

This stream, connecting two lakes, flowed through an area of boulders and peat deposits. The habitat throughout the sampling area consisted of shallow run (R3) flowing through a boulder garden. Water depths were between 14 and 32 cm at the time of sampling (mid-June); however, the submerged lichen on the boulders indicated that water levels would be approximately 5 cm lower under baseflows. Instream cover consisted of the pocket water of large boulders.

One round whitefish was captured, and a second was observed but not captured, during 425 s of backpack electrofishing (CPUE 0.14 fish/min). The probability of encountering fish throughout the stream is considered to be high as the habitat was similar for the whole length of the stream is expected.

STREAM 39.0 **UTM: 12W 0513371 7380269** **PLATE 16**

Stream 39.0 consisted of shallow melt water flow in a low-lying peat area (Plate 16). The probability of encountering fish in this stream is considered to be negligible.

STREAM 39.3 **UTM: 12W 0513814 7380600** **PLATE 17**

This stream consisted of a long riffle/boulder garden (RF/BG) situated between two lakes. At the time of sampling (mid June), there was a considerable amount of overflow on either side of the stream. The presence of lichen on many of the boulders in the stream channel indicated that stream water levels were normally very low during baseflow periods. Stream 39.3 had one of the highest gradients (3%) of streams surveyed in June 1996.

Instream substrate consisted mainly of boulders and fractured bedrock; although, there were areas where peat and grass contributed to the overall substrate. The pocket water of boulders provided the only available form of instream cover.

No fish were captured or observed during 210 s of backpack electrofishing in the vicinity of the proposed stream crossing. Due to the habitat conditions and proximity of the site to two lakes the potential for encountering fish at this site is considered to be moderate. The probability of encountering fish in the immediate vicinity of the lakes situated upstream and downstream of the proposed crossing location is high.

STREAM 39.8 **UTM: 12W 0514070 7381064** **PLATE 18**

At the time of sampling in mid-June 1996, Stream 39.8 had no defined channel (Plate 18). Water was present as melt water flow in a low-lying peat bog, interspersed with peat and lichen covered boulders. The probability of encountering fish in this stream is considered to be negligible.

STREAM 42.1 **UTM: 12W 0514619 7383356** **PLATE 19**

Stream 42.1 is a short (approximately 100 m) stream situated between two large lakes. The stream habitat consisted of a series of shallow and moderately deep runs (R2 and R3), moderately deep pools (P2), and some areas of overflow. Substrate was mainly sand and silt. Instream cover was limited to areas of aquatic vegetation. Water depth varied from 14 to 54 cm, with the mean depth being less than 20 cm in most locations in the stream.

The stream and lake shores at the mouth and headwaters of the stream were backpack electrofished for 440 s with no success; however, four fish were observed in the lake at the upstream end of the sampling area. Due to low water conductivity, electrofishing effectiveness was low and these fish could not be captured. One large fish was suspected to be a lake trout, the other three fish were slimy sculpins. Based on these observations the potential for encountering fish in the stream is considered to be moderate (i.e., transients) and high along the lake shorelines.

STREAM 43.3 **UTM: 12W 0514432 7384442** **PLATES 20 - 21**

Stream 43.3 flows underground through a boulder field from its originating lake. Portions of the stream immediately below the boulder field were still ice and snow covered at the time of sampling (mid-June; Plate 20). The stream was sampled near the confluence with Stream 43.6. A large pool was located immediately upstream

of the confluence (Plate 20). Downstream of the confluence, the stream channel consisted of long shallow runs (R3 and R2; Plate 21). There were small deep holes (approximately 50 to 100 cm deep) adjacent to boulders in these runs. Considerable amounts of overflow were present on either side of the stream channel. Instream cover was limited to the pocket water of boulders and small areas of terrestrial grasses that were inundated.

No fish were captured or observed during 325 s of backpack electrofishing. Observations by the sampling crew (relatively small channel and distance to the downstream lake) indicate the potential for encountering fish at this location is low. The probability to encounter fish at the stream mouth and along the lake shores is considered to be high.

STREAM 43.6 **UTM: 12W 0514330 7384449** **PLATE 22**

Stream 43.6 originates from snow melt in an upland area. The stream channel was braided, with considerable overflow from the origin to a location approximately 100 m upstream of the confluence with Stream 43.3. The main channel consisted of riffles and shallow runs (R2 and R3). The substrate consisted of a mixture of gravel, cobble, and boulder. There was no instream cover habitat.

Given the condition of the stream channel and origin of the stream, the stream is probably intermittent and does not flow during the late summer. For this reason and because no fish were captured immediately downstream in Stream 43.3, the probability of encountering fish in Stream 43.6 is considered to be low.

STREAM 44.7 **UTM: 12W 0514192 7385799** **PLATE 23**

Stream 44.7 consisted of small pockets of melt water in an area of boulder and peat deposits. There was no flow and water depth could only be measured between large boulders at the time of sampling (mid-June). The probability of encountering fish at this location is considered to be negligible.

STREAM 46.8 **UTM: 12W 0514100 738800** **PLATE 24**

Stream 46.8 had no defined channel and consisted of a series of water pockets and some surface flow in a peat bog. The probability of encountering fish in this stream is considered to be negligible.

STREAM 49.2 **UTM: 12W 0513186 7390463** **PLATE 25**

This stream originates from a small pond located in an upland area and has areas of both overland and underground flow. The lake downstream of the crossing site had ice frozen to the bottom at the time of sampling (mid-June). The grass observed in the pond and stream channel suggests that the watershed has intermittent flow. The habitat type in flowing portions of the stream was a shallow run (R3) over predominantly boulder substrate, with water depths of 5 to 12 cm. Due to the intermittent nature of the stream and lack of potential overwintering areas downstream, the probability of encountering fish in Stream 49.2 is considered to be negligible.

STREAM 51.0E **UTM: 12W 0513842 7392093** **PLATE 26**

Stream 51.0E is located to the east of the proposed road alignment at the south end of Old Sam Lake. The stream originates from a small lake located approximately 150 m south of Old Sam Lake. The stream channel consisted of a series of braided channels separated by raised areas of gravel and peat with shallow riffle habitat. The substrate throughout the stream was predominantly cobble material with small quantities of sand and gravel. The interstitial spaces of the cobble substrate provided the only form of instream cover. The water depth was very shallow, with most areas being less than 15 cm deep.

Backpack electrofishing was conducted along the entire length of the stream from the mouth in Old Sam Lake to its origin. Portions of the small lake, from which Stream 51.0E originates, were also sampled. A total effort of 361 s yielded one lake trout and four slimy sculpins (CPUE of 0.84 fish/min). All of the fish captured were encountered within 25 m of Old Sam Lake. Based on these findings, the probability of encountering fish near Old Sam Lake is high; however, due to the nature of the stream channel, the probability of encountering fish in the upper reach of the stream is low.

STREAM 51.4W **UTM: 12W 0513600 7392300** **PLATE 27**

Stream 51.4W was dry at the time of sampling (mid-June) and there was no defined stream channel.

STREAM 52.0W **UTM: 12W 0514100 738800** **PLATE 28**

Stream 52.0W is a small first order stream originating from a shallow lake located approximately 1 km southwest of Old Sam Lake. The stream habitat consisted of a series of moderately deep and shallow runs (R2 and R3) separated by riffle/boulder gardens (RF/BG) and chutes (CH). Most areas of the stream were less than 50 cm in depth. The pocket water of large boulders provided the only instream cover.

Backpack electrofishing for 840 s yielded 14 slimy sculpin and 5 lake trout (CPUE of 1.36 fish/min.). The lake trout were encountered within 60 m and the slimy sculpin within 125 m of Old Sam Lake. Beyond 125 m no fish were captured or observed. All of the lake trout captured were young of the year (y-o-y); the slimy sculpin were either y-o-y or juveniles.

Based on observations made by the field team, the probability of encountering fish within 150 m of Old Sam Lake is high, whereas in upstream areas the probability is low.

STREAM 52.1W **UTM: 12W 0512774 7392881** **PLATE 28 - 29**

Stream 52.1W is located approximately 100 m north of Stream 52.0W and originates from the same lake as 52.0W. The stream habitat consists of a series of ledges and pools formed by large boulders. Along the left upstream bank there is a boulder field approximately 20 m wide that water flowed through and under.

Backpack electrofishing was conducted for 625 s. Two lake trout and 16 slimy sculpin were captured (CPUE of 1.73 fish/min). One fish, suspected to be a burbot (approximately 200 mm in length), was observed, but escaped into the interstitial spaces of the boulders before it could be captured. As with Stream 52.0W, the fish captured were in close proximity to the lake; therefore, the probability of encountering fish near Old Sam Lake is high. The probability of encountering fish in the upper reaches of this stream is considered to be low.

STREAM 53.5 **UTM: 12W 0513151 7394267** **PLATE 30**

Stream 53.5 is the outlet stream for Old Sam Lake. The stream was very wide (40 m) and water velocities were relatively high at the time of sampling (mid-June). These flows combined with the boulder substrate made wading in the stream very difficult for the sampling crew. The stream habitat consisted mainly of a shallow run (R3) and boulder garden. There was abundant instream cover habitat in the form of pocket water of boulders.

Backpack electrofishing was conducted for 482 s, during which no fish were captured or observed. Given that fish were encountered near the mouths of other tributary streams to Old Sam Lake and the presence of good instream habitat and cover, it was surprising that no fish were encountered at this site. The lack of fish captured may be due to sampling difficulties, and it is felt that the probability of encountering fish should be rated as high, particularly where the stream originates from the lake.

STREAM 55.2 **UTM: 12W 0511881 7395977** **PLATE 31**

Stream 55.2 had a narrow, shallow channel flowing for over a kilometre in an upland area. The stream was surveyed closer to the lake which the stream empties into, where the probability of encountering fish would be higher. As the stream nears the lake, its gradient steepens to approximately 4%. The stream consists of a narrow stream channel (< 1.0 m in most places) with a series of shallow runs (R3) separated by areas of underground flow. At the time of sampling (mid-June), portions of the stream were still covered by snow. Substrate was predominantly cobble and boulder with small pockets of gravel. Instream cover was limited to the pocket water of boulders and small areas of grass.

A single burbot was captured during 642 s of backpack electrofishing (CPUE of 0.9 fish/min). The presence of the burbot (a piscivorous species) suggests that other species of fish may be present in the lake into which Stream 55.2 flows. The probability of encountering fish in the upper reaches of Stream 55.2 is considered to be negligible due to the areas of underground flow and steep gradient near the lake.

STREAM 56.5 **UTM: 12W 0510483 7395750** **PLATE 32**

Stream 56.5 consisted of a series of shallow runs (R3) and flats (F3). The stream flows for several hundred metres before disappearing into a boulder field. The probability of encountering fish is considered to be negligible in this stream.

STREAM 56.9 **UTM: 12W 05103777 7396402** **PLATE 33**

This stream had narrow (< 1.0 m) runs (R3), with braided sections where it flowed through a peat bog. There were also several shallow pools less than 0.5 m in depth. The gradient was steeper and boulders more predominant as the stream neared the lake. The probability of encountering fish was considered to be negligible.

STREAM 58.2 **UTM: 12W 0510437 7397691** **PLATE 34**

Stream 58.2 originates from a small lake and flows through a boulder garden with no defined banks. The stream stopped flowing after approximately 200 m and dispersed into a peat bog.

The lake margins and portions of the stream close to the lake were backpack electrofished for 301 s during which no fish were captured or observed. Due to the intermittent nature of the stream, the probability of encountering fish is considered to be negligible.

STREAM 59.7 **UTM: 12W 0510713 7399041** **PLATE 35**

This stream consisted of a series of braided shallow runs (R3) separated by a short section of riffle/boulder garden (RF/BG). The widths of the individual channels were generally less than 1.0 m. Instream cover consisted entirely of the pocket water of large cobble and boulders.

No fish were captured or observed during 447 s of backpack electrofishing. The lake downstream of the sampling site does not provide overwintering habitat as it is only 1 to 1.5 m deep. Due to the nature of the stream channel and the lack of overwintering habitat in downstream areas, the probability of encountering fish in Stream 59.7 is considered to be negligible.

STREAM 62.2 **UTM: 12W 0509232 7401125** **PLATE 36**

Stream 62.2 originates from a small lake located to the west of the proposed stream crossing and flows through a boulder field. Grass and shrubs were observed growing in the stream channel, which indicated that stream flows were intermittent. The probability of encountering fish in this stream is considered to be negligible.

STREAM 65.2 **UTM: 12W 0507400 7403200** **PLATE 37**

Stream 65.2 was not flowing at the time of sampling (mid-June); although, water was present in small isolated pools. The stream channel is a boulder filled glacial relic and has no fisheries potential.

STREAM 66.2 **UTM: 12W 0506500 7404200** **PLATE 38**

This stream originates from snow melt and ground water seepage located in an upland area. The stream channel is poorly defined for most of its length and becomes braided where the water flows through a low-lying peatland. The grass on the bottom of the stream channel indicated that the stream is intermittent during the summer. Based on field observations and a lack of overwintering habitat in downstream areas, the probability of encountering fish in Stream 66.2 is considered to be negligible.

STREAM 68.2 **UTM: 12W 0505600 7405300** **PLATE 39**

Stream 68.2 originates from a small lake which, based on the grass growing on the bottom of the lake, would be dry following spring snow melt. The stream also appeared to receive inputs of groundwater. The stream channel is narrow (<0.5 m) and only one pool could be found where the stream widened to a maximum width of 2 m. Based on the origin of the stream and the lichen on the submerged rocks, the stream is most likely intermittent. In addition, as the stream flows to the north and enters a small lake, the stream disappears into a boulder field. Therefore, the probability of encountering fish in the stream is considered to be negligible.

STREAM 69.7 **UTM: 12W 0504584 7407069** **PLATE 40**

Stream 69.7 had a diversity of stream habitat with alternating runs (R2 and R3), riffle/boulder garden (RF/BG), and one deep pool (P1). Instream cover was mainly pocket water of large boulders and overhanging willows. Substrate was primarily boulders and cobble, with gravel in isolated areas. The lichen on the boulders indicated that under baseflow conditions the water levels in the stream would be considerably lower than during spring freshet.

The stream was backpack electrofished for 468 s with no fish captured or observed. The lack of fish is most likely due to the fact that approximately 400 m downstream of the proposed crossing site the stream flows underground for approximately 30 m. Therefore, the probability of encountering fish is considered to be negligible.

STREAM 71.8 **UTM: 12W 0502970 7408025** **PLATE 41 - 42**

Stream 71.8 is a large tributary stream of the Hood River. The stream enters the river at the location of the 1996 winter road crossing of the Hood River.

The stream originates from a large deep lake and follows a meandering course to the northeast. There are several areas where the stream becomes extensively braided in wide expanses of cobble substrate. In these areas, semi-permanent ice sheets contribute melt water throughout the summer. The ice sheets had disappeared by late August 1996, although in some years these ice sheets do not completely melt.

The stream was sampled approximately three kilometres upstream of the Hood River to avoid any potential influence from the Hood River. The stream was wide (51 m) and water velocities exceeded 1.3 m/s at the time of sampling (mid-June). Water depth was generally between 30 and 40 cm, although, depths in excess of 50 cm did occur. The habitat consisted of a sequence of riffles (RF) and riffle/boulder gardens (RF/BG). The channel was braided and separated by raised areas of cobbles and boulders, some of which were vegetated. The substrate was predominantly cobble with small amounts of sand and gravel. Instream cover habitat was limited to the interstitial spaces of the cobble substrate.

In the course of 408 s of backpack electrofishing no fish were captured or observed. Based on observations both of Stream 71.8 and downstream in the Hood River, the probability of encountering fish is considered to be low.

STREAM 71.9 **THE HOOD RIVER** **PLATES 43 - 46**

An area encompassing approximately 4.5 km upstream and 5 km downstream of the 1996 winter road crossing was examined in June 1996. This reach of the Hood River is confined by a long chute and rapid at the upstream end (Plate 43) and a second set of rapids and falls at the downstream end of the sampling area (Plate 44). Along its length, the Hood River has a wide flood plain that is periodically constricted at bedrock outcroppings, which correspond with abrupt changes in elevation. The chutes and falls shown in Plates 43 and 44 are a good example of this channel constrictions and elevation changes.

Within the study reach, the south bank of the river has cut along the side of a sand esker, resulting in sand and gravel being the predominant substrate. The river is characterized by long deep runs (R1) and flats (F1), many of which are greater than 3 m in depth (Plate 45), separated by shallow riffles and rapids. Instream cover habitat was limited to water depth in the study section.

The study reach was sampled by drift boat electrofishing. A total of 2484 s of effort was expended to sample the 4 km section of river between the chute at the upstream end of the study reach and the 1996 winter road crossing. No fish were captured or observed during this period of time. Below the 1996 winter road crossing, the electrofisher generator malfunctioned; consequently, the lower 5 km of the study section was sampled only by angling. During a total effort of 1.5 hours of angling, no fish were captured or observed in this section.

While the low conductivity of the water (30 μS/cm) limited the effectiveness of this type of electrofishing equipment, the study team felt that the lack of good fish cover and overwintering habitat in the study reach probably restricts fish from establishing resident populations. It is known that fish (lake trout and slimy sculpin) are located upstream of the study section (Stewart and MacDonald 1987); they may only utilize the study reach as transients after they move downstream through the chute and rapids. Furthermore, the falls at the downstream end of the study reach effectively block any upstream movements of fish. In addition, upstream movements of anadromous species (i.e., Arctic char and broad whitefish) are blocked near Bathurst Inlet by Wilberforce Falls (Plate 46). Therefore, the probability of encountering fish in this section of the Hood River is low.

STREAM 74.8 **UTM: 12W 0503758 7411554** **PLATE 47**

This stream had a narrow channel (generally <1.0 m) and overflowed in many areas. There was a short series of riffles and shallow runs (R3) with organic material and grass for substrate at the proposed crossing location. Approximately 200 m downstream of the crossing point the stream flows into a low-lying bog 200 m in width and disperses. Below the bog the channel reforms and the stream flows into a lake, which is in turn connected to the Hood River.

The lake at the downstream end of Stream 74.8 freezes to the bottom and has a semi-permanent ice cover. For most of the summer the only open water in the lake is a meltwater channel. Based on the intermittent nature of the stream at the crossing location, the lack of overwintering habitat in downstream areas, and the apparent absence of fish in the Hood River, the probability of encountering fish in this stream is considered to be negligible.

STREAM 76.9 **UTM: 12W 0503907 7412683** **PLATES 48 - 49**

This stream originates from snow melt runoff and possibly a ground water seep in an upland area. There was overflow at the proposed crossing location. Approximately 400 m downstream of the crossing are a series of ledges 0.25 to 1.0 m in height and a 1.5 m cascade that block any potential upstream fish movements. Stream 76.9 was flowing over grass and then became snow covered for the last 150 m prior to reaching the next unnamed stream (Plate 49).

Due to the intermittent nature of the stream, downstream fish barriers, and lack of overwintering habitat, the probability of encountering fish is negligible.

STREAM 83.2 **UTM: 12W 0501400 7417750** **PLATE 50**

Stream 83.2 originates from a small lake to the west of the proposed crossing, in an underground flow through a boulder field. The stream width is less than 1 m for most of its length (Plate 50), although, the stream was up to 4 m in width in some areas. The stream flows southeast and overland in many areas before finally dispersing into a low-lying bog. As there is no potential for fish to move into this stream from downstream areas, the probability of encountering fish is considered to be negligible.

3.2 ROUTE 2

Route 2 branches west from Route 1 at approximately Km 22. The proposed road travels west-northwest for approximately 17 km. The route then turns to the north and follows a chain of lakes and streams before crossing the Hood River (Figure 3.1). There are 11 stream crossings between Km 22 and the re-connection point with Route 1 at Reno Lake. Route 2 was surveyed during the fall sampling session (21 - 30 August 1996). Table 3.3 provides a summary of the habitat observed at each of the proposed stream crossings, as well as the probability of encountering fish at these sites.

Between Km 50 and Km 70, Route 2 follows a series of lakes that are connected by wide streams. The waterbodies in this 20 km section were too large to effectively sample with a backpack electrofisher. There is adequate overwintering habitat (i.e., water >3 m) in many of the water bodies, therefore the probability of encountering fish in this section of Route 2 is considered to be high. As most of the water bodies traversed by Route 2 are lakes, there should be no significant implications to fish (e.g., blockage of spring movements, introduction of sediment, etc.).

Table 3.3 Summary of streams crossed by proposed Route 2.

Stream No.	Stream Order	Watershed	Habitat Type	Fish Captured	Probability of Encountering Fish[1]
36.8	1	Hood River	low bog, with traces of overflow	none	negligible
37.4	2	Hood River	boulder filled channel with no defined banks; isolated pools with no flow	burbot, slimy sculpin, round whitefish	high near stream mouth
40.7	2	Hood River	boulder filled channel with poorly defined banks and overflow	not sampled (n.s.)[2]	high along lake margin
42.5	1	Hood River	stream consists of overflow	n.s.	low; high along lake margin
43.2	2	Hood River	stream consists of overflow	n.s.	negligible
45.3	2	Hood River	intermittent stream in boulder field with no defined banks and no flow	n.s.	negligible
46.9	2	Hood River	intermittent stream, dry	n.s.	negligible
48.6	1	Hood River	intermittent stream, dry	n.s.	negligible
70.8	1	Hood River	intermittent stream with very little water; flows underground before reaching lake	none	negligible
71.7	2	Hood River	very shallow stream with runs (R3)[3] and riffles; cobble substrate; stream braided as it flows towards lake	none	low
73.2	1	Hood River	shallow intermittent stream, no defined banks, organic substrate	none	negligible
74,4	1	Hood River	series of ledges and pools as stream originates from lake, stream disperses and substrate changes to sand as stream nears the Hood River	slimy sculpin	moderate

[1]Negligible indicates absence of habitat; low indicates fish may be present under unusual circumstances; medium indicates that potential seasonal use of the stream; and high indicates that fish were captured (refer to Section 3.1 for more details of these terms).
[2]Not sampled due to the lack of water or absence of habitat.
[3]Refer to Appendix A, Table A for definitions.

As experienced along Route 1, many of the streams along Route 2 also proved to be intermittent and were not flowing at the time of sampling. Streams that were flowing generally had poorly defined channels and poor instream habitat. Flows at the time of sampling were 15 to 25 cm higher than normal due to a recent snow melt and heavy rains; there were often areas of overflow on either side of the stream channels.

Instream habitat features in the few streams that had flows were generally boulder and cobble riffles or shallow runs. There was very little instream cover other than the pocket water of boulders and interstitial spaces between large cobble and boulders.

Fish were found in only two of the streams sampled. Fish species encountered included burbot, round whitefish, and slimy sculpin (Table 3.4).

Table 3.4 Fish species captured in streams along Route 2 by backpack electrofishing, August 1996.

Stream	Species	*n*	Fork Length Range (mm)	Weight Range (g)	CPUE[1]	
					Species	Site
37.4	Burbot	1	160	44	0.19	
	Round Whitefish	4	40-56	< 10	0.75	
	Slimy Sculpin	2	48-52	< 10	0.38	1.32
74.4	Slimy Sculpin	1	30	< 10	0.12	0.12

[1]Catch per unit effort (CPUE) = number of fish captured per minute of electrofishing.

3.2.1 Stream Descriptions

The following discussions provide an overview of the habitat found at each site. More detailed habitat information has been enclosed in Appendix A2.

STREAM 36.8 **UTM: 12W 0507514 7374307** **PLATE 51**

There was no stream channel at the location indicated on the 1:50 000 NTS map (#76L/7). The site being a low-lying peat bog with some surface water. The visible water was a result of the recent snow melt and heavy rains; therefore, the probability of encountering fish is negligible.

STREAM 37.4 **UTM: 12W 0507050 7374513** **PLATE 52**

Stream 37.4 is a short stream (approximately 200 m) connecting two lakes. The stream channel was poorly defined, as the stream flows through a boulder field. There was no detectable flow of water in the stream at the time of sampling (late August).

The mouth of the stream and lake margins were backpack electrofished for 320 s, during which time one burbot, four round whitefish and two slimy sculpin were captured (CPUE of 1.32 fish/min). Fish use of the stream in late summer was confined to the stream mouth, although, it may be possible for fish to move between the two lakes during peak flows in the spring. Therefore, the probability of encounter fish in Stream 37.4 is considered to be high.

STREAM 40.7 **UTM: 12W 0505400 7376500** **PLATE 53**

This stream is very short (< 100 m in length) connecting two large lakes. Water depths were very shallow (< 10 cm) and flow was dispersed in the low-lying boggy terrain at the time of sampling (late August). The presence of grass in the stream and absence of a defined channel suggest that the stream is intermittent during the summer.

While no fish were observed, fish may be able to utilize the stream during peak flows in the spring. Therefore, the probability of encountering fish in the stream in the spring is considered to be high, but by late summer, fish use would be confined to the lake margins at the origin and mouth of the stream.

STREAM 42.5 **UTM: 12W 0505700 7378300** **PLATE 54**

This stream flowed through a wide low-lying bog. The water depth was shallow (< 20 cm) with areas of overflow at the time of sampling (late August). The NTS map (#76L/10) indicates that the stream originates from a lake; however, the upper reach of the stream consisted entirely of overflow.

Equipment malfunction prevented the study team from electrofishing this stream. Based on sampling of similar streams in the study area, the probability of encountering fish in the stream is low, although, there is a high probability of encountering fish along the lake margins.

STREAM 45.3 **UTM: 12W 0504900 7381100** **PLATE 55**

The stream consisted of a boulder filled channel, with some areas of standing water. The probability of encountering fish is considered to be negligible.

STREAM 46.9 **UTM: 12W 0507050 7374513** **PLATE 56**

The stream consisted of a boulder filled channel, with some areas of standing water. The probability of encountering fish is considered to be negligible.

STREAM 48.6 **UTM: 12W 0507050 7374513** **PLATES 57 - 58**

The stream consisted of a boulder filled channel, with some areas of standing water. The probability of encountering fish is considered to be negligible. According to the NTS maps (#76L/10), Stream 48.6 flows into another larger stream; however, surface topography suggests it would actually flow into an old boulder-filled oxbow channel that is no longer connected to the larger stream (Plate 58).

STREAM 70.8 **UTM: 12W 0501049 7404084** **PLATE 59**

This stream originates from surface flow down the side of a steep esker, and was barely flowing at the time of sampling (late August). The stream channel was 0.75 to 1.5 m in width and had boulder, cobble, and gravel substrates. The stream went underground at a location 100 m upstream from the lake that Stream 70.8 flows into (Plate 59). Therefore, the probability of encountering fish in the stream is negligible.

STREAM 71.7 **UTM: 12W 0500197 7404413** **PLATE 60**

The habitat features in this stream consisted of a 200 m long series of shallow runs (R3) and shallow riffles. Substrate consisted mainly of boulders and cobbles with isolated pockets of sand and gravel. Water depths were very shallow (< 15 cm).

The stream was sampled for 300 s, during which no fish were captured or observed. Therefore, the probability of encountering fish is considered to be low.

STREAM 73.2 **UTM: 12W 0499013 7405321** **PLATES 61 - 62**

This stream is situated on a plateau above the Hood River. The stream had a poorly defined channel with organic substrate (Plate 61). The stream originates from surface runoff (Plate 62) and is intermittent, although, the stream did have some water in it at the time of sampling (late August). According to the NTS map (#76L/14), the stream originates from a small lake. Under current conditions the water level in the lake would have to be approximately 10 m higher for water from the lake to reach the stream channel.

Due to the intermittent nature of the stream and the steep gradient as the stream approaches the Hood River, the probability of encountering fish is considered to be negligible.

STREAM 74.4 **UTM: 12W 0498154 7406158** **PLATES 63 - 64**

This stream originates from a small deep lake. The stream flows around a boulder field at the outlet of the lake and downs a series of rock ledges. The stream channel is often less than 1 m in width in the upper reaches of the stream (Plate 63). Below the section of rock ledges, the stream widens into a series of shallow runs (R3) and riffles. Instream cover was provided mainly by the pocket water of boulders and small areas of aquatic vegetation. As the stream flows down into the Hood River flood plain the substrate changes to sand and the banks become very unstable. Close to the Hood River the stream disperses into a fan across a wide sandy flood plain (Plate 64). While the water levels were low at the time of sampling (late August), during spring, water levels were observed to cover the sandy flood plain shown in Plate 64.

The stream was sampled by backpack electrofisher for 509 seconds. This effort yield a single y-o-y slimy sculpin (CPUE of 0.12 fish/min.) Based on the observations made in August and June, the probability of encountering fish is considered to be moderate.

3.3 ROUTE 3

Route 3 originates from Route 2 at the location where Route 2 turns northward (Figure 3.1). Route 3 travels west for approximately 30 km before reaching a large tributary of the Hood River. The route then follows the tributary north to the Hood River. Route 3 crosses the Hood River where it widens to form a large lake and then re-joins Route 2 on the north side of the Hood River (Figure 3.1).

There were only three streams crossed by Route 3 which were small enough to sample by backpack electrofishing. Two streams had boulder substrate and were quite shallow, while the third stream was intermittent and dry at the time of sampling (Table 3.5).

Fish were encountered in only one of the streams sampled (Table 3.6). Burbot was the only species of fish captured along Route 3. The presence of burbot, and the deep lakes traversed by Route 3, suggest that other species of fish may inhabit the lakes in this portion of the study area.

Table 3.5 Summary of streams crossed by proposed Route 3.

Stream No.	Stream Order	Watershed	Habitat Type	Fish Captured	Probability of Encountering Fish[1]
48.0	3	Hood River	stream consists of shallow runs (R3) separated by riffle/boulder gardens; cobble boulder substrate	Burbot	High near lakes at upstream & downstream ends
51.5	3	Hood River	long riffle/boulder garden and shallow runs (R3)[2]	none	High near lakes
59.3S	2	Hood River	intermittent, mainly dry with some water at stream mouth	none	negligible

[1]Negligible indicates absence of habitat; low indicates fish may be present under unusual circumstances; medium indicates that potential seasonal use of the stream; and high indicates that fish were captured (refer to Section 3.1 for more details of these terms).
[2]Not sampled due to the lack of water or absence of habitat.

Table 3.6 Fish species captured in streams along Route 3 by backpack electrofishing, August 1996.

Stream	Species	n	Fork Length Range (mm)	Weight Range (g)	CPUE[1]	
					Species	Site
48.0	Burbot	3	70-100	10-20	0.37	0.37

[1]Catch per unit effort (CPUE)=number of fish captured per minute of electrofishing.

3.3.1 Stream Descriptions

The following discussions will provide an overview of the habitat found at each site. More detailed habitat information has been enclosed in Appendix A3.

STREAM 48.0 **UTM: 12W 0497275 7374407** **PLATE 65**

This stream connects two lakes. The habitat consists of a short section of shallow run (R3) at the upstream end of the stream, followed by a long (350 m) section of riffle/boulder garden (RF/BG). The stream is situated in a low-lying bog with peat and boulder banks. The stream was 2 to 4 m wide; although, under peak flows the stream could be up to 50 m in width. The channel becomes braided closer to the lower lake towards the downstream end of the stream.

Three burbot were captured during 484 s of backpack electrofishing (CPUE of 0.37 fish/min). As with many other streams sampled during this study, the burbot were associated with the area of the stream in close proximity to the upper lake. Therefore, the potential to encounter fish is considered to be high at either end of the stream (i.e., closest to the lakes) and moderate in the middle reach of the stream.

STREAM 51.5 **UTM: 12W 04940805 7373142** **PLATES 66 - 67**

As with Stream 48.0, this stream is relatively short and joins two lakes. The habitat in this stream consisted of a long series of riffle/boulder gardens (RF/BG) separated by shallow runs (R3). The substrate was predominantly boulders with small amounts of cobble. Instream cover was limited to the pocket water of boulders and very small amounts of aquatic vegetation. Water depths were 25 to 50 cm with some overflow along either bank at the time of sampling (late August); however, lichen on submerged boulders indicated that the water levels would normally be 10 to 15 cm lower at baseflows.

The upper end of the stream was sampled by backpack electrofishing for approximately 100 seconds. During sampling session, no fish were captured or observed. Based on aerial observations the lake at the upstream end of the stream most likely freezes to the bottom in the winter. Therefore, the probability of encountering fish in the upper reaches of the stream is low. The probability of encountering fish is high in the lower reaches of the stream as the lower lake does provide some overwintering habitat.

STREAM 59.3 **UTM: 12W 0487600 7374800** **PLATE 68**

The stream consisted of a dry boulder filled channel. The probability of encountering fish is considered to be negligible.

DOWNSTREAM TO THE HOOD RIVER **PLATES 69 - 70**

The section of the Route 3 from Km 60 to where the road leaves the Hood River at approximately Km 115 traverses large streams and rivers which could not be sampled with a backpack electrofisher (Plates 69 and 70). Due to the availability of overwintering habitat in this section there is a high probability of fish being present, particularly in the Hood River.

3.4 ROUTE 4

Route 4 originates at the west end of Kathawachaga Lake and heads northeast to intersect Route 2 at the location where Route 2 turns northward (Figure 3.1). This alternative is shorter than the combination of Routes 1 and 2 and provides the flexibility of eventually joining with the proposed Jericho Road which may be built by Canamera Geological to service its camps at Carat and Jericho lakes.

Route 4 crosses 14 streams between Kathawachaga Lake and where it links with Route 2. Table 3.7 provides a summary of the habitat observed in these streams and the fisheries potential. Three other streams adjacent to the route, near Kathawachaga Lake, were also examined. Route 4 was surveyed from 21 to 30 August 1996.

Table 3.7 Summary of streams crossed by proposed Route 4.

Stream No.	Stream Order	Watershed	Habitat Type	Fish Captured	Probability of Encountering Fish[1]
1.0W	1	Burnside River	braided channel through bog, upper reaches intermittent	outside permitted sampling area	high at stream mouth
3.5E	2	Burnside River	braided channel through bog, cobble & boulder substrate	outside permitted sampling area	high at stream mouth
3.7E	1	Burnside River	series of long riffles and shallow runs (R3)[2], with some braided sections	outside permitted sampling area	high
7.6	4	Burnside River	long (~75 m) sections of riffle/boulder gardens and runs (R2); substrate boulders	Arctic grayling	high
10.8	3	Burnside River	stream habitat consists of shallow runs (R3); with boulder substrate	none	low
12.0	1	Burnside River	intermittent stream, heavily braided near stream mouth; large areas of overflow	not sampled (n.s.)[3]	low
14.6	3	Cracroft River	poorly defined channel with cobble/boulder substrate; wide areas of overflow	burbot	high near lake
16.1	1	Cracroft River	dry boulder field	n.s.	negligible
16.9	1	Cracroft River	dry boulder field	n.s.	negligible
19.5	3	Cracroft River	water flows through boulder field; flows underground at crossing	n.s.	negligible
21.0	1	Cracroft River	shallow, braided near mouth, most likely intermittent	n.s.	negligible
21.3	2	Cracroft River	very shallow stream, heavily braided, most likely intermittent during dry periods	to shallow to electrofish	negligible
23.2	1	Cracroft River	overflow, no defined banks	n.s.	negligible
23.7	2	Cracroft River	riffle boulder garden, with overflow on both banks	burbot, round whitefish	high
26.3	2	Cracroft River	very shallow (< 10 cm) runs (R3), stream flows underground at crossing	n.s.	low near stream mouth
28.3	1	Cracroft River	small intermittent stream with cobble and boulder substrate	n.s.	negligible
30.9	1	Cracroft River	shallow runs (R2 & R3) separated by short riffles, substrate frozen organic material; stream flows underground downstream of crossing	none	negligible

[1]Negligible indicates absence of habitat; low indicates fish may be present under unusual circumstances; medium indicates that potential seasonal use of the stream; and high indicates that fish were captured (refer to Section 3.1 for more details of these terms).
[2]Refer to Appendix A, Table A for definitions.
[3]Not sampled due to the lack of water or absence of habitat.

As with the other alternate routes many streams were not flowing at the time of sampling. Boulders were the predominant substrate in streams that were flowing. Instream cover was very limited, with the only readily available form being the pocket water of large boulders. Due to a snowfall and melt followed by rain, many streams were 15 to 25 cm higher than under baseflow conditions.

Of the 14 streams sampled, fish were encountered in only three streams. The species represented in the captures along Route 4 included Arctic grayling, round whitefish and burbot. As with the other streams surveyed during this study, the CPUE was low (Table 3.8).

Table 3.8 Fish species observed or captured in streams along Route 4 by backpack electrofishing, August 1996.

Stream	Species	*n*	Fork Length Range (mm)	Weight Range (g)	CPUE[1]	
					Species	Site
7.6	Arctic Grayling	3	56-75	<10	0.42	0.42
14.6	Burbot	1*				
23.7	Burbot	3	85-100		0.46	
	Round Whitefish	1	109		0.15	0.61

[1]Catch per unit effort (CPUE)=number of fish captured per minute of electrofishing.
*Observed.

3.4.1 Stream Descriptions

The following discussions provide an overview of the habitat found at each site. More detailed habitat information has been enclosed in Appendix A4.

STREAM 1.0W **PLATE 71**

This stream is located to the west of Route 4 and flows into Kathawachaga Lake. The stream was braided and shallow (<20 cm deep) at the time of sampling (late August).

Unfortunately, due to the timing of the development of Route 4, this stream was to the south of the permitted sampling area and therefore backpack electrofishing could not be conducted. Due to the proximity of the stream to Kathawachaga Lake, the probability of encountering fish near the stream mouth is considered to be high.

STREAM 3.5E **PLATE 72**

This stream is located to the east of the proposed route and flows into Kathawachaga Lake. The stream was braided and shallow (<20 cm deep) at the time (late August) of sampling with a cobble substrate.

Due to the timing of the development of Route 4, this stream was to the south of the permitted sampling area and therefore backpack electrofishing could not be conducted. Because of the proximity of the stream to Kathawachaga Lake, the probability of encountering fish near the stream mouth is considered to be high.

STREAM 3.7E **PLATE 72**

This stream is located to the east of the proposed route and flows into Kathawachaga Lake. The stream was braided and shallow (<20 cm deep) at the time of sampling (late August) with a cobble substrate.

As for streams 1.0W and 3.5E, this stream was to the south of the permitted sampling area and therefore backpack electrofishing could not be conducted. Due to the proximity of the stream to Kathawachaga Lake, and the size of the stream, the probability of encountering fish throughout the stream is considered to be high.

STREAM 7.6 **UTM: 12W 0495473 7350393** **PLATE 73**

The stream habitat consisted of long sections (approximately 75 m) of riffle/boulder garden (RF/BG) and moderately deep runs (R2). The substrate was boulders throughout the stream. Portions of the stream were braided where the channels are separated by boulders and peat islands. Instream cover is in the interstitial spaces and pocket water of boulders.

A total of 425 s of backpack electrofishing resulted in the capture of three juvenile Arctic grayling (CPUE of 0.42 fish/min). Of the four proposed routes, this was the only stream sampled in which Arctic grayling were encountered. Their presence indicates that Arctic grayling can successfully negotiate passage up Stream 7.6 from Kathawachaga Lake.

STREAM 10.8 **UTM: 12W 0497000 7353400** **PLATE 74**

The stream habitat consists almost entirely of shallow run with boulder substrate (R3/BG). There were small areas of moderately deep runs (R2) and deep pools (P1), although, these pools were usually less than 1 m in diameter. Due to the boulders in the channel it was difficult to obtain an accurate measurement of depth. In most areas the water depth was approximately 20 cm deep. The lichen on the boulders indicated that under baseflow conditions the stream probably stops flowing and isolated pools of water are left amongst the boulders.

No fish were captured or observed during 323 s of backpack electrofishing. Based on the lack of fish in the stream, indications of very low water levels under baseflows, and the lack of overwintering habitat in the lake upstream of the crossing location, the probability of fish utilizing this stream is low.

STREAM 12.0 **UTM: 12W 0497700 7355000** **PLATE 75**

This stream was intermittent and dispersed through a low-lying peat bog and fen. Water was flowing overland at the time of sampling (late August). The lake which this stream flows into does not have sufficient depth quantity to support an overwintering fish population and it is unlikely that fish could move in from downstream areas. The probability of encountering fish in this stream is considered to be negligible.

STREAM 14.6 **UTM: 12W 0498247 7357787** **PLATE 76 - 77**

This stream consisted of many small channels flowing through a low-lying peat fen. The stream originated from a boulder field situated between two lakes. The channel surveyed consisted entirely of shallow run (R3) habitat. The substrate varied from 100% boulders in some areas to 100% silt in other locations. Instream cover was limited to the interstitial spaces of large boulders.

The stream and lake shore were sampled by backpack electrofishing. A total effort of 195 s of electrofishing resulted in no fish captured. A single burbot (approximately 50 mm) in length was observed; its presence indicates that the lake which Stream 14.6 empties into can support overwintering fish populations. The burbot (a piscivore) also suggests that other species of fish may inhabit the lake. Therefore, the probability of encountering fish near the lake is considered to be high.

STREAM 16.1 **UTM: 12W 0498200 7357800** **PLATE 78**

There was no stream at the time of sampling (late August). The probability of encountering fish in this stream is considered to be negligible.

STREAM 16.9 **UTM: 12W 0498800 7358950** **PLATE 79**

There was no stream at the time of sampling (late August). The probability of encountering fish in this stream is considered to be negligible.

STREAM 19.5 **UTM: 12W 0500500 7361700** **PLATE 80**

There was no stream at the time of sampling (late August); although, there was some flow in a boulder field. The probability of encountering fish in this stream is considered to be negligible.

STREAM 21.0 **UTM: 12W 0501350 7362900** **PLATE 81**

This stream does not appear on the NTS map (#76L/7). The stream originates from a boulder field and is probably intermittent. The stream was too shallow to sample with a backpack electrofisher. The probability of encountering fish in this stream is considered to be negligible.

STREAM 21.2 **UTM: 12W 0501400 7363050** **PLATE 81**

This stream originates from a large lake and flows through a peat low land situated between two boulder covered ridges. At the location of the proposed crossing the stream is extensively braided and shallow. The stream is most likely intermittent and was only flowing due to the recent snow melt and heavy rains at the time of sampling (late August). Therefore, the probability of encountering fish in the stream is considered low, although, near the stream mouth the probability is high as the lake at the downstream end of the stream can probably support overwintering fish populations.

STREAM 23.2 **UTM: 12W 0502355 7364922** **PLATE 82**

This stream had no defined banks and there was only unchannelized melt water flow at the time of sampling (late August). The probability of encountering fish is considered to be negligible.

STREAM 23.7 **UTM: 12W 0502424 7365492** **PLATE 83**

This stream originates from a small lake and flows southeast into a much larger unnamed lake. The stream channel was wide (3.4 m) in most places and there was overflow along both banks at the time of sampling (late August). Stream habitat in the vicinity of the proposed crossing and downstream to the lake was riffle/boulder garden (RF/BG). Instream cover was mainly the pocket water of boulders; although, aquatic vegetation also contributed.

A total of three burbot and one round whitefish were captured with a total effort of 394 s of backpack electrofishing (CPUE of 0.61 fish/min.). All of the fish captured were within 100 m upstream of the stream mouth. Therefore, the probability of encountering fish at the stream mouth is high, but low in the upper reaches of the stream.

STREAM 26.3 **UTM: 12W 0503400 7366700** **PLATE 84**

The stream was very shallow (< 10 cm deep) at the time of sampling and flows underground at the proposed crossing location. The probability of encountering fish is considered to be negligible at the crossing location and low at the stream mouth as the two lakes downstream of Stream 26.3 will likely freeze to the bottom in the winter.

STREAM 21.0 **UTM: 12W 0504796 7368679** **PLATE 85**

This is a short stream (300 m) which flows through a gap in an esker, and connects two lakes. It appeared that most of the water in the stream originated as runoff from the esker. The habitat found in the stream at the proposed crossing location consisted of long (200 m) boulder and cobble riffle, with shallow flats (F3) and pools (P3) developing downstream of the crossing towards the lake. Instream cover habitat was limited to a small area of aquatic vegetation in the flats.

The probability of encountering fish in this stream is considered to be negligible.

STREAM 30.9 **UTM: 12W 0506037 7370824** **PLATES 86 - 87**

The stream at this site exhibits a narrow channel (< 1.0 m wide). Approximately 200 m downstream of the proposed crossing the stream flows underground through a boulder field (Plate 86). Therefore, the stream was sampled approximately 500 m downstream of the proposed crossing, near its mouth, where the probability of encountering fish would be higher.

Below the area of underground flow there is a long section (150 m) of moderately deep run (R2; Plate 87). Following this, the lower reach of the stream consisted of a series of short (often less than 3 m in length), shallow runs (R3) and riffles. The substrate consisted of boulders, cobble and silt. Downstream, towards the lake, substrate was frozen silt.

The stream was sampled by backpack electrofishing for 262 seconds. During this time no fish were captured or observed. Based on the observations of the study team and the general lack of overwintering habitat in downstream areas, the probability of encountering fish in the lower reaches of Stream 30.9 is considered to be low. Due to the presence of the underground flow, the probability of encountering fish at the proposed crossing location is considered to be negligible.

4.0 LAKE SURVEYS

Four lakes (Reno Lake South, Reno Lake North, West Lake and Ulu Lake) in the immediate vicinity of the Ulu camp, the mine site and the main fuel storage area have the potential to be impacted by daily activities occurring in these three areas. Surveys of the four lakes were carried out between 22-29 July 1996. The goal of the surveys were to determine fish species composition and relative abundance in the four lakes.

4.1 RENO LAKE SOUTH

Reno Lake South is located south of the esker on which Camp 3 was situated and is isolated from other lakes in the region and the Hood River. The lake is divided into two distinct basins (East and West) by the narrows found directly south of Camp 3, with the East Basin being the larger of the two basins. Several small streams, located to the west of the lake, provide water to Reno Lake South (Figure 4.1).

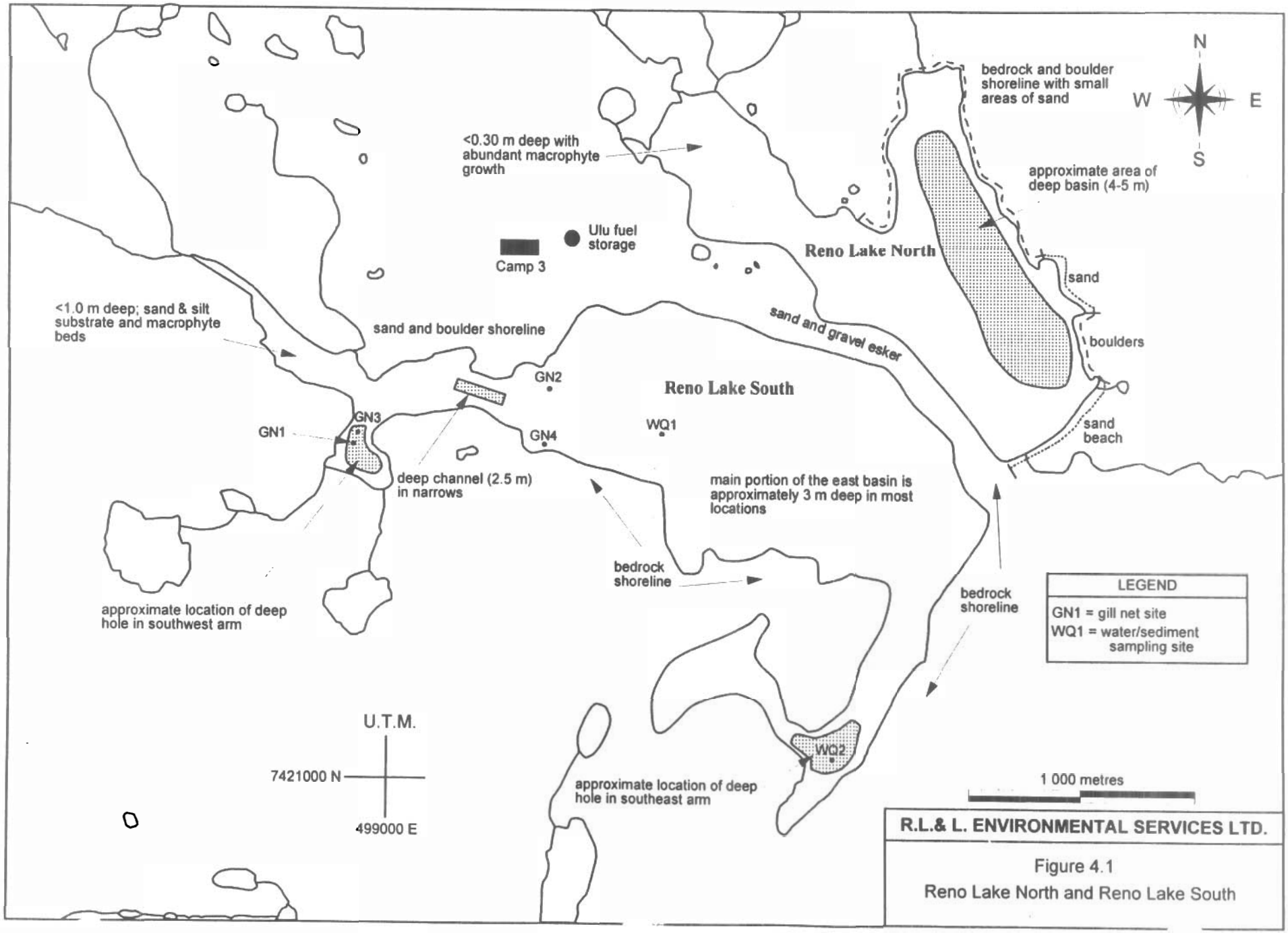
4.1.1 Basin Morphometry

The East Basin is generally shallow (<3.0 m in most places) with sand substrate. The northern shoreline is sand (from the esker) with isolated boulder outcroppings. The southern shoreline of the lake consists of bedrock outcroppings, consequently the substrate along the south shore is a diverse mix of large boulders and sand. The deepest part of the basin (z_{max} = 8.5 m) is found in the southeast arm of the lake.

The West Basin is "Y"-shaped and oriented from east to west. The southwestern arm is deeper than the northwestern arm with a mean depth of 2-3 m and a maximum depth of 10 m. The southwestern arm has a boulder and sand substrate while the northwestern arm has predominately sand substrate, with emergent macrophytes.

As the lake has up to 2.4 m of ice in the winter, most of the lake freezes to the bottom (Kevin Mealy, Echo Bay Mines Ltd., Surface Manager, Ulu Project, personal communication, 17 June 1996). Resident lake trout can overwinter in the deep holes found in the southeast and southwest arms of the lake.

In the spring, the west basin and narrows become ice free several weeks prior to the east basin; consequently, lake trout which overwinter in the southwest arm are concentrated in the narrows during the early spring (i.e., mid to late June). This was evident in June 1996, from the reports of angling success by the staff at Camp 3.


N
W
E
S
bedrock and boulder shoreline with small areas of sand
<0.30 m deep with abundant macrophyte growth
approximate area of deep basin (4-5 m)
Ulu fuel storage
Camp 3
Reno Lake North
sand
boulders
<1.0 m deep; sand & silt substrate and macrophyte beds
sand and boulder shoreline
sand and gravel esker
GN2
Reno Lake South
GN3
GN1
GN4
WQ1
sand beach
deep channel (2.5 m) in narrows
main portion of the east basin is approximately 3 m deep in most locations
bedrock shoreline
bedrock shoreline
approximate location of deep hole in southwest arm
LEGEND
GN1 = gill net site
WQ1 = water/sediment sampling site
U.T.M.
7421000 N
499000 E
WQ2
approximate location of deep hole in southeast arm
1 000 metres
R.L.& L. ENVIRONMENTAL SERVICES LTD.
Figure 4.1
Reno Lake North and Reno Lake South

4.1.2 Water and Sediment Chemistry

The extremely low concentrations of nutrients (e.g., Total Kjeldahl Nitrogen [TKN] 0.27 mg/L and total phosphorus 0.06 mg/L) and Secchi depths in excess of 4 m indicate that Reno Lake South can be classified as oligotrophic (i.e., a lake with low nutrient input and low organic production). Routine water and metals scans indicated that the concentrations of ions and metals in the water column were either at trace levels or not detectable. Complete analytical results have been provided in Appendix C.

Reno Lake South was the only lake in which mercury was detectable. The mercury concentration in the water was 0.0002 mg/L which was slightly above the analytical detection limits of 0.0001 mg/L.

Sediment samples proved difficult to obtain; sediments were frequently too hard for the corer to penetrate or boulders were encountered. When a sediment core was obtained, sediments were soft, highly flocculent, and underlain by a clay like material. Water content analysis showed that the sediment was 91% water which made performing the standard analytical tests for sediment difficult.

Analytical tests of the lake sediment samples indicated that metals were at background levels and hydrocarbons were not detectable.

4.1.3 Fisheries

Four gill net sets were placed in Reno Lake South for a 24 hour period (Figure 4.1) and a total of 20 lake trout were captured. The majority of the fish (n=18) were captured in the southwest arm of Reno Lake South, while the two remaining fish were to the east of the narrows. The combined CPUE was 0.66 fish/hour of set time/100 m^2 of net (Table 4.1).

Table 4.1 Fish species captured by gill nets in Reno Lake South, 22-23 July 1996.

Species	n	Fork Length Range (mm)	Weight Range (g)	CPUE[1]
Lake Trout	20	232-408	136-828	0.66
Total	**20**			**0.66**
Effort (hours set)	16.9			

[1]CPUE = No. of fish/hour of set time/100 m^2 of net.

All of the lake trout captured were relatively small ranging from 232-408 mm in length and weighing 138-828 g. Anglers from Camp 3 reported similar size ranges in their catches, although, several larger individuals up to 660 mm in length have been reported.

Ageing of the fish captured was not a component of the present study; however, several ageing structures from lake trout were examined. These structures indicated that fish of the size captured by most recreational anglers at Camp 3 (i.e., fish approximately 400 mm in length and weighing 600 to 800 g) are between 10 and 14 years of age.

4.2 RENO LAKE NORTH

Reno Lake North is located to the northeast of Camp 3 and is separated from Reno Lake South by a sand and gravel esker. Reno Lake North is isolated from the surrounding lakes and fish in the lake are resident year round (Figure 4.1).

4.2.1 Basin Morphometry

The shoreline of Reno Lake North is relatively uniform, with sand and gravel found on the southeast, northwest and southern shorelines. Along the northern shoreline the geology changes to a series of bedrock outcrops and areas of boulders. The western arm of the lake is very shallow (generally <0.30 m in most places) with sand substrate and emergent grass. Substrate in the rest of the lake is predominantly sand and silt, although, boulders can be found along the northern shoreline. The northeastern part of the main basin of the lake is the deepest, with a maximum depth of approximately 8 m (Figure 4.1).

As with Reno Lake South, Reno Lake North accumulates up to 2.4 m of ice in the winter and most of the lake freezes to the bottom (Kevin Mealy, pers. comm., 17 June 1996). Resident fish can overwinter in the deep part of the central basin, located near the northeastern shoreline.

4.2.2 Water and Sediment Chemistry

As with Reno Lake South, the northern lake is also oligotrophic due to the low levels of nutrients (e.g., TKN 0.34 mg/L and total phosphorus 0.08 mg/L). The Secchi depth of 5.0 m indicated that this lake had very low levels of suspended particulate material in the water column. Metals in the water column were either at normal background levels or not detectable. Hydrocarbons, including oil and grease, were not detectable in the water column.

Sediment samples could not be analysed as the sample bottles were unfortunately broken during shipment to the analytical lab.

4.2.3 Fisheries

Reno Lake North had the most diverse species composition of the four lakes sampled during the July 1996 program. Three species of fish were captured in the lake, including lake trout, round whitefish and a land-locked population of Arctic charr (*Salvelinus alpinus*).

Two short duration nets sets (approximately 3.5 hours each) resulted in the capture of seven lake trout and three round whitefish. As there had been reports by anglers from Camp 3, that Arctic charr had been captured in Reno Lake North, the study team made one overnight net set in hopes that Arctic charr would be captured during the longer set time. The overnight net set yielded five Arctic charr, 24 lake trout and 23 round whitefish. The combined CPUE for Reno Lake South was 1.09 fish/hour of set time/100 m^2 of net (Table 4.2), which was the highest CPUE recorded during the July sampling period.

Table 4.2 Fish species captured by gill nets in Reno Lake North, 23-24 July 1996.

Species	n	Fork Length Range (mm)	Weight Range (g)	CPUE[1]
Arctic Charr	5	375-419	606-890	0.12
Lake Trout	21	290-444	254-866	0.52
Round Whitefish	18	160-421	52-748	0.45
Total	**44**			**1.09**
Effort (hours set)	22.37			

[1]CPUE - No. of fish/hour of set time/100 m^2 of net.

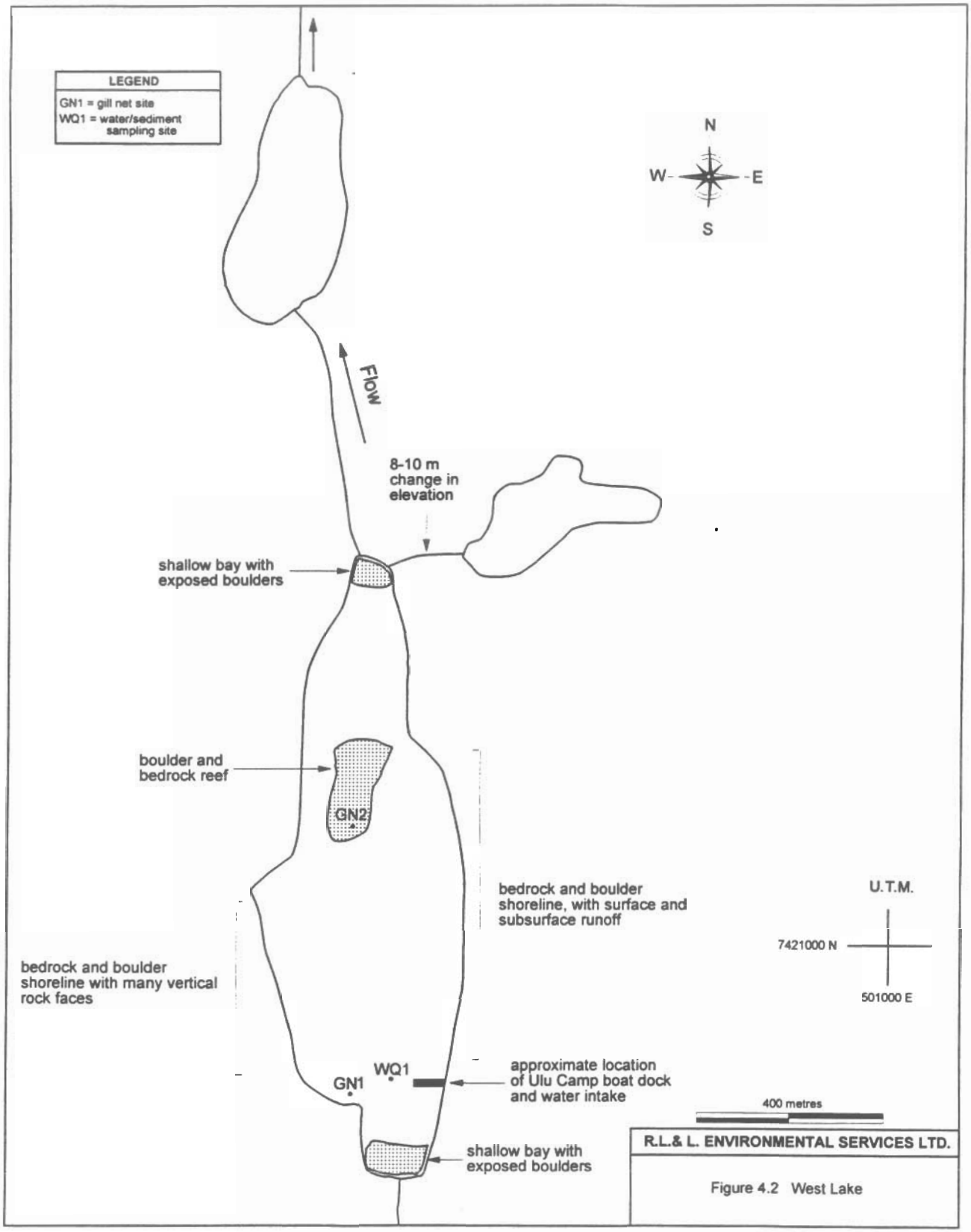
Several lake trout mortalities occurred during netting. The stomach contents of these individuals were examined in order to obtain information on their diet. While most of the stomachs examined were empty, several contained what appeared to be a large Fairy shrimp (*Anostracons* species). In addition, many of the fish were captured near the lead line of the gill net, which suggests that the lake trout at the time of sampling were foraging near the lake bottom for invertebrates. The presence of Arctic charr and round whitefish suggests that larger lake trout may also be foraging on these species.

4.3 WEST LAKE

West Lake is located on the western side of the ridge in which the gold bearing deposit is located. The Ulu Camp, which is to house the mine staff, will be located approximately 500 m east of West Lake and the lake will serve as a source of potable water for the camp.

The lake receives water mainly from surface ground water sources, which was particularly evident on the eastern slopes above the lake. Even in late August water could be observed flowing off the ridge to the east of the lake, through boulder fields and small peat wetlands before entering the lake. There is a small stream indicated on the 1:50 000 NTS maps, which flows into the south of the lake; however, the stream is intermittent and only flowed briefly during the initial spring snow melt (Figure 4.2; Plate 88).

The outlet of the lake is located at the north end of the lake, where there is a small boulder filled channel which connects West Lake to the next small lake to the north (Plate 89). The conditions of the stream channel would not permit fish to move between the lakes; therefore, fish in Ulu Lake are year round residents.


LEGEND
GN1 = gill net site
WQ1 = water/sediment sampling site
N
W
E
S
Flow
8-10 m change in elevation
shallow bay with exposed boulders
boulder and bedrock reef
GN2
bedrock and boulder shoreline, with surface and subsurface runoff
bedrock and boulder shoreline with many vertical rock faces
U.T.M.
7421000 N
501000 E
GN1
WQ1
approximate location of Ulu Camp boat dock and water intake
400 metres
shallow bay with exposed boulders
R.L.& L. ENVIRONMENTAL SERVICES LTD.
Figure 4.2 West Lake

4.3.1 Basin Morphometry

West Lake is situated in the bottom of a long narrow valley cut into the bedrock (Plate 89). The lake is partially divided into two basins by a boulder reef located in the northern part of the lake. Despite its relatively small size, the lake has areas of considerable depth. The deepest area was located at the southern end of the lake where depths of 10 m were recorded, while the northern basin exhibited slightly shallower maximum depths of 8 m.

The shoreline of the lake consisted mainly of vertical bedrock faces and piles of boulders. Rapid depth changes occur very close to the shoreline due to the shape of the lake and shoreline composition. For example, near the south end of the lake there is a sheer rock face with approximately 2.5 m of water immediately offshore. The multitude of boulders and cobble combined with the water depth provide numerous areas which are potential spawning areas for lake trout.

By mid-July the deeper southern basin of the lake had developed a thermocline between seven and eight metres depth. The thermocline was not evident in the northern basin, which exhibited a uniform temperature profile (Figure 4.3). West Lake was the only lake in this study to develop a thermocline, this is most likely due to the nature of the surrounding topography. The lake is sheltered from the strong prevailing winds by high bedrock ridges situated around the lake which prevent wind induced mixing of the lake.

4.3.2 Water and Sediment Chemistry

Analysis of water samples obtained in July 1996 indicate that West Lake is oligotrophic (e.g., TKN 0.32 mg/L and total phosphorus 0.08 mg/L) and had a Secchi depth of 7.0 m. Metals were at background concentrations in the water column (Appendix C).

Based on the results of the initial water chemistry results reported by Rescan (1991), there was an increase in the surface water conductivity, water hardness and dissolved solids from June 1990 to August 1991. Water conductivity increased from 10 to 208 μmho (μS/cm) and water hardness increased from 8 to 52.4 mg/L (as equivalents of $CaCO_3$). Dissolved solids increased from <10 to 166 mg/L during the same period (Rescan 1991).

At the profundal zone sampling station the water conductivity was 830 μS/cm at the surface and 1200 μS/cm at the bottom of the lake in July 1996. This is extremely high compared to the other lakes sampled in the area which had conductivities of 50 to 100 μS/cm. In addition, a strong chemocline had developed at the same depth as the thermocline where the water conductivity increased from 860 to 1100 μS/cm (Figure 4.3).

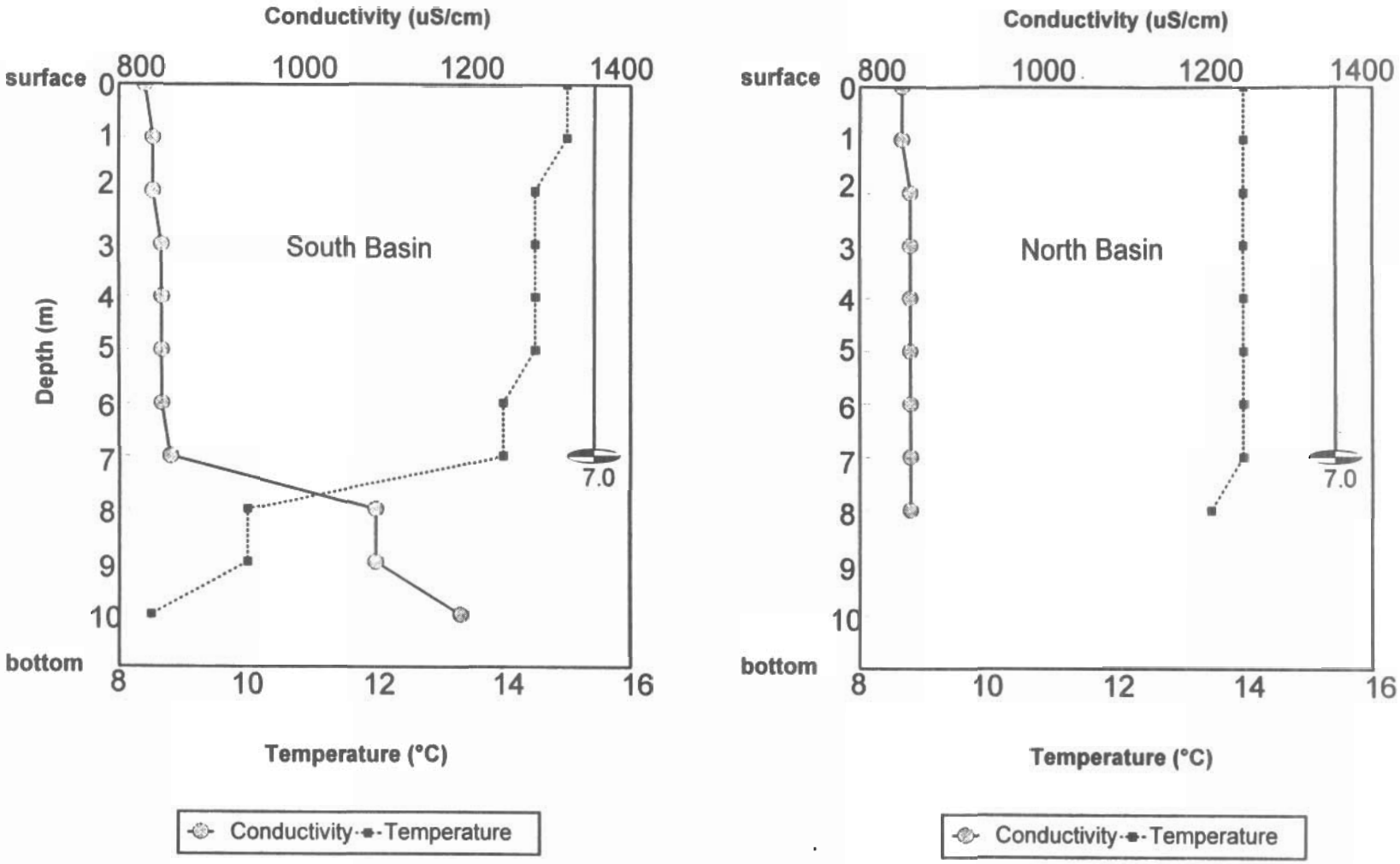


Figure 4.3 Summer temperature, conductivity and Secchi depth during summer in the south and north basins of West Lake.

Water chemistry results from 1996 confirm that concentrations of calcium, sodium, chloride, and water hardness were all elevated in relation to levels observed in other nearby lakes such as Ulu Lake (Table 4.3). In addition, levels of strontium were also significantly higher than other lakes in the area. The elevated levels of salt and the strong chemocline may now be sufficient to prevent complete mixing of the lake water in the fall when the thermocline breaks down; consequently, the lake may become meromictic.

Table 4.3 Comparison of selected water quality constituents from West and Ulu lakes.

Constituent	West Lake (mg/L)	Ulu Lake (mg/L)
Calcium	13.9	1.9
Sodium	23.8	0.8
Chloride	59.7	2.9
Hardness	46.3	7.9
Strontium	0.129	0.0082

The analysis of the lake sediments indicated similarly high levels of sodium (171 mg/kg) and chloride (560 mg/kg). In addition, concentrations of magnesium and potassium were also elevated in comparison to other lakes in the vicinity (39.4 and 15 mg/kg respectively). Other constituents of sediment quality were generally at background levels and hydrocarbons were not detectable.

4.3.3 Fisheries

Two test-gang gill net sets were carried out for a total effort of 7.98 hours. In this period only three lake trout were captured. The CPUE of 0.21 fish/hour of set time/100 m^2 of net was the lowest CPUE of the four lakes examined during the July sampling session.

The fish captured were small (335-344 mm) and in very good condition (Table 4.4). There was one fish mortality during the capture. When subjected to an internal examination, the sex of the fish could not be determined as there were no gonads visible.

Table 4.4 Fish species captured by gill nets in West Lake, 25 July 1996.

Species	n	Fork Length Range (mm)	Weight Range (g)	CPUE[1]
Lake Trout	3	335-344	458-542	0.21
Total	**3**			**0.21**
Effort (hours set)	7.98			

[1]CPUE = No. of fish/hour of set time/100 m^2 of net.

4.4 ULU LAKE

Ulu Lake is located to the east of the mine site at the base of the ridge on which the mine is located. Ulu Lake receives inputs from surface water run off and from a small lake located above the southwest end of the lake (Figure 4.4). This lake, identified (by the study team) as East Lake, will receive waste water from the camp as well as water from the mine and ore stock piles. The stream marked on the NTS map (#76L/15) as connecting Discharge and Ulu Lake is actually a relic boulder filled channel (Plate 90), although, water could be heard flowing through the boulders. Portions of the stream are visible for a short distance aboveground along the north side of the boulder channel (Plate 91). The NTS map (#76L/15) indicates a second inflow located at the northeast end of the lake. This stream is also a relic stream bed (Plates 92 and 93). There was no water evident in the channel during the three sampling sessions conducted in 1996.

The outlet of Ulu Lake is located at the southeast end of the lake. The outlet stream is a small boulder filled channel which had barely detectable flows at the time of sampling in July (Plate 94). Downstream of Ulu Lake there is a series of small, shallow, lakes connected by short sections of stream. The stream (locally designated by the study team as Ulu Creek) flows east and eventually joins with a tributary (identified by Rescan as the Frayed Knots River) of the Hood River approximately 4.5 km east of Ulu Lake (Plates 95 and 96).

The lakes immediately downstream of Ulu Lake (Plates 97 and 98) are too shallow to support overwintering fish populations. In addition, the streams which connect the lakes experience several abrupt elevation changes where the streams flow over shear bedrock faces, some up to 10 m in height (Plates 99 and 100). Therefore, fish populations in Ulu Lake are isolated from any that might be in downstream areas.

4.4.1 Basin Morphometry

Ulu Lake is bordered on the west and north sides by the ridge on which the Ulu mine is located. To the east and south the topography becomes flat and opens into a wide, rolling plain. The lake consists of a single basin which does not thermally stratify during the summer. The deepest area of the lake can be found near the southwest end of the lake. The east side of the lake is shallow (<2 m) with abundant boulder fields and several boulder reefs, particularly near the outlet stream.

4.4.2 Water and Sediment Chemistry

As with the other lakes in the study, Ulu Lake is oligotrophic and had a Secchi depth of 6.5 m. Metals in the water column were either at background levels or not detectable. Hydrocarbons, including oil and grease, were not detectable in the water column of Ulu Lake (Appendix C).

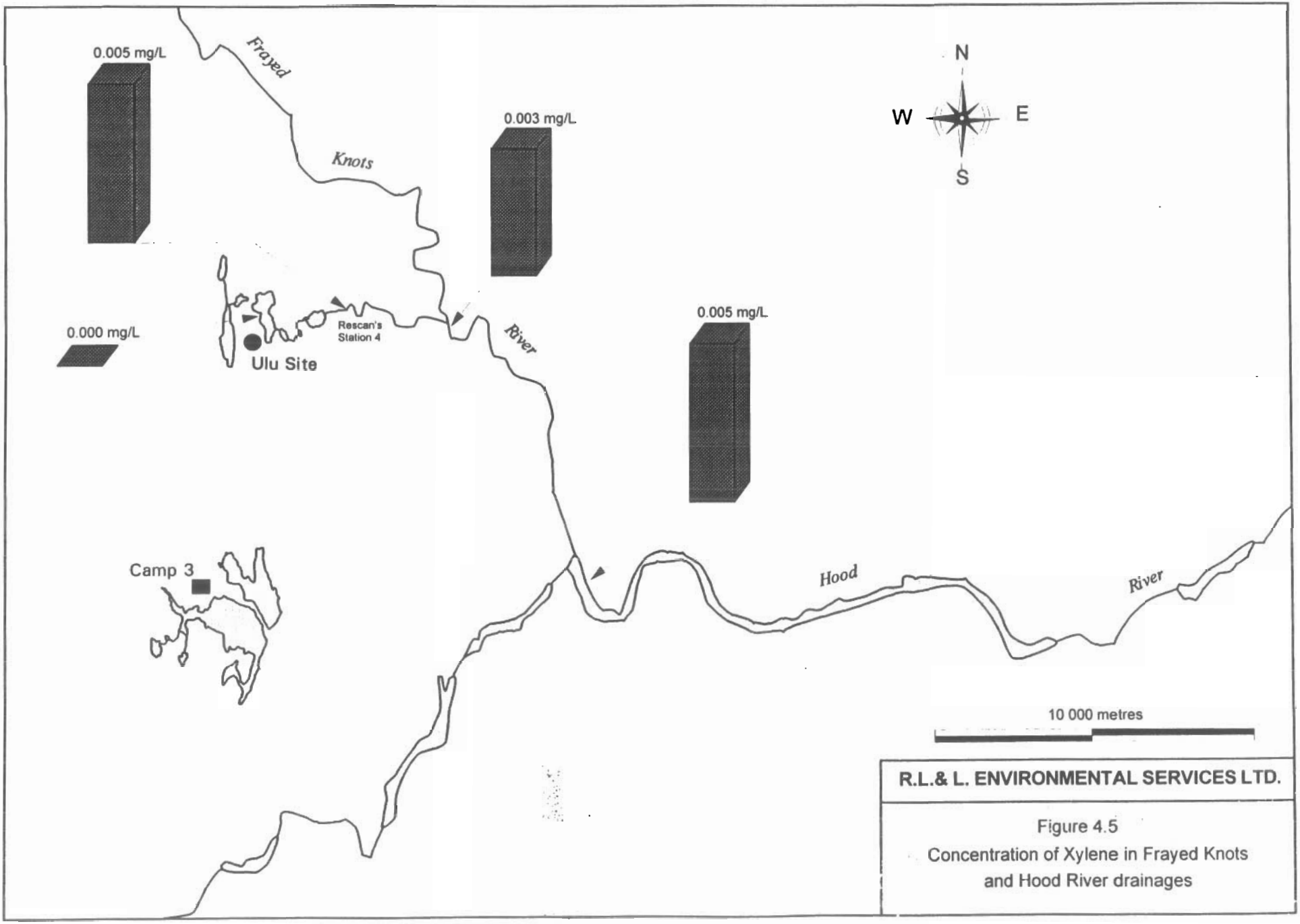


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Figure 4.5
Concentration of Xylene in Frayed Knots
and Hood River drainages

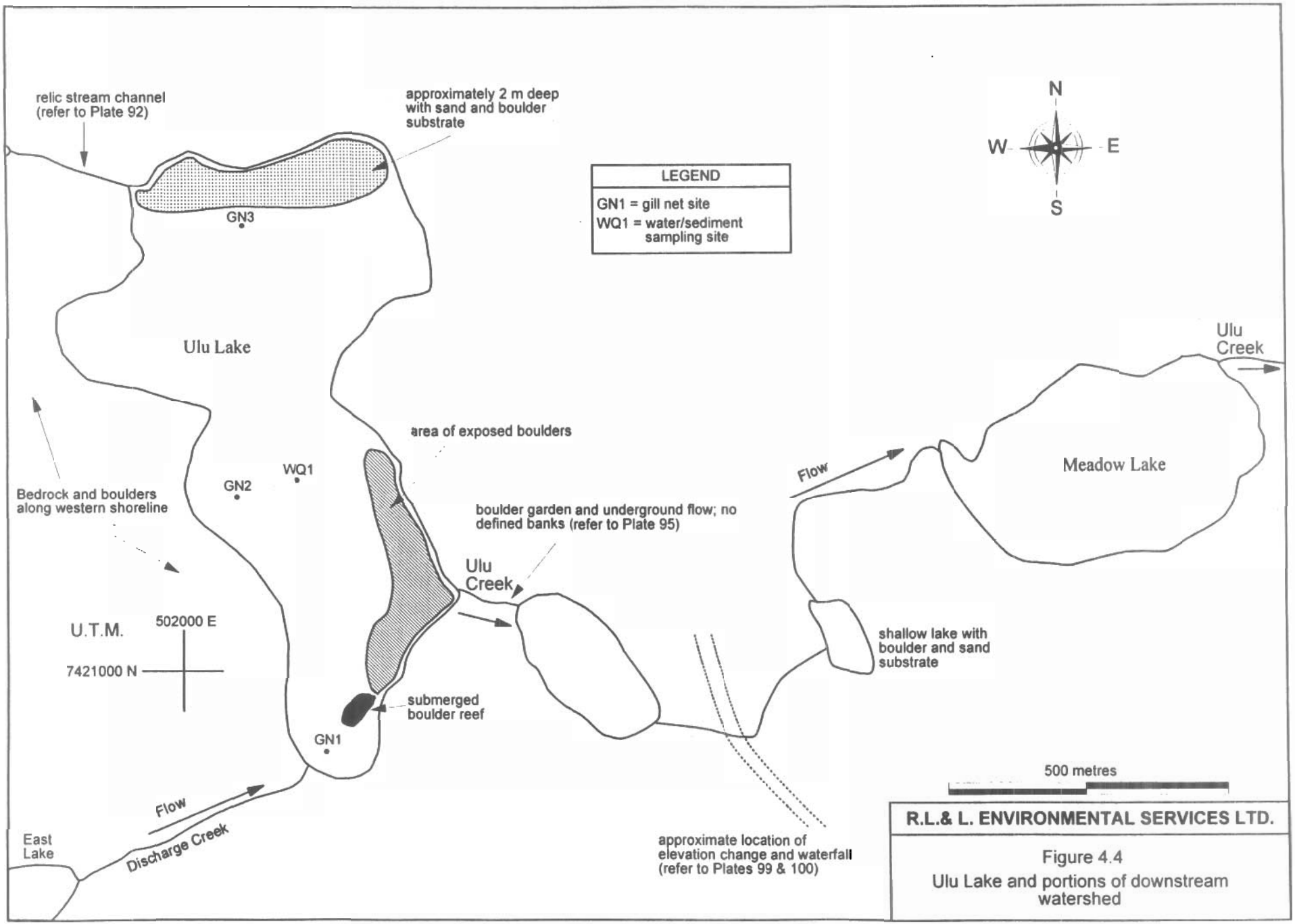

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Figure 4.4

Ulu Lake and portions of downstream watershed

Similar trends in water quality were observed at sampling sites situated downstream of Ulu Lake; however, there were indications of trace levels of hydrocarbon contamination downstream of Ulu Lake. Detectable levels of xylene (a component of the BTEX fraction of refined hydrocarbons) were present at Rescan's Station 4, in the Frayed Knots River (downstream of Ulu Creek) as well as in the Hood River downstream of the confluence with the Frayed Knots River (Figure 4.5). Unfortunately, the water sample from the upstream control site on the Hood River was broken during shipping. Therefore it could not be determined if the xylene was also present upstream of the confluence of the Frayed Knots and Hood rivers. While the levels of xylene are not at significant concentrations (0.003 to 0.005 mg/L) and marginally above detection limits (0.001 mg/L), the results indicate that there is some source of refined hydrocarbon contamination in the Ulu Creek drainage, to the east of the Echo Bay camp and mine site.

As with the sediment in the other lakes sampled, sediments were soft, highly flocculent and underlain by a clay material. Water content analysis showed that sediment was 90% water which made performing the standard analytical tests for sediment difficult. Analytical tests of the lake sediment samples indicated that metals were at background levels and hydrocarbons were not detectable.

4.4.3 Fisheries

Three short duration gill net sets were used to sample the fish population in Ulu Lake. A total of six lake trout were captured in 9.98 hours of set time (CPUE 0.33 fish/hour of set time/100 m^2 of net; Table 4.5). The largest lake trout of the July sampling session was captured in this lake. This particular fish was 455 mm in length and weighed 1056 g, and was determined to be an immature male (Plate 101).

Table 4.5 Fish species captured by gill nets in Ulu Lake, 26 July 1996.

Species	n	Fork Length Range	Weight Range	CPUE[1]
Lake Trout	6	250-455	156-1056	0.33
Total	**6**			**0.33**
Effort (hours set)	9.98			

[1]CPUE = No. of fish/hour of set time/100 m^2 of net.

5.0 SUMMARY

5.1 PROPOSED WINTER ROAD ROUTES

The four proposed winter routes traverse a rugged landscape of bedrock, boulders and relic glacial features. These features have contributed to the formation of streams which generally cannot support resident fish populations. The majority of the streams that are crossed by the proposed routes are small (often less than 1 m across), shallow (frequently less than 20 cm deep), with very little instream habitat that is suitable for supporting fish.

In the southern portion of the study area the majority of the streams are in the Cracroft River and Burnside River watersheds. While these major rivers are known to support both resident and anadromous fish populations (Stewart and McDonald 1978), the small headwater streams are effectively cut off from downstream populations by lakes which freeze to the bottom and sections of shallow, bog streams which are intermittent. Therefore, species such as Arctic grayling and Arctic charr were absent from all but one stream (which was connected to Kathawachaga Lake).

In the northern part of the study area, streams are located in the Wright and Hood river watersheds. Again these streams were generally found to be isolated, intermittent streams with very poor quality fish habitat.

A total of 75 streams and portions of the Hood River were assessed during the June and August stream surveys, including: 43 streams along Route 1, 12 streams along Route 2, 3 on Route 3 and 17 on Route 4. Fish were captured or observed in only 14 (18%) of the streams. Species encountered included Arctic grayling, burbot, lake trout, round whitefish and slimy sculpin. Numerically slimy sculpins were the most abundant, followed by round whitefish, lake trout, burbot and Arctic grayling (Table 5.1).

Catch per unit effort (CPUE) was very low ranging from 0 to 1.73 fish per minute of electrofishing. The CPUE of streams in the Ulu Project study area is at the lower end of the CPUE recorded for streams in the vicinity of Lupin, 155 km to the south. In streams near Lupin the CPUE ranged from 0.7 to 9.3 fish per minute of electrofishing (R.L. & L. Environmental Services Ltd. 1993).

Table 5.1 Summary of catch composition during stream surveys.

Species	Route 1	Route 2	Route 3	Route 4	Species Total
Arctic Grayling				3	3
Burbot	1	1	3	3	8
Lake Trout	8				8
Round Whitefish	8	4		1	13
Slimy Sculpin	34	3			37
Route Totals	51	8	3	7	69

Fish were only encountered in streams where there was adequate overwintering habitat, in the form of a deep (i.e., >3 m) lake, in close proximity to the stream. Use of the streams by fish was generally confined to the transition zone between the stream and the large lake, often within 150 m of the stream mouth. Only in Stream 37.0 (Route 1) was a fish found more than 150 m from the stream mouth. In the case of Stream 37.0, the stream is situated between two large lakes and good quality fish habitat could be found over its entire length.

Overwintering habitat appears to limit the distribution of fish in the study area. As most streams and many of the lakes freeze to the bottom, deep water refugias are critical habitat features. During the winter ice can reach thicknesses of 2.4 to 2.7 m, therefore lakes must have water depths in excess of 3 m for fish to overwinter. Ice of this thickness not only prevents self-sustaining populations from becoming established, but also forms barriers to the upstream passage of fish, particularly Arctic grayling, prior to spring break up.

Fish encountered in streams were either young-of-the year (y-o-y) or rearing juveniles, although, several of the burbot captured were larger juveniles or sub-adults. Fish appeared to be using the shallow water and multitude of boulders in the lower portions of the streams as rearing areas. Based on the 1996 sampling, the extent which Arctic grayling utilize streams in the study area could not be determined. The y-o-y and juveniles move into these streams as soon as they are flowing in the spring in order to avoid predation by larger fish (i.e., lake trout and burbot) which cannot enter the shallow water of the streams.

5.2 LAKE SURVEYS

Analysis of the water samples obtained from the four lakes during the July 1996 field program indicate that all four of the lakes are oligotrophic. Concentrations of essential nutrients (i.e., nitrogen, phosphorus, and carbon) were all at very low levels. Wetzel (1983) indicates that a carbon:nitrogen (C:N) ratio of approximately 12:1 is indicative of autochthonous organic matter produced by the decomposition of plankton. Carbon:nitrogen ratios ranging from 6:1 to 8:1 in the four lakes studied in July, suggest that these lakes receive very little allochthonous organic material and rely on autochthonous carbon fixation to supply new carbon to the lakes' food webs. This supposition is supported by the water clarity (i.e., Secchi readings of 4-7 m) which indicates that there is very little suspended material in the water column.

Water and sediment samples were analysed for metals and hydrocarbons in order to provide an indication of what the pre-development concentrations were. These tests have shown that, with the exception of strontium in West Lake, levels of metals were at background concentrations in all of the lakes and that hydrocarbons were not detectable.

The levels of sodium, chloride and calcium as well as the extremely high conductivity in West Lake all indicate that the lake may have received some form of saline substance. The levels of strontium (a metal often associated with drill bits) suggests that this discharge may be a result of some previous exploration activity that has occurred in the vicinity. The concentrations of these elements are not at levels which could pose a risk to the resident fish population or human health (CCME 1993). If calcium and water hardness continue to increase, there may be some aesthetic concerns with the Ulu Camp water supply (e.g., soaps not lathering, etc.).

The only hydrocarbon to be detected in any of the water samples was xylene. Xylene was detected at Station 4 on Ulu Creek, in the Frayed Knots River (immediately downstream of the confluence with Ulu Creek) and in the Hood River (downstream of the confluence with the Frayed Knots River). Xylene is part of the volatile BTEX fraction of refined petroleum. Its presence in the Ulu Creek drainage as well as downstream areas suggests that there is a small residual source of hydrocarbon contamination.

Fish were captured in all four of the lakes sampled. The CPUE was very low in all of the lakes, ranging from 0.21 to 1.09 fish/hour of net set time/100 m^2 of net (Table 5.2). The CPUE for the four lakes is comparable or higher than the levels reported by Stewart and McDonald (1978) for stations on the Hood River and James River.

Table 5.2 Summary of CPUE for the four lakes sampled in July 1996.

Lake	Number of Fish Captured	Hours of Set Time	CPUE[1]
Reno Lake South	20	16.9	0.66
Reno Lake North	44	22.4	1.09
West Lake	3	8.0	0.21
Ulu Lake	6	10.0	0.33

[1]CPUE = No. of fish/hour of set time/100 m^2 of net.

Lake trout were captured in all of the lakes sampled. Only in Reno Lake North were species other than lake trout encountered, these included round whitefish and Arctic charr.

As with the streams in the study area, overwintering habitat is critical to the survival of the lake resident fish populations. In each lake there are small areas where water depth is sufficient (i.e., >3 m) to support fish when there is 2.4 m ice on the lakes. It should be stressed that these areas are a small percentage of the lakes' total area, thus making resident fish populations susceptible to over exploitation by recreational angling, particularly to ice fishing in the late spring.

All of the fish captured in the gill nets were very small, with only one fish exceeding 1000 g. The lake trout in these lakes are typical of high latitude populations (i.e. they are very slow growing and slow to reach maturity). An examination of several otoliths taken from fish captured by anglers showed that fish 400 mm in length, weighing 600 to 800 g, were between 10 and 14 years of age. The length-at-age relationship is similar to that reported for Dismal Lake and Maze Lake which are located at similar latitudes (Johnson 1976). As lake trout populations at this latitude are not sexually mature until they are 13 years old (Scott and Crossman 1973), the fish being targeted by anglers are just reaching maturity, thus the populations are very sensitive to angling pressure.

As all three of the lake resident species encountered are fall spawners (McPhail and Lindsey 1970), spawning must occur at sufficient depths so that ice formation will not freeze the developing embryos. While specific spawning areas were not identified, such areas most likely correspond with the fringes of the deep water overwintering areas.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed winter road routes traverse an area which can be characterized as having poor quality fish habitat. Of the 76 crossing locations assessed in June and August 1996, fish were encountered in only 14 of the streams.

Route 2 is the route preferred by Echo Bay Mines Ltd. (Mr. Rod Cooper, Echo Bay Mines Ltd., pers. comm. October 1996) However, based on fisheries resource and habitat values, none of the proposed winter road routes stands out as having significantly more potential impact on the aquatic environment than the others. Regardless of which route is finally chosen, the stream crossing locations should be maintained at least 150 m upstream of any lake which is greater than 3 m in depth.

All four of the lakes in the Ulu Project area sampled in 1996 have resident fish (primarily lake trout) populations. These populations are isolated from other populations in the area and are sensitive to over exploitation.

Water and sediment quality in three lakes (Reno Lake North, Reno Lake South and Ulu Lake) are typical of unperturbed lakes. West Lake appears to have experienced an introduction of a saline substance as evidenced by elevated concentrations of sodium, calcium and chloride.

6.1 RECOMMENDATIONS FOR FUTURE ACTIVITY

Portions of Routes 2 and 3 could not be sampled for fish presence or absence due to the large size of the lakes and connecting streams. These areas should be examined (depending on which route is finally chosen) in 1997 to determine fish use. As the water conductivity is very low, use of the Avon and Type VI electrofisher may not be practical, therefore two alternative methods could be employed:

- snorkel float the streams sections in the spring; or
- sling a boat into the lakes and employ gill nets.

Route 4 is selected as the route of choice, then Streams 1.0W, 3.5E, and 3.7E which were outside of the licenced survey area, need to be assessed.

Should portions of Routes 2, 3 and 4 be selected for the final winter road, streams on these routes should be surveyed again in spring to document seasonal use of these streams, particularly those near Kathawachaga Lake where there is a high probability of encountering Arctic grayling.

The ice thickness on the Hood River needs to be assessed prior to utilizing either Route 2 or 3. This is important particularly for the location where Route 2 crosses the Hood River, as this location is immediately above the narrows of the river and was ice free earlier than other portions of the river.

Further water sampling should be conducted to determine the source of the xylene contamination in Ulu creek and downstream areas.

Since East Lake/Ulu Lake systems will be receiving effluent from the mine and camp, additional information is needed to fully understand the dynamics of these lakes and assess what potential impacts any discharge may have. This information includes:

- Volume and rate of discharge from East Lake. Because most of the discharge appears to be underground a tracer method may be required. Discharge should be measured throughout the year,
- Volume and rate of discharge from Ulu Lake, and
- Water residence time in East and Ulu lakes.

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7.2 PERSONAL COMMUNICATION

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8.0 GLOSSARY

Anachromous: Refers to species of fish which undergo seasonal migrations, usually between marine and freshwater environments.

Anthrogogenic: Man made.

Areal: A defined space of area.

Electrofishing: A method of capturing fish using an electrical current to attract and then stun fish.

Fork Length: A measurement of the length of a fish from its snout to the fork in the tail.

Meromictic: Refers to lakes in which the layers of water do not completely circulate and mix each year.

Refugias: Locations where fish can find shelter.

Zmax: Maximum depth of a lake.

Oigotrophic Lakes: Lakes with low rates of productivity, usually as a result of low inputs of inorganic nutrients.

PHOTOGRAPHIC PLATES

Plate 1 Route 1 - **Stream 4.6** looking upstream.

Plate 2 Route 1 - **Stream 5.5** looking upstream

Plate 3 Route 1 - **Stream 7.0** looking upstream. Note: grass in stream channel.

Plate 4 Route 1 - **Stream 13.8** looking upstream. Note: mostly overland flow.

Plate 5 Route 1 - **Stream 18.0** looking downstream.

Plate 6 Route 1 - **Stream 20.4** looking upstream.

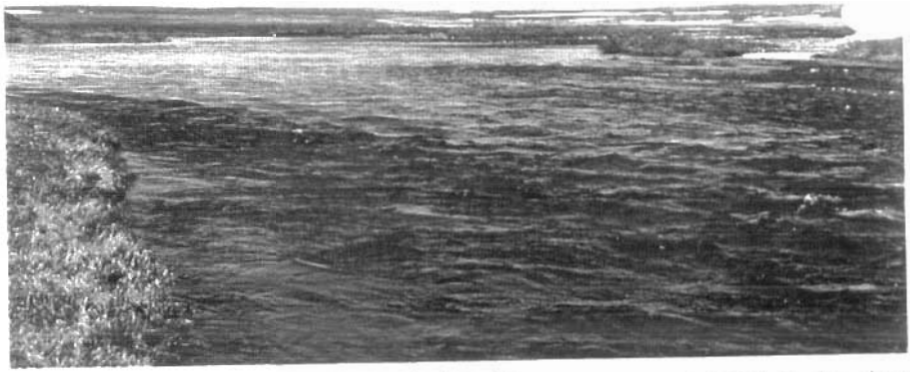

Plate 7 Route 1 - **Stream 20.4** looking upstream at bend in the river immediately west of the esker.

Plate 8 Route 1 - Area angled on **Stream 22.5**.

Plate 9 Route 1 - **Stream 29.6** looking upstream.

Plate 11 Route 1 - **Stream 31.5** looking upstream.

Plate 10 Route 1 - **Stream 30.9** looking upstream. Note: narrow channel and overland flow along margins of the channel

Plate 12 Route 1 - **Stream 32.2** looking upstream. Note: Stream "flows" to the left of the rock outcropping in the center of the picture.

Plate 13 Route 1 - **Stream 34.2** looking upstream.

Plate 14 Route 1 - **Stream 35.8** looking upstream.

Plate 15 Route 1 - **Stream 37.0** looking downstream.

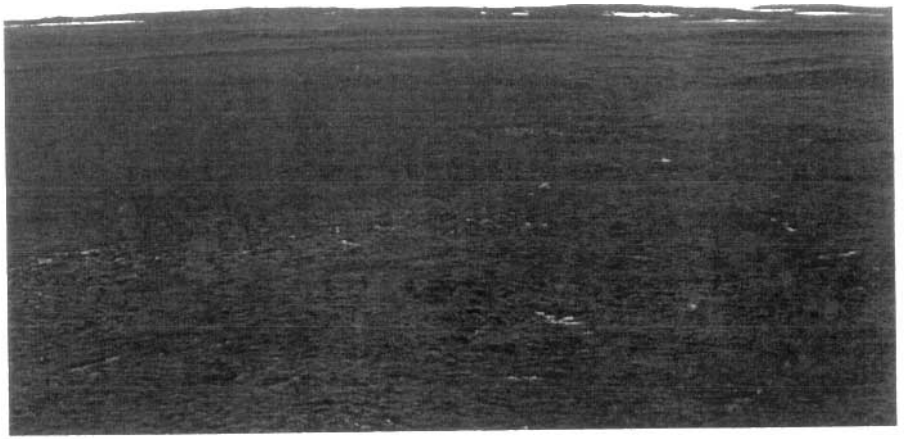

Plate 16 Route 1 - **Stream 39.0**.

Plate 17 Route 1 - **Stream 39.3** looking downstream.

Plate 18 Route 1 - **Stream 39.8** looking downstream.

Plate 19 Route 1 - **Stream 42.1** upstream towards lake.

Plate 20 Route 1 - **Stream 43.3** upstream of confluence with 43.6.

Plate 21 Route 1 - **Stream 43.3** looking upstream.

Plate 22 Route 1 - **Stream 43.6** looking downstream towards confluence with 43.3.

Plate 23 Route 1 - **Stream 44.7** looking upstream.

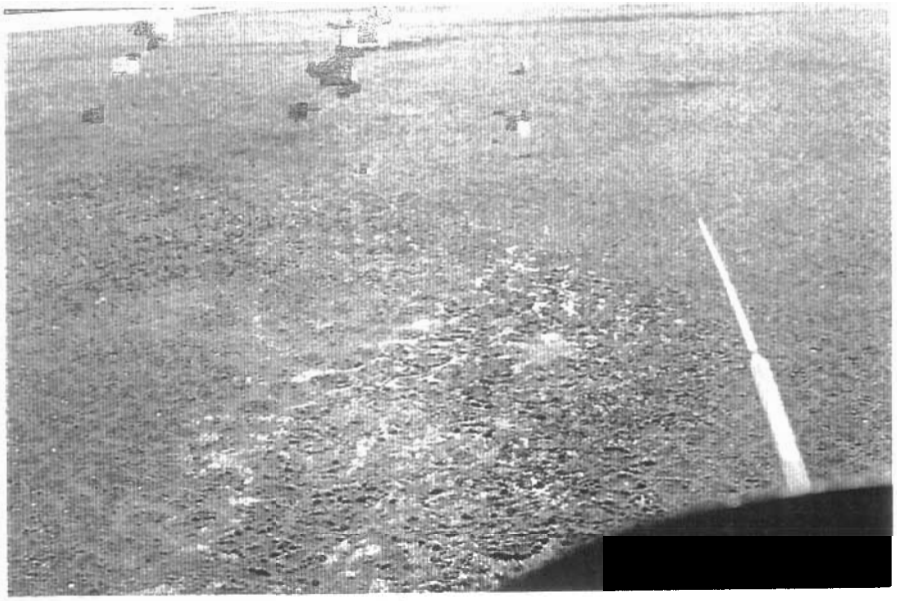

Plate 24 Route 1 - **Stream 46.8**.

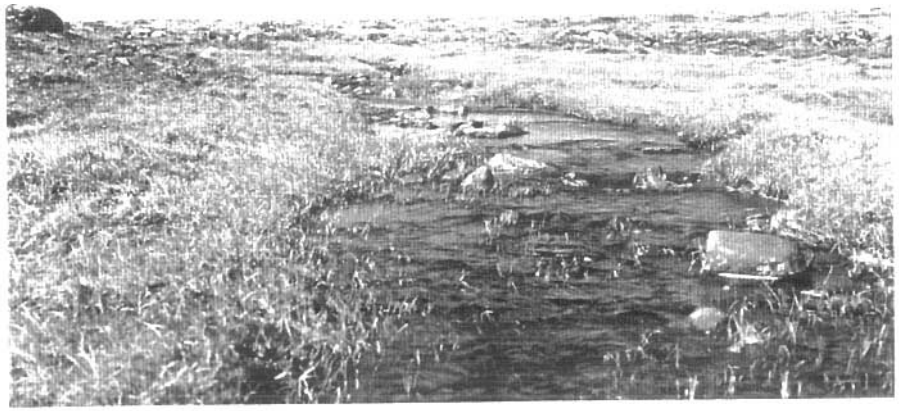

Plate 25 Route 1 - **Stream 49.2** looking upstream.

Plate 26 Route 1 - **Stream 51.OE** looking upstream.

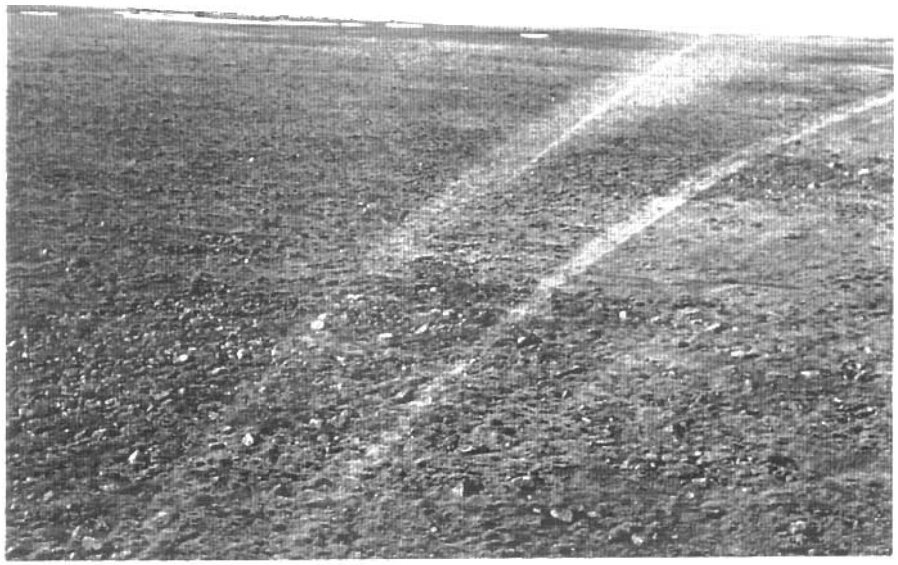

Plate 27 Route 1 - **Stream 51.4W**.

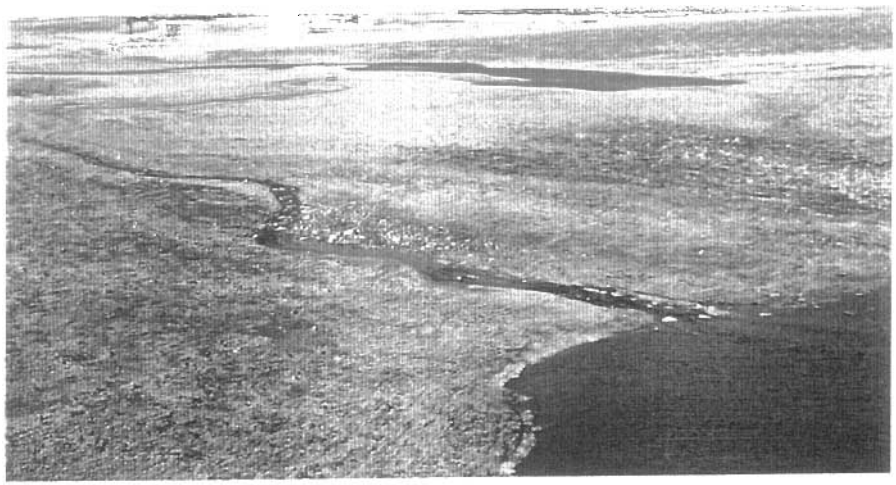

Plate 28 Route 1 - **Stream 52.0W** is on left side of photograph and 52.1W is on right side.

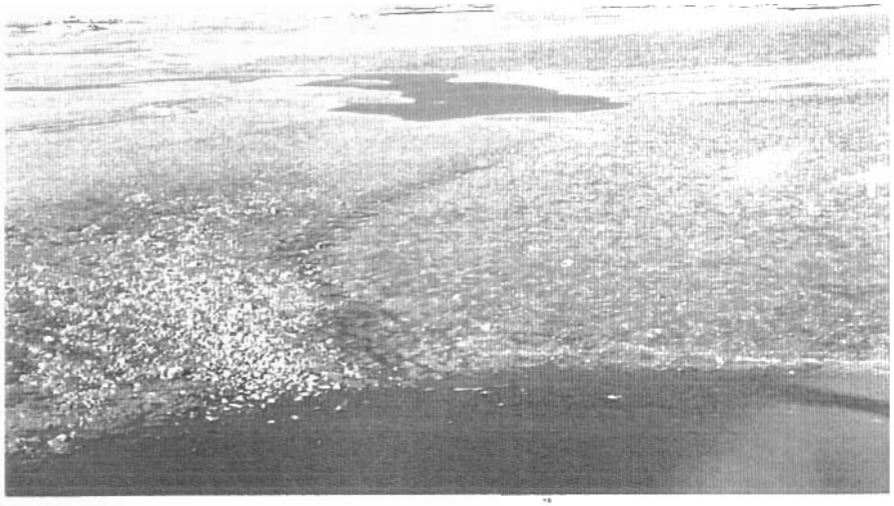

Plate 29 Route 1 - **Stream 52.1W** looking upstream.

Plate 30 Route 1 - **Stream 53.5** looking downstream through cut in esker.

Plate 31 Route 1 - **Stream 55.2** looking downstream.

Plate 32 Route 1 - **Stream 56.5** is the braided channel on left side of photograph.

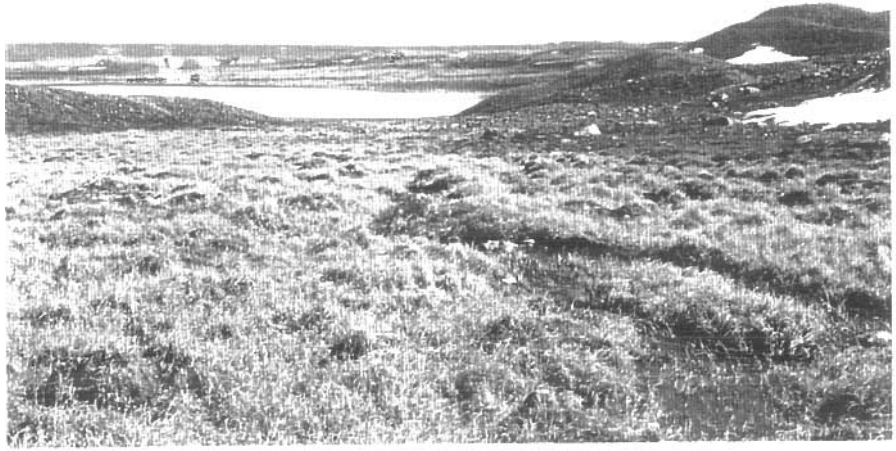

Plate 33 Route 1 - **Stream 56.9** looking downstream.

Plate 34 Route 1 - **Stream 58.2** looking upstream to origin.

Plate 35 Route 1 - **Stream 59.7** looking downstream.

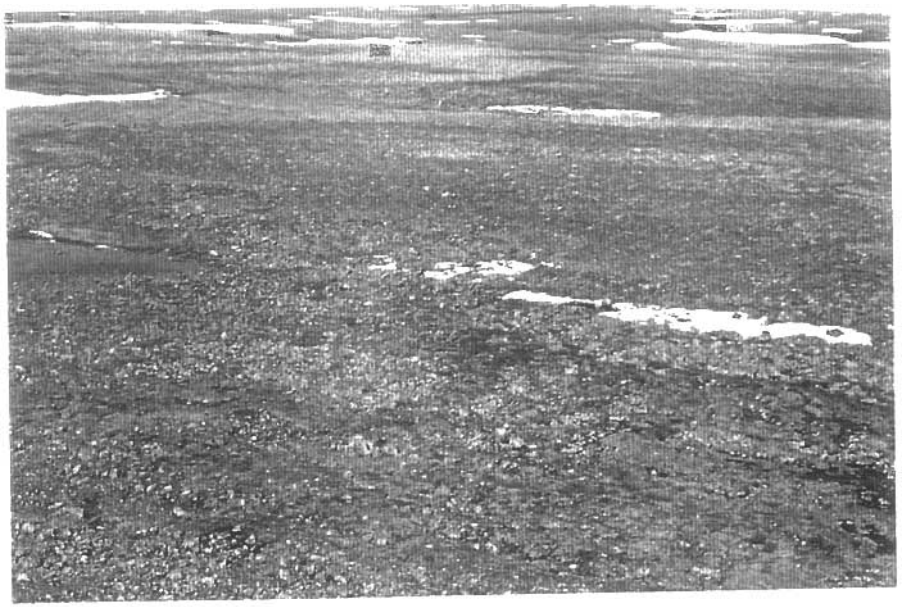

Plate 36 Route 1 - **Stream 62.2**.

Plate 37 Route 1 - **Stream 65.2** looking upstream.

Plate 38 Route 1 - **Stream 66.2** looking upstream.

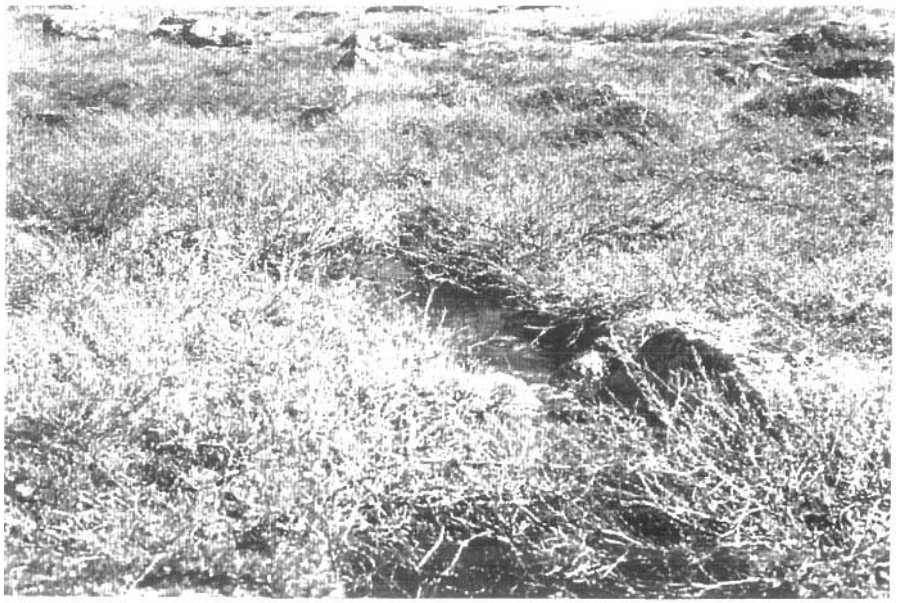

Plate 39 Route 1 - **Stream 68.2** looking upstream.

Plate 40 Route 1 - **Stream 69.7** looking upstream.

Plate 41 Route 1 - **Stream 71.8** looking upstream.

Plate 42 Route 1 - **Stream 71.8** upstream of sampling area looking upstream.

Plate 43 Route 1 - **Hood River** - Rapid and chute at upstream end of sampling reach.

Plate 44 Route 1 - Falls which block the **Hood River**, at downstream end of section which was boat shocked with the Avon.

Plate 45 Route 1 - **Hood River** downstream of sampling reach.

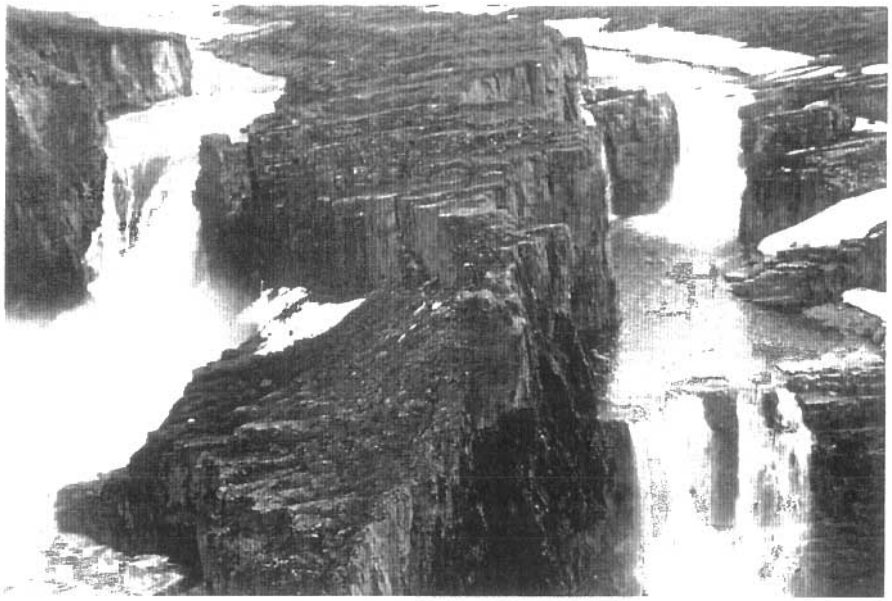

Plate 46 Route 1 - Wilberforce falls, **Hood River**.

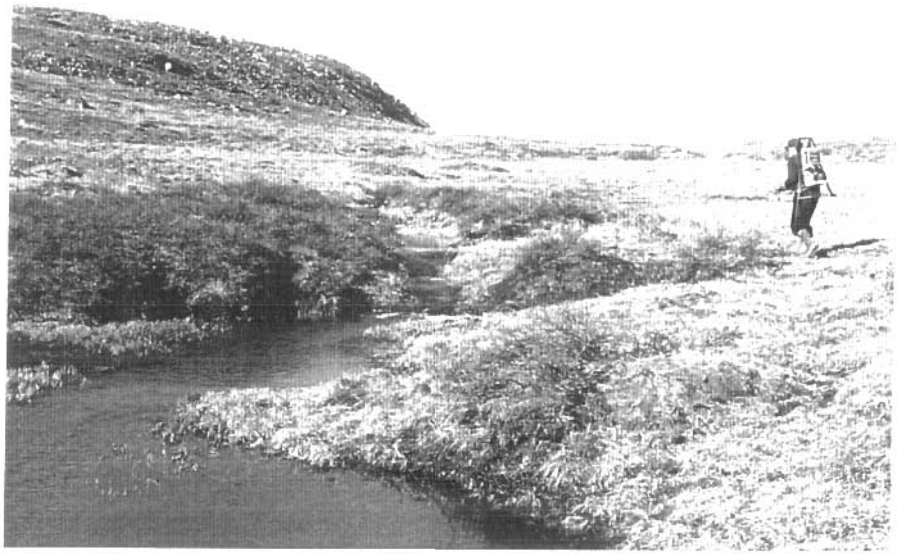

Plate 47 Route 1 - **Stream 74.8** looking upstream.

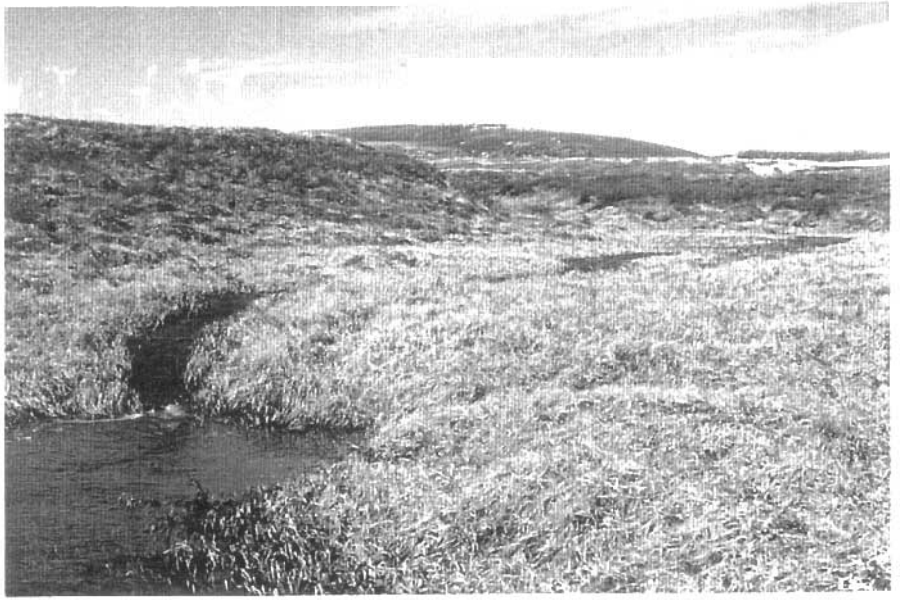

Plate 48 Route 1 - **Stream 76.9** looking upstream.

Plate 49 Route 1 - **Stream 76.9** looking downstream. Note: snowbank covering stream channel.

Plate 50 Route 1 - **Stream 83.2** looking downstream.

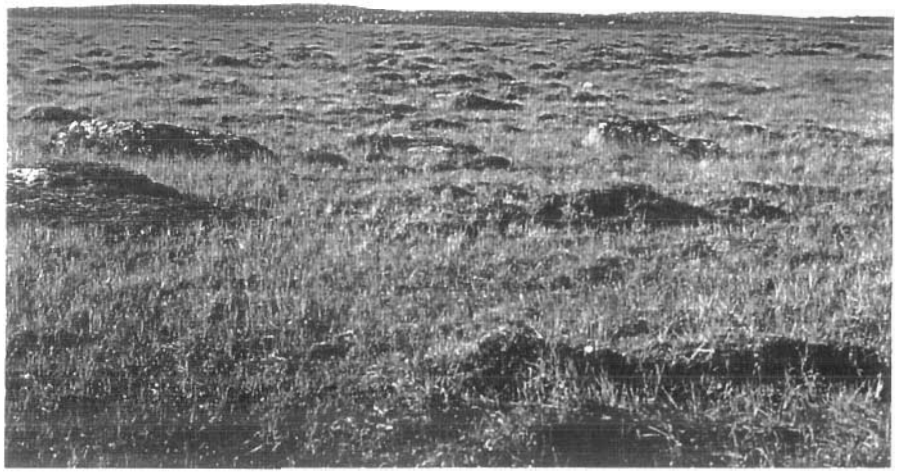

Plate 51 Route 2 - **Stream 36.8**.

Plate 52 Route 2 - **Stream 37.4** looking upstream.

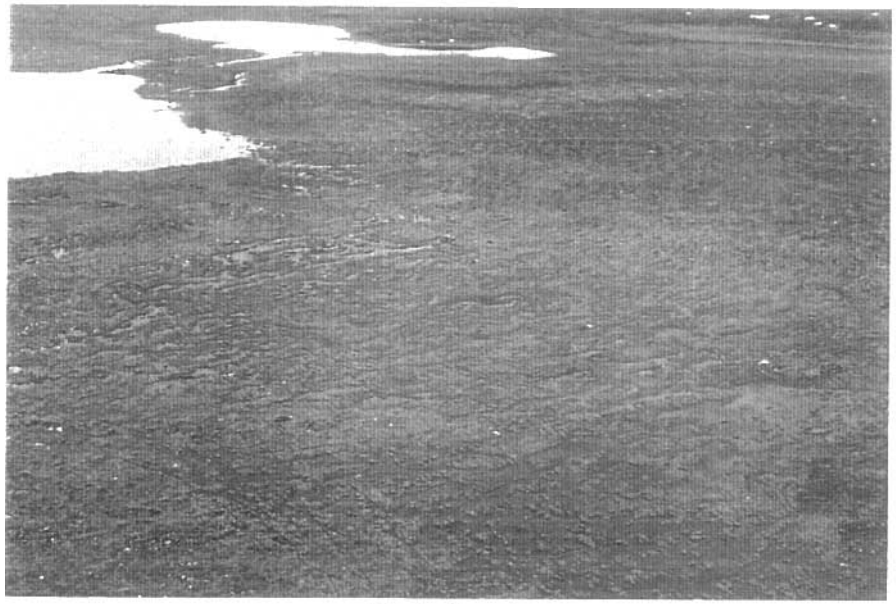

Plate 53 Route 2 - **Stream 40.7** looking downstream.

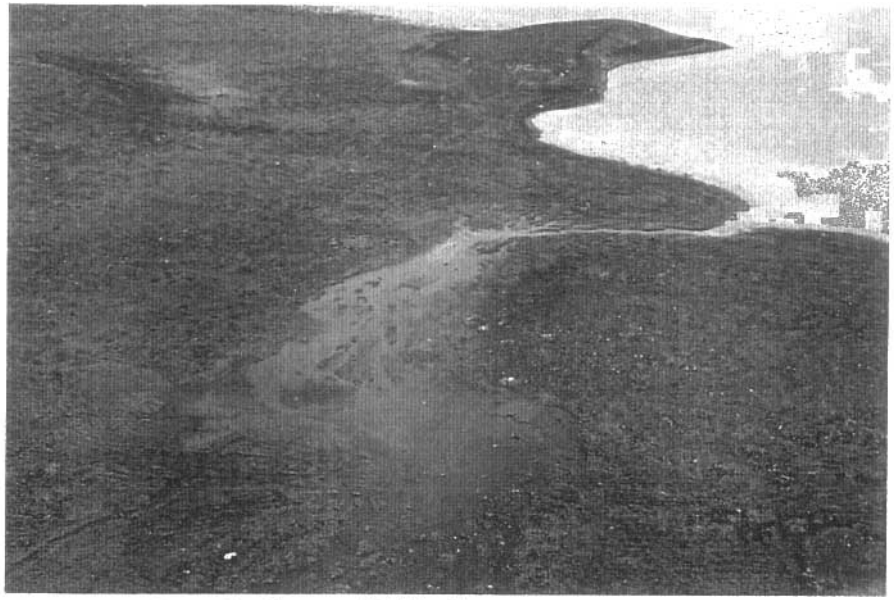

Plate 54 Route 2 - **Stream 42.5** looking upstream.

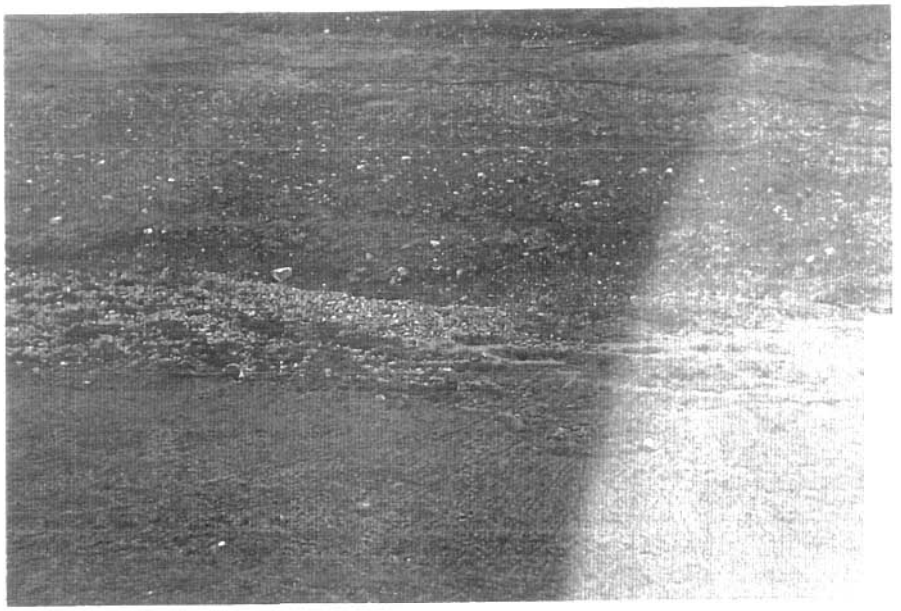

Plate 55 Route 2 - **Stream 45.3**.

Plate 56 Route 2 - **Stream 46.9** looking upstream looking upstream.

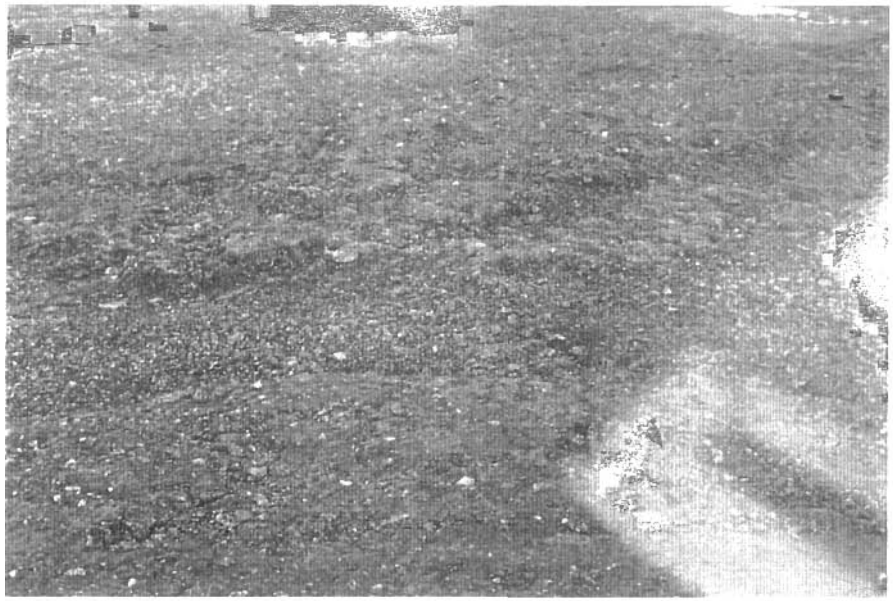

Plate 57 Route 2 - **Stream 48.6**.

Plate 58 Route 2 - Old oxbow channel which **Stream 48.6** would flow into when it has water.

Plate 59 Route 2 - **Stream 70.8** looking upstream from where stream flows underground.

Plate 60 Route 2 - **Stream 71.7** looking downstream towards lake.

Plate 61 Route 2 - **Stream 73.2** looking downstream towards Hood River.

Plate 62 Route 2 - Origin of **Stream 73.2**

Plate 63 Route 2 - **Stream 74.4** looking upstream.

Plate 64 Route 2 - **Stream 74.4** looking downstream towards Hood River.

Plate 65 Route 3 - **Stream 48.0** looking upstream.

Plate 66 Route 3 - **Stream 51.5** looking upstream towards origin.

Plate 67 Route 3 - **Stream 51.5** looking downstream towards next lake.

Plate 68 Route 3 - **Stream 59.3** looking upstream.

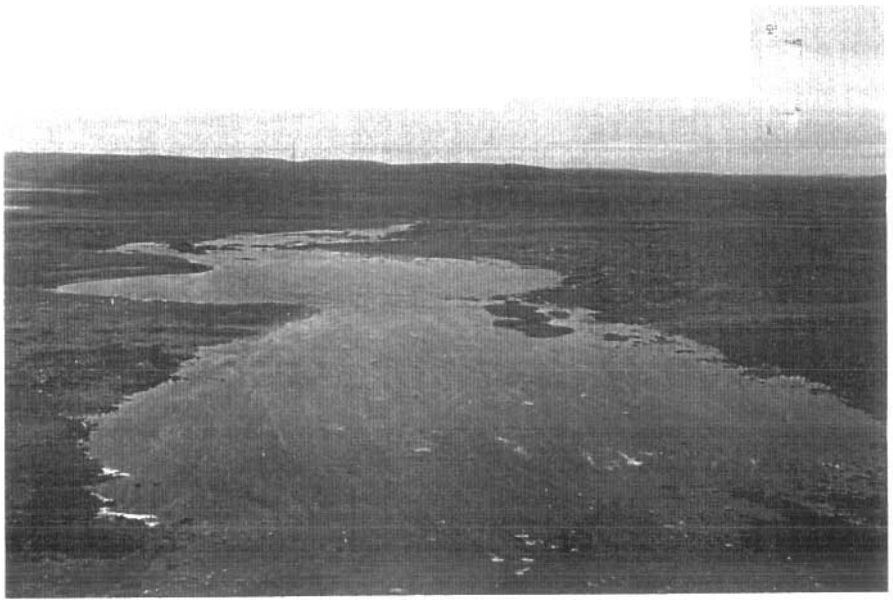

Plate 69 Route 3 - **Km 66.0** looking northwest.

Plate 70 Route 3 - **Km 64.5** looking west.

Plate 71 Route 4 - **Stream 1.0W** looking upstream.

Plate 72 Route 4 - **Streams 3.5E** (left side) and 3.7E (right side) as they flow into tributary stream north of Kathawachaga Lake.

Plate 73 Route 4 - **Stream 7.6** looking upstream.

Plate 74 Route 4 - **Stream 10.8** looking downstream from lake that it originates from.

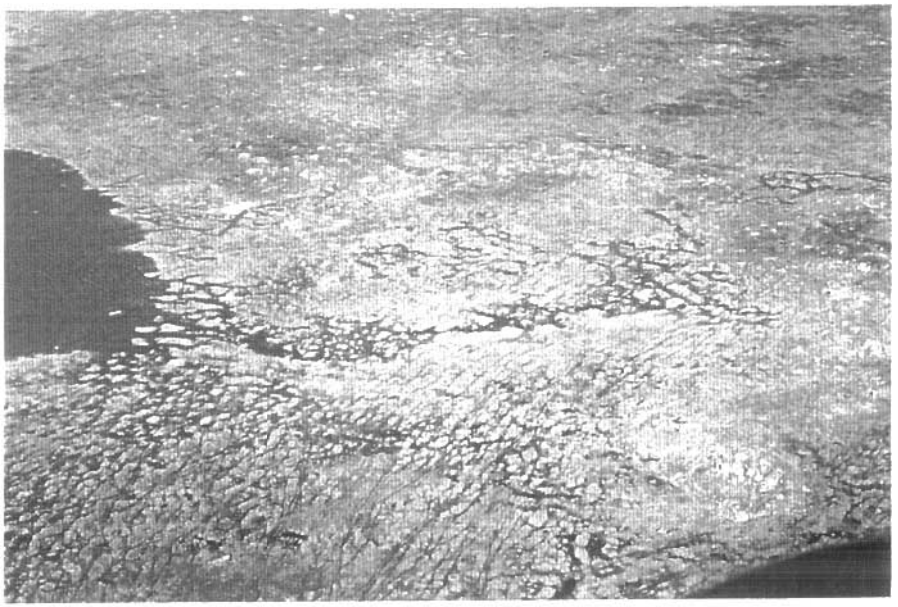

Plate 75 Route 4 - **Stream 12.0**. Stream located in center of picture.

Plate 76 Route 4 - **Stream 14.6**.

Plate 77 Route 4 - **Stream 14.6** looking upstream.

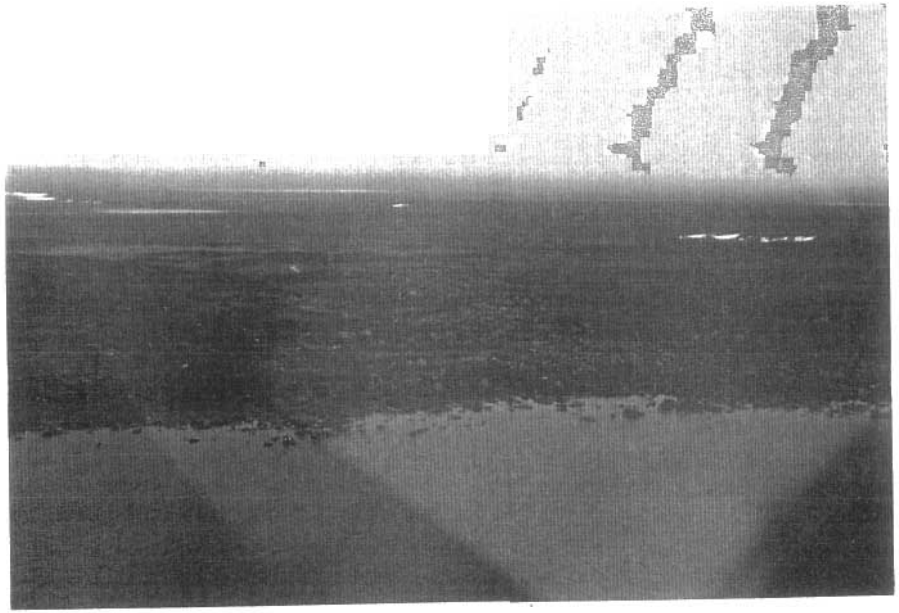

Plate 78 Route 4 - **Stream 16.1** (boulder channel).

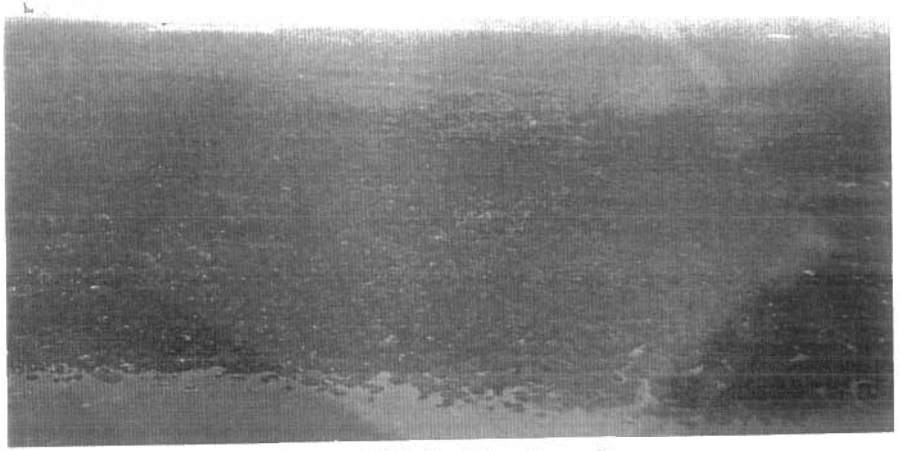

Plate 79 Route 4 - **Stream 16.9** (boulder channel).

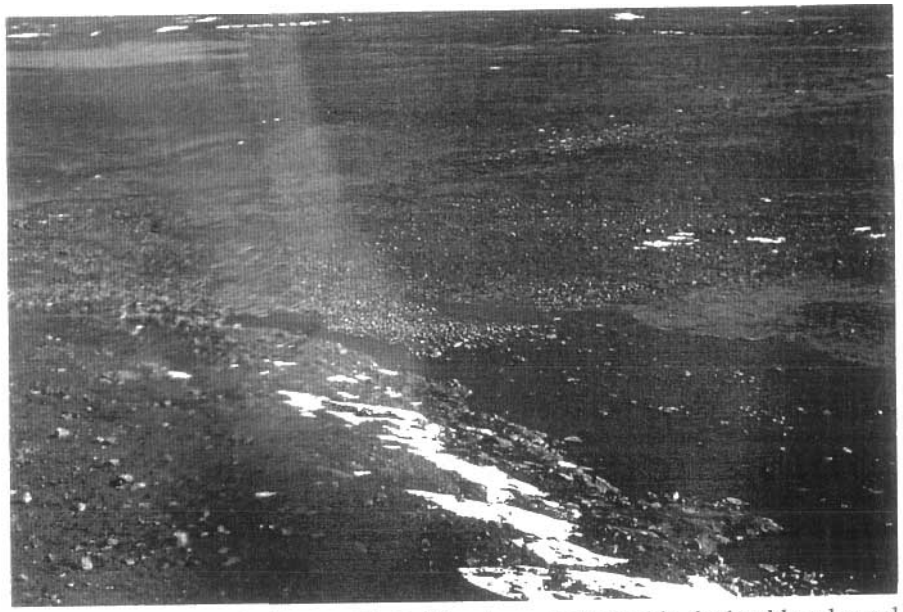

Plate 80 Route 4 - **Stream 19.5**. The stream is located in the boulder channel in center right of photograph.

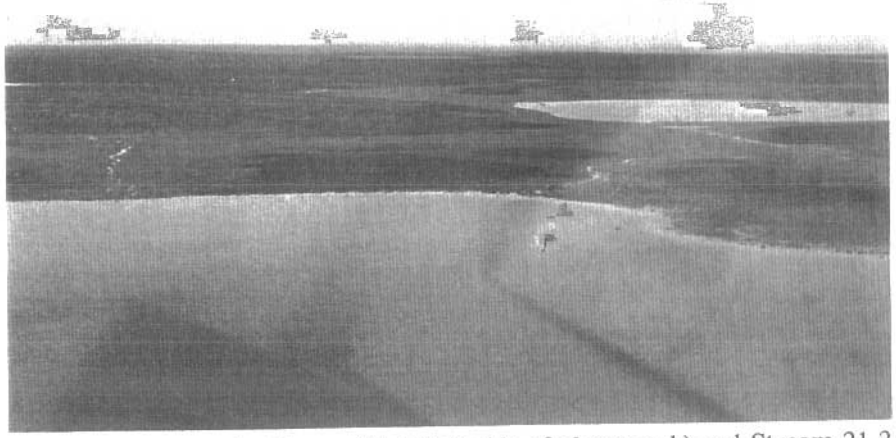

Plate 81 Route 4 - **Stream 21.0** (left side of photograph) and **Stream** 21.2 (right side of photograph).

Plate 82 Route 4 - **Stream 23.2** looking upstream.

Plate 83 Route 4 - **Stream 23.7** looking downstream. Note: dispersed overland flow on either side of mainstream channel (center of picture).

Plate 84 Route 4 - **Stream 26.3** looking upstream.

Plate 85 Route 4 - **Stream 28.3** looking upstream.

Plate 87 Route 4 - **Stream 30.9** looking downstream towards lake.

Plate 86 Route 4 - **Stream 30.9** looking upstream to where stream flows underground in a boulder field. Road will cross at top of ridge in background of picture.

Plate 88 Road crossing at south end of **West Lake**. Note: culvert at location of tributary stream.

Plate 89 **West Lake** looking south towards road. Note: outlet stream in center foreground.

Plate 90 Ancient stream bed downstream of **East Lake** and to the south of Discharge Creek. Note: East Lake is above the line of boulders in the middle of the photograph.

Plate 91 **Discharge Creek** where it flows above ground, downstream of East Lake.

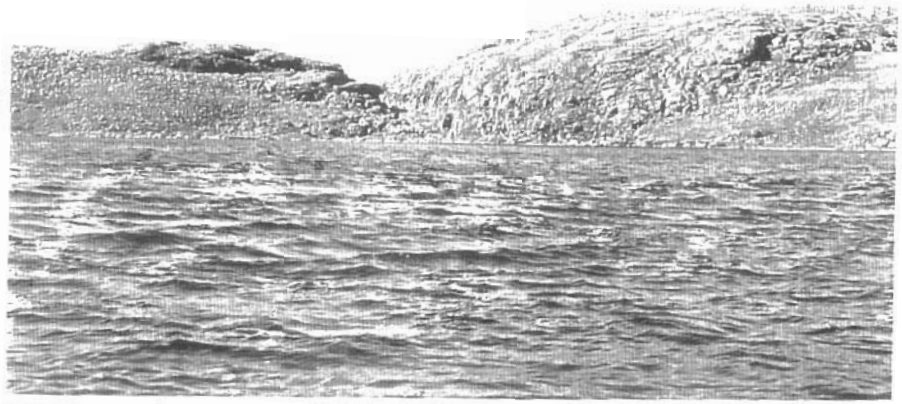

Plate 92 Canyon at north end of **Ulu Lake** which is marked as a stream on NTS maps.

Plate 93 Ancient streambed in canyon at northwest end of **Ulu Lake**.

Plate 94 **Ulu Lake** looking west. Outlet stream is located at the bottom of the picture.

Plate 95 **Ulu Creek** looking upstream from confluence with the Frayed Knots River.

Plate 96 Widening of **Ulu Creek** downstream of Station 4.

Plate 97 Lake downstream of **Ulu Lake**.

Plate 98 Looking east from Ulu Lake towards **Meadow Lake**.

Plate 100 Close-up of portions of the waterfall shown in Plate 99.

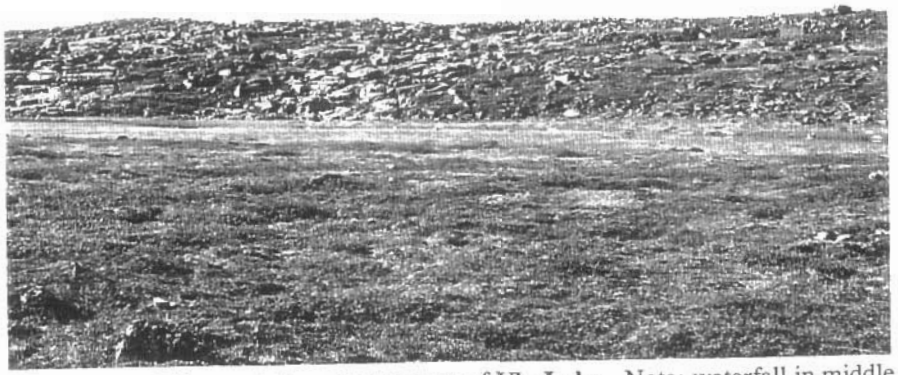

Plate 99 Ridge rock face downstream of **Ulu Lake**. Note: waterfall in middle of picture.

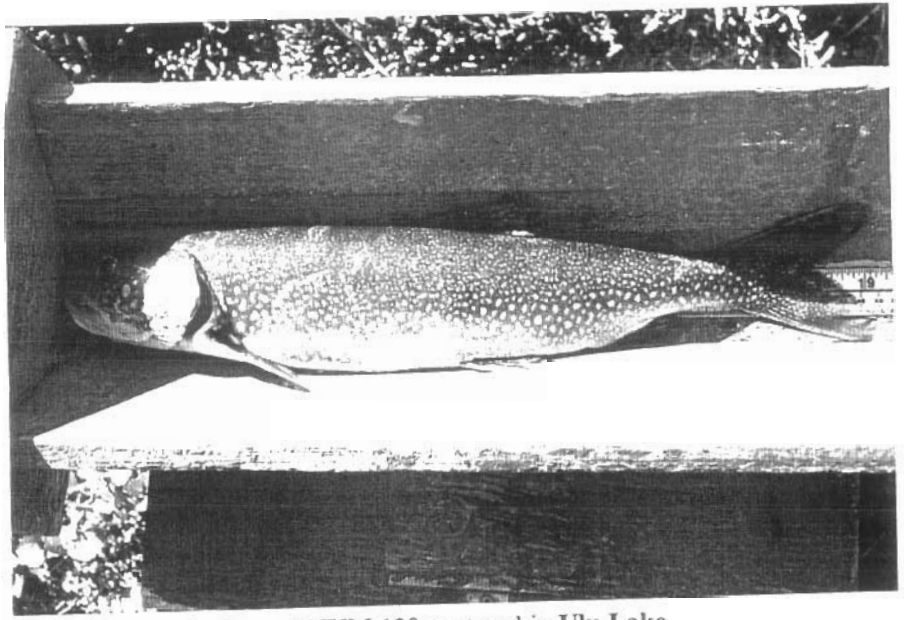

Plate 101 Lake Trout SNUM 130 captured in **Ulu Lake**.

APPENDIX A

HABITAT INFORMATION SHEETS

Table A1. R.L.& L. system of habitat, cover, and substrate classification and coding for small streams.

Habitat Type	Water Depth	Surface	Turbulence	Substrate	Velocity
RF	< 0.5 m	broken	high	coarse	high
RF/BG	< 0.5 m	broken	high	coarse/boulders	high
RA	> 0.5 m	broken	high	very coarse	high
R1	> 1.0 m	irregular	moderate	coarse	mod. - high
R2	0.5 - 1.0 m	irregular	moderate	coarse	mod. - high
R2/BG	0.5 - 1.0 m	irregular	moderate	coarse/boulders	mod. - high
R3	< 0.5 m	rarely broken	moderate	coarse	moderate
R3/BG	< 0.5 m	rarely broken	moderate	coarse/boulders	moderate
P1	> 1.0 m	smooth	low	variable	low
P2	0.5 - 1.0 m	smooth	low	variable	low
P3	< 0.5 m	smooth	low	variable	low
F1	> 1.0 m	smooth	laminar	fines	very low
F2	0.5 - 1.0 m	smooth	laminar	fines	very low
F3	< 0.5 m	smooth	laminar	fines	very low

Other Features

CH	chutes; areas of channel constriction
BD	beaver dams
LG	ledges; bedrock outcrops forming hydraulic controls
LJ	log jams; channel obstructed by logs

Cover Type

WD	large instream woody debris
DF	dead fallen logs above stream (not submerged)
OB	undercut, overhanging bank
OV	overhanging terrestrial vegetation
AV	aquatic vegetation
BG	boulder garden

Substrate Classification

Silt	<0.1 mm
Sand	0.1 - 2 mm
Gravel	2 - 64 mm
Cobble	64 - 256 mm
Boulder	>256 mm

APPENDIX A1

HABITAT INFORMATION SHEETS
ROUTE 1

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 4.6

Date: 18-Jun-96

Grid Zone: 12W

Easting: 516700 Northing: 7350600

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range	0	0
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range	0	0
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Where stream is marked on the map there is only a bog, no defined channel and very little surface water.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
0		0	0	0	0	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 5.5

Date: 18-Jun-96

Grid Zone: 12W

Easting: 517105 Northing: 7351145

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range	0	0
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	2	4
	range	1-3	1-5
Height (m)		0.5	1
Cover (%Area)	trees/shrubs:	40	20
	grass/forbs:	30	20
	rock/cobble:	30	60
	exposed soil:	0	0
Bank Material (%)	organic:	30	20
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	70	80

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		5.9	6.4	3.8
Habitat Unit #:		1	1	2
HabitatType:		RF/BG	RF/BG	R3
Water Depth (cm)	0.25 width:	10	44	32
	0.50 width:	30	32	24
	0.75 width:	30	26	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	5	5	50
	Boulder (64-256 mm):	95	95	50
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	77.3	76.7	58.3
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	7
Specific Conductivity (uS/cm):	6.5
Ambient Conductivity (uS/cm):	13.2
Water Colour:	clear

Comments:

Some underground flow through boulder field for unit #3 below. Some excellent fish habitat at d/s end of stream towards lake, however, no fish were captured or observed. Most rocks which are now underwater are covered with lichen, indicates that water levels during the summer are very low, if not nonexistent. Diagram on data sheet.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	RF/BG	125	5	0	90	0	10		0	0	Braided near lake.
2	R3	25	4	0	80	0	10		0	0	Some underground flow.
3	R3	150	2.5	0	60	0	40		0	0	Stream channel bordered by thick willows.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 7.0

Date: 18-Jun-96

Grid Zone: 12W

Easting: 516714 Northing: 7352850

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		2.2	0	0
Habitat Unit #:		0	0	0
HabitatType:		R3		
Water Depth (cm)	0.25 width:	6	0	0
	0.50 width:	16	0	0
	0.75 width:	4	0	0
	max:	0	0	0
Substrate (%)	organic:	100	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	15	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6.5
Specific Conductivity (uS/cm):	12.8
Ambient Conductivity (uS/cm):	25.6
Water Colour:	clear

Comments:

Stream originates from underground flow. Flow overground for about 30 m and then goes underground before reaching lake downstream or the crossing location.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 13.8

Date: 18-Jun-96

Grid Zone: 12W

Easting: 520045 Northing: 0

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	22	0	0
	0.50 width:	16	0	0
	0.75 width:	8	0	0
	max:	0	0	0
Substrate (%)	organic:	100	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	35	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	18
Specific Conductivity (uS/cm):	11.7
Ambient Conductivity (uS/cm):	13.7
Water Colour:	clear

Comments:

All overland flow and has no stream banks. Originates on an esker and discharges into a bog at the end of the lake. No defined banks.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 18.0

Date: 18-Jun-96

Grid Zone: 12W

Easting: 520051 Northing: 7362499

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		3.5	2.6	2.2
Habitat Unit #:		1	9	9
HabitatType:		R2	RF	RF
Water Depth (cm)	0.25 width:	24	44	34
	0.50 width:	25	42	14
	0.75 width:	56	50	26
	max:	0	0	0
Substrate (%)	organic:	60	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	10	0	0
	cobble (64-256 mm):	30	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	25	36.3	58.3
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	11.5
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	14.5
Water Colour:	clear

Comments:

Stream had no defining banks.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R2	61.1	2.5	0	30	0	0		0	0	
2	P1	18.8	15	0	0	0	0		0	0	
3	R2	18.8	4	0	0	0	0		0	0	
4	R3	11.6	0.4	0	0	0	0		0	0	Width 8.0m with overland flow
5	R2	13.8	0.4	0	0	0	0		0	0	Width 8.0m with overland flow
6	OLF	12.5	6	0	0	0	0		0	0	Narrow channel approximately 0.2m wide <0.4m deep
7	R2	26.2	0.5	0	0	0	0		0	0	8.0 m wide with overland flow
8	CH	2	0.4	0	0	0	0		0	0	overland flow, approximately 4m wide
9	RF	47.8	3.5	0	100	0	0		0	0	
10	R1	25	8	0	70	0	0		0	0	
11	P1	50	10	0	0	0	0		0	0	
12	R1	50	12	0	0	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 20.4

Date: 18-Jun-96

Grid Zone: 12W

Easting: 521834 Northing: 7364210

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.5	0.5
Cover (%Area)	trees/shrubs:	1	1
	grass/forbs:	99	99
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		43.6	35	15
Habitat Unit #:		0	0	0
HabitatType:		RF	R1	BW
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	50	0	0
Substrate (%)	organic:	0	0	100
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	10	0	0
	Boulder (64-256 mm):	90	100	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	84.6	0	0
	min:	15	0	0
	max:	125	0	0

Water Temperature (C):	5.5
Specific Conductivity (uS/cm):	10.2
Ambient Conductivity (uS/cm):	21.1
Water Colour:	clear

Comments:

TR#2: too fast to wade instream, no data
TR#3: >1.5m deep
See map on reverse of data sheet for habitat mapping information.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
0		0	0	0	0	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 20.4

Date: 19-Jun-96

Grid Zone: 12W

Easting: 521300 Northing: 7356800

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	50
	range		
Height (m)		0.1	15
Cover (%Area)	trees/shrubs:	0	10
	grass/forbs:	70	0
	rock/cobble:	30	0
	exposed soil:	0	90
Bank Material (%)	organic:	60	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	50
	gravel (2-64 mm):	0	30
	cobble (64-256 mm):	0	20
	boulder (64-256 mm):	40	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	5.5
Specific Conductivity (uS/cm):	10.2
Ambient Conductivity (uS/cm):	21.1
Water Colour:	clear

Comments:

Site at outlet of lake, approximately 3 km upstream of site sampled on 18 June 96.
Two people angled for 0.5 hrs, upstream and downstream of a riffle boulder garden. One lake trout was captured holding in a plunge pool in the boulder garden.

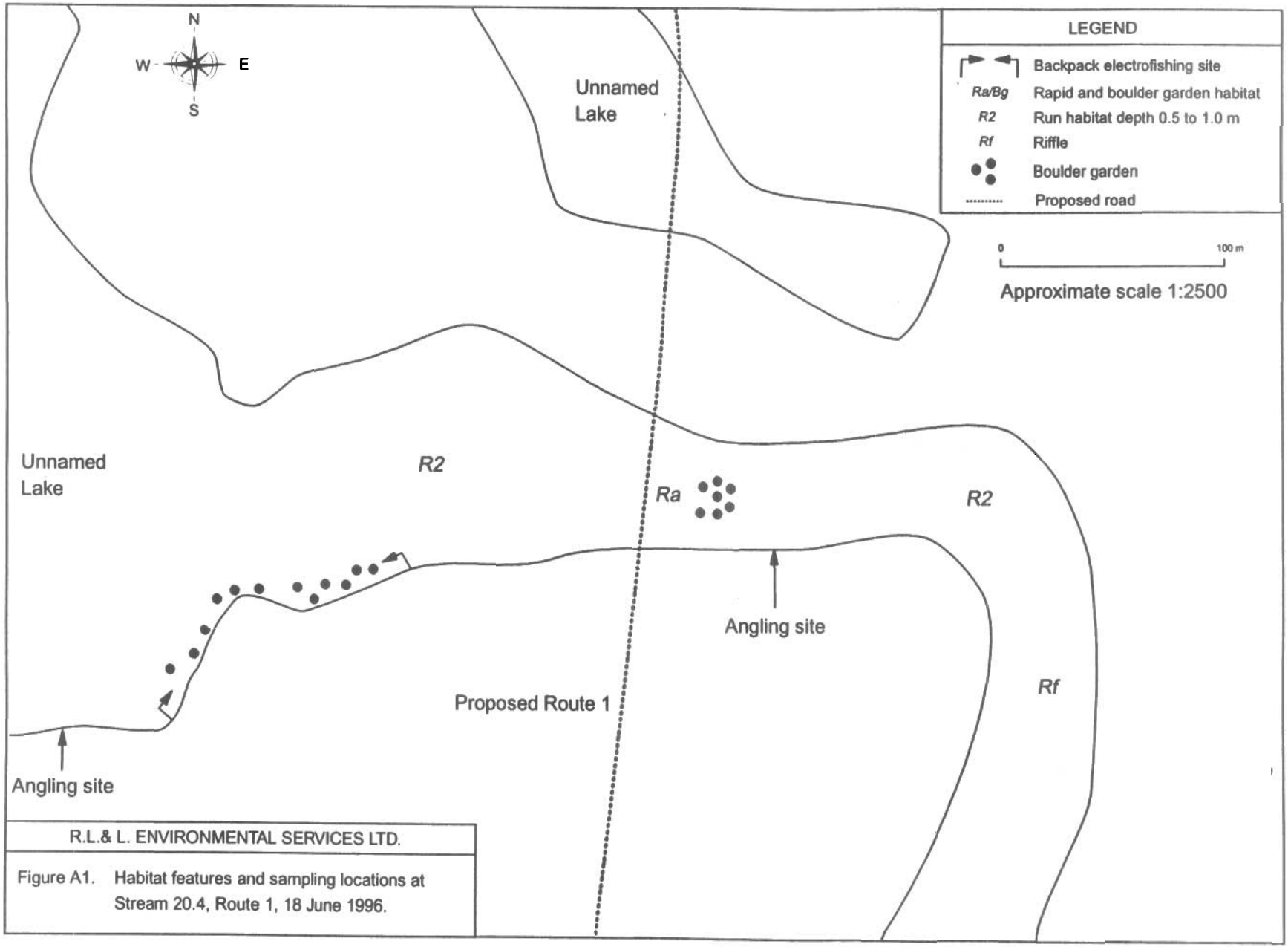

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Figure A1. Habitat features and sampling locations at Stream 20.4, Route 1, 18 June 1996.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 29.6

Date: 18-Jun-96

Grid Zone: 12W

Easting: 517523 Northing: 7372424

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	14.5
Specific Conductivity (uS/cm):	17
Ambient Conductivity (uS/cm):	24
Water Colour:	clear

Comments:

Poorly defined channel with no banks, originating from snow melt on side of esker, flows through a wide bog (intermittent). Substrate: decomposing organic material. Too shallow to measure flow.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 22.5

Date: 19-Jun-96

Grid Zone: 12W

Easting: 5214500 Northing: 7356800

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

See map on data sheet for habitat mapping.
Angling below riffle in backwater, caught 1 LKTR male (Code 10) which was too heavy to weigh (>2000g).

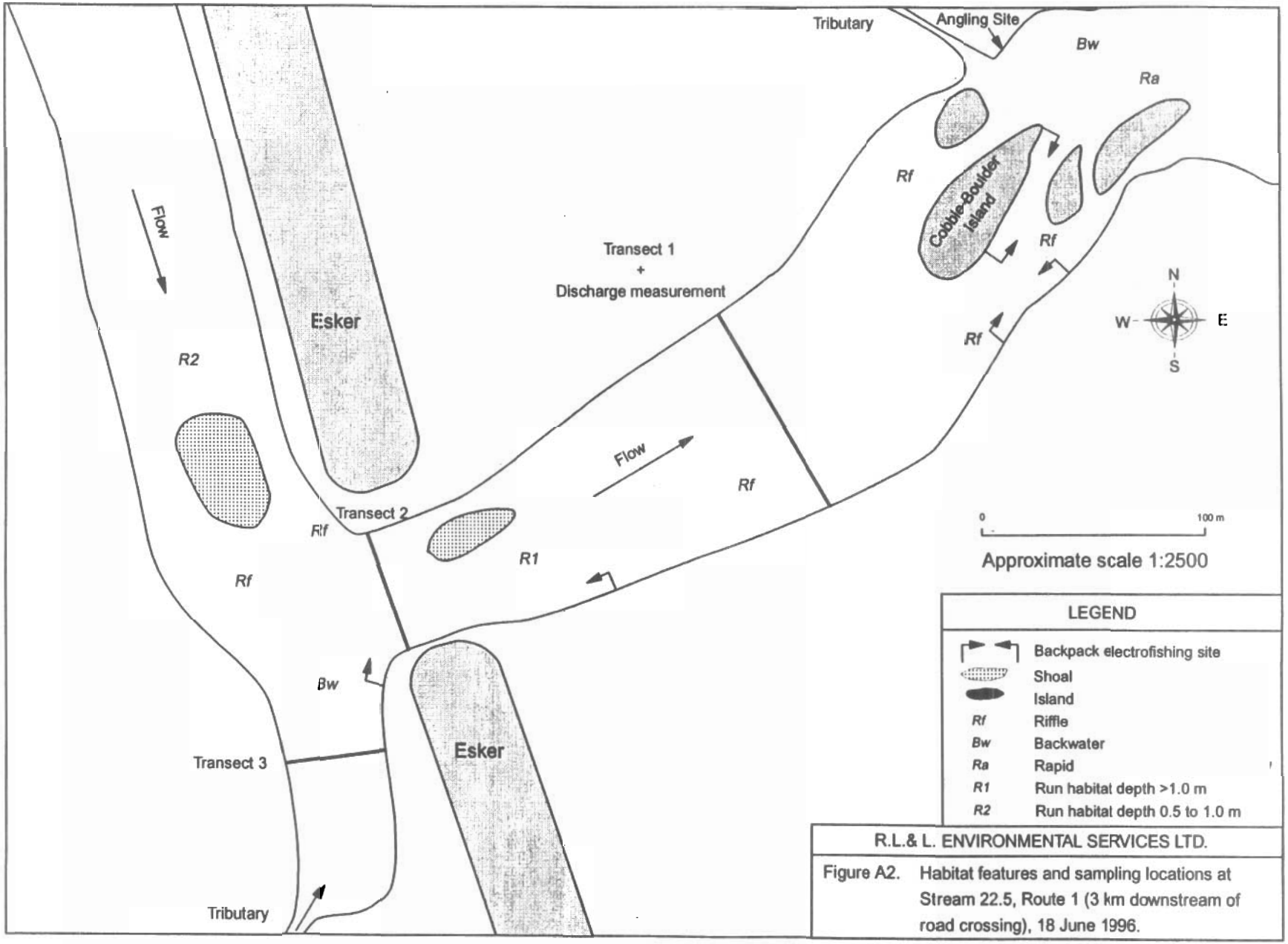

Figure A2. Habitat features and sampling locations at Stream 22.5, Route 1 (3 km downstream of road crossing), 18 June 1996.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 30.9

Date: 18-Jun-96

Grid Zone: 12W

Easting: 516444 Northing: 7373092

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0.5	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	100	100
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1.9	2.6	6
Habitat Unit #:		9	1	4
HabitatType:		R2	R3	R3
Water Depth (cm)	0.25 width:	0	28	24
	0.50 width:	0	16	14
	0.75 width:	0	16	6
	max:	58	0	0
Substrate (%)	organic:	70	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	20	0	85
	gravel (2-64 mm):	10	0	10
	cobble (64-256 mm):	0	100	5
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	7.9	21.7	6.7
	min:	4	0	0
	max:	10	0	0

Water Temperature (C):	6.5
Specific Conductivity (uS/cm):	28
Ambient Conductivity (uS/cm):	50.9
Water Colour:	clear

Comments:

Gravel, cobble, and boulder in many places; substrate frozen. Stream channel higher than surrounding terrain (photo 19).

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	14.9	2.6	0	20	0	0		0	0	
2	RF/BG	30	4	0	80	0	0		70	0	RUB ice covered
3	P2	2	4	0	0	0	0		0	0	
4	RF/BG	27.6	2.8	0	80	0	0		70	0	RUB ice covered
5	R3	50	60	0	0	0	0		70	50	
6	RF/OLF	10	2	0	0	0	0		0	0	
7	RF	12	1.5	0	0	0	0		0	0	
8	P1	4.1	2	0	0	0	0		0	0	
9	R2	26.4	2	0	0	0	0		0	0	
10	P2	3.3	3	0	70	0	0		0	0	
11	R2	150	1	0	10	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 31.5

Date: 18-Jun-96

Grid Zone: 12W

Easting: 516296 Northing: 7373260

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0.8	0	0
Habitat Unit #:		0	0	0
HabitatType:		R3		
Water Depth (cm)	0.25 width:	6	0	0
	0.50 width:	10	0	0
	0.75 width:	6	0	0
	max:	0	0	0
Substrate (%)	organic:	80	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	10	0	0
	gravel (2-64 mm):	10	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	33	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	12
Specific Conductivity (uS/cm):	16
Ambient Conductivity (uS/cm):	25
Water Colour:	clear

Comments:

No defined banks. Stream flows through a wide boggy area with thick peat deposits; stream disperses and stops flowing downstream of crossing location.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 32.2

Date: 18-Jun-96

Grid Zone: 12W

Easting: 516144 Northing: 7374478

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	10
Specific Conductivity (uS/cm):	24
Ambient Conductivity (uS/cm):	42
Water Colour:	clear

Comments:

No banks. Overland flow through a bog, and is intermittent

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 34.2

Date: 18-Jun-96

Grid Zone: 12W

Easting: 514875 Northing: 7375739

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		20	12
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	60	70
	rock/cobble:	40	30
	exposed soil:	0	0
Bank Material (%)	organic:	60	70
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	10	0
	boulder (64-256 mm):	30	30

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		6.6	16.8	6
Habitat Unit #:		2	1	2
HabitatType:		RF/BG	R3	RF/BG
Water Depth (cm)	0.25 width:	16	24	16
	0.50 width:	20	32	14
	0.75 width:	22	18	22
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	30	20	30
	Boulder (64-256 mm):	70	80	70
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	32.1	13.3	43.3
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	5
Specific Conductivity (uS/cm):	15.4
Ambient Conductivity (uS/cm):	31
Water Colour:	clear

Comments:

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	100	10.3	0	30	0	0		0	0	16.8 with overland flow
2	RF/BG	125	12	0	80	0	0		0	0	channel braided

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 35.8

Date: 18-Jun-96

Grid Zone: 12W

Easting: 515063 Northing: 7377450

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1.25	1	0.9
Habitat Unit #:		6	6	8
HabitatType:		R3	R3	R2
Water Depth (cm)	0.25 width:	12	12	14
	0.50 width:	18	16	56
	0.75 width:	16	6	10
	max:	0	0	0
Substrate (%)	organic:	100	100	100
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	79.2	93.3	36.7
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	4
Specific Conductivity (uS/cm):	16
Ambient Conductivity (uS/cm):	33
Water Colour:	clear

Comments:

Pools formed in peat/permafrost. Vertical walls with some polygons of frozen peat on sides or bottom.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R2	8.1	0.55	0	0	0	0		0	0	width 5.5 with overland flow
2	R1	7.7	6.8	0	0	0	0	Depth	0	0	
3	OLF	8.6	2	0	0	0	0		0	0	
4	R1	19.8	2.5	0	0	0	0		0	0	width 10m with overland flow
5	OLF	5.7	6.6	0	0	0	0		0	0	
6	R3	15.4	0.7	0	0	0	0		0	0	width 7m with overland flow
7	OLF	12.7	4	0	0	0	0		0	0	small channel ~ 10cm wide, 30cm deep
8	R2	5.4	0.7	0	0	0	0		0	0	4m wide with overland flow
9	OLF	4.6	4	0	0	0	0		0	0	
10	R2	2.6	0.4	0	0	0	0		0	0	5m wide with overland flow
11	OLF	12.3	4	0	0	0	0		0	0	
12	P2	7.7	10	0	0	0	0		0	0	overland flow
13	R3	6.6	0.5	0	0	0	0		0	0	
14	P1	8.3	1.25	0	0	0	0		0	0	6m with overland flow
15	R3	9.2	1.5	0	0	0	0		0	0	
16	R1	9	4.1	0	0	0	0		0	0	
17	OLF	2	2	0	0	0	0		0	0	
18	P1	5.6	2.5	0	0	0	0		0	0	
19	R3	3.3	1.5	0	0	0	0		0	0	
20	P1	7.4	8.5	0	0	0	0		0	0	
21	R3	3.4	0.7	0	0	0	0		0	0	2.5m wide with overland flow
22	P1	6.7	6.9	0	0	0	0		0	0	max depth ~3.0m
23	R3	4.5	0.5	0	0	0	0		0	0	2.5 wide with overland flow
24	P1	10.5	4.5	0	0	0	0		0	0	max depth ~1.5m
25	R3	5.7	0.5	0	0	0	0		0	0	2.0 wide with overland flow
26	P1	7.2	4.5	0	0	0	0		0	0	maximum depth approximately 2.5
27	R3	4.2	0.5	0	0	0	0		0	0	3.0 wide with overland flow
28	P1	20.9	8	0	0	0	0		0	0	maximum depth 2.5 m
29	CH	1	0.75	0	0	0	0		0	0	
30	P1	9.4	9.5	0	0	0	0		0	0	maximum depth 1.5 m
31	OLF/RF	2.8	1.3	0	0	0	0		0	0	
32	R2	4.6	2	0	0	0	0		0	0	
33	P1	11.7	14	0	0	0	0		0	0	maximum depth >3.0 m
34	R2	8.9	1.5	0	0	0	0		0	0	4 m wide with overland flow
35	P1	14.2	10	0	0	0	0		0	0	maximum depth 3.0

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 37.0

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514827 Northing: 7378491

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.2	0.3
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	80	95
	rock/cobble:	20	5
	exposed soil:	0	0
Bank Material (%)	organic:	60	70
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	40	30

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		3.2	8.7	7.5
Habitat Unit #:		0	0	0
HabitatType:		R3/BG	R3/BG	R3/BG
Water Depth (cm)	0.25 width:	22	34	32
	0.50 width:	14	14	28
	0.75 width:	14	30	18
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	30	0	0
	Boulder (64-256 mm):	70	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	6	31.7	31.7
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	11.5
Specific Conductivity (uS/cm):	18.3
Ambient Conductivity (uS/cm):	30
Water Colour:	clear

Comments:

Lichen on rocks suggests that summer water levels are considerably lower. Stream is RF/BG for it's entire length b/w lakes (see map for length). Stream is 7-9 m wide. Some areas of overland flow. Cover is 100% boulders.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 39.0

Date: 17-Jun-96

Grid Zone: 12W

Easting: 513371 Northing: 7380269

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	11
Specific Conductivity (uS/cm):	28
Ambient Conductivity (uS/cm):	42
Water Colour:	clear

Comments:

Sampled near origin where there was only 3 m of defined channel.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 39.3

Date: 17-Jun-96

Grid Zone: 12W

Easting: 513814 Northing: 7380600

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	2	2
	range	1-6	
Height (m)		1	0.2
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	60	60
	rock/cobble:	40	40
	exposed soil:	0	0
Bank Material (%)	organic:	60	60
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	20	20
	boulder (64-256 mm):	20	20

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		8.8	23	16.5
Habitat Unit #:		1	1	1
HabitatType:		RF/BG	RF/BG	RF/BG
Water Depth (cm)	0.25 width:	52	14	78
	0.50 width:	50	30	98
	0.75 width:	34	20	44
	max:	0	0	0
Substrate (%)	organic:	0	0	40
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	20	0	0
	Boulder (64-256 mm):	80	100	60
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	43.8	38.5	28.3
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	12.5
Ambient Conductivity (uS/cm):	27
Water Colour:	clear

Comments:

RF/BG for entire length between two lakes. Considerable amounts of overland flow. Many of the boulders in main channel covered with lichen suggesting very low summer flows. Overall stream gradient is ~3%. Instream cover entirely boulder and fractured bedrock.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 39.8

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514070 Northing: 7381064

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.05	0.05
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	80	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	20	20
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		2.4	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	22	10	10
	0.50 width:	20	14	18
	0.75 width:	4	10	10
	max:	44	0	0
Substrate (%)	organic:	100	100	100
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	1.7	4	7.7
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	13
Specific Conductivity (uS/cm):	17.8
Ambient Conductivity (uS/cm):	23.8
Water Colour:	clear

Comments:

No defined channel, overland flow only. Organic bottom, covered with terrestrial grasses. Boulder covered with peat.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 42.1

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514619 Northing: 7383356

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	100	100
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		3.1	1.3	4.5
Habitat Unit #:		1	1	2
HabitatType:		R3	R3	R2
Water Depth (cm)	0.25 width:	14	20	18
	0.50 width:	24	26	54
	0.75 width:	30	16	50
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	80	80
	sand (0.1-2 mm):	100	10	10
	gravel (2-64 mm):	0	10	10
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	3.6	8.3	2.7
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	7
Specific Conductivity (uS/cm):	13.2
Ambient Conductivity (uS/cm):	21.8
Water Colour:	clear

Comments:

No fish in stream. Observed 4 fish in lake at upstream end of the site, but capture as fish were not strongly attracted to anode and were able to hide in boulders. One may have been a lake trout, other 3 possible slimy sculpin.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	20	1.3	0	0	0	0	Vegetation 50%	0	0	Overland flow
2	R2	4.5	1.8	0	0	0	0	Vegetation 20%	0	0	
3	R3	3.2	1.8	0	0	0	0		0	0	
4	P2	3	2.5	0	0	0	0		0	0	
5	R3	26.1	2.7	0	0	0	0	Vegetation 20%	0	0	
6	R2	3.1	1	0	0	0	0		0	0	+1 m of R3
7	R3	10.3	4	0	0	0	0	Vegetation 30%	0	0	
8	OLF	40	12	0	0	0	0	Vegetation 80%	0	0	inundated grass

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 43.3

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514432 Northing: 7384442

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	8
	range		
Height (m)		0	2
Cover (%Area)	trees/shrubs:	0	40
	grass/forbs:	0	0
	rock/cobble:	0	30
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	2	5
	range		
Height (m)		0.2	0.4
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	90	0
	rock/cobble:	10	0
	exposed soil:	0	0
Bank Material (%)	organic:	80	60
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	20	40

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		9.8	4.5	15
Habitat Unit #:		1	1	1
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	20	16	18
	0.50 width:	18	50	42
	0.75 width:	16	24	32
	max:	52	83	84
Substrate (%)	organic:	50	60	60
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	50	40	40
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	42.5	33.3	20
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	16.5
Ambient Conductivity (uS/cm):	35.7
Water Colour:	clear

Comments:

Sampled near confluence with Stream 43.6. Narrow, shallow channel with many deep pools formed behind large boulders. Approximately 30 m upstream of confluence, Stream 43.3 was ice and snow covered. Grass was evident in most of the stream channel.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	300	20	0	50	0	0	Vegetation 50%	0	0	OLF through boulder field
2	R2	150	10	0	70	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 43.6

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514330 Northing: 7384449

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	1
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	90	90
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	10	10

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1.1	1.1	1.1
Habitat Unit #:		0	0	0
HabitatType:		RF	R2	R3
Water Depth (cm)	0.25 width:	14	40	20
	0.50 width:	16	50	24
	0.75 width:	28	54	28
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	40	0	30
	cobble (64-256 mm):	40	40	40
	Boulder (64-256 mm):	20	60	30
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	58.3	15	46.7
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	11
Specific Conductivity (uS/cm):	16.4
Ambient Conductivity (uS/cm):	25.5
Water Colour:	clear

Comments:

Approximately 100m u/s of confluence with Stream 43.3, stream becomes braided with lots of overland flow. Stream originates from ground water from an upland bog. Did not shock as no o/w habitat in stream and no fish observed d/s in stream 43.3.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 44.7

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514192 Northing: 7385799

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	50	50
	rock/cobble:	50	50
	exposed soil:	0	0
Bank Material (%)	organic:	50	50
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	50	50

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:		BG	BG	BG
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	32	36	42
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	100	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	10
Specific Conductivity (uS/cm):	12.2
Ambient Conductivity (uS/cm):	18
Water Colour:	clear

Comments:

No defined channel, flows through a boulder field, could only measure depth in puddles of water between boulders. Velocity measured in several places where water flowed over boulders into next puddle. The stream originated from a shallow pool; total stream length was ~ 150 m.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	BG	0	0	0	100	0	0		0	0	
2	Bog	0	0	0	0	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 46.8

Date: 17-Jun-96

Grid Zone: 12W

Easting: 514100 Northing: 738800

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Drying up, sporadic surface flow and pockets of water, very boggy, no defined channel.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 49.2

Date: 17-Jun-96

Grid Zone: 12W

Easting: 513186 Northing: 7390463

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	2
	range		
Height (m)		0.15	0.25
Cover (%Area)	trees/shrubs:	95	100
	grass/forbs:	0	0
	rock/cobble:	5	0
	exposed soil:	0	0
Bank Material (%)	organic:	95	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	5	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1.3	1.1	2.3
Habitat Unit #:		0	0	0
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	12	12	16
	0.50 width:	8	12	10
	0.75 width:	8	6	10
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	30	60	30
	cobble (64-256 mm):	60	30	60
	Boulder (64-256 mm):	10	10	10
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	41.7	26.7	15
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	13.5
Specific Conductivity (uS/cm):	21.3
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

This intermittent stream originates from an upland area of overland flow and has areas of underground flow. There is a pond on the upland, bottom covered with terrestrial grass (i.e., will dry up) and cobble. Pond fed by overland flow. See photograph for habitat types.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 51E

Date: 17-Jun-96

Grid Zone: 12W

Easting: 513842 Northing: 7392093

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	2
	range		
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	90	90
	rock/cobble:	10	10
	exposed soil:	0	0
Bank Material (%)	organic:	80	90
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	10	0
	cobble (64-256 mm):	10	0
	boulder (64-256 mm):	0	10

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		3.2	2.7	2.2
Habitat Unit #:		0	0	0
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	12	8	8
	0.50 width:	6	6	10
	0.75 width:	8	12	26
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	10	10	10
	gravel (2-64 mm):	10	10	10
	cobble (64-256 mm):	80	80	80
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	26.7	26.7	16.7
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	9
Specific Conductivity (uS/cm):	14.2
Ambient Conductivity (uS/cm):	22.9
Water Colour:	clear

Comments:

Stream habitat consists of shallow runs (R3) and the channel is series of braided channels originating from small pond. Substrate in pond soft, organic material. All fish captured within 80 m of lake. Due to the braiding of the channel, measuring discharge was not possible.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 51.4

Date: 17-Jun-96

Grid Zone: 12W

Easting: 513600 Northing: 7392300

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Dry. No information collected.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 52.0W

Date: 17-Jun-96

Grid Zone: 12W

Easting: 512804 Northing: 7392749

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	3	1
	range		
Height (m)		0.5	1.2
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	90	40
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	5
	gravel (2-64 mm):	0	10
	cobble (64-256 mm):	0	10
	boulder (64-256 mm):	10	35

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		8.4	5.7	4.7
Habitat Unit #:		2	4	5
HabitatType:		R3	RF/BG	RF/BG
Water Depth (cm)	0.25 width:	30	36	50
	0.50 width:	48	30	40
	0.75 width:	48	42	22
	max:	48	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	10	0	0
	gravel (2-64 mm):	30	0	0
	cobble (64-256 mm):	60	0	0
	Boulder (64-256 mm):	0	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	24	75	130
	min:	0	0	0
	max:	0	115	0

Water Temperature (C):	9
Specific Conductivity (uS/cm):	14.3
Ambient Conductivity (uS/cm):	24.3
Water Colour:	clear

Comments:

Plunge pools below boulder chutes.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
3	R2	10	12	0	30	0	0		0	0	
4	RF/BG	100	5	0	0	0	0		0	0	
5	RF/BG	10	5	0	30	0	0	Grass 10%	0	0	
6	R3	25	5	0	30	0	0	Grass 10%	0	0	
7	CH	3	5	0	0	0	0		0	0	
8	RF/BG	30	5	0	30	0	0		0	0	
9	CH	2	5	0	0	0	0		0	0	
10	RF/BG	25	8	0	0	0	0		0	0	
11	R2	0	5	0	0	0	0		0	0	R2 continues to lake
1	RF/BG	30	8	0	100	0	0		0	0	
2	R3	20	10	0	70	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 52.1W

Date: 17-Jun-96

Grid Zone: 12W

Easting: 512774 Northing: 7392881

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	2
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	50	100
	rock/cobble:	50	0
	exposed soil:	0	0
Bank Material (%)	organic:	50	90
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	50	10

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	30	24	14
	0.50 width:	16	14	20
	0.75 width:	24	22	12
	max:	0	0	0
Substrate (%)	organic:	20	10	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	20	0	0
	gravel (2-64 mm):	20	30	30
	cobble (64-256 mm):	20	40	40
	Boulder (64-256 mm):	20	20	30
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	25	15	25
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	9
Specific Conductivity (uS/cm):	16.8
Ambient Conductivity (uS/cm):	28.7
Water Colour:	clear

Comments:

No discharge because of flow through boulder field. Max. depth 44cm. Stream is a series of ledges and pools formed by boulders. These extend upstream to source for ~600m. Source is same lake as 52.0W. On LUB side, there is a boulder field ~ 20m wide which water is flowing through.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 53.5

Date: 16-Jun-96

Grid Zone: 12W

Easting: 513151 Northing: 7394267

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	80	98
	rock/cobble:	10	2
	exposed soil:	10	0
Bank Material (%)	organic):	0	98
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	50	0
	gravel (2-64 mm):	30	0
	cobble (64-256 mm):	10	0
	Boulder (64-256 mm):	10	2

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	30	2
	range	20-40	1-3
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	70	100
	rock/cobble:	0	0
	exposed soil:	30	0
Bank Material (%)	organic:	0	70
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	20	0
	gravel (2-64 mm):	20	0
	cobble (64-256 mm):	30	0
	boulder (64-256 mm):	30	30

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		12	16	50
Habitat Unit #:		0	0	0
HabitatType:		R3/BG	R3	R3/BG
Water Depth (cm)	0.25 width:	11	70	30
	0.50 width:	28	29	51
	0.75 width:	40	20	50
	max:	60	120	60
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	5	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	95	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	25	40	10
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	4
Specific Conductivity (uS/cm):	11.3
Ambient Conductivity (uS/cm):	22.4
Water Colour:	clear

Comments:

Discharge data: transect #1 LUB, transect #13 RUB. Wide stream, some overland flow through BG. Excellent fish habitat. EF: 482 seconds, no fish observed or captured.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 55.2

Date: 16-Jun-96

Grid Zone: 12W

Easting: 511881 Northing: 7395977

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0.6	0.6	0.9
Habitat Unit #:		1	1	1
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	6	5	10
	0.50 width:	25	18	25
	0.75 width:	6	12	6
	max:	25	18	0
Substrate (%)	organic:	20	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	10	0
	cobble (64-256 mm):	80	60	70
	Boulder (64-256 mm):	0	30	30
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	8.5	0.5	5.5
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	12
Specific Conductivity (uS/cm):	14.5
Ambient Conductivity (uS/cm):	21.8
Water Colour:	clear

Comments:

Sampled approximately 150m upstream of lake. Channel is braided as it flows toward lake; stream flows underground for 3m. Upstream of underground flow, channel is narrow (0.5 - 0.75 m wide) with a lot of overland flow.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	160	0.8	0	10	0	0	Grass 30%	0	0	
2	UNGR	3	8	0	100	0	0		0	0	
3	R3	15	1	0	30	0	0		0	0	Some braiding
4	Snow	50	0	0	0	0	0	100% snow covered	0	0	
5	R3	50	3	0	70	0	0		0	0	
6	Lake	0	0	0	0	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 56.5

Date: 16-Jun-96

Grid Zone: 12W

Easting: 510483 Northing: 7395750

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	2	2
	range		
Height (m)		0.3	0.3
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	80	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	20	20
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1	0	0
Habitat Unit #:		0	0	0
HabitatType:		R3	R3	F3
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	10	14	12
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	10	0	0
	gravel (2-64 mm):	30	50	50
	cobble (64-256 mm):	60	50	50
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	5	5	4
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	16
Specific Conductivity (uS/cm):	16.2
Ambient Conductivity (uS/cm):	20.2
Water Colour:	clear

Comments:

Narrow channel with several wide pools (one 15m long x 5m wide). Approximately 300m downstream, channel disappears into boulder field. Lower part of stream: gradient >20% as the stream flows over a ridge into the same lake as 56.9.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	150	1	0	0	0	0		0	0	
2	F3	30	6	0	0	0	0		0	0	no cover; 42 cm deep
3	R3	15	1	0	0	0	0		0	0	no cover
4	P2	15	5	0	0	0	0		0	0	no cover
5	R3	200	1	0	0	0	0		0	0	no cover

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 56.9

Date: 16-Jun-96

Grid Zone: 12W

Easting: 510377 Northing: 7396402

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	5	15
	range	5	1-30
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1	1.2	1
Habitat Unit #:		1	1	1
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	5	0	0
	0.50 width:	20	0	0
	0.75 width:	10	0	0
	max:	20	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	100	100	100
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	8	3.1	8
	min:	0	0	0
	max:	8	0	0

Water Temperature (C):	12
Specific Conductivity (uS/cm):	13.1
Ambient Conductivity (uS/cm):	19.4
Water Colour:	clear

Comments:

Stream flows through peat bog. Channel is narrow, there is standing water in the bog. Several braided sections. Several pools <0.5 m in depth. Towards the lake at d/s end of stream, gradient much steeper for last 200 m.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	500	1	0	0	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 58.2

Date: 16-Jun-96

Grid Zone:

Easting: 510437 Northing: 7397691

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	60	60
	rock/cobble:	40	40
	exposed soil:	0	0
Bank Material (%)	organic):	60	60
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	40	40

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	60	60
	rock/cobble:	40	40
	exposed soil:	0	0
Bank Material (%)	organic:	60	60
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	40	40

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		5.1	4.4	5.3
Habitat Unit #:		0	0	0
HabitatType:		BG	BG	BG
Water Depth (cm)	0.25 width:	42	44	44
	0.50 width:	46	36	28
	0.75 width:	52	36	24
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	100	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	5	5	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	7
Specific Conductivity (uS/cm):	21
Ambient Conductivity (uS/cm):	38.6
Water Colour:	clear

Comments:

EF: 301sec backpack, 60sec of lake shore, no fish observed. Stream runs through BG consisting of lichen-covered angular and semiangular boulders. No defined banks. Bank material a combination of boulders with extensive organic material covered by moss and lichen. Downstream approximately 20m, stream stops flowing. Stream may be pooling up in boulder garden area or in bog area.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 59.7

Date: 16-Jun-96

Grid Zone: 12W

Easting: 510713 Northing: 7399041

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1	0.8	0.4
Habitat Unit #:		1	1	1
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	5	1	10
	0.50 width:	20	8	25
	0.75 width:	10	1	20
	max:	20	8	25
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	50	0	0
	cobble (64-256 mm):	20	100	100
	Boulder (64-256 mm):	30	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	9.5	9.5	9.5
	min:	0	0	0
	max:	13.5	9.5	9.5

Water Temperature (C):	14
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	9.5
Water Colour:	clear

Comments:

No discharge calculated; numerous channels approximately 1.0m wide (max) and 0.3m deep. Channel is braided at crossing with many areas of overland flow. Flows into a lake that is 1-1.5m deep. EF for 497 seconds with no fish captured or observed.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	250	5	0	50	0	0		0	0	Total width (braided).
2	RF/BG	8	8	0	0	0	0		0	0	
3	R3	100	1.5	0	30	0	0	Grass 10%	0	0	other=grass

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 62.2

Date: 16-Jun-96

Grid Zone: 12W

Easting: 509232 Northing: 7401125

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	8
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	17.7
Water Colour:	clear

Comments:

Intermittent stream; originates from small lake to the west. Areas with overland flows, ephemeral, grass and shrubs in stream channel. Flows through boulder field.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 65.2

Date: 16-Jun-96

Grid Zone: 12W

Easting: 507400 Northing: 7403200

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Dry, puddles in boulder field.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 66.2

Date: 16-Jun-96

Grid Zone: 12W

Easting: 506500 Northing: 7404200

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	22.7
Water Colour:	clear

Comments:

Stream is intermittent, bottom of channel entirely covered with grass. Stream originates from upland ground water seep and snow melt. Stream channel is defined for approximately 200 m then disappears into a rubble field.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 68.2

Date: 16-Jun-96

Grid Zone: 12W

Easting: 505600 Northing: 7405300

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	11
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	30.5
Water Colour:	clear

Comments:

Stream appears to be intermittent as the bottom of the source lake is covered with grass. Originates in small lake, channel narrow, less than 0.5 m, poorly defined channel, many ground water seepages, flows into a lake ~ 1.0 km to the north, barely flowing through rubble field.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 69.7

Date: 16-Jun-96

Grid Zone: 12W

Easting: 504584 Northing: 7407069

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	15	15
	range	10-20	10-20
Height (m)		0.75	1
Cover (%Area)	trees/shrubs:	40	20
	grass/forbs:	60	80
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	20	20
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	80	80

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		8	6	7.5
Habitat Unit #:		6	3	1
HabitatType:		RF	RF	R3
Water Depth (cm)	0.25 width:	20	28	48
	0.50 width:	28	24	34
	0.75 width:	18	42	42
	max:	28	42	48
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	10
	cobble (64-256 mm):	60	40	10
	Boulder (64-256 mm):	40	60	80
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	55	40	30
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	7.5
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	21.8
Water Colour:	clear

Comments:

Lichen on rocks in stream indicating the stream is intermittent. 100 m downstream of site, stream becomes steep, flowing through a cut 15 m deep, with boulder and cobble substrate. Approximately 400m downstream of site, stream flows underground for approximately 30 m. EF:468 seconds; no fish captured or observed.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R2	50	8	0	40	0	0		0	0	
2	P1	25	9	0	40	0	0	Water Depth 60%	0	0	
3	R3	20	6	0	90	0	10		0	0	
4	RF/BG	16	4	0	90	0	10		0	0	Two channels.
5	R3	20	10	0	90	0	10		0	0	
6	RF/BG	40	8	0	70	0	15		0	0	
7	R3	25	10	0	60	0	20		0	0	
8	RF/BG	10	70	0	70	0	15		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 71.8

Date: 16-Jun-96

Grid Zone: 12W

Easting: 5502970 Northing: 7408025

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	5	5
	grass/forbs:	85	85
	rock/cobble:	10	10
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	40	40
	gravel (2-64 mm):	40	40
	cobble (64-256 mm):	20	20
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		32	15	20
Habitat Unit #:		0	0	0
HabitatType:		RF	RF	RF
Water Depth (cm)	0.25 width:	50	30	25
	0.50 width:	36	20	30
	0.75 width:	75	30	30
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	10	10	20
	gravel (2-64 mm):	10	20	40
	cobble (64-256 mm):	60	40	40
	Boulder (64-256 mm):	20	30	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	120	120
	min:	0	80	0
	max:	0	215	165

Water Temperature (C):	5.5
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	27
Water Colour:	clear

Comments:

EF: 408sec; no fish captured or observed. See map on data sheet for habitat types. This site is near the confluence with the Hood River.

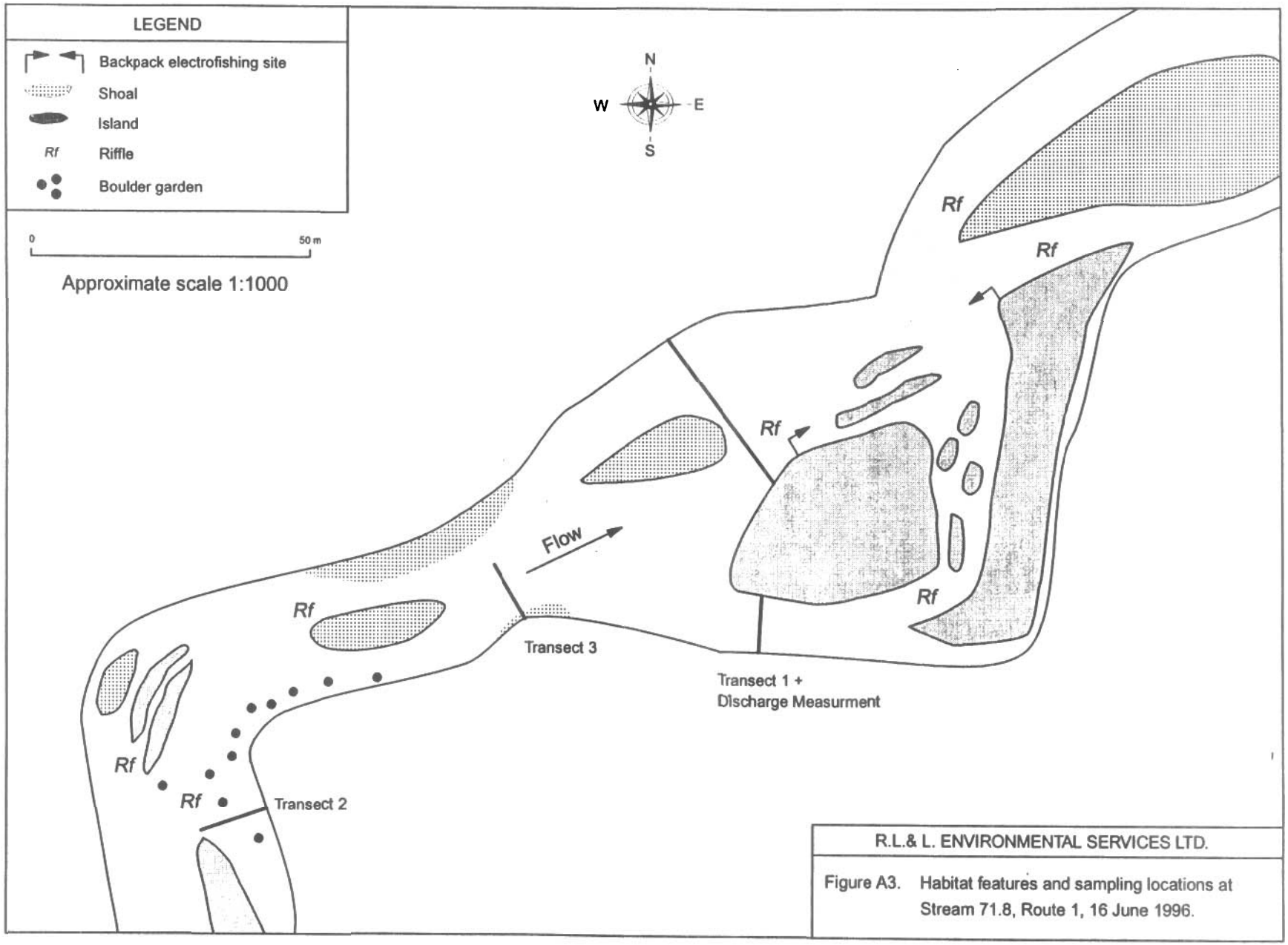

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Figure A3. Habitat features and sampling locations at Stream 71.8, Route 1, 16 June 1996.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: Hood Ri

Date: 15-Jun-96

Grid Zone:

Easting: 0 Northing: 0

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	80	90
	rock/cobble:	0	0
	exposed soil:	20	10
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	100	100
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0.3	0.3
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		100	0	0
Habitat Unit #:		9	0	0
HabitatType:		RF		
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	2	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	40	0	0
	gravel (2-64 mm):	30	0	0
	cobble (64-256 mm):	30	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	3
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	29
Water Colour:	clear/yellow

Comments:

See map for habitat features and bank characteristics. Predominantly deep runs (R1) separated by riffle areas on chutes. Substrate mainly sand; ~25km u/s of Wilberforce Fall substrate changes to cobble and boulders. Banks in most areas low with exposed substrate (ie. sand or cobble depending on where you are along the river). No areas of overhanging bank were observed. Where there is vegetation along the banks, it is usually grass with sporadic willow species in some areas. Habitat Type section of this form: starting at u/s end below falls from lake part of the river.

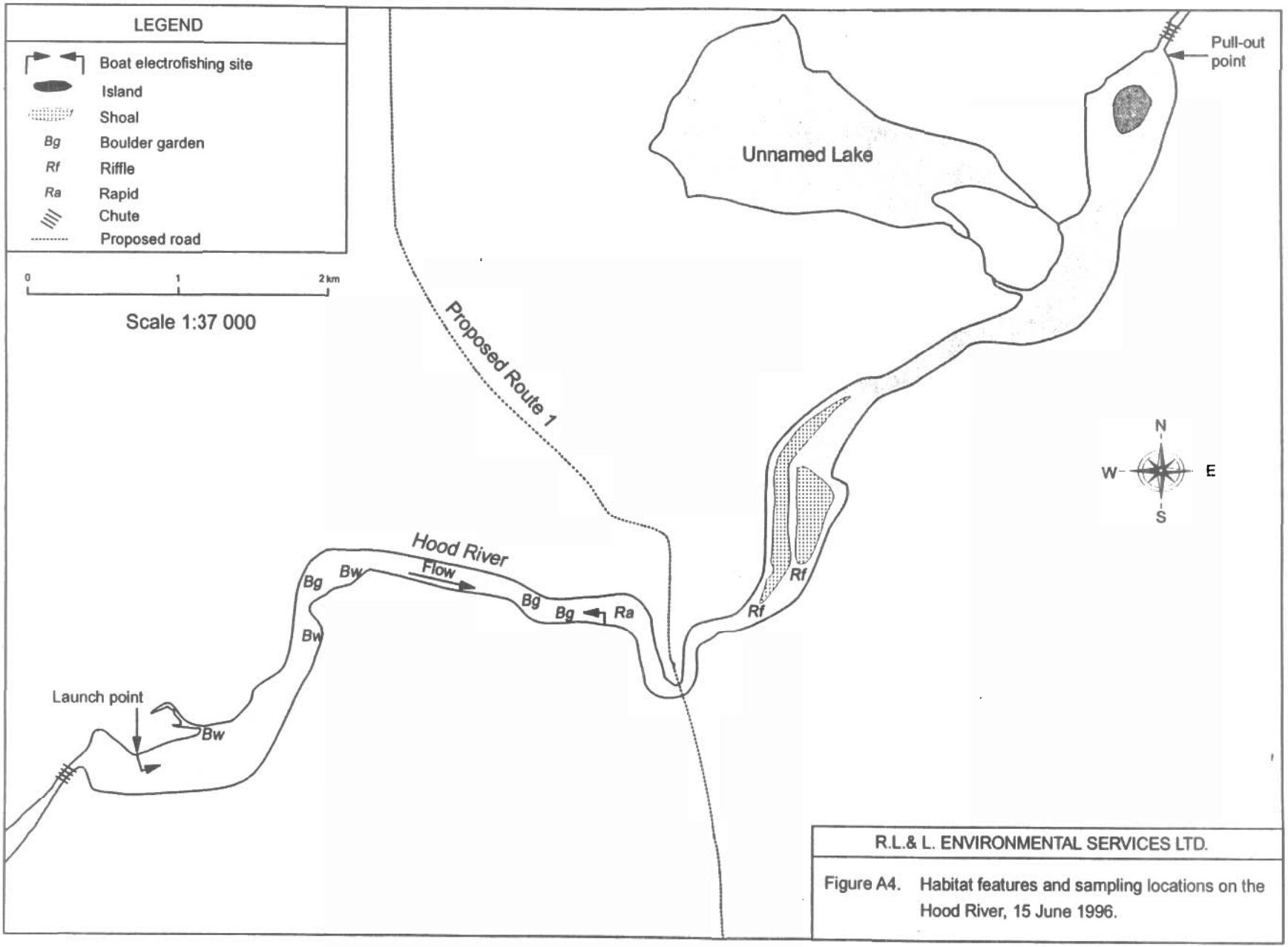

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Figure A4. Habitat features and sampling locations on the Hood River, 15 June 1996.

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 76.9

Date: 16-Jun-96

Grid Zone: 12W

Easting: 503907 Northing: 7412683

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.15	0.15
Cover (%Area)	trees/shrubs:	2	2
	grass/forbs:	98	98
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0.3	0.8	0.3
Habitat Unit #:		0	0	0
HabitatType:		RF	P3	RF
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	10	40	10
Substrate (%)	organic:	100	100	100
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	110	10	155
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	3.5
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	16.4
Water Colour:	clear

Comments:

Stream originates from upland ground water seep and snow melt. Flows over grasses in some places; occasional pools (<50cm deep). Grasses in channel indicate stream is intermittent. Approximately 400m downstream of crossing there are series of ledges 0.25-1.0m high with <10cm of water flowing over them (=fish barrier). Below this is 1.5 m cascade. Last 150 m to confluence, the stream flows under a snow bank. Gradient 1 at crossing, 3-5 downstream toward the lake.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	RF	3.6	12	0	0	0	0		0	0	Overland flow
2	R3	1	0.8	0	0	0	0		0	0	Overland flow

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 74.8

Date: 16-Jun-96

Grid Zone: 12W

Easting: 503758 Northing: 7411554

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range	1-3	1-3
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	1	1
	grass/forbs:	99	99
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0.5	1	0.3
Habitat Unit #:		0	0	0
HabitatType:		RF	RF	RF
Water Depth (cm)	0.25 width:	20	20	10
	0.50 width:	20	20	10
	0.75 width:	20	20	10
	max:	20	20	10
Substrate (%)	organic:	100	100	100
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	95	70	105
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	48
Water Colour:	clear

Comments:

Grass in channel indicates stream is intermittent. Stream is a series of runs and short riffles (<1.0 m long). 200 m downstream of crossing, stream flows through bog, poorly defined channel. The bog is approximately 200 m long, defined stream channel from this point on with similar stream habitat as at the crossing. No habitat types recorded as stream flows overland and then ends up in boggy area. EF: 168sec, no fish captured or observed.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 1 Stream: 83.2

Date: 16-Jun-96

Grid Zone:

Easting: 0 Northing: 0

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0.3	0.3
Cover (%Area)	trees/shrubs:	95	95
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	5	5
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	100	100
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		4	0.3	0.6
Habitat Unit #:		0	0	0
HabitatType:		RF	RF	RF
Water Depth (cm)	0.25 width:	10	5	5
	0.50 width:	30	20	15
	0.75 width:	20	10	20
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	20
	sand (0.1-2 mm):	0	0	80
	gravel (2-64 mm):	25	0	0
	cobble (64-256 mm):	75	15	0
	Boulder (64-256 mm):	0	85	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	85	55	22
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	5
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	14.5
Water Colour:	clear

Comments:

Stream originates via underground flow from lake to the west. Flows into a low boggy area to the east. No access for fish from downstream areas. Stream was flowing over grass in RoW and appears to be intermittent. Widest part of the stream was 4 m wide, rest of stream approximately 0.3 m wide.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

APPENDIX A2

HABITAT INFORMATION SHEETS
ROUTE 2

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 36.8

Date: 25-Aug-96

Grid Zone: 12W

Easting: 507514 Northing: 7374307

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	30
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Overland flow, no defined banks.
Peat hummocks where stream channel is supposed to be.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 37.4

Date: 25-Aug-96

Grid Zone: 12W

Easting: 507050 Northing: 7374513

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		30	30	30
Habitat Unit #:		1	1	1
HabitatType:		BG	BG	BG
Water Depth (cm)	0.25 width:	5	5	5
	0.50 width:	5	5	5
	0.75 width:	5	5	5
	max:	5	5	5
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	100	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	5
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

No defined bank, boulder filled channel; Areas of peat and vegetation in boulder field. Water to low to get discharge.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 40.7

Date: 28-Aug-96

Grid Zone: 12W

Easting: 505400 Northing: 7376500

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Stream very short (< 100 m) connecting two lakes. Stream very shallow (< 10 cm) and flow disperses in the low lying boggy terrain.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 42.5

Date: 28-Aug-96

Grid Zone: 12W

Easting: 505700 Northing: 7378300

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Shallow stream in low lying bog, with some areas of overland flow.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 45.3

Date: 28-Aug-96

Grid Zone: 12W

Easting: 504900 Northing: 7381100

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

No flow, although some water is visible in boulder field

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 46.9

Date: 28-Aug-96

Grid Zone: 12W

Easting: 504850 Northing: 7382600

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Dry boulder channel.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 48.6

Date: 28-Aug-96

Grid Zone: 12W

Easting: 504500 Northing: 7384300

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Dry boulder channel. Photograph R9/9 shows an old boulder filed oxbow, now isolated from the mainstem channel which Stream 48.6 is suppose to flow into (according to NTS map).

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 70.8

Date: 24-Aug-96

Grid Zone: 12W

Easting: 501049 Northing: 7404084

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		1	1
Cover (%Area)	trees/shrubs:	20	30
	grass/forbs:	20	40
	rock/cobble:	5	0
	exposed soil:	55	30
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	80	80
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	20	20

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	20
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

No slope for the lower banks because both the LUB and RUB were vertical.
Small stream about 0.75cm wide, cobble, sand and boulder substrate.
Approximately 100m from lake the stream goes underground.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 71.7

Date: 24-Aug-96

Grid Zone: 12W

Easting: 500197 Northing: 7404413

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	2
	range		
Height (m)		0.4	0.4
Cover (%Area)	trees/shrubs:	0	5
	grass/forbs:	100	95
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		2.4	5	5
Habitat Unit #:		4	1	1
HabitatType:		R3	R3	R3
Water Depth (cm)	0.25 width:	15	5	5
	0.50 width:	10	5	5
	0.75 width:	25	5	5
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	20	30	30
	cobble (64-256 mm):	80	70	70
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	20	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	20
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Stream is a cobble/boulder run (R3) and RF approximately 200m upstream from lake. For most of the stream, the channel is braided and 2-5cm in depth, making it to shallow to measure water velocity.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 73.2

Date: 24-Aug-96

Grid Zone: 12W

Easting: 499013 Northing: 7405321

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	5
Specific Conductivity (uS/cm):	30
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Narrow channel (1-3m wide) which is braided in places, 2-5cm deep. Water in channel at the time of sampling appears to be snow melt runoff. No defined banks at this time.
NTS map shows stream originating from lake, stream now intermittent, lake would have to be at least 10m higher for to flow from lake.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 2 Stream: 74.4

Date: 24-Aug-96

Grid Zone: 12W

Easting: 498154 Northing: 7406158

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	90	90
	rock/cobble:	0	0
	exposed soil:	10	10
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	90	90
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	10	10

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		2.8	3	20
Habitat Unit #:		5	8	6
HabitatType:		R3	RF/BG	R3
Water Depth (cm)	0.25 width:	35	5	20
	0.50 width:	35	20	15
	0.75 width:	20	10	12
	max:	35	20	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	100	5	95
	gravel (2-64 mm):	0	5	5
	cobble (64-256 mm):	0	20	0
	Boulder (64-256 mm):	0	70	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	18	25	20
	min:	0	0	0
	max:	42	60	70

Water Temperature (C):	9
Specific Conductivity (uS/cm):	20
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

D/S banks are 100% sand.
Stream originates from lake, first several hundred meters of stream are steep with rapids and stepped pools.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	61	4	0	0	0	0		100	100	Maximum width 20m.
2	RF	5	2	0	50	0	0		100	100	
3	R3	7.2	5	0	5	0	0		100	100	Ephemeral stream enters stream at this location
4	RF	13.4	7.4	0	0	0	0		100	100	
5	R3	19.2	2.5	2	0	0	0		100	100	
6	R3	62.5	20	5	15	0	0		40	70	Stream braided, with sand substrate. Maximum width 3
7	R3	10.7	2	0	5	0	0		0	0	Braided with four channels. Combined wetted width ~1
8	RF/BG	47.4	3	0	80	0	0		0	0	

APPENDIX A3

HABITAT INFORMATION SHEETS
ROUTE 3

Echo Bay Mines - Ulu Project

Project 521

Route: 3 Stream: 48.0

Date: 27-Aug-96

Grid Zone: 12W

Easting: 497275 Northing: 7374407

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		3.3	2.5	2.3
Habitat Unit #:		1	2	2
HabitatType:		R3	RF/BG	RF/BG
Water Depth (cm)	0.25 width:	20	15	20
	0.50 width:	34	25	15
	0.75 width:	32	15	10
	max:	34	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	20	10	0
	cobble (64-256 mm):	40	30	20
	Boulder (64-256 mm):	40	60	80
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	9
Specific Conductivity (uS/cm):	20
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Channel 3.3m wide, boulder and cobble substrate, changing to gravel near lakes. Overland flow along both banks, making bank full width would be approximately 50m wide.
Note: Lichen on rocks in stream channel suggests that in a normal year, this stream does not flow in late summer.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	12.4	3.3	0	60	0	0		0	0	
2	RF/BG	350	5	5	80	0	0		0	0	Channel is braided

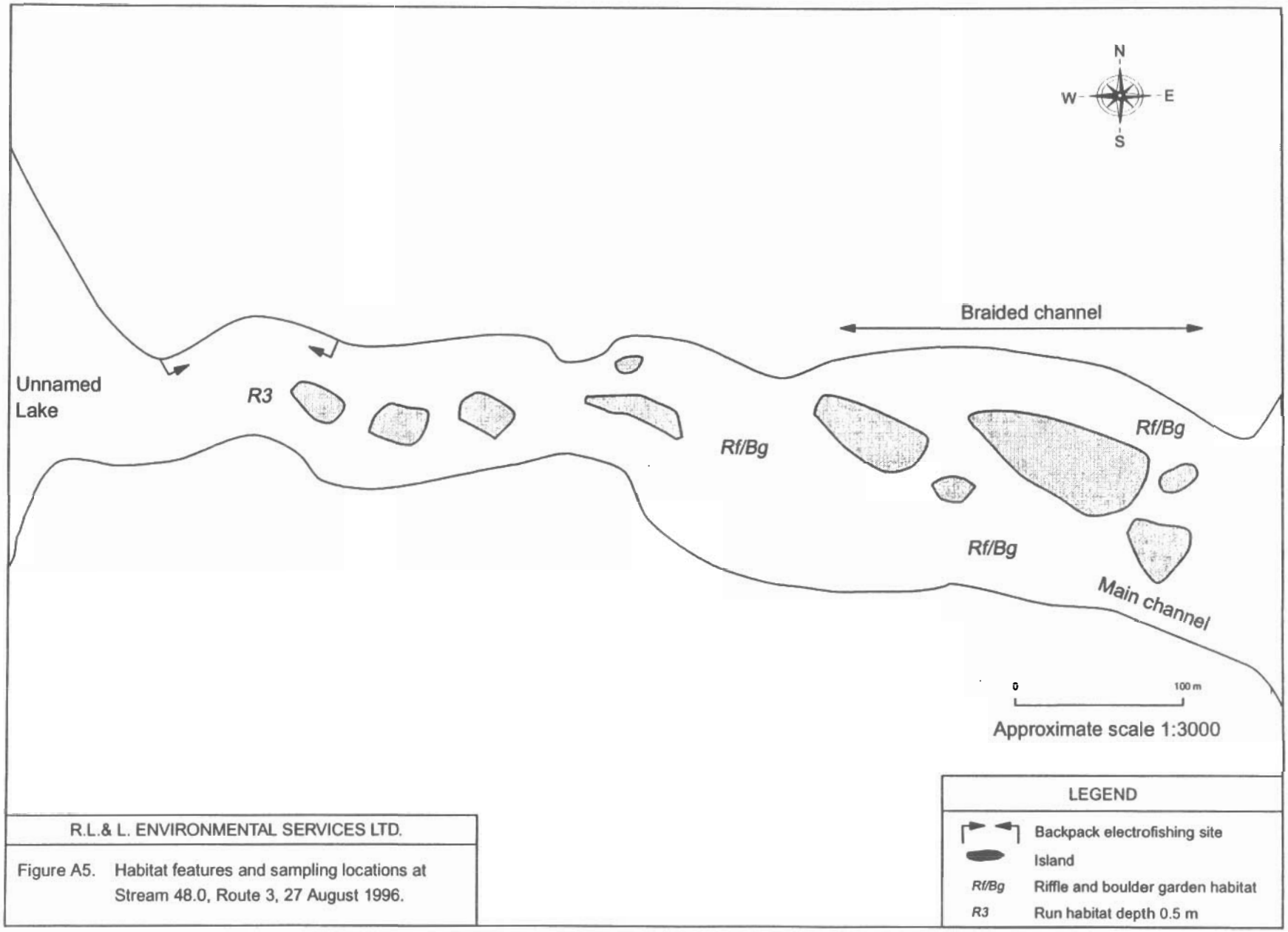

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Figure A5. Habitat features and sampling locations at Stream 48.0, Route 3, 27 August 1996.

Echo Bay Mines - Ulu Project

Project 521

Route: 3 Stream: 51.5

Date: 27-Aug-96

Grid Zone: 12W

Easting: 494080 Northing: 7373142

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	2	1
	range		
Height (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	75
	grass/forbs:	100	20
	rock/cobble:	0	5
	exposed soil:	0	0
Bank Material (%)	organic:	90	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	10	20

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		15.6	15	25
Habitat Unit #:		1	1	1
HabitatType:		RF/BG	RF/BG	RF/BG
Water Depth (cm)	0.25 width:	20	50	25
	0.50 width:	1	50	25
	0.75 width:	25	50	25
	max:	42	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	5	0	0
	gravel (2-64 mm):	5	0	0
	cobble (64-256 mm):	20	0	40
	Boulder (64-256 mm):	70	100	60
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	8
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

RF/BG for 200m; with areas of overland flow on both banks.
Lichen on rocks indicates base flow = 10-15cm below current water depth
At the upstream end of sampling location, rocks are covered with filamentous green algae.
Note: upstream lake may freeze to bottom in the winter.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	RF/BG	200	15	5	95	0	0		0	0	Braided in places
2	R3	100	15	0	100	0	0		0	0	Braided

Echo Bay Mines - Ulu Project

Project 521

Route: 3 Stream: 59.3

Date: 27-Aug-96

Grid Zone: 12W

Easting: 487600 Northing: 7374800

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Dry boulder filled channel, most likely has some water during spring freshet.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

APPENDIX A4

HABITAT INFORMATION SHEETS
ROUTE 4

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 7.6

Date: 27-Aug-96

Grid Zone: 12W

Easting: 495473 Northing: 7350393

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.15	0.15
Cover (%Area)	trees/shrubs:	5	5
	grass/forbs:	65	65
	rock/cobble:	30	30
	exposed soil:	0	0
Bank Material (%)	organic:	60	60
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	40	40

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		13	12	14
Habitat Unit #:		1	0	0
HabitatType:		RF/BG	R3	RF/BG
Water Depth (cm)	0.25 width:	65	40	35
	0.50 width:	55	50	38
	0.75 width:	40	45	45
	max:	65	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	100	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	4
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Combination of RF/BG and R2 habitat between two lakes. Substrate is boulder throughout, with some braided sections separated where channels were separated by peat & boulder islands.
Note: Due to Swoffer malfunction (lost impeller) velocity could not be measured. Using the floating orange method velocity estimated to be approximately 0.60 m/s.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 10.8

Date: 28-Aug-96

Grid Zone: 12W

Easting: 497000 Northing: 7353400

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	2	2
	range		
Height (m)		0	30
Cover (%Area)	trees/shrubs:	30	30
	grass/forbs:	10	10
	rock/cobble:	60	60
	exposed soil:	0	0
Bank Material (%)	organic:	30	30
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	70	70

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		5	6	5
Habitat Unit #:		1	1	1
HabitatType:		R3/BG	R3/BG	R3/BG
Water Depth (cm)	0.25 width:	20	20	18
	0.50 width:	20	20	20
	0.75 width:	20	20	19
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	100	100	100
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	34	25	30
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	8
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Entire stream is a R3/BG, some small areas with R2 and small P1 (<0.75m across).
Lichen on rocks indicate water level 20-30cm lower under normal base flow conditions.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

APPENDIX B

FISHERIES DATA

Echo Bay Mines - Ulu Project

Project 521

.oute: 4 Stream: 12

Date: 25-Aug-96

Grid Zone: 12W

Easting: 497700 Northing: 7355000

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Small intermittent stream, with mostly overland flow. Only had water due to recent snow melt and rain. Did not land.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

.oute: 4 Stream: 14.6

Date: 25-Aug-96

Grid Zone: 12W

Easting: 498247 Northing: 7357787

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
leight (m)		0.1	0.1
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	80	80
	rock/cobble:	20	20
	exposed soil:	0	0
Bank Material (%)	organic:	80	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	20	20

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		2.3	3	0
Habitat Unit #:		1	1	0
HabitatType:		R3	R3	
Water Depth (cm)	0.25 width:	28	30	0
	0.50 width:	35	35	0
	0.75 width:	30	30	0
	max:	35	35	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	100	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	5	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	95	0	0
Silt Depth (cm)	mean:	0	3	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	20	15	0
	min:		0	0
	max:	0	0	0

Water Temperature (C):	6
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

No really defined channel, there is a mostly cobble/boulder channel with overland for 30m on either side of the cobble and boulders. Braided near stream mouth, overland flow through boulders on either side of channel

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	300	2.5	0	80	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 19.5

Date: 25-Aug-96

Grid Zone: 12W

Easting: 500500 Northing: 7361700

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Some above ground flow in BG; however, stream flows underground at crossing.
Did not sample.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

.oute: 4 Stream: 21.0

Date: 27-Aug-96

Grid Zone: 12W

Easting: 501350 Northing: 7362900

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Stream is very small and does not appear on NTS 1:50 000 map. Stream originates from a boulder upland and is most likely ephemeral. Stream had some water, most likely due to recent snow fall/melt and heavy rains. Stream was to shallow to electrofish.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

.oute: 4 Stream: 21.2

Date: 27-Aug-96

Grid Zone: 12W

Easting: 501400 Northing: 7363050

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Stream is very shallow and heavily braided at stream mouth. The stream flows through a wide marshy area between the two lakes. Stream appears to be intermittent; however, had water due to recent snow fall/melt and rain. There is the potential for fish to be present in this stream during the spring freshet.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 23.2

Date: 25-Aug-96

Grid Zone: 12W

Easting: 502355 Northing: 7364922

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	10
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

No defined banks, non-channelized overland flow. At the time of sampling there was no detectable flow.

Echo Bay Mines - Ulu Project

Project 521

Habitat Da ·UD

Route: 4 Stream: 28.3

Date: 25-Aug-96

Grid Zone: 12W

Easting: 504796 Northing: 7368679

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	5	5
	grass/forbs:	95	95
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	80	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	10	10
	gravel (2-64 mm):	10	10
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1.8	1.8	1.8
Habitat Unit #:		1	1	1
HabitatType:		RF	RF	RF
Water Depth (cm)	0.25 width:	10	10	15
	0.50 width:	20	15	15
	0.75 width:	16	15	20
	max:	20	16	20
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	100	100	100
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0.45	0.5	0.5

Water Temperature (C):	7
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Stream is intermittent, flowing due to recent rain and snow melt. Lichen on rocks in stream channel.
Boulder/cobble riffles between lakes.

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 23.7

Date: 25-Aug-96

Grid Zone: 12W

Easting: 502424 Northing: 7365492

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	80	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	20	20

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		3.4	0	0
Habitat Unit #:		1	0	0
HabitatType:		RF/BG		
Water Depth (cm)	0.25 width:	35	0	0
	0.50 width:	34	0	0
	0.75 width:	34	0	0
	max:	40	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	20	0	0
	Boulder (64-256 mm):	80	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	40	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	8
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Overland flow on either sides of stream channel. 300m u/s of lake, meandering run habitat with overland flow. Habitat is uniform throughout stream (See transect #1). Judging from lichen on rocks in the stream channel, base flows are usually 25cm lower than current conditions.
Note: Recommend moving road 100m u/s to available fish bearing area at stream mouth.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	RF/BG	250	3	10	90	0	0		0	0	Width varies from 3-6m.

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 26.3

Date: 27-Aug-96

Grid Zone: 12W

Easting: 503400 Northing: 7366700

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		0	0	0
Habitat Unit #:		0	0	0
HabitatType:				
Water Depth (cm)	0.25 width:	0	0	0
	0.50 width:	0	0	0
	0.75 width:	0	0	0
	max:	0	0	0
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	0	0	0
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0

Water Temperature (C):	0
Specific Conductivity (uS/cm):	0
Ambient Conductivity (uS/cm):	0
Water Colour:	

Comments:

Very shallow stream (<10 cm deep), stream flows from underground through boulder field for approximately 100 m. Could not sample due to backpack electrofisher malfunction. However, the fisheries potential is very low as lakes upstream and downstream will freeze to the bottom during the winter.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 28.3

Date: 25-Aug-96

Grid Zone: 12W

Easting: 504796 Northing: 7368679

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0.2	0.2
Cover (%Area)	trees/shrubs:	5	5
	grass/forbs:	95	95
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	80	80
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	10	10
	gravel (2-64 mm):	10	10
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1.8	1.8	1.8
Habitat Unit #:		1	1	1
HabitatType:		RF	RF	RF
Water Depth (cm)	0.25 width:	10	10	15
	0.50 width:	20	15	15
	0.75 width:	16	15	20
	max:	20	16	20
Substrate (%)	organic:	0	0	0
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	100	100	100
	Boulder (64-256 mm):	0	0	0
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	0	0	0
	min:	0	0	0
	max:	0.45	0.5	0.5

Water Temperature (C):	7
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Stream is intermittent, flowing due to recent rain and snow melt. Lichen on rocks in stream channel. Boulder/cobble riffles between lakes.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	RF	200	1.5	0	0	0	0		0	0	
2	F3	50	10	80	0	0	0		0	0	
3	P3	50	50	0	20	0	0		0	0	

Echo Bay Mines - Ulu Project

Project 521

Route: 4 Stream: 30.9

Date: 25-Aug-96

Grid Zone: 12W

Easting: 506037 Northing: 7370824

Upper Banks at RoW		LUB	RUB
Slope (degrees)	mean	0	0
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	0	0
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic):	0	0
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	Boulder (64-256 mm):	0	0

Lower Banks at RoW		LUB	RUB
Slope (degrees)	mean	1	1
	range		
Height (m)		0	0
Cover (%Area)	trees/shrubs:	0	0
	grass/forbs:	100	100
	rock/cobble:	0	0
	exposed soil:	0	0
Bank Material (%)	organic:	100	100
	silt (<0.1 mm):	0	0
	sand (0.1-2 mm):	0	0
	gravel (2-64 mm):	0	0
	cobble (64-256 mm):	0	0
	boulder (64-256 mm):	0	0

Transects		Tr#1	Tr#2	Tr#3
Channel Width (m):		1	1	1
Habitat Unit #:		1	2	9
HabitatType:		R3	RF	R2
Water Depth (cm)	0.25 width:	30	15	50
	0.50 width:	34	15	65
	0.75 width:	26	15	55
	max:	34	15	65
Substrate (%)	organic:	10	10	50
	silt (<0.1 mm):	0	0	0
	sand (0.1-2 mm):	0	0	0
	gravel (2-64 mm):	0	0	0
	cobble (64-256 mm):	30	10	20
	Boulder (64-256 mm):	60	80	30
Silt Depth (cm)	mean:	0	0	0
	min:	0	0	0
	max:	0	0	0
Velocity (cm/s)	mean:	24	20	20
	min:	15	15	10
	max:	43	30	25

Water Temperature (C):	4
Specific Conductivity (uS/cm):	10
Ambient Conductivity (uS/cm):	0
Water Colour:	clear

Comments:

Stream consists of narrow channel (<1.0m wide) with 20 m sections of RF, separated by 20 m sections of R3. Stream bottom consists of frozen organic material with a few isolated boulders.
Stream disappears into a boulder field.
Sampled downstream of crossing near lake.

Echo Bay Mines - Ulu Project

Project 521

Habitat Data Subreport

Unit Number	Habitat Type	Length	Width	Instream Cover (%)					Unstable Ban		Comments
				AV	BG	OB	OV	Other	LUB	RUB	
1	R3	17.8	75	20	50	0	0		0	0	
2	RF	0.5	0.5	10	75	0	0		0	0	
3	R3	7	0.75	80	0	0	0		0	0	
4	RF	1.7	0.5	80	0	0	0		0	0	
5	R3	3.8	0.4	0	50	0	0		0	0	
6	RF.	2.9	0.4	80	0	0	0		0	0	
7	R3	5.4	0.8	80	0	0	0		0	0	
8	RF	1.8	0.5	20	0	0	0		0	0	
9	R2	14.6	1	50	0	0	0		0	0	
10	RF	5.7	0.8	20	0	0	0		0	0	
11	R2	150	1.5	80	0	0	0		0	0	
12	UNGR	0	0	0	0	0	0		0	0	

Table B.2 Life history information for fish captured in the Ulu Project Area, June-August 1996

SNUM	Date	Capture Location	Species	Length (mm)	Weight (g)	Sex Code	Capture Method	Capture Code	Floy Tag Number	Floy Tag Colour	Comments
53	18-Jun-96	Stream 20.4	RNWH	72	<10		EF	0			
54	18-Jun-96	Stream 20.4	RNWH	63	<10		EF	0			
55	18-Jun-96	Stream 18.0	RNWH	126	28		EF	0			
56	19-Jun-96	Stream 20.4	LKTR	654	2326	10	AL	0			
57	19-Jun-96	Stream 20.4	LKTR	694	2000	10	AL	0			
58	22-Jul-96	Reno Lake South	LKTR	235	138		GN	0			
59	22-Jul-96	Reno Lake South	LKTR	285	240		GN	0			
60	22-Jul-96	Reno Lake South	LKTR	322	396		GN	0	6101	Orange	
61	22-Jul-96	Reno Lake South	LKTR	404	714		GN	0	6102	Orange	
62	22-Jul-96	Reno Lake South	LKTR	300	294	99	GN	1			
63	22-Jul-96	Reno Lake South	LKTR	269	214	99	GN	1			
64	22-Jul-96	Reno Lake South	LKTR	264	305	99	GN	1			
65	22-Jul-96	Reno Lake South	LKTR	344	412		GN	0			
66	23-Jul-96	Reno Lake South	LKTR	232	136		GN	0			
67	23-Jul-96	Reno Lake South	LKTR	408	828		GN	0	6103	Orange	
68	23-Jul-96	Reno Lake South	LKTR	340	370		GN	0			
69	23-Jul-96	Reno Lake South	LKTR	376	592		GN	0	6104	Orange	
70	23-Jul-96	Reno Lake South	LKTR	298	250		GN	0	6105	Orange	
71	23-Jul-96	Reno Lake South	LKTR	235	392		GN	0			
72	23-Jul-96	Reno Lake South	LKTR	333	394		GN	0			
73	23-Jul-96	Reno Lake South	LKTR	335	398		GN	0			
74	23-Jul-96	Reno Lake South	LKTR	351	454		GN	0			
75	23-Jul-96	Reno Lake South	LKTR	258	184	99	GN	1			
76	23-Jul-96	Reno Lake South	LKTR	275	218	99	GN	1			
77	23-Jul-96	Reno Lake South	LKTR	275	202	99	GN	1			
78	23-Jul-96	Reno Lake North	LKTR	390	752		GN	0	6106	Orange	
79	23-Jul-96	Reno Lake North	LKTR	390	636		GN	0	6107	Orange	
80	23-Jul-96	Reno Lake North	RNWH	389	654		GN	0	6108	Orange	
81	23-Jul-96	Reno Lake North	RNWH	400	660		GN	1			
82	23-Jul-96	Reno Lake North	RNWH	399	718		GN	0			
83	23-Jul-96	Reno Lake North	LKTR	370	560		GN	0	6109	Orange	
84	23-Jul-96	Reno Lake North	LKTR	402	646		GN	0	6110	Orange	
85	23-Jul-96	Reno Lake North	LKTR	403	722		GN	0	6111	Orange	
86	23-Jul-96	Reno Lake North	LKTR	404	770		GN	1			
87	23-Jul-96	Reno Lake North	LKTR	385	538		GN	1			
88	24-Jul-96	Reno Lake North	RNWH	365	566		GN	0			
89	24-Jul-96	Reno Lake North	RNWH	160	259		GN	0			
90	24-Jul-96	Reno Lake North	RNWH	404	662		GN	0			
91	24-Jul-96	Reno Lake North	RNWH	410	748		GN	0			
92	24-Jul-96	Reno Lake North	RNWH	393	716		GN	0			
93	24-Jul-96	Reno Lake North	RNWH	398	538		GN	0			
94	24-Jul-96	Reno Lake North	RNWH	410	694		GN	0			
95	24-Jul-96	Reno Lake North	RNWH	378	576		GN	0			
96	24-Jul-96	Reno Lake North	RNWH	350	458		GN	0			
97	24-Jul-96	Reno Lake North	RNWH	410	676		GN	0			
98	24-Jul-96	Reno Lake North	RNWH	373	598		GN	0			
99	24-Jul-96	Reno Lake North	RNWH	347	406		GN	0			
100	24-Jul-96	Reno Lake North	RNWH	421	732		GN	0			
101	24-Jul-96	Reno Lake North	RNWH	383	670		GN	0			
102	24-Jul-96	Reno Lake North	LKTR	318	352		GN	0			
103	24-Jul-96	Reno Lake North	LKTR	444	866		GN	0			
104	24-Jul-96	Reno Lake North	LKTR	384	672		GN	0			

Table B.2 Life history information for fish captured in the Ulu Project Area, June-August 1996

SNUM	Date	Capture Location	Species	Length (mm)	Weight (g)	Sex Code	Capture Method	Capture Code	Floy Tag Number	Floy Tag Colour	Comments
105	24-Jul-96	Reno Lake North	LKTR	340	418		GN	0			
106	24-Jul-96	Reno Lake North	RNWH	375	496		GN	0			
107	24-Jul-96	Reno Lake North	LKTR	420	860		GN	0			
108	24-Jul-96	Reno Lake North	ARCH	398	748		GN	0			
109	24-Jul-96	Reno Lake North	ARCH	419	890		GN	0			
110	24-Jul-96	Reno Lake North	ARCH	380	642		GN	0			
111	24-Jul-96	Reno Lake North	ARCH	375	634		GN	0			
112	24-Jul-96	Reno Lake North	ARCH	378	606		GN	0			
113	24-Jul-96	Reno Lake North	LKTR	381	560		GN	0			
114	24-Jul-96	Reno Lake North	LKTR	390	670		GN	0			
115	24-Jul-96	Reno Lake North	LKTR	390	670		GN	0			
116	24-Jul-96	Reno Lake North	LKTR	373	542		GN	0			
117	24-Jul-96	Reno Lake North	LKTR	335	424		GN	0			
118	24-Jul-96	Reno Lake North	LKTR	375	626		GN	0			
119	24-Jul-96	Reno Lake North	LKTR	330	390		GN	0			
120	24-Jul-96	Reno Lake North	LKTR	290	254		GN	0			
121	24-Jul-96	Reno Lake North	RNWH	189	52		GN	0			
122	24-Jul-96	Reno Lake North	LKTR	390	630		GN	0			
123	25-Jul-96	Ulu West Lake	LKTR	335	542		GN	0			
124	25-Jul-96	Ulu West Lake	LKTR	344	528		GN	0			
125	25-Jul-96	Ulu West Lake	LKTR	340	458	99	GN	1			
126	26-Jul-96	Ulu Lake	LKTR	455	1056	1	GN	1			
127	26-Jul-96	Ulu Lake	LKTR	250	156	99	GN	1			
128	26-Jul-96	Ulu Lake	LKTR	370	640	11	GN	1			
129	26-Jul-96	Ulu Lake	LKTR	390	670	11	GN	1			
130	26-Jul-96	Ulu Lake	LKTR	418	824		GN	0			
131	26-Jul-96	Ulu Lake	LKTR	418	850		GN	0			
132	24-Aug-96	Stream 74.4 (Route 2)	SLSC	30	< 10		EF	0			
133	25-Aug-96	Stream 37.4 (Route 2)	BURB	160	44		EF	0			
134	25-Aug-96	Stream 37.4 (Route 2)	RNWH	55	< 10		EF	0			
135	25-Aug-96	Stream 37.4 (Route 2)	RNWH	40	< 10		EF	0			
136	25-Aug-96	Stream 37.4 (Route 2)	RNWH	56	< 10		EF	0			
137	25-Aug-96	Stream 37.4 (Route 2)	RNWH	40	< 10		EF	0			
138	25-Aug-96	Stream 37.4 (Route 2)	SLSC	48	< 10		EF	0			
139	25-Aug-96	Stream 37.4 (Route 2)	SLSC	52	< 10		EF	0			
140	25-Aug-96	Stream 23.7 (Route 4)	BURB	100	NW		EF	0			to windy for scale to work
141	25-Aug-96	Stream 23.7 (Route 4)	BURB	85	NW		EF	0			to windy for scale to work
142	25-Aug-96	Stream 23.7 (Route 4)	BURB	85	NW		EF	0			to windy for scale to work
143	25-Aug-96	Stream 23.7 (Route 4)	RNWH	109	NW		EF	0			to windy for scale to work
144	27-Aug-96	Stream 7.6 (Route 4)	ARGR	75	< 10		EF	0			
145	27-Aug-96	Stream 7.6 (Route 4)	ARGR	60	< 10		EF	0			
146	27-Aug-96	Stream 7.6 (Route 4)	ARGR	56	< 10		EF	0			
147	27-Aug-96	Stream 48.0 (Route 3)	BURB	70	< 10		EF	0			
148	27-Aug-96	Stream 48.0 (Route 3)	BURB	72	< 10		EF	0			
149	27-Aug-96	Stream 48.0 (Route 3)	BURB	100	10-20		EF	0			

Table B1. R.L. & L. fish coding system

SEX AND MATURITY DESCRIPTIONS

M	F	CLASS	DESCRIPTION
99		Immature A	Sex indeterminable due to small gonad size.
01	11	Immature B	Small gonad size; fish has never spawned and will not spawn during the coming spawning season.
02	12	Maturity questionable	Small gonad size; it cannot be determined if fish is immature or if it will spawn during the coming spawning season.
03	13	Developing A	Definite gonad development; fish has never spawned before but will spawn during the coming season.
04	14	Developing B	Definite gonad development; the fish has spawned before and will spawn during the coming season.
05	15	Developing C	Definite gonad development; the fish has spawned before but will not spawn during the coming spawning season, i.e., alternate year spawners.
06	16	Developing D	Used to indicate definite gonad development when the classification into categories developing A,B, or C cannot be determined, or when such a breakdown is unsuitable or unnecessary.
07	17	Gravid/fully developed	Sexual organs fill ventral cavity testes white, drops of milt fall with pressure; eggs completely round, some already translucent.
08	18	Ripe	Roe or milt are extruded by slight pressure on the belly.
09	19	Spent	Spawning completed; resorption of residual ovarian tissue is not yet complete.
10	20	External	Sex determined by external characteristics; maturity and sex not verified by gonad examination.
97	97	Adult	Based on fish size; sex not determined.
98	98	Juvenile	Based on fish size; sex not determined.

*NOTE Site abbreviation is in km from confluence where applicable.

OTHER CODES

CODE	AGEING METHODS	CODE	AGEING METHODS
SC	Scales	CL	Cleithra
OT	Otoliths	CS	Cleithra and scales
SO	Scales and otoliths	VE	Vertebrae
FR	Fin ray	OB	Other bones
SF	Scales and fin rays	LF	Length-frequency

CODE	CAPTURE METHODS (COL. 33-34)
FD	Found dead
SL	Set line
DN	Dip net
GN	Gill net
ES	Electroshocker - Boat shocker
EF	Electrofisher - backpack shocker
BS	Beach seine
OB	Observed - not captured
TU	Trap - fish moving upstream
TD	Trap - fish moving downstream
AL	Angling (Using lures)
AF	Angling (Using flies)
AB	Angling (Using bait)
CR	Creel - sampled from a fisherman's creel
CF	Commercial fisherman's catch
DF	Domestic fisherman's catch
GT	Gee minnow trap

CODE	TAG CODE (COL. 38)
Y, W, R	Color code for tag (i.e., Yellow, White, or Red)
F	Fin clip: 1=Adipose, 2=R. Pectoral, 3=L. Pectoral, 4=R. Pelvic, 5=L. Pelvic, 6=Dorsal, 9=Fin Punch.

CODE	CAPTURE CODE (COL. 60)
0	First capture, released
1	First capture, sacrificed
2	Recapture, released
3	Recapture, sacrificed

CODE	PRESERVATION CODE (COL. 61)
1	Whole specimen preserved
2	Stomach only preserved
3	Whole specimen and stomach preserved separately
4	Stomach contents evacuated and preserved
5	Gonads preserved
6	Parasites preserved
7	Head preserved

Table B.2 Life history information for fish captured in the Ulu Project Area, June-August 1996

SNUM	Date	Capture Location	Species	Length (mm)	Weight (g)	Sex Code	Capture Method	Capture Code	Floy Tag Number	Floy Tag Colour	Comments
1	15-Jun-96	Reno Lake South	LKTR	436	838	11	AL	1			Captured by anglers from Camp 3
2	15-Jun-96	Reno Lake South	LKTR	425	736	11	AL	1			Captured by anglers from Camp 3
3	14-Jun-96	Reno Lake South	LKTR	402	656	11	AL	1			Captured by anglers from Camp 3
4	14-Jun-96	Reno Lake South	LKTR	454			AL	1			Captured by anglers from Camp 3
5	14-Jun-96	Reno Lake South	LKTR	457			AL	1			Captured by anglers from Camp 3
6	16-Jun-96	Stream 55.2	BURB	275	126		EF	0			
7	17-Jun-96	Stream 52.0W	SLSC	92	<10		EF	0			
8	17-Jun-96	Stream 52.0W	LKTR	65	<10		EF	0			
9	17-Jun-96	Stream 52.0W	SLSC	67	<10		EF	0			
10	17-Jun-96	Stream 52.0W	SLSC	71	<10		EF	0			
11	17-Jun-96	Stream 52.0W	SLSC	58	<10		EF	0			
12	17-Jun-96	Stream 52.0W	LKTR	53	<10		EF	0			
13	17-Jun-96	Stream 52.0W	SLSC	51	<10		EF	0			
14	17-Jun-96	Stream 52.0W	LKTR	59	<10		EF	0			
15	17-Jun-96	Stream 52.0W	SLSC	69	<10		EF	0			
16	17-Jun-96	Stream 52.0W	LKTR	63	<10		EF	0			
17	17-Jun-96	Stream 52.0W	SLSC	52	<10		EF	0			
18	17-Jun-96	Stream 52.0W	LKTR	57	<10		EF	0			
19	17-Jun-96	Stream 52.0W	SLSC	58	<10		EF	0			
20	17-Jun-96	Stream 52.0W	SLSC	43	<10		EF	0			
21	17-Jun-96	Stream 52.0W	SLSC	60	<10		EF	0			
22	17-Jun-96	Stream 52.0W	SLSC	52	<10		EF	0			
23	17-Jun-96	Stream 52.0W	SLSC	33	<10		EF	0			
24	17-Jun-96	Stream 52.0W	SLSC	33	<10		EF	0			
25	17-Jun-96	Stream 52.0W	SLSC	42	<10		EF	0			
26	17-Jun-96	Stream 52.1 W	SLSC	53	<10		EF	0			
27	17-Jun-96	Stream 52.1 W	SLSC	62	<10		EF	0			
28	17-Jun-96	Stream 52.1 W	SLSC	66	<10		EF	0			
29	17-Jun-96	Stream 52.1 W	SLSC	58	<10		EF	0			
30	17-Jun-96	Stream 52.1 W	SLSC	67	<10		EF	0			
31	17-Jun-96	Stream 52.1 W	SLSC	72	<10		EF	0			
32	17-Jun-96	Stream 52.1 W	SLSC	65	<10		EF	0			
33	17-Jun-96	Stream 52.1 W	SLSC	70	<10		EF	0			
34	17-Jun-96	Stream 52.1 W	SLSC	63	<10		EF	0			
35	17-Jun-96	Stream 52.1 W	SLSC	67	<10		EF	0			
36	17-Jun-96	Stream 52.1 W	SLSC	54	<10		EF	0			
37	17-Jun-96	Stream 52.1 W	SLSC	46	<10		EF	0			
38	17-Jun-96	Stream 52.1 W	SLSC	44	<10		EF	0			
39	17-Jun-96	Stream 52.1 W	SLSC	55	<10		EF	0			
40	17-Jun-96	Stream 52.1 W	SLSC	58	<10		EF	0			
41	17-Jun-96	Stream 52.1 W	SLSC	62	<10		EF	0			
42	17-Jun-96	Stream 52.1 W	LKTR	63	<10		EF	0			
43	17-Jun-96	Stream 52.1 W	LKTR	52	<10		EF	0			
44	17-Jun-96	Stream 51.0E	LKTR	55	<10		EF	0			
45	17-Jun-96	Stream 51.0E	SLSC	55	<10		EF	0			
46	17-Jun-96	Stream 51.0E	SLSC	61	<10		EF	0			
47	17-Jun-96	Stream 51.0E	SLSC	68	<10		EF	0			
48	17-Jun-96	Stream 51.0E	SLSC	54	<10		EF	0			
49	17-Jun-96	Stream 37.0	RNWH	155	30		EF	0			
50	18-Jun-96	Stream 20.4	RNWH	111	14		EF	0			
51	18-Jun-96	Stream 20.4	RNWH	81	<10		EF	0			
52	18-Jun-96	Stream 20.4	RNWH	57	<10		EF	0			

APPENDIX C

WATER AND SEDIMENT CHEMISTRY DATA

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

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W.O. NO. 3 116258
PAGE 1

RL & L ENV. SERVICES
17312-106 AVENUE
EDMONTON, AB
T5S 1H9

DAVE HAMILTON

WATER ANALYSIS REPORT

SAMPLE		1 01 RENO LAKE NORTH	2 02 RENO LAKE N.	3 02 RENO LAKE S.	4 U/O LAKE
ROUTINE WATER					
pH		6.50		5.88	5.81
ELECTRICAL COND	uS/cm	13.0		11.0	27.0
CALCIUM	mg/L	1.1		0.7	1.9
MAGNESIUM	mg/L	0.4		0.3	0.8
SODIUM	mg/L	1.1		0.9	2.3
POTASSIUM	mg/L	0.51		0.61	0.63
IRON	mg/L	<0.04		<0.04	<0.04
MANGANESE	mg/L	<0.003		<0.003	0.004
SULPHATE	mg/L	0.9		1.2	4.3
CHLORIDE	mg/L	0.9		0.5	2.9
BICARBONATE	mg/L	6.1		5.5	5.3
T ALKALINITY	mg/L	5		4	4
HARDNESS	mg/L	4.4		3.0	7.9
T DIS SOLIDS	mg/L	8		7	15
IONIC BALANCE	%	-102		-90.5	-106
WATER NUTRIENTS					
TOTAL KJEHL NIT	mg/L	0.34	0.47	0.27	0.25
AMMONIA-N	mg/L	0.008	0.006	<0.005	0.022
NITRATE-N	mg/L	<0.05	<0.05	<0.05	<0.05
NITRITE	mg/L	<0.05	<0.05	<0.05	<0.05
PHOSPHORUS(TOT)	mg/L	0.08	0.06	0.06	0.05
PHOSPHORUS,DISS	mg/L	0.05	<0.05	<0.05	<0.05
NITRATE&NITRITE	mg/L	<0.05		<0.05	<0.05
ORGANICS					
TOT ORG CARBON	mg/L	3.1	3.1	2.0	1.7
OIL AND GREASE	mg/L	<0.2	<0.2	<0.2	<0.2
TOTAL, COLD VAPO					
MERCURY	mg/L	<0.0001	<0.0001	0.0002	<0.0001
TRACE ICP,TOTAL					
ALUMINUM	mg/L	0.073	0.093	0.055	0.051
ANTIMONY	mg/L	<0.005	<0.005	<0.005	<0.005
ARSENIC	mg/L	<0.01	0.02	<0.01	<0.01
BARIUM	mg/L	0.0020	0.0020	0.0021	0.0041

Lab Manager: KHS

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
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WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

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PAGE 2

RL & L ENV. SERVICES
17312-106 AVENUE
EDMONTON, AB
T5S 1H9

DAVE HAMILTON

WATER ANALYSIS REPORT

SAMPLE		1 01 RENO LAKE NORTH	2 02 RENO LAKE N.	3 02 RENO LAKE S.	4 U/O LAKE
TRACE ICP,TOTAL					
BERYLLIUM	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
BISMUTH	mg/L	<0.007	<0.007	<0.007	<0.007
BORON	mg/L	0.019	<0.002	<0.002	<0.002
CADMIUM	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
CALCIUM	mg/L	1.06	1.04	0.949	1.83
CHROMIUM	mg/L	<0.0008	<0.0008	<0.0008	<0.0008
COBALT	mg/L	<0.0007	<0.0007	<0.0007	<0.0007
COPPER	mg/L	<0.001	<0.001	<0.001	<0.001
IRON	mg/L	<0.003	<0.003	<0.003	<0.003
LEAD	mg/L	<0.002	<0.002	<0.002	<0.002
LITHIUM	mg/L	0.00024	0.00023	0.00017	0.00066
MANGANESE	mg/L	0.0043	0.0044	0.0015	0.0036
MAGNESIUM	mg/L	0.435	0.447	0.364	0.770
MOLYBDENUM	mg/L	<0.001	<0.001	0.002	<0.001
NICKEL	mg/L	<0.001	<0.001	<0.001	<0.001
PHOSPHORUS	mg/L	0.027	<0.006	<0.006	<0.006
POTASSIUM	mg/L	0.40	3.06	2.36	1.71
SELENIUM	mg/L	<0.003	<0.003	0.004	<0.003
SILICON	mg/L	0.127	0.237	0.249	0.436
SILVER	mg/L	<0.001	<0.001	<0.001	<0.001
SODIUM	mg/L	0.480	0.411	0.361	1.37
STRONTIUM	mg/L	0.0031	0.0029	0.0025	0.0083
SULPHUR	mg/L	0.297	0.304	0.437	1.38
THALLIUM	mg/L	<0.004	<0.004	<0.004	<0.004
TIN	mg/L	<0.003	<0.003	<0.003	<0.003
TITANIUM	mg/L	0.0013	0.0012	0.0020	0.0009
VANADIUM	mg/L	<0.001	<0.001	<0.001	<0.001
ZINC	mg/L	<0.0005	<0.0005	<0.0005	<0.0005

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DATE 08 AUG 96 10:36
P.O. NO.
W.O. NO. 3 116258
PAGE 3

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17312-106 AVENUE
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DAVE HAMILTON

WATER ANALYSIS REPORT

SAMPLE		5 U/O WEST LAKE	6 STATION #6	7 STATION #4	8 USI HOOD RIVER
ROUTINE WATER					
pH		5.83	5.80	5.83	5.91
ELECTRICAL COND	uS/cm	223	27.0	26.0	16.0
CALCIUM	mg/L	13.9	1.8	1.8	1.3
MAGNESIUM	mg/L	2.8	0.7	0.8	0.5
SODIUM	mg/L	23.8	1.7	1.5	0.7
POTASSIUM	mg/L	1.30	0.52	0.49	0.53
IRON	mg/L	<0.04	<0.04	0.07	<0.04
MANGANESE	mg/L	0.031	<0.003	<0.003	<0.003
SULPHATE	mg/L	8.6	3.7	2.9	1.2
CHLORIDE	mg/L	59.7	2.6	2.3	0.4
BICARBONATE	mg/L	5.1	5.3	6.6	7.5
T ALKALINITY	mg/L	4	4	5	6
HARDNESS	mg/L	46.3	7.5	7.6	5.5
T DIS SOLIDS	mg/L	113	14	13	8
IONIC BALANCE	%	-101	-98.2	-97.4	-95.5
WATER NUTRIENTS					
TOTAL KJEHL NIT	mg/L	0.32	0.25	0.54	0.34
AMMONIA-N	mg/L	0.022	<0.005	<0.005	<0.005
NITRATE-N	mg/L	<0.05	<0.05	<0.05	<0.05
NITRITE	mg/L	<0.05	<0.05	<0.05	<0.05
PHOSPHORUS(TOT)	mg/L	0.08	0.07	0.08	0.10
PHOSPHORUS,DISS	mg/L	<0.05	<0.05	<0.05	<0.05
NITRATE&NITRITE	mg/L	<0.05	<0.05	<0.05	<0.05
ORGANICS					
TOT ORG CARBON	mg/L	2.7	1.9	2.5	2.4
OIL AND GREASE	mg/L	<0.2	<0.2	<0.2	<0.2
TOTAL, COLD VAPO					
MERCURY	mg/L	<0.0001	<0.0001	<0.0001	<0.0001
TRACE ICP,TOTAL					
ALUMINUM	mg/L	0.047	0.049	0.056	0.057
ANTIMONY	mg/L	<0.005	<0.005	<0.005	<0.005
ARSENIC	mg/L	<0.01	<0.01	<0.01	0.01
BARIUM	mg/L	0.0315	0.0035	0.0036	0.0032

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DATE 08 AUG 96 10:36
P.O. NO.
W.O. NO. 3 116258
PAGE 4

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DAVE HAMILTON

WATER ANALYSIS REPORT

SAMPLE		5 U/O WEST LAKE	6 STATION #6	7 STATION #4	8 US1 HOOD RIVER
TRACE ICP,TOTAL					
BERYLLIUM	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
BISMUTH	mg/L	<0.007	<0.007	<0.007	<0.007
BORON	mg/L	0.004	<0.002	<0.002	<0.002
CADMIUM	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
CALCIUM	mg/L	13.7	1.79	1.91	1.49
CHROMIUM	mg/L	<0.0008	<0.0008	<0.0008	<0.0008
COBALT	mg/L	0.0007	<0.0007	<0.0007	<0.0007
COPPER	mg/L	0.002	<0.001	<0.001	<0.001
IRON	mg/L	<0.003	<0.003	0.067	<0.003
LEAD	mg/L	<0.002	<0.002	<0.002	<0.002
LITHIUM	mg/L	0.00344	0.00061	0.00071	0.00037
MANGANESE	mg/L	0.0329	0.0029	0.0044	0.0051
MAGNESIUM	mg/L	2.66	0.760	0.807	0.575
MOLYBDENUM	mg/L	<0.001	0.002	<0.001	0.001
NICKEL	mg/L	<0.001	<0.001	<0.001	<0.001
PHOSPHORUS	mg/L	<0.006	<0.006	<0.006	<0.006
POTASSIUM	mg/L	3.23	2.26	1.77	2.47
SELENIUM	mg/L	<0.003	<0.003	<0.003	<0.003
SILICON	mg/L	0.288	0.430	0.419	0.269
SILVER	mg/L	<0.001	<0.001	<0.001	<0.001
SODIUM	mg/L	23.5	1.36	1.36	0.443
STRONTIUM	mg/L	0.129	0.0082	0.0077	0.0041
SULPHUR	mg/L	2.84	1.28	1.07	0.430
THALLIUM	mg/L	0.010	<0.004	<0.004	<0.004
TIN	mg/L	<0.003	<0.003	<0.003	<0.003
TITANIUM	mg/L	0.0018	0.0007	0.0014	0.0015
VANADIUM	mg/L	<0.001	<0.001	<0.001	<0.001
ZINC	mg/L	<0.0005	<0.0005	<0.0005	<0.0005

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W.O. NO. 3 116258
PAGE 5

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DAVE HAMILTON

WATER ANALYSIS REPORT

SAMPLE		9 DS1 HOOD RIVER	10 DS2 HOOD RIVER	11 FNR FRAYED NOT RIVER	12 RENO LAKE SOUTH #1
ROUTINE WATER					
pH		5.92	5.90	5.91	5.83
ELECTRICAL COND	uS/cm	15.0	15.0	16.0	11.0
CALCIUM	mg/L	1.2	1.2	1.4	0.9
MAGNESIUM	mg/L	0.5	0.5	0.5	0.3
SODIUM	mg/L	0.7	0.7	1.4	0.7
POTASSIUM	mg/L	0.64	0.46	0.52	0.45
IRON	mg/L	<0.04	<0.04	0.06	<0.04
MANGANESE	mg/L	<0.003	<0.003	<0.003	<0.003
SULPHATE	mg/L	1.2	1.2	1.5	1.0
CHLORIDE	mg/L	0.2	0.5	0.9	0.3
BICARBONATE	mg/L	7.1	6.9	6.8	5.5
T ALKALINITY	mg/L	6	6	6	5
HARDNESS	mg/L	5.1	5.1	5.8	3.8
T DIS SOLIDS	mg/L	8	8	10	6
IONIC BALANCE	%	-101	-93.9	-112	-94.4
WATER NUTRIENTS					
TOTAL KJEHL NIT	mg/L	0.38	0.28	0.31	0.34
AMMONIA-N	mg/L	<0.005	<0.005	<0.005	<0.005
NITRATE-N	mg/L	<0.05	<0.05	<0.05	<0.05
NITRITE	mg/L	<0.05	<0.05	<0.05	<0.05
PHOSPHORUS(TOT)	mg/L	0.08	0.08	0.10	0.08
PHOSPHORUS,DISS	mg/L	<0.05	<0.05	<0.05	0.07
NITRATE&NITRITE	mg/L	<0.05	<0.05	<0.05	<0.05
ORGANICS					
TOT ORG CARBON	mg/L	2.2	2.3	2.4	2.0
OIL AND GREASE	mg/L	<0.2	<0.2	<0.2	<0.2
TOTAL, COLD VAPO					
MERCURY	mg/L	<0.0001	<0.0001	0.0002	0.0001
TRACE ICP,TOTAL					
ALUMINUM	mg/L	0.101	0.058	0.053	0.059
ANTIMONY	mg/L	<0.005	<0.005	<0.005	<0.005
ARSENIC	mg/L	<0.01	0.01	<0.01	<0.01

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DAVE HAMILTON

WATER ANALYSIS REPORT

SAMPLE		9 DS1 HOOD RIVER	10 DS2 HOOD RIVER	11 FNR FRAYED NOT RIVER	12 RENO LAKE SOUTH #1
TRACE ICP,TOTAL					
BARIUM	mg/L	0.0033	0.0028	0.0021	0.0022
BERYLLIUM	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
BISMUTH	mg/L	<0.007	<0.007	<0.007	<0.007
BORON	mg/L	<0.002	<0.002	<0.002	<0.002
CADMIUM	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
CALCIUM	mg/L	1.36	1.34	1.24	0.941
CHROMIUM	mg/L	<0.0008	<0.0008	<0.0008	<0.0008
COBALT	mg/L	<0.0007	<0.0007	<0.0007	<0.0007
COPPER	mg/L	<0.001	0.002	<0.001	<0.001
IRON	mg/L	0.046	<0.003	0.029	<0.003
LEAD	mg/L	<0.002	<0.002	<0.002	<0.002
LITHIUM	mg/L	0.00043	0.00034	0.00042	0.00017
MANGANESE	mg/L	0.0064	0.0042	0.0050	0.0015
MAGNESIUM	mg/L	0.571	0.542	0.543	0.366
MOLYBDENUM	mg/L	<0.001	<0.001	<0.001	<0.001
NICKEL	mg/L	<0.001	<0.001	<0.001	<0.001
PHOSPHORUS	mg/L	<0.006	<0.006	<0.006	<0.006
POTASSIUM	mg/L	3.83	1.10	1.36	0.81
SELENIUM	mg/L	<0.003	<0.003	<0.003	<0.003
SILICON	mg/L	0.313	0.248	0.217	0.247
SILVER	mg/L	<0.001	<0.001	<0.001	<0.001
SODIUM	mg/L	0.494	0.470	0.611	0.356
STRONTIUM	mg/L	0.0041	0.0039	0.0041	0.0025
SULPHUR	mg/L	0.399	0.392	0.371	0.308
THALLIUM	mg/L	0.007	<0.004	0.008	<0.004
TIN	mg/L	<0.003	<0.003	<0.003	<0.003
TITANIUM	mg/L	0.0053	0.0017	0.0005	0.0013
VANADIUM	mg/L	<0.001	<0.001	<0.001	<0.001
ZINC	mg/L	<0.0005	<0.0005	<0.0005	<0.0005

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DATE 08 AUG 96 10:36
P.O. NO.
W.O. NO. 3 116258
PAGE 7

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DAVE HAMILTON

WATER ANALYSIS REPORT

note ELECTRICAL COND 'ELECTRICAL COND' (EC) is in microsiemens/cm and is a measure of solids in solution
note T ALKALINITY 'ALKALINITY' is CARBONATE/BICARBONATE expressed as CALCIUM CARBONATE
note HARDNESS 'HARDNESS' is calcium and magnesium expressed as CALCIUM CARBONATE
note NITRATE&NITRITE is expressed as nitrogen

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W.O. NO. 3 116258
PAGE 8

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DAVE HAMILTON

WATER ANALYSIS REPORT

---PARAMETER----	DATE OF-ANALYSIS	------ANALYZED BY-------	---PARAMETER----	DATE OF-ANALYSIS	------ANALYZED BY-----
pH	02Aug96	TO LUONG (NU)	ELECTRICAL COND	02Aug96	TO LUONG (NU)
CALCIUM	01Aug96	DARREN CRICHTON	MAGNESIUM	01Aug96	DARREN CRICHTON
SODIUM	01Aug96	DARREN CRICHTON	POTASSIUM	01Aug96	DARREN CRICHTON
IRON	01Aug96	DARREN CRICHTON	MANGANESE	01Aug96	DARREN CRICHTON
SULPHATE	01Aug96	DARREN CRICHTON	CHLORIDE	01Aug96	THERESA LIEU
BICARBONATE	02Aug96	TO LUONG (NU)	T ALKALINITY	02Aug96	TO LUONG (NU)
HARDNESS	02Aug96	DARREN CRICHTON	T DIS SOLIDS	02Aug96	DARREN CRICHTON
IONIC BALANCE	02Aug96	DARREN CRICHTON	TOTAL KJEHL NIT	01Aug96	THERESA LIEU
AMMONIA-N	01Aug96	THERESA LIEU	NITRATE-N	01Aug96	THERESA LIEU
NITRITE	01Aug96	THERESA LIEU	PHOSPHORUS(TOT)	01Aug96	THERESA LIEU
PHOSPHORUS,DISS	01Aug96	THERESA LIEU	TOT ORG CARBON	02Aug96	THERESA LIEU
OIL AND GREASE	08Aug96	BARBARA CREPIN	MERCURY	02Aug96	DARREN CRICHTON
ALUMINUM	02Aug96	DARREN CRICHTON	ANTIMONY	02Aug96	DARREN CRICHTON
ARSENIC	02Aug96	DARREN CRICHTON	BARIUM	02Aug96	DARREN CRICHTON
BERYLLIUM	02Aug96	DARREN CRICHTON	BISMUTH	02Aug96	DARREN CRICHTON
BORON	02Aug96	DARREN CRICHTON	CADMIUM	02Aug96	DARREN CRICHTON
CALCIUM	02Aug96	DARREN CRICHTON	CHROMIUM	02Aug96	DARREN CRICHTON
COBALT	02Aug96	DARREN CRICHTON	COPPER	02Aug96	DARREN CRICHTON
IRON	02Aug96	DARREN CRICHTON	LEAD	02Aug96	DARREN CRICHTON
LITHIUM	02Aug96	DARREN CRICHTON	MANGANESE	02Aug96	DARREN CRICHTON
MAGNESIUM	02Aug96	DARREN CRICHTON	MOLYBDENUM	02Aug96	DARREN CRICHTON
NICKEL	02Aug96	DARREN CRICHTON	PHOSPHORUS	02Aug96	DARREN CRICHTON
POTASSIUM	02Aug96	DARREN CRICHTON	SELENIUM	02Aug96	DARREN CRICHTON
SILICON	02Aug96	DARREN CRICHTON	SILVER	02Aug96	DARREN CRICHTON
SODIUM	02Aug96	DARREN CRICHTON	STRONTIUM	02Aug96	DARREN CRICHTON
SULPHUR	02Aug96	DARREN CRICHTON	THALLIUM	02Aug96	DARREN CRICHTON
TIN	02Aug96	DARREN CRICHTON	TITANIUM	02Aug96	DARREN CRICHTON
VANADIUM	02Aug96	DARREN CRICHTON	ZINC	02Aug96	DARREN CRICHTON

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DAVE HAMILTON

WATER ANALYSIS REPORT

The following published METHODS OF ANALYSIS were used:

10301L pH
Electrometric (pH meter)
Ref. APHA 4500-H+

02041L ELECTRICAL COND
Conductance meter
Ref. APHA 2510 B

20103 CALCIUM
ICP spectroscopy @ 317.9 nm
Ref. APHA 3120 B

12102L MAGNESIUM
ICP spectroscopy @ 285.2 nm
Ref. APHA 3120 B

11102L SODIUM

19111 POTASSIUM
Diss.,ICP Spectroscopy, Ref. APHA 3120 B

6304L IRON

6306L SULPHATE
ICP spectroscopy @ 180.7 nm
Ref. APHA 3120 B

17203L CHLORIDE
Automated colorimetry, Thiocyanate
Ref. APHA 4500 Cl-,E

06201L BICARBONATE
Potentiometric titration with standard
acid to pH 8.3 and pH 4.5
Ref. APHA 2320 B

10101 T ALKALINITY
Potentiometric titration with standard
acid to pH 4.5 & pH 8.3. Report as CaCO3
Ref. APHA 2320 B

10602 HARDNESS
Calculation from 2.5*Ca + 4.1*Mg
Reported as CaCO3
Ref. APHA 2340 B

00203 T DIS SOLIDS
SUM OF IONS CALCULATION
Ca + Mg + K + Na + SO4 + Cl + 0.6*T Alk
Ref. APHA 1030 F

NWL4994 IONIC BALANCE

00100 IONIC BALANCE 2
%Diff=(Sum Cations-Sum Anions)/
(Sum Cations+Sum Anions)*100
Ref. APHA 1030 F

07021P TOTAL KJEHL NIT
Total, block digest with K2SO4/HgO
and H2SO4, auto phenate colorimetry.
Ref.US EPA 351.2;Crowther MOE

07557 AMMONIA-N
Automated phenate colorimetry
Ref. APHA 4500 NH3,H

07301 NITRATE-N
Diss., Auto. colorimetry, Cd reduction
Ref. APHA 4500 NO3-E

07205 NITRITE
Automated colorimetry
Ref. APHA 4500 NO2,B

15406 PHOSPHORUS(TOT)
Total,Autoclave with persulphate/H2SO4
Auto. colorimetry with ascorbic acid
Ref. APHA 4500 P,B/E

15103 PHOSPHORUS,DISS
Diss.,Autoclave with persulphate/H2SO4
Auto. colorimetry with ascorbic acid
Ref. APHA 4500 P,E

Method References:

1. APHA Standard Methods for the Examination of Water and Wastewater, American Public Health Assoc., 17th ed.
2. EPA a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, 3rd ed., US EPA, 1986
b. Methods for Chemical Analysis of Water and Wastewater, US EPA, 1983
3. MSS Manual on Soil Sampling and Methods of Analysis, Cdn. Soc. of Soil Science, J. A. McKeague, 2nd ed.

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DAVE HAMILTON

WATER ANALYSIS REPORT

7105L NITRATE&NITRITE
Automated colorimetry Cadmium reduction
Ref. APHA 4500-NO3-,F

6005L TOT ORG CARBON
Auto persulphate/UV digest. Colorimetric
Ref. MOE(Ontario Environment)

6524 OIL AND GREASE
Separatory funnel extr. with Freon.
Analysis by IR spectroscopy @ 2930 cm-1.
Ref. APHA 5520 C

ethod References:

. APHA Standard Methods for the Examination of Water and Wastewater, American Public Health Assoc., 17th ed.

. EPA a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, 3rd ed., US EPA, 1986
b. Methods for Chemical Analysis of Water and Wastewater, US EPA, 1983

. MSS Manual on Soil Sampling and Methods of Analysis, Cdn. Soc. of Soil Science, J. A. McKeague, 2nd ed.

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Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6019

TO:	RLH Environmental Services	**DATE SAMPLED:**	
		DATE RECEIVED:	30-Jul-96
ATTN:	Dave Hamilton	**DATE REPORTED:**	8-Aug-96
		LAB FILE#:	96-08-1475
		Project:	

HYDROCARBON ASSESSMENT - WATER

EDMONTON WO# 116258	1	3	4	7	
LAB #	**W1541**	**W1542**	**W1543**	**W1544**	**Detection**
CLIENT #	**Reno Lk North**	**Reno Lk South**	**Ulu Lake**	**Station 4**	**Limit**
[1]Non-Halogenated Aromatics:					
Benzene	<0.001	<0.001	<0.001	<0.001	0.001
Toluene	<0.001	<0.001	<0.001	<0.001	0.001
Ethylbenzene	<0.001	<0.001	<0.001	<0.001	0.001
Total Xylenes (o, m & p)	<0.001	<0.001	<0.001	0.005	0.001
[1]Total Purgeables (C_5 - C_{10})	<0.01	0.01	<0.01	0.04	0.01
[2]Total Extractables (C_{11} - C_{30}+)	<0.1	<0.1	<0.1	<0.1	0.1

Results expressed in mg/L (ppm)

[1]Assessment as per US EPA Method 8020

[2]Assessment as per Alta. Env. Method A108.0

NORWEST LABS

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Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6019

TO: RLH Environmental Services

ATTN: Dave Hamilton

DATE SAMPLED:
DATE RECEIVED: 30-Jul-96
DATE REPORTED: 8-Aug-96
LAB FILE#: 96-08-1475

Project:

HYDROCARBON ASSESSMENT - WATER

EDMONTON WO# 116258	10	11	12	
LAB #	W1545	W1546	W1547	Detection
CLIENT #	Hood River	Frayned Knot Rvr.	Reno Lk South#1	Limit
[1]Non-Halogenated Aromatics:				
Benzene	<0.001	<0.001	<0.001	0.001
Toluene	<0.001	<0.001	<0.001	0.001
Ethylbenzene	<0.001	<0.001	<0.001	0.001
Total Xylenes (o, m & p)	0.005	0.004	<0.001	0.001
[1]Total Purgeables (C_5 - C_{10})	0.03	0.03	0.01	0.01
[2]Total Extractables (C_{11} - C_{30}+)	<0.1	<0.1	<0.1	0.1

R. Corbet, M.Sc., P. Ag.
Manager - Organics

Results expressed in mg/L (ppm)
[1]Assessment as per US EPA Method 8020
[2]Assessment as per Alta. Env. Method A108.0

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TO:	RLH Environmental Services	**DATE SAMPLED:**	
		DATE RECEIVED:	30-Jul-96
ATTN:	Dave Hamilton	**DATE REPORTED:**	8-Aug-96
		LAB FILE#:	96-08-1475
		Project:	

BTEX
QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Calibration - Check (CC)

	Expected Amt. (ng)	Detected Amt. (ng)	% Rec.	Acceptable Range
Benzene	60.0	62.6	104	80-120
Toluene	60.0	65.3	109	80-120
Ethyl Benzene	60.0	60.4	101	80-120
M & P Xylenes	120.0	122.4	102	80-120
O-Xylene	60.0	56.3	94	80-120

$$\text{Accuracy} = \frac{\text{Ave \% Rec. MS + Ave \% Rec. MSD}}{2} = 96 \text{ \% Accuracy}$$

$$\text{\% RSD} = \frac{\text{Ave \% Rec. MS - Ave \% Rec. MSD}}{\text{\% Accuracy}} = 2.7 \text{ \% RSD}$$

The calculated values are based on matrix spike and duplicate recovery data performed on your samples at the time of analysis.

Date Acquired: Aug7/96 Analyst: Gavin January

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TO:	RLH Environmental Services	**DATE SAMPLED:**	
		DATE RECEIVED:	30-Jul-96
ATTN:	Dave Hamilton	**DATE REPORTED:**	8-Aug-96
		LAB FILE#:	96-08-1475
		Project:	

TOTAL EXTRACTABLE HYDROCARBONS
QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Calibration Check (CC)

	Actual Amt. (ng)	Detected Amt. (ng)	% Rec.
Diesel	8073	7462	92

$$\text{Accuracy} = \frac{\text{Ave \% Rec. MS + Ave \% Rec. MSD}}{2} = 103 \text{ \% Accuracy}$$

$$\text{\% RSD} = \frac{\text{Ave \% Rec. MS - Ave \% Rec. MSD}}{\text{\% Accuracy}} = 1.4 \text{ \% RSD}$$

The calculated values are based on matrix spike and duplicate recovery data performed on your samples at the time of analysis.

Date Acquired: Aug6/96 Analyst: Gavin January

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P.O. NO.
W.O. NO. 3 116257
PAGE 1

RL & L ENV. SERVICES
17312-106 AVENUE
EDMONTON, AB
T5S 1H9

DAVE HAMILTON

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		1 02 RENO LAKE SOUTH	2 UWL ULU WEST LAKE	3 01 ULU LAKE	4 02 ULU LAKE
SALINITY					
pH		6.4	5.6	5.8	5.7
ELECTRICAL COND	dS/m	0.50	2.11	0.52	0.38
SATURATION %	%	90	111	166	154
SOD. ADS. RATIO		0.7	2.6	0.6	0.4
ORGANIC MATTER					
TOT ORG CARBON	%	1.66	5.64	4.90	5.19
ORGANIC MATT %	%	2.95	10.0	8.72	9.24
PHYSICAL					
MOIST.WET WT.	%	91.0	88.9	92.7	90.2
SOLUBLE SALTS					
CALCIUM	meq/L	3.50	10.7	3.11	2.14
CALCIUM	mg/kg	63.2	238	103	66.0
MAGNESIUM	meq/L	0.94	2.94	0.94	0.69
MAGNESIUM	mg/kg	10.3	39.4	18.8	12.8
SODIUM	meq/L	1.08	6.71	0.83	0.49
SODIUM	mg/kg	22.4	171	31.5	17.4
POTASSIUM	meq/L	0.11	0.35	0.18	0.16
POTASSIUM	mg/kg	3.79	15.0	11.4	9.71
SULPHATE-S	meq/L	1.68	6.96	3.57	2.67
SULPHATE-S	mg/kg	24.2	124	94.6	65.9
CHLORIDE	meq/L	0.38	14.2	1.27	0.72
CHLORIDE	mg/kg	12.0	560	74.9	39.5
THEO GYPSUM REQ	t/ac	<0.1	<0.1	<0.1	<0.1
SOIL ORGANICS					
HYDROCARBONS	ug/gm	<10	<10	<10	<10
TRACE ICP 3051					
ALUMINUM	ug/gm	11600	24200	20300	20600
ARSENIC	ug/gm	4.6	23.7	12.6	14.7
ANTIMONY	ug/gm	0.51	2.99	1.54	0.85
BARIUM	ug/gm	66.1	251	130	126
BERYLLIUM	ug/gm	0.389	1.67	2.08	2.12

Lab Manager: _____

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PAGE 2

RL & L ENV. SERVICES
17312-106 AVENUE
EDMONTON, AB
T5S 1H9

DAVE HAMILTON

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		1 02 RENO LAKE SOUTH	2 UWL ULU WEST LAKE	3 01 ULU LAKE	4 02 ULU LAKE
TRACE ICP 3051					
BISMUTH	ug/gm	1.74	7.29	3.26	3.55
CADMIUM	ug/gm	0.139	1.11	1.74	1.89
CALCIUM	ug/gm	2680	4240	2700	2500
CHROMIUM	ug/gm	27.2	46.5	40.4	40.1
COBALT	ug/gm	8.45	80.6	19.3	15.2
COPPER	ug/gm	29.6	424	179	175
IRON	ug/gm	19600	94300	31500	30400
LEAD	ug/gm	7.2	27.7	22.6	22.9
MAGNESIUM	ug/gm	5180	6440	5950	6050
MANGANESE	ug/gm	292	1050	421	313
MERCURY	ug/gm	0.03	0.27	0.11	0.11
MOLYBDENUM	ug/gm	1.57	2.42	2.95	2.87
NICKEL	ug/gm	21.6	115	95.0	94.3
PHOSPHORUS	ug/gm	583	1590	654	609
SELENIUM	ug/gm	0.39	1.48	1.01	<0.15
SILVER	ug/gm	<0.001	<0.001	<0.001	<0.001
SILICON	ug/gm	509	1810	1280	868
STRONTIUM	ug/gm	9.56	24.0	12.6	11.4
THALLIUM	ug/gm	1.06	1.80	1.06	0.27
TITANIUM	ug/gm	510	450	536	531
TIN	ug/gm	<0.15	<0.15	<0.15	<0.15
VANADIUM	ug/gm	32.0	41.8	36.4	35.6
ZINC	ug/gm	60.1	292	427	448

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PAGE 3

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DAVE HAMILTON

SOILS AND SEDIMENTS ANALYSIS REPORT

note HYDROCARBONS ANALYSIS REPORTED ON A DRY WEIGHT BASIS.

PSA ANALYSIS NOT COMPLETED DUE TO INSUFFICIENT SAMPLE SIZE.

Lab Manager: _____

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T5S 1H9

DAVE HAMILTON

SOILS AND SEDIMENTS ANALYSIS REPORT

The following published METHODS OF ANALYSIS were used:

MSS 3.14	pH
MSS 3.26	SOD. ADS. RATIO
MSS 3.21	SATURATED PASTE
MSS 3.26	CALCIUM
MSS 3.26	MAGNESIUM
MSS 3.26	SODIUM
TGR	THEO GYPSUM REQ
EPA3540H	HYDROCARBONS

Soxhlet extraction with Freon; add silica gel. Analysis by IR spectroscopy. Ref. US EPA 3540/EPA 418.1

EPA3051	ALUMINUM
EPA3051	ARSENIC
EPA3051	ANTIMONY
EPA3051	BARIUM
EPA3051	BERYLLIUM
EPA3051	BISMUTH
EPA3051	CADMIUM
EPA3051	CALCIUM
EPA0351	CHROMIUM
EPA3051	COBALT
EPA3051	COPPER
EPA3051	IRON
EPA3051	LEAD
EPA3050	MAGNESIUM
EPA3051	MANGANESE
EPA3051	MERCURY
EPA3051	MOLYBDENUM
EPA3051	NICKEL
EPA3051	PHOSPHORUS
EPA3051	SELENIUM
EPA3051	SILVER
EPA3051	SILICON
EPA3051	STRONTIUM
EPA3051	THALLIUM
EPA3050	TITANIUM
EPA3051	TIN
EPA3051	VANADIUM
EPA3051	ZINC

Method References:

1. APHA Standard Methods for the Examination of Water and Wastewater, American Public Health Assoc., 17th ed.

2. EPA a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, 3rd ed., US EPA, 1986

b. Methods for Chemical Analysis of Water and Wastewater, US EPA, 1983

3. MSS Manual on Soil Sampling and Methods of Analysis, Cdn. Soc. of Soil Science, J. A. McKeague, 2nd ed.

* NORWEST SOIL RESEARCH LTD has been accredited by the STANDARDS COUNCIL of CANADA for specific tests registered with the COUNCIL.

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TO: RLH Environmental Services

ATTN: Dave Hamilton

DATE SAMPLED:
DATE RECEIVED: 30-Jul-96
DATE REPORTED: 7-Aug-96
LAB FILE#: 96-08-1487

HYDROCARBON ASSESSMENT - SOIL

EDM WO#116257	#1	#2	#3	#4	
LAB #	R4269	R4270	R4271	R4272	Detection
CLIENT #	Reno Lk South	ULU W. Lake	01 ULU Lake	02 ULU Lake	Limit
[1]Non-Halogenated Aromatics:					
Benzene	<0.02	<0.02	<0.02	<0.02	0.02
Toluene	<0.02	<0.02	<0.02	<0.02	0.02
Ethylbenzene	<0.02	<0.02	<0.02	<0.02	0.02
Total Xylenes (o, m & p)	<0.02	<0.02	<0.02	<0.02	0.02
[1]Total Purgeables (C_5-C_{10})	1.4	<0.1	<0.1	<0.1	0.1
[2]Total Extractables (C_{11}-C_{30+})	<10	<10	<10	<10	10

R. Corbet. M.Sc., P.Ag.
Manager - Organics

Results expressed in mg/kg (ppm) as received

[1]Assessment as per US EPA Method 8020

[2]Assessment as per Alta. Env. Method A108.0

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		LAB FILE#:	96-08-1487

BTEX
QUALITY ASSURANCE DATA

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Calibration - Check (CC)

	Expected Amt. (ng)	Detected Amt. (ng)	% Rec.	Acceptable Range
Benzene	40.0	42.1	105	80-120
Toluene	40.0	43.9	110	80-120
Ethyl Benzene	40.0	40.8	102	80-120
M & P Xylenes	80.0	81.0	101	80-120
O-Xylene	40.0	39.9	100	80-120

$$\text{Accuracy} = \frac{\text{Ave \% Rec. MS + Ave \% Rec. MSD}}{2} = 96 \text{ \% Accuracy}$$

$$\text{\% RSD} = \frac{\text{Ave \% Rec. MS - Ave \% Rec. MSD}}{\text{\% Accuracy}} = 2.7 \text{ \% RSD}$$

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Date Acquired: Aug6/96 Analyst: Gavin January

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		LAB FILE#:	96-08-1487

TOTAL EXTRACTABLE HYDROCARBONS
QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Calibration Check (CC)

	Actual Amt. (ng)	Detected Amt. (ng)	% Rec.
Diesel	8073	7462	92

$$\text{Accuracy} = \frac{\text{Ave \% Rec. MS + Ave \% Rec. MSD}}{2} = 103 \text{ \% Accuracy}$$

$$\text{\% RSD} = \frac{\text{Ave \% Rec. MS - Ave \% Rec. MSD}}{\text{\% Accuracy}} = 1.4 \text{ \% RSD}$$

The calculated values are based on matrix spike and duplicate recovery data performed on your samples at the time of analysis.

Date Acquired: Aug6/96

Analyst: Gavin January