Environment Canada
Environmental Protection Service
Pacific Region
Yukon Branch

BASELINE STUDY OF THE WATERSHEDS NEAR THE JASON PROPERTY, MACMILLAN PASS, YUKON TERRITORY

Regional Program Report No. 83-08

by

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ABSTRACT

A predevelopment study was undertaken by the Environmental Protection Service in the watersheds near the Jason Property in MacMillan Pass, Yukon in July, 1981.

The presence of ore minerals in the study area was reflected by their presence in water and sediment. The metals of concern when a mine and mill become active will be arsenic, barium, cadmium, copper, manganese, nickel, silver, lead and zinc. The water courses in the area have soft waters with low buffering capacity. The numbers of bottom fauna collected were low.

RÉSUMÉ

En juillet 1981, le Service de la protection de l'environnement a entrepris une étude sur les bassins hydrologiques situés pres de la concession Jason, au col MacMillan (Yukon).

L'analyse de l'eau et des sédiments a révélé la présence de minerais dans la région sur laquelle a porté l'étude. Les minéraux qui seront en cause lorsque la mine et l'usine seront en activité sont l'arsenic, le barium, le cadmium, le cuivre, le manganèse, le nickel, l'argent, le plomb et le zinc. L'eau douce des cours d'eau de la région a une faible capacité comme solution tampon. Lors de l'échantillonnage, la faune benthique s'est révélée peu nombreuse.

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1 INTRODUCTION

A study of water quality, sediment composition and bottom fauna was conducted July 7th to 9th, 1981 by the Environmental Protection Service, Yukon Branch, in the watersheds near the Jason Property. The purpose of the study was to obtain background information on the environmental quality of streams in the vicinity of the Jason Property which is expected to be developed as a mine.

1.1 Background

The original staking of the Jason Property occurred in August, 1974 when a total of forty-four claims were staked for Ogilvie Joint Venture, a consortium of Brinex, Mitsubishi and Ventures West (Marchand et al 1978). Further staking took place from 1975 to 1977 and in 1981. The present owners, Aberford Resources Ltd., became involved in the property in 1979-80 under the name of Pan Ocean Oil Ltd. Property work in the summer of 1975 led to exploratory diamond drilling of seven holes (total of 2100 ft, 640 m) in October, 1975. From 1975 to 1981 extensive and intensive exploratory work was conducted. This exploratory work involved grid soil geochemical sampling, a gravity survey, backhoe trenching, detailed geological mapping and diamond and rotary drilling.

At the time of this study a 100 person camp was set up by Cordilleran Engineering beside Sekie Creek 1 between the North Canol Road and the South MacMillan River. Cordilleran Engineering carried out exploration work on the Jason Property in 1981 for Pan Ocean Oil Ltd.

Metallurgical testing, and further surface diamond drilling are planned for 1982 to 1984 (Stephen, 1982).

Development of the Jason Property as a mine will depend on mineral prices, improvement of the North Canol Road for transportation and development of an energy source. Development will probably only occur if the nearby Tom and Amax properties are developed concurrently. The federal and territorial governments have indicated their intention to improve the North Canol Road within the next few years.

Baseline information on the MacMillan Pass Area has been collected by several groups. General environmental studies include those by: Amax Environmental Services Group, 1976; Gill, 1975; McNicholl (editor) 1980; and Pearson and Associates, 1981. Water quality studies include those by: Brown, 1982; and Monenco Consultants Ltd., 1982. Waterflows, wildlife and/or fish information is reported by: Gill, 1979; and Department of Indian Affairs and Northern Development, 1982. These reports are mentioned as references for additional information but an evaluation of their contents is not a part of this report.

1.2 Mineralization Description

The mineralization on the Jason property was described in an enclosure of W.J. Stephen, 1982 as follows:

> Three mineralized zones have been discovered; the Main Zone, the South Zone, and the End Zone. Minerals present are galena (PbS), sphaelerite (ZnS), pyrrhotite (FeS), siderite ($FeCO_3$), barite ($BaSO_4$), chalcopyrite ($CuFeS_2$), and silver minerals.
>
> The Main Zone has been intersected by a total of 29 diamond drill holes. Indicated reserves are 5.0 million tons (4.5 million tonne) of 2.1% lead and 9.8% zinc.
>
> The South Zone has been intersected by 15 diamond drill holes and contains inferred reserves of 5.7 million ton (5.2 million tonne) of 11.9% lead, 5.2% zinc and 4.7 oz/ton silver (161 gm/tonne Ag).
>
> The End Zone contains inferred reserves of 0.6 million ton (0.5 million tonne) of 10.3% lead, 2.8% zinc and 2.3 oz/ton silver (79 gm/tonne Ag).

2 STUDY AREA

The Jason Property study area is located along the North Canol Road, approximately 218 km (135 miles) northeast of Ross River and 13 km (8 miles) southwest of the Yukon-Northwest Territories Border (Figure 1). The claims lie on both sides of the South MacMillan River. Access to the Jason Property is 619 km (377 miles) by road or 370 km (225 miles) by air from Whitehorse.

Aberford Resources Ltd. is the owner of the Jason Property (Jason, Mike, Ace and J.S. claims). These claims are bordered by Hudson Bay Exploration to the east, Cominco to the north, and Welcome North to the south (Figure 2).

The waterbodies which would be affected by further development of the Jason Property are the South MacMillan River, which runs through the property, and the Hess River to the northwest of the property. Both rivers are part of the Yukon River system. Arctic grayling, chinook salmon, whitefish and slimy sculpins are known to use some reaches of the Hess and South MacMillan rivers. The South MacMillan River is used by recreational canoeists and kayakers. The Hess River is accessible by air only. A preliminary proposal located the mill and physical plant near the South MacMillan River and tailings impoundment near Hoodoo Valley Creek, a tributary of the Hess River (Stephen, 1982).

The study area lies at elevations 1075 m to 1850 m at 63° 10'N, 130° 15'W.

The climate in the Jason Property area is cold, partly because of its northerly location and partly because of its higher elevation. Meteorological data collectd at Tsichu River, N.W.T. (elevation 1265 m) which is approximately 30 km northwest should be comparable to that found at the Jason Property. The 20 year mean annual temperature at Tsichu River was calculated to be -7.7°C with a mean temperature in January of -24.1°C and in July of 10°C. The extreme temperatures recorded from the years of 1975 to 1981 were -51.1°C and 27.2°C. Precipitation is relatively heavy because

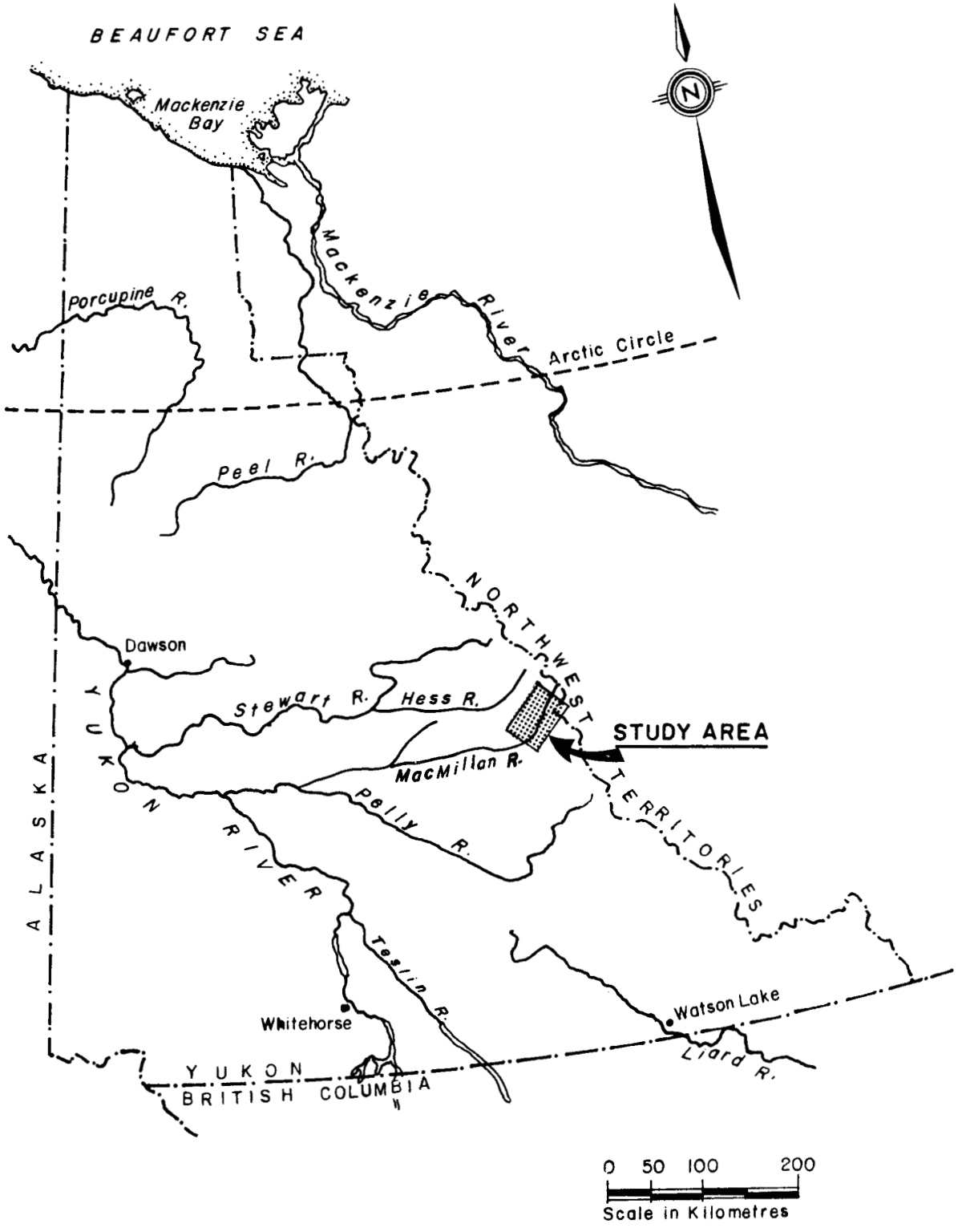

FIGURE 1 LOCATION OF THE JASON PROPERTY STUDY AREA

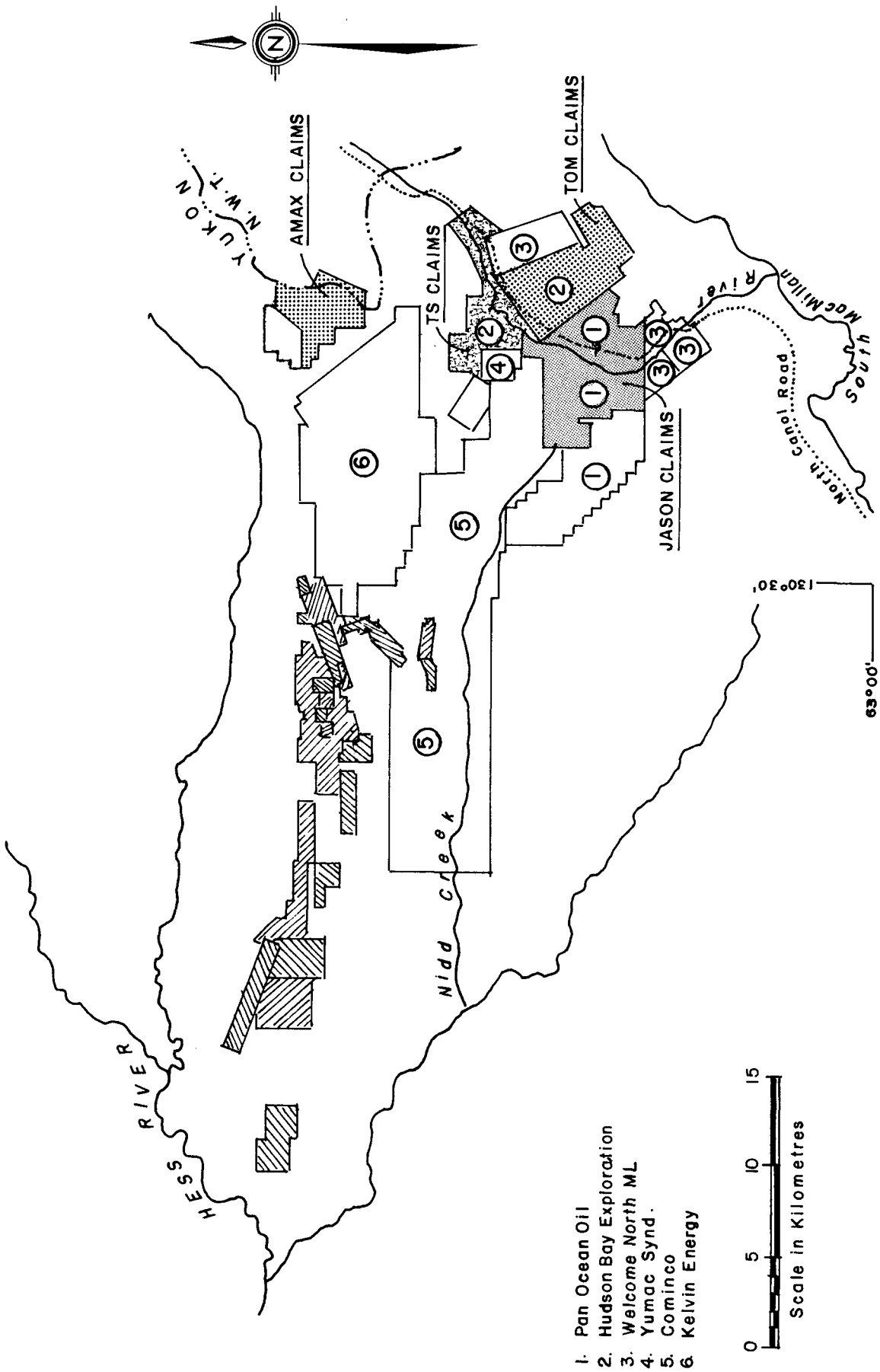

FIGURE 2 LOCATION OF JASON PROPERTY RELATIVE TO OTHER PROPERTIES IN THE MacMILLAN PASS AREA (November 1981)

the Tsichu River and the Jason Property are located on the southwesterly windward slopes of the Mackenzie/Selwyn Mountain Range. The annual precipitation at Tsichu River is near 500 mm. Of this 500 mm, 200 mm falls as rain and 300 mm falls as snow. As a comparison the Whitehorse mean annual temperature is -1.3°C. The mean annual precipitation at Whitehorse is approximately 270 mm which is relatively evenly divided between rain and snow. (Wahl, 1981). Because the Jason Property is in a narrower river valley, it may have slightly greater extremes of temperature than those at Tsichu River.

Sample stations were located on tributaries to both the Hess and South MacMillan Rivers. Samples were taken at ten sites, and their locations are shown in Figure 3. A description of sample sites is provided in Table 1. Sample sites are illustrated by photographs in Figures 4 to 13.

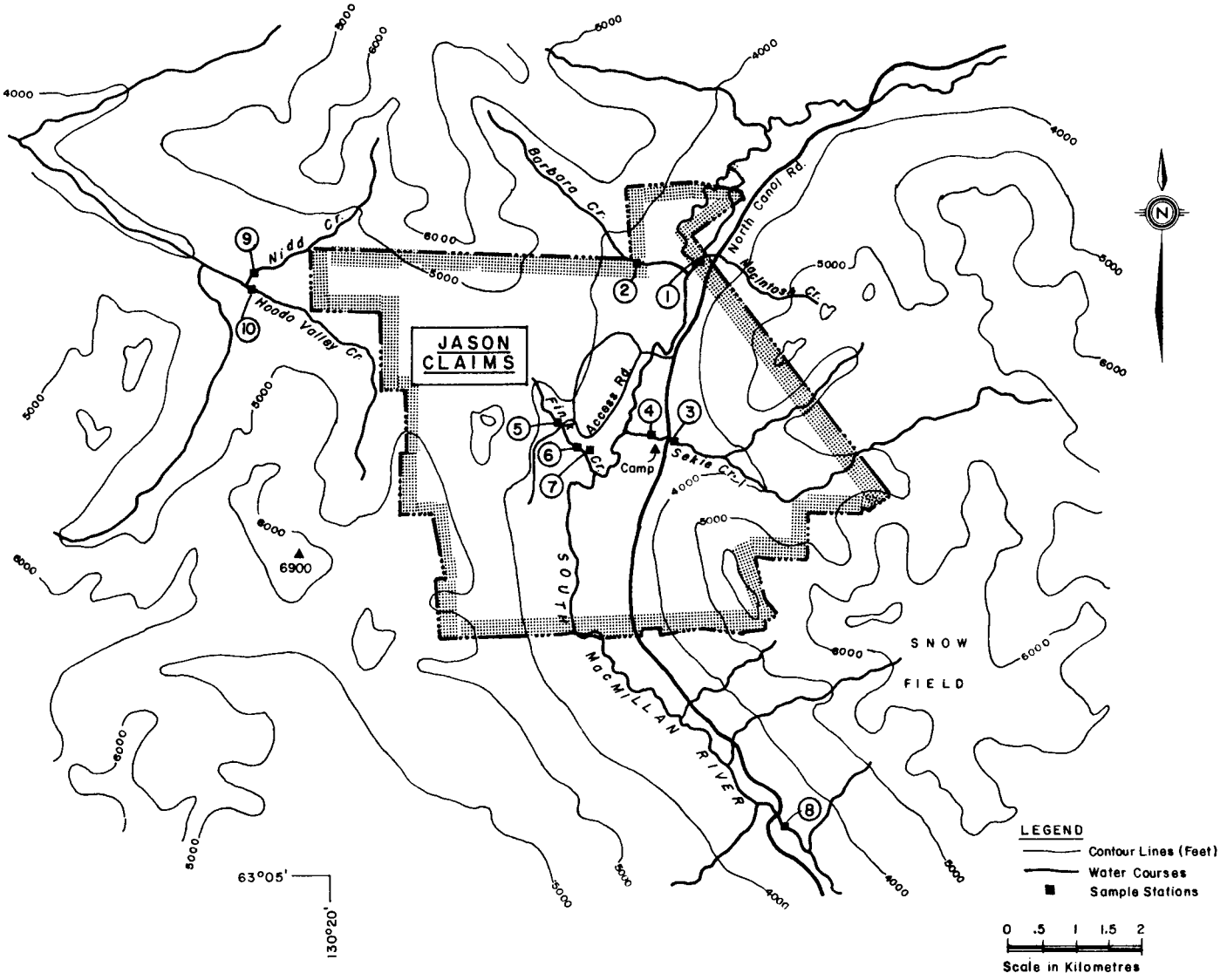

FIGURE 3 JASON PROPERTY STUDY AREA - SHOWING CREEKS, MINERAL CLAIMS, AND SAMPLE STATIONS

TABLE 1 DESCRIPTION OF SAMPLE SITES IN THE JASON PROPERTY STUDY AREA

STATION	LOCATION	STREAM BOTTOM	REMARKS
1	63°10'N 130°13'W on the South MacMillan River at the northern boundary of the Jason claims (southern boundary of Tom claims). Upstream of the influence of the other sample creeks stations 2 through 7. Elevation 1151 m.	Substrate is uniformly composed of medium to large cobbles with sand in interstices. 95% of gravel discarded from sediment sample. Stream velocity was 1.2 m/s.	Stable banks. Vegetation grasses, mosses and buck brush. 0% shaded. River too deep for electrofishing but looks suitable for fish.
2	63°10'N 130°14'W on Barbara Creek. 0.75 km upstream from its confluence with the South MacMillan River. Elevation 1192 m.	Medium cobble to fine gravels. Some submerged mosses indicating recent water level increase. Stream velocity was 1.5 m/s.	Lush growth of grasses and buck brush. 5% shaded. Not suitable for electrofishing but looks suitable for fish. Upstream reaches are very steep with many cascades which may be a barrier to fish passage.
3	63°08'N 130°13'W on Sekie Creek 1, upstream of the bridge and upstream of the 1981 Jason exploration camp. Elevation 1175 m.	Large river rounded boulders, mixed with coarse to fine gravels. 50% of gravel discarded from sediment sample. Stream velocity was 2 m/s.	Lush growth of buck brush, grasses and moss. 0% shaded. Not suitable for electrofishing because of fast flow.
4	63°08'N 130°13'W. 300 m downstream from Station 3 on Sekie Creek 1. Downstream from 1981 Jason exploration camp. Elevation 1158 m.	Medium boulders midstream decreasing to medium gravels at creek periphery. Moss holds bottom gravels together. Stream velocity was 2 m/s.	Spruce, tall buck brush and grasses on stable braided channels. 10% shaded. Not suitable for electrofishing but looks suitable for fish.
5	63°08'N 130°16'W. 0.5 km downstream from Rat Lake on Fink Creek and 1.75 km upstream of its confluence with South MacMillan River. Upstream of the influence of exploration activities. Elevation 1275 m.	Large gravel to fine sand covered with red precipitate. Intertwined roots in braided channel. Stream velocity was .6 m/s.	Grasses, horsetail and willow overhang creek. 50% shaded.

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APPENDIX ~~5.2~~ 6.2 CADMIUM CONCENTRATIONS IN SURFACE WATERS OF YUKON TERRITORY

	LOCATION			DATE	NUMBER OF SAMPLES	TOTAL Cd CONCENTRATION(ug/L)		REFERENCE
	DESCRIPTION	LATITUDE	LONGITUDE			Geometric Mean[1]	Range	
1				July 81	1	3.0 L		41
2						<1.0 L		
3						<1.0 L		
4						<1.0 L		
5						<1.0 L		
6						<1.0 L		
7	Flow from drill hole entered on Marie Lake.	63 08	130 16			<1.0		
8						3.1 L		
9						<1.0 L		
10						<1.0 L		

APPENDIX 82 / 87 CADMIUM CONCENTRATIONS IN SEDIMENTS OF ~~BRITISH COLUMBIA~~ YUKON

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LOCATION				DATE	NUMBER OF SAMPLES	CADMIUM CONCENTRATION (mg/kg Dry Weight)		REFERENCE
SITE NO.	DESCRIPTION	LATITUDE	LONGITUDE			MEAN[1]	RANGE	
1				July 81	3 combined	5.497	4.84 - 6.13	5.50
2					3 ✓	7.12	6.90 - 7.28	7.18
3					3 ✓	0.567	<0.56 - <0.57	<0.61
4					3 ✓	0.573	<0.57 - <0.58	<0.67
5					3 ✓	5.28	1.64 - 7.75	4.45
6					3 ✓	2.13	1.79 - 2.73	1.87
8					3 ✓	3.867	3.79 - 4.00	3.81
9					3 ✓	7.243	6.33 - 7.95	7.45
10					3 ✓	6.92	5.34 - 9.11	6.31

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TABLE 1 DESCRIPTION OF SAMPLE SITES IN THE JASON PROPERTY STUDY AREA (Continued)

STATION	LOCATION	STREAM BOTTOM	REMARKS
6	63°08'N 130°16'W on Fink Creek 0.5 km downstream from Station 5. Downstream of most exploration activities. Elevation 1228 m.	Small boulders with some gravel and silt. Stream velocity was 1.2 m/s.	Stable banks with a lush growth of buck brush and mosses. 90% shaded. Not suitable for electrofishing. Weir just downstream of station is probably barrier to fish.
7	63°08'N 130°16'W flow from drill hole (#DDH 79-51A). Water runs into creek 50 m downstream of station #6. Elevation 1209 m.		Contact with air causes water to deposit rusty-red sediment on ground.
8	63°05'N 130°12'W on the South MacMillan River 10 and 4 km downstream from the northern and southern Jason Boundaries respectively and thus affected by creeks sampled at stations 2 to 7. Elevation 1075 m.	Large boulders to medium cobbles and sand. Sediment taken in lee of a boulder. Stream velocity was 2 m/s.	Stable banks with willows, grasses and some spruce. 0% shaded. Not suitable for electrofishing.
9	63°09'N 130°22'W on Nidd Creek at the western Jason boundary and 70 m upstream from its confluence with Hoodoo Valley Creek. Drains west to Hess River. Elevation 1220 m.	Stream bottom composition is boulders and coarse to fine gravel. Sediment samples taken from gravel bar which represent 5% of creek bottom. Stream velocity was 1.3 m/s.	Stable banks with grasses, willows, mosses and spruce. 85% shaded. Not suitable for electrofishing.
10	63°09'N 130°22'W Hoodoo Valley Creek at western Jason Boundary, 20 m upstream from its confluence with Nidd Creek which drains west to Hess River. Elevation 1200 m.	A majority of the creek bottom is small boulders and medium gravels. 50% of gravel was discarded from sediment sample. Stream velocity was 1 m/s.	Banks stable with mosses, grasses, willows and spruce. 0% shaded. Not suitable for electrofishing.

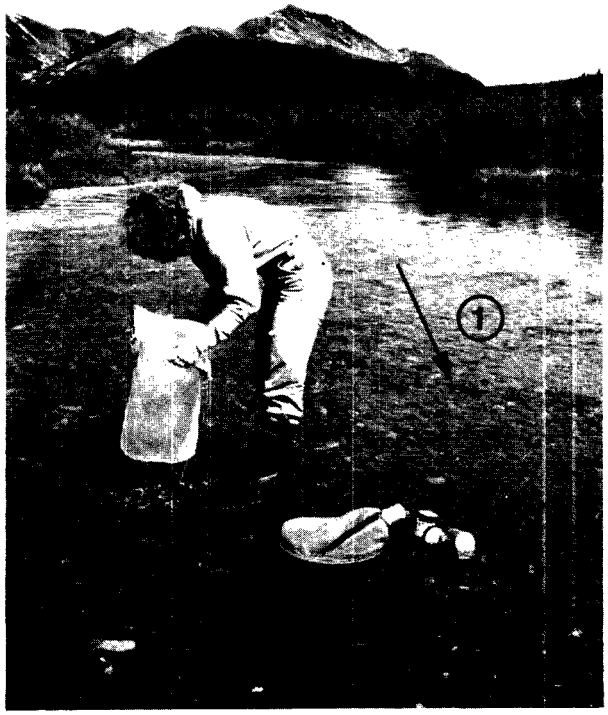

FIGURE 4 STATION #1 - SOUTH MACMILLAN RIVER LOOKING UPSTREAM. VEGETATION CONSISTS OF WILLOW, GRASSES AND BUCKBRUSH.

FIGURE 5 STATION #2 - BARBARA CREEK LOOKING DOWNSTREAM. A LUSH GROWTH OF WILLOWS AND POPLARS SHADES THE CREEK.

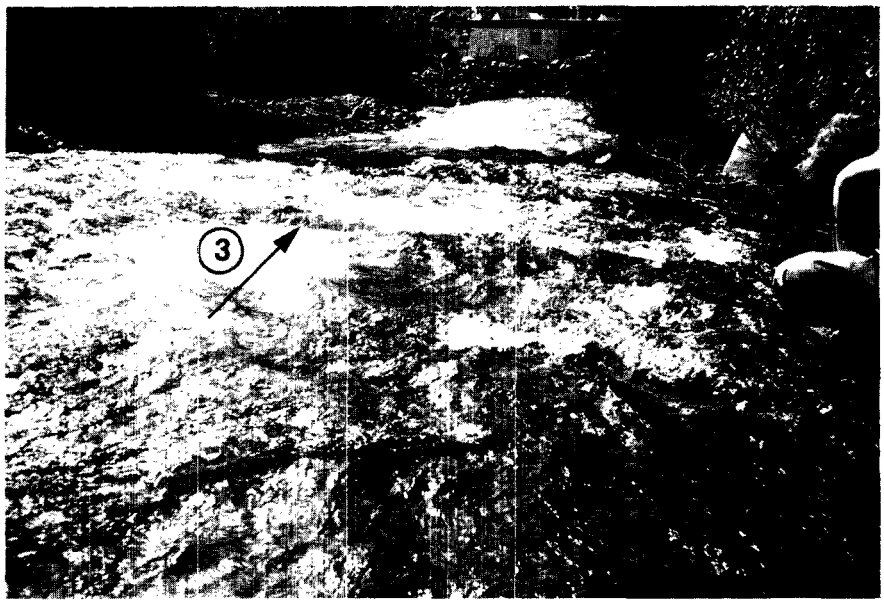

FIGURE 6 STATION #3 - SEKIE CREEK #1 LOOKING DOWNSTREAM TO NORTH CANOL ROAD AND JASON PROPERTY EXPLORATION CAMP

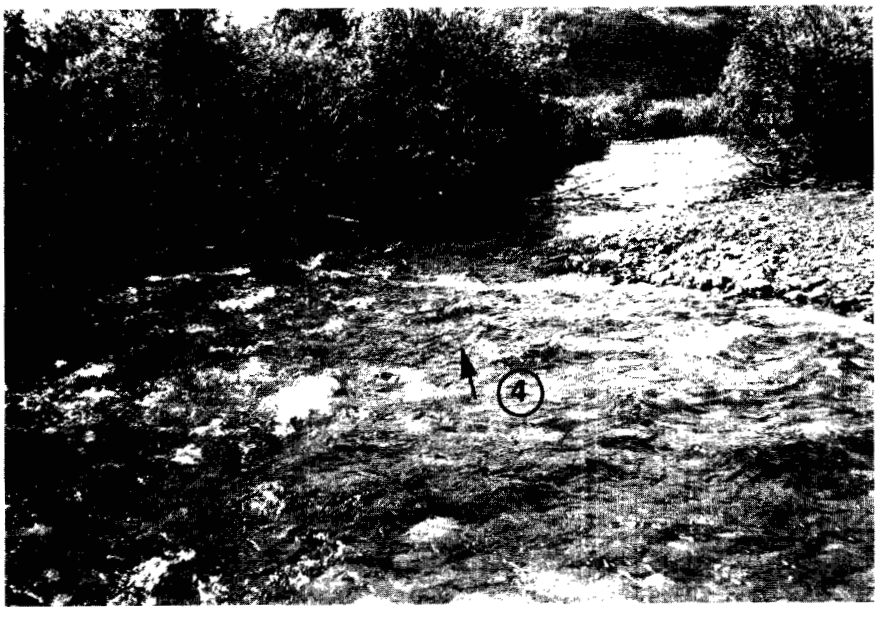

FIGURE 7 STATION #4 - SEKIE CREEK #1 DOWNSTREAM OF JASON PROPERTY EXPLORATION CAMP. TALL WILLOWS AND POPLARS PARTIALLY SHADE CREEK.

FIGURE 8 STATION #5 - FINK CREEK UPSTREAM OF ALL EXPLORATION ROADS. CREEK BED OVERGROWN WITH WILLOWS.

FIGURE 9 STATION #6 - FINK CREEK DOWNSTREAM OF MOST EXPLORATION ACTIVITIES. COMPLETELY SHADED BY WILLOWS GROWING ON BANKS.

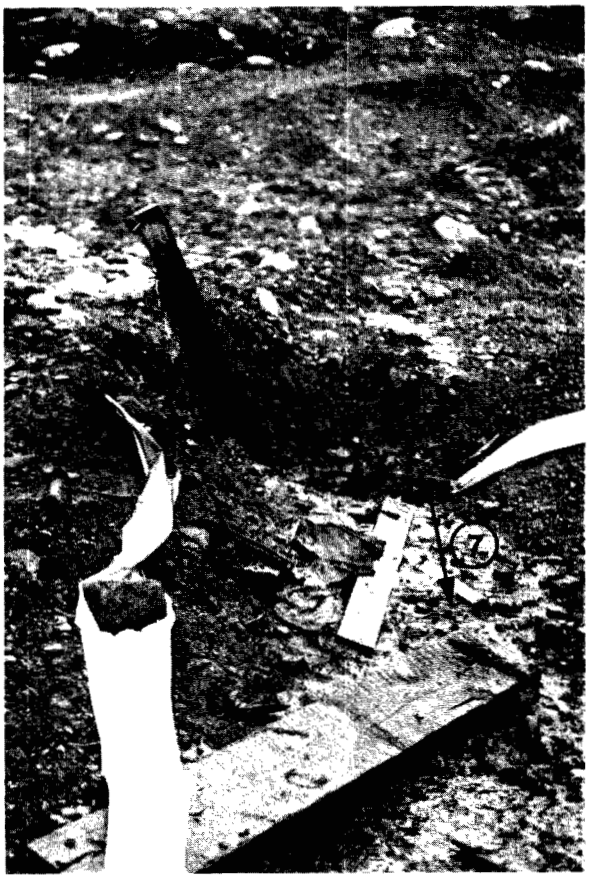

FIGURE 10 STATION #7 - FLOWING DRILL HOLE #DDH-79-51A. WATER TURNS GROUND RUSTY AS IT FLOWS TO JOIN FINK CREEK DOWNSTREAM OF STATION #6.

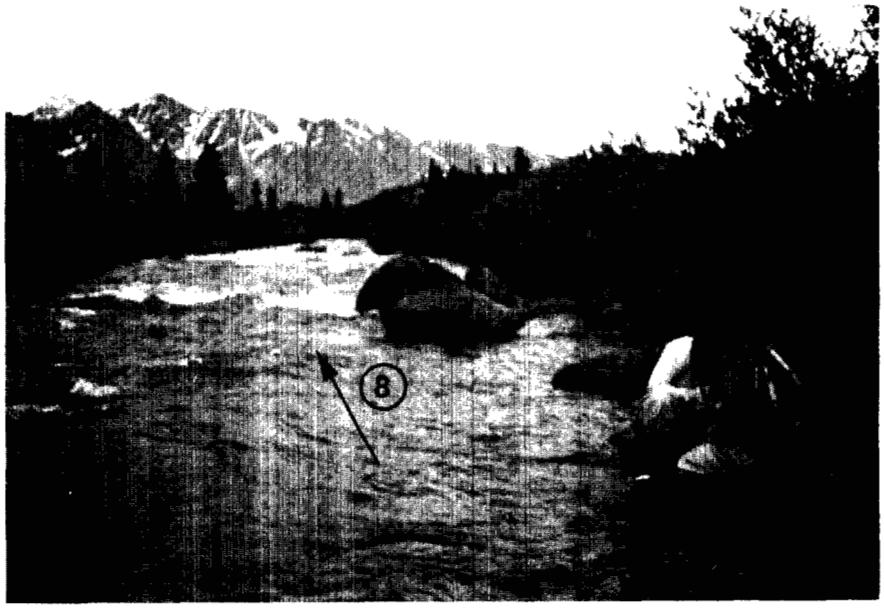

FIGURE 11 STATION #8 - SOUTH MACMILLAN RIVER 70 METRES DOWNSTREAM OF SOUTH MACMILLAN BRIDGE #2 ON THE NORTH CANOL ROAD.

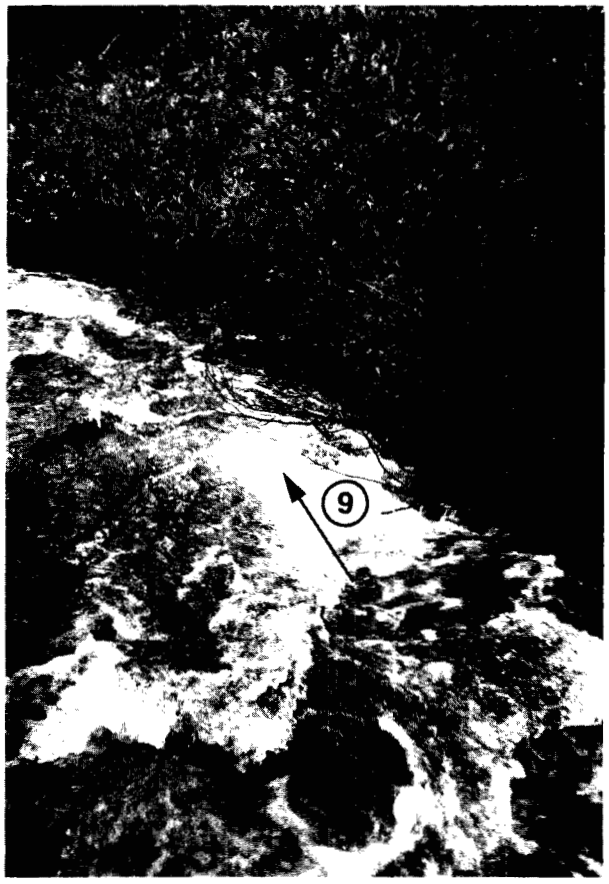

FIGURE 12 STATION #9 - NIDD CREEK 70 METRES UPSTREAM FROM IT'S CONFLUENCE WITH HOODOO VALLEY CREEK. GRASSES, WILLOWS AND A FEW SPRUCE TREES SHADE CREEK BED.

FIGURE 13 STATION #10 - HOODOO VALLEY CREEK 20 METRES UPSTREAM FROM IT'S CONFLUENCE WITH NIDD CREEK. VEGETATION CONSISTS OF GRASSES, WILLOWS AND A FEW SPRUCE WHICH DO NOT SHADE CREEK BED.

3 METHODS

Access to sample sites 1, 3, 4, 5, 6, 7 and 8 was by truck, and to sample sites 2, 9 and 10 by helicopter. Each station was sampled once during the period July 7, 8, and 9, 1981.

3.1 Water Quality

Water samples were collected and preserved at each of the ten (10) sample sites as described in Appendix I, Table 1. Water samples were collected from Station 1 on July 7, 1981, Stations 2, 3, 4, 8, 9 and 10 on July 8, 1981 and Stations 5, 6, and 7 on July 9, 1981.

Temperature, pH, flow and conductivity were measured in the field by the Environmental Protection Service staff. Dissolved Oxygen (DO) was measured in camp at MacMillan Pass. All other water quality analysis were done by Laboratory Services, Environmental Protection Service, 4195 Marine Drive, West Vancouver, B.C. Analytical methods are described in Appendix I, Table 1.

Water samples were collected and preserved for analysis of conductivity, pH, colour, turbidity, filterable residue (FR), non-filterable residue (NFR), total alkalinity, total hardness, total phosphates, nitrite, nitrate, ammonia, sulphate, cyanide, chloride and the following extractable metals:

Aluminum (Al)	Copper (Co)	Selenium (Se)
Antimony (Sb)	Iron (Fe)	Silicon (Si)
Arsenic (As)	Lead (Pb)	Silver (Ag)
Barium (Ba)	Magnesium (Mg)	Sodium (Na)
Beryllium (Be)	Manganese (Mn)	Strontium (Sr)
Cadmium (Cd)	Mercury (Hg)	Tin (Sn)
Calcium (Ca)	Molybdenum (Mo)	Titanium (Ti)
Chromium (Cr)	Nickel (Ni)	Vanadium (V)
Cobalt (Co)	Potassium (K)	Zinc (Zn)

The percent dissolved oxygen (% DO) saturation was calculated by first determining the dissolved oxygen saturation concentration (S') from the formula:

$$S' = S \frac{P}{760} \quad \text{(APHA et al 1975)}$$

where S' = dissolved oxygen (DO) saturation concentration at the in situ temperature and atmospheric pressure

S = DO saturation concentration at sea level for in situ temperature

P = atmospheric pressure in mm of mercury (mm Hg) at site elevation

The percent dissolved oxygen saturation was obtained by using the ratio of field dissolved oxygen and S' in the following formula:

$$\frac{\text{Field DO}}{S'} \times 100 = \% \text{ DO Saturation}$$

Field DO = Dissolved Oxygen concentration measured in the field.

3.2 Sediments

Sediment samples were collected at the same time as water samples. Sediments were not collected from Station 7 (drill hole DDH 79-5IA). Four sediment samples were collected at each site, using an aluminum shovel to scoop the samples into labelled Whirl Pak bags. A description of sediment collecton, preparation and analysis methods is given in Appendix I, Table 2. All sediment samples were shipped to Vancouver by air for analysis at Laboratory Services, Environmental Protection Service, 4195 Marine Drive, West Vancouver, B.C.

One sediment sample per station was analysed for cyanide concentration. The other three sediment samples were each analyzed for particle size and the following leachable metals:

Aluminum (Al)	Iron (Fe)	Selenium (Se)
Antimony (Sb)	Lead (Pb)	Silicon (Si)
Arsenic (As)	Magnesium (Mg)	Silver (Ag)
Barium (Ba)	Manganese (Mn)	Sodium (Na)
Beryllium (Be)	Mercury (Hg)	Strontium (Sr)
Cadmium (Cd)	Molybdenum (Mo)	Tin (Sn)
Calcium (Ca)	Nickel (Ni)	Titanium (Ti)
Chromium (Cr)	Phosphorus (P)	Vanadium (V)
Copper (Cu)	Potassium (K)	Zinc (Zn)

3.3 Bottom Fauna

Bottom fauna were sampled at nine of the ten Environmental Protection Service sampling stations at the same time as water and sediment. Station 7 (drillhole DDH 79-51A) was omitted because of its unsuitability for bottom fauna. Three samples were collected at each site using a 30 cm x 30 cm Surber sampler (total area, 900 cm^2) with a mesh size of 0.76 mm. Bottom fauna collection, preservation and identification methods are given in Appendix I, Table 3.

Diversity indices were calculated from the bottom fauna data collected, using the formula described by Pielou (1975) as follows:

$$\text{Species Diversity } (H') = -\sum_{i=1}^{g} (P_i \log_{10} P_i)$$

where $P_i = n_i/N$

n_i = total number of individuals in the ith genus in one sample

N = total number of individuals identified to genus and/or species taxonomic level in one sample

g = total number of genera in one sample

The use of individuals identified to genus level instead of to species level results in slightly lower diversity indices (H') values (Hughes, 1978). Individuals that were not identified to genus or species level were not included in the Species Diversity calculation but are listed in Appendix IV Tables 1 and 2.

3.4 Fish

The study objective was to collect fish by electrofishing to obtain tissue samples for metals analysis. None of the station sites were suitable for electrofishing because they were too deep and/or too fast or were obstructed with intertwined willows. Notes were made on suitability of sample streams as fish habitat.

4 RESULTS AND DISCUSSION

4.1 Water Quality

Jason Property water quality data is listed in Appendix II. Detection limits and analytical procedures for water quality are found in Appendix I, Table 1. All values were compared to the recommended levels for drinking water and aquatic life which are listed in Appendix I, Table 4.

The only parameters to exceed drinking water criteria were ammonia (NH_3-N), arsenic (As), iron (Fe), and manganese (Mn). The stations at which these parameters were exceeded are listed below. All of these parameters were exceeded at station 7 (artesian drill hole). Iron concentrations were exceeded at station 5 and 6 on Fink Creek and stations 1 and 8 on the South MacMillan River. Manganese concentrations were slightly exceeded at stations 1, 6 and 9. The concentrations of all these parameters reflect drilling operations and/or the presence of minerals containing them in the Jason Property area. All measurements of selemium (Se) in the study area were below the analysis detection limit of 0.075 mg/l Se, although this detection limit is above the recommended drinking water level of 0.01 mg/l Se.

The total organic carbon analysis on Sekie Creek 1 above and below the exploration camp showed no increase below the camp suggesting that waste water from the camp was not reaching Sekie Creek 1.

A review of Jason water quality data indicates that 10 parameters of the 45 measured differed from recommended levels for aquatic life. At Stations 3 and 4 (Sekie Creek 1) conductivity and filterable residue are low for supporting healthy aquatic life. Total phosphate was elevated at Station 6 (Fink Creek) and Station 7 (artesian drill hole) probably because of its presence in ore or in drilling materials. The iron level at Station 7 was elevated thirty times over the recommended aquatic life limit of 1.0 mg/l. Iron concentrations were also slightly exceeded in the South MacMillan River (Station 1). Arsenic levels were exceeded at Station 7. Aluminium

levels were high in all sample streams except Barbara Creek (Station 2) and the artesian drill hole (Station 7). Cadmium concentration was high in the South MacMillan River. Copper was high only in Nidd Creek (Station 9) reflecting its presence in ore minerals. Nickel concentrations were high in the South MacMillan River and the artesian drill hole (Station 7). Zinc concentrations were slightly elevated in Sekie Creek 1 and Hoodoo Valley Creek, high in the South MacMillan River and Fink Creek, and very high in the artesian drill hole reflecting the presence of zinc in the ore body.

Exploration activities on the Jason Property have affected Fink Creek as was illustrated by the higher levels of turbidity, conductivity, total phosphate, ammonia, potassium and zinc in downstream Fink Creek Station 6 when compared to upstream Station 5. Turbidity was increased by erosion of roads and clearings. The other parameters were probably increased by flows from artesian drill holes such as the one at Station 7.

Parameters such as aluminum, cadmium, iron, nickel and zinc are already slightly elevated over aquatic life limits in the South MacMillan River. The softness and low mineral content in the South MacMillan River and all the creeks sampled make their aquatic environments particularly sensitive to the discharge of metals which could occur when a mine and mill are developed.

4.2 Sediments

4.2.1 Sediment Metal Concentrations. Sediment metal concentrations are given in Appendix III, Table 1. Many metals are present in high concentrations reflecting the minerals present in the area. The presence of some of these metals has already been noted in the water quality results. Further disturbance and future mine and mill development may cause the leaching of other metals to the aquatic environment.

Sediment metals concentrations were compared to those in other Yukon streams as given in Mathers et al 1981. Metals that were higher are shown for each station in Table 2.

4.2.2 Sediment Particle Size Analysis. The results of the sediment particle size analysis are given in Appendix III, Table 2. As stated in Table 1, Description of Sample Sites, stream bed composition included boulders, cobbles and gravels at some sites. When sediment samples were taken all material larger than 2 cm was discarded. These larger materials make it difficult to take representative samples. Therefore, the particle size distribution data must be evaluated with caution, keeping in mind the station description information. Most of the sediment samples were coarse with a high percentage of the particles larger than 150 um. Station 6 (Fink Creek) had the finest sediment with 23% finer than 149 um. Only the screened portion of sediment smaller than 149 um was analysed for metals since these particles are judged to have the most effect on the aquatic environment. Therefore Station 6 sediment would have the most effect on the aquatic environment since it had the most fine particles and was also high in metals compared to other Yukon streams (Mathers et al 1981).

4.3 Bottom Fauna

A taxonomic list of bottom fauna collected in the Jason Property study is given in Appendix IV, Table 1. Appendix IV, Table 2 lists the numbers of individuals in each taxonomic group in each sample, and the diversity index for that sample. A summary of Jason Property bottom fauna numbers and diversity is given in Table 3.

The diversity index is a measure of community structure and relative stability. Communities of high diversity are characterized by large numbers of species with no single species overwhelmingly abundant. Communities of low diversity contain few species, some of

TABLE 2 JASON PROPERTY STATIONS WITH HIGHER SEDIMENT METALS CONCENTRATIONS THAN OTHER YUKON STREAMS

Station	Location	High metal concentrations
1	South MacMillan River	As, Ba, Cd, Cu, Ni, Pb, Zn
2	Barbara Creek	Ba, Cd, Cu, Mg, Mn, Ni, Zn
3	Sekie Creek 1	As, Ba, Cu, Ni, Zn
4	Sekie Creek 1	As, Ba, Cu, Ni, Zn
5	Fink Creek	As, Ba, Cd, Cu, Fe, Mn, Ni, Zn
6	Fink Creek	Ba, Cd, Cu, Ni, Pb, Zn
8	South MacMillan River	As, Ba, Cd, Cu, Ni, Pb, Zn
9	Nidd Creek	As, Ba, Cd, Cu, Mn, Ni, Pb, Zn
10	Hoodoo Creek	As, Ba, Cd, Cu, Ni, Zn

TABLE 3 SUMMARY OF JASON PROPERTY BOTTOM FAUNA NUMBER AND DIVERSITY INDICES

STATION NUMBER	DIVERSITY (H')	NUMBER PER FT^2	CALCULATED NUMBER PER M^2
1-1	0	0	0
1-2	0.48	3	32
1-3	0.28	3	32
2-1	0.73	115	1237
2-2	0.57	113	1216
2-3	0.68	76	818
3-1	0	7	75
3-2	0.42	10	108
3-3	0	5	54
4-1	0.48	8	86
4-2	0.48	7	75
4-3	0.28	5	54
5-1	0.88	56	603
5-2	0.89	16	172
5-3	0.53	31	334
6-1	0.45	36	387
6-2	0.43	14	151
6-3	0.42	29	312
8-1	0	1	11
8-2	0	3	32
8-3	0	1	11
9-1	0.52	19	204
9-2	0.60	46	495
9-3	0.41	103	1108
10-1	0.30	3	32
10-2	0.85	19	204
10-3	0	1	11

which are represented in disproportionately high numbers. High diversity is characteristic of undisturbed, unpolluted waters. Low diversity is often associated with disturbed, stressed or polluted waters.

The diversity indices and numbers per ft^2 in most of this study area are lower than those reported for other alpine streams in the Yukon by Archibald et al, 1981. It may be helpful to note that diversity is calculated using $\log_{10}$ and that a diversity of 0.90 in $\log_{10}$ equals a diversity of 3.0 in $\log_2$. Barbara Creek (Station 2) was the only station with values for diversity and numbers similar to those found by Archibald et al (1981) in the nearby Howards Pass area.

It is thought that the other streams sampled at the Jason Property have a low capability to support bottom fauna and indirectly fish populations. This is supported by the low hardness and conductivity of these waters and the cold climate which have been linked to low productivity as well as the cold climate.

A total of 624 bottom fauna were collected in the Jason Property study area. The numbers of individuals from the three samples taken at each sample station varied greatly. Stations 1 and 8 (South MacMillan River) had the lowest counts with six and five individuals respectively. Station 2 far surpassed all other station counts with a total of 304 individuals or 49% of the total bottom fauna collected.

The most abundant genera were Baetis with 190 individuals collected and Cinygmula with 114 individuals collected. Both of these genera fall into the order Ephemeroptera, Phylum Arthropoda. A review of taxonomic groups found at Jason and at Howard's Pass (Archibald, et al, 1981) shows that eleven of the twenty-three found in the Jason study were common to both. However 54 taxonomic groups were identified at Howards Pass as opposed to 23 in the Jason study.

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APPENDICES

APPENDIX I

COLLECTION, PRESERVATION, ANALYSIS OR IDENTIFICATION METHODS AND WATER QUALITY CRITERIA

APPENDIX I TABLE 1 WATER SAMPLE COLLECTION, PRESERVATION AND ANALYSIS METHODS

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE[1]	ANALYTICAL PROCEDURE	METHOD SECTION[2]
Temperature		In situ temperature reading.	Standard Centigrade Thermometer	
Flow		Flow measurements taken for general evaluation purposes only.	Cross-section of stream was estimated and the velocity of flow was measured by noting the time it took a twig to travel a given length of the stream, i.e., 5 m. Flow measurement given in m^3/s.	
Dissolved Oxygen	1.00 mg/l	Duplicate samples collected in 300 ml glass BOD bottles. The BOD bottles were rinsed 3 times with sample before filling. Preserved with 2 ml manganese sulphate and 2 ml alkali-iodide-azide solution and shaken 15 times. A water seal was maintained and DO analysis was done within 7 days.	Iodometric Azide Modification Winkler Titration Method	048
pH		Small aliquots of sample were taken and read soon after collection. No preservative.	Potentiometric	080
Conductivity	0.2 umhos/cm	In situ measurement. Laboratory measurement. No preservative. The measurement was taken from the same as NH_3 below.	YSI Conductivity Meter Model 33 Radiometer Conductivity Meter (CDMC) with radiometer conductivity cell.	044

APPENDIX I TABLE 1 WATER SAMPLE COLLECTION, PRESERVATION AND ANALYSIS METHODS (continued)

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE[1]	ANALYTICAL PROCEDURE	METHOD SECTION[2]
Ammonia NH_3-N	0.0050 mg/l	Single samples collected in 2 litre linear polyethylene containers. The container was rinsed 3 times with sample before it was filled. No preservatives. Stored at 4°C.	Phenol Hypochlorite-Colorimetric-Automated	058
Colour	5 (colour units)	Same sample as NH_3.	Platinum-Cobalt Visual Comparison	040
Turbidity	1.0 (FTU)	Same sample as NH_3.	Nephelometric Turbidity	130
Non-Filterable Residue (NFR)	5.0 mg/l	Same sample as NH_3.	Filtration, drying and weighing of residue on filter	104
Filterable Residue (FR)	10.0 mg/l	Same sample as NH_3.	Filtration, drying and weighing of filtrate	100
Total Alkalinity	1.0 mg/l as $CaCO_3$	Same sample as NH_3.	Potentiometric Titration	006
Total Organic Carbon (TOC)	1.0 mg/l	Single samples collected in 100 ml glass jars. No preservative. Stored at 4°C.	Carbon Infra-red Analyzer	016
Total Inorganic Carbon (TIC)	1.0 mg/l	Same sample as TOC	Carbon Infra-red Analyzer	016
Total Phosphate T PO_4-P	0.0050 mg/l	Same sample as NH_3.	Acid-persulphate, Autoclave Digestion	086

APPENDIX I TABLE 1 WATER SAMPLE COLLECTION, PRESERVATION AND ANALYSIS METHODS (continued)

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE[1]	ANALYTICAL PROCEDURE	METHOD SECTION[2]
Nitrite NO_2-N	0.0050 mg/l	Same sample as NH_3.	Diazotization-Colorimetric-Automated	070
Nitrate NO_3-N	0.010 mg/l	Same sample as NH_3.	Cadmium Copper Reduction Colorimetric Automated	072
Sulphate SO_4	1.00 mg/l	Same sample as NH_3.	Barium Chloranilate -UV Spectrophotometric	122
Chloride Cl	0.50 mg/l	Same sample as NH_3.	Thiocyanate-Combined Reagent-Colorimetric	024
Cyanide CN	0.03 mg/l	Sample was collected in a 1 litre nalgene wide mouth bottle, which was rinsed 3 times with sample before filling. The sample was preserved with NaOH pellets to pH >12 and stored at 4°C.	Tetracyanonickelate (II) - UV - Colorimetric	032
Silica Total Si	0.50 mg/l	Same sample as NH_3.	Ascorbic Acid Reduction - Colorimetric	118
Mercury Total Hg	0.00020 mg/l	Single samples were collected in a 200 ml linear polyethylene bottle. Preserved with a 10 ml nitric dichromate solution.	Open Flameless System for Hg-AAS Determination	211 224 284 411

APPENDIX I TABLE 1 WATER SAMPLE COLLECTION, PRESERVATION AND ANALYSIS METHODS (continued)

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE[1]	ANALYTICAL PROCEDURE	METHOD SECTION[2]
Extractable Metals	mg/l	Single samples collected in 200 ml linear polyethylene bottles. The bottle was rinsed 3 times with sample before filling. Preserved to a pH <1.5 using 2.0 ml concentrated HNO_3.	Inductively Coupled Argon Plasma (ICAP) combined with Optical Emission Spectrometer (OES)	210 592
Al	0.050			
As	0.075			
Ba	0.0015			
Be	0.0010			
Ca	0.050			
Cd	0.0040			
Co	0.0075			
Cr	0.0075			
Cu	0.0050			
Fe	0.0050			
Mg	0.10			
Mn	0.0010			
Mo	0.015			
Na	0.050			
Ni	0.040			
Pb	0.040			
Sb	0.040			
Se	0.075			
Sn	0.10			
Sr	0.0020			
Ti	0.0040			
V	0.020			
Zn	0.0050			

APPENDIX I TABLE 1 WATER SAMPLE COLLECTION, PRESERVATION AND ANALYSIS METHODS (continued)

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE[1]	ANALYTICAL PROCEDURE	METHOD SECTION[2]
Cd	0.0010	Same sample as metals.	Graphite Atomic Absorption Flameless Technique (AAS)	Atomic Absorption Jerrel-Ash 850 Manual
Cu	0.0010	Same sample as metals.		
Pb	0.0010	Same sample as metals.		
Zn	0.0010	Same sample as metals.		
Ag	0.030 mg/l	Same sample as metals.	Flame Atomic Absorption Spectrophotometry	210 290
K	0.010 mg/l	Same sample as metals.	Flame Atomic Emission Spectrophotometry	210 423
Total Hardness	0.030 mg/l as $CaCO_3$	Same sample as metals.	The sum of the ICAP results for Mg x 4.116 and Ca x 2.497 reported as mg/l $CaCO_3$	

1 As described in Environment Canada (1976).

2 As described in Department of Environment (1979).

APPENDIX I TABLE 2 SEDIMENT COLLECTION, PREPARATION AND ANALYSIS METHODS

PARAMETER	COLLECTION/PREPARATION	ANALYSIS	METHOD CODE[1]
All Parameters	Creek and River Stations: Sediment samples were collected using an aluminum shovel to scoop sample into pre-labelled Whirl-Pak bags. Four samples were taken at each station. Material larger than 2 cm was discarded. Samples were kept cool and were frozen (-19°C) as soon as possible.		
Cyanide CN	Some distilled water was added to a known weight of sediment sample before starting the digestion step in the analytical procedure.	Tetracyanonickelate (II) - UV - Colorimetric Method	032
Mercury Hg (Total)	Sample was freeze-dried for 48 hours to remove water. Sample was sieved through a size 100 mesh (.15 mm) stainless steel sieve. The portion passing through was analyzed for mercury. Sample was completely oxidized by digestion with H_2SO_4 and H_2O_2.	Atomic Absorption Spectrophotometer - Open Flameless System	231 236 238 275 284 411
Metals (Leachable) Al Ba Be Ca Cd Cr Cu	Same as Mercury except portion passing through was analyzed for metals. Sample was leached with HCl and HNO_3. The sample was heated for 3 hours.	Inductively Coupled Argon Plasma (ICAP) Combined with Optical Emission Spectrometer (OES)	231 236 238 242

APPENDIX I TABLE 2 SEDIMENT COLLECTION, PREPARATION AND ANALYSIS METHODS (continued)

PARAMETER	PREPARATION	ANALYSIS	METHOD CODE[1]
Metals (Leachable) (continued)			
Fe			
Mg			
Mn			
Mo			
Na			
Ni			
P			
Pb			
Si			
Sn			
Sr			
Ti			
V			
Zn			
As	Same as other metals.	Hydride Generation ICAP	J. Davidson
[2]Sb	Same as other metals.	Hydride Generation ICAP	EPS Lab
[2]Se	Same as other metals.	Hydride Generation ICAP	
Ag	Same as other metals.	Flame Atomic Absorption Spectrophotometry	290
Cd	Same as other metals.	Graphite Flameless Atomic Absorption	Jerrel-Ash 850 Manual
K	Same as other metals.	Flame Atomic Emission Spectrophotometry	423
Particle Size	Sample was freeze-dried.	Standard Sieving Operation	078

1 Department of Environment, Department of Fisheries and Oceans, Laboratory Manual, Environmental Protection Service, Fisheries and Marine Service (1979).

2 The concentrations of Sb and Se are for information only since the analysis method has not yet been fully tested.

APPENDIX I TABLE 3 BOTTOM FAUNA COLLECTION, PRESERVATION AND IDENTIFICATION METHODS

FIELD COLLECTION, SAMPLING PROCEDURES AND PRESERVATION	LABORATORY PROCEDURES	IDENTIFICATION AND ENUMERATION
Surber Sampler: Creek and river samples were taken using a Surber Sampler with a 60 cm long net (mesh size 0.75 mm). Area sampled was 900 cm^2 (1 ft^2). Surber samples were washed into a cup at the bottom of a plankton net (.75 mm mesh size), put in separate labelled glass jars and preserved with 10% formalin. 3 samples were taken at each station.	Bottom fauna was removed from other material in a labelled vial containing 70% methanol.	Bottom fauna was sent to Dr. C. Low, Consulting Invertebrate Biologist, Nanaimo, B. C. for identification to genus, species if possible, and enumeration.

APPENDIX I TABLE 4 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE

SUBSTANCE	RECOMMENDED LEVEL(S) FOR DRINKING WATER	REFERENCE(S)	RECOMMENDED LEVEL(S) FOR AQUATIC LIFE	REFERENCE(S)
Physical				
Colour Pt. Counts	15	1		
Odour and taste	0	1		
Turbidity J.T.U.	5	1		
Chemical				
Alkalinity mg/l (Total)	Not considered a public health problem	4	>20	3
Aluminum (Al) mg/l	Not considered a public health problem	7	0.1	5
Ammonia (NH_3-N) mg/l	0.5	4	0.02 (unionized)	3
Antimony (Sb) mg/l				
Arsenic (As) mg/l	0.05	1	0.05	2
Barium (Ba) mg/l	1.0	1	5.0	7
Boron (Bo) mg/l	1.0	1		
Cadmium (Cd) mg/l	0.005	1	0.0002	2
Calcium (Ca) mg/l	75-200	7		
Chloride (Cl)mg/l	250	1		
Chromium (Cr) mg/l	0.05	1	0.04	2
Cobalt (Co) mg/l				
Conductivity @ 25°C (umhos/cm)	Depends on dissolved salts	7	150-500	6
Copper (Cu) mg/l	1.0	1	0.005	5
Cyanide (CN) mg/l	0.2	1	0.005	3
Dissolved oxygen (% saturation)	Near 100%	4	$\geq$5.0 mg/l	3

APPENDIX I TABLE 4 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE (continued)

SUBSTANCE	RECOMMENDED LEVEL(S) FOR DRINKING WATER	REFERENCE(S)	RECOMMENDED LEVEL(S) FOR AQUATIC LIFE	REFERENCE(S)
Fluoride (F) mg/l	1.5	1	1.5	7
Hardness (Total) as mg/l $CaCO_3$	80-100	1		
Iron (Fe) mg/l	0.3	1	1.0	3
Lead (Pb) mg/l	0.05	1	0.005 (soft H_2O*)	2
			0.01 (hard H_2O*)	2
Magnesium (Mg) mg/l	50	4		
Manganese (Mn) mg/l	0.05	1	1.0	7
Mercury (Hg) mg/l	0.002	1	0.0001-0.0002	2
Molybdenum (Mo)				
Nickel (Ni) mg/l	0.25	2	0.025 (soft H_2O*)	2
			0.25 (hard H_2O*)	2
Nitrate (NO_3-N) mg/l	10	1		
Nitrite (NO_2-N) mg/l	0.001	1		
pH units	6.5 - 8.5	1	6.5 - 9.0	3
Phosphorus (P) mg/l (Total)			0.020 to prevent algae	5
Potassium (K) mg/l				
Residue: Filterable mg/l (Total dissolved solids)	1000	4	70 - 400 with a maximum of 2000	6
Residue: Non-Filterable (mg/)				
Selenium (Se) mg/l	0.01	1	0.01	2
Silica (Si) mg/l				
Silver (Ag) mg/l	0.05	1	0.0001	2
Sodium (Na) mg/l	20	1		
Strontium (Sr) mg/l	10	1		
Sulphate (SO_4) mg/l	500	1		
Tin (Sn) mg/l	Not present in natural waters	7		
Titanium (Ti) mg/l				

APPENDIX I TABLE 4 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE (continued)

SUBSTANCE	RECOMMENDED LEVEL(S) FOR DRINKING WATER	REFERENCE(S)	RECOMMENDED LEVEL(S) FOR AQUATIC LIFE	REFERENCE(S)
Total Inorganic Carbon (TIC)				
Total Organic Carbon (TOC)	5.0	5		
Vanadium (V)				
Zinc (Zn) mg/l	5.0	1	0.030	5

* Soft water has a total hardness less than 95 mg/l as $CaCO_3$. Hard water has a total hardness of more than 95 mg/l as $CaCO_3$ (Reference 6).

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APPENDIX I TABLE 4 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE (continued)

SUBSTANCE	RECOMMENDED LEVEL(S) FOR DRINKING WATER	REFERENCE(S)	RECOMMENDED LEVEL(S) FOR AQUATIC LIFE	REFERENCE(S)

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APPENDIX II

WATER QUALITY DATA

APPENDIX II JASON PROPERTY WATER QUALITY DATA - JULY 7, 8 & 9, 1981

STATION NUMBER	FLOW m^3/s	TEMP (°C)	D.O. (mg/l)	% D.O. SATURATION (%)	IN SITU pH	LAB pH	IN SITU CONDUCTIVITY (umhos/cm)	LAB CONDUCTIVITY (umhos/cm)	COLOUR (colour units)	TURBIDITY (FTU)	N.F.R. (mg/l)
1	1.86	7	9.50	90	6.5	7.0	110	175	<5	6.3	14.0
2	0.48	4	11.2	99	7.3	7.9	70	141	<5	<1.0	<5.0
3	1.67	6	11.0	101	7.6	5.8	30	38.0	<5	1.0	6.0
4	1.75	6	10.9	100	7.6	5.9	25	37.9	<5	1.0	<5.0
5	.10	7	9.80	94	7.6	7.7	90	149	10	1.4	<5.0
6	0.19	5	10.6	96	8.0	8.1	110	180	20	27.0	40.5
7			0.0	0	6.8	6.5		287	20	160	46.0
8	7.69	7	10.3	96	7.8	7.4	88	143	8	3.8	8.5
9	0.31	4	11.2	99	7.9	8.0	118	203	<5	1.0	<5.0
10	0.65	4	10.4	92	7.7	7.5	72	124	<5	<1.0	<5.0

APPENDIX II JASON PROPERTY WATER QUALITY DATA - JULY 7, 8 & 9, 1981 (continued)

STATION NUMBER	F. RESIDUE (mg/l)	TOTAL ALKALINITY (mg/l as $CaCO_3$)	TOTAL HARDNESS (mg/l as $CaCO_3$)	T.O.C. (mg/l C)	T.I.C. (mg/l C)	TOTAL PO_4-P (mg/l)	NO_2-N (mg/l)	NO_3-N (mg/l)	NH_3-N (mg/l)	SO_4 (mg/l)	CN (mg/l)	Cl (mg/l)
1	119	19.2	71.0			0.0180	<0.0050	0.044	0.0223	57.9	<0.03	0.62
2	86	46.4	62.7			0.0081	<0.0050	<0.010	<0.0050	18.9	<0.03	0.69
3	30	2.40	11.7	1.0	<1.0	0.0050	<0.0050	0.034	<0.0050	13.8	<0.03	0.62
4	29	2.40	12.4	<1.0	<1.0	0.0050	<0.0050	0.034	<0.0050	13.3	<0.03	<0.50
5	93	52.0	71.1			0.0180	<0.0050	<0.010	0.0053	13.6	<0.03	0.76
6	112	71.2	86.4			0.0873	<0.0050	<0.010	0.0138	15.8	<0.03	0.88
7	193	44.0	123			0.775	<0.0050	<0.010	0.617	82.0	<0.03	0.70
8	95	36.4	60.3			0.0120	<0.0050	0.028	0.0080	44.1	<0.03	0.70
9	125	56.8	91.8			0.0069	<0.0050	0.028	0.0050	39.2	<0.03	0.59
10	84	28.0	52.3			0.0060	<0.0050	0.018	<0.0050	29.4	<0.03	0.58

APPENDIX II JASON PROPERTY WATER QUALITY DATA - JULY 7, 8 & 9, 1981 (continued)

STATION NUMBER	Ag mg/l	Al mg/l	As mg/l	Ba mg/l	Be mg/l	Ca mg/l	Cd mg/l	Co mg/l	Cr mg/l	Cu mg/l	Fe mg/l	Hg mg/l	K mg/l
1	<0.030	1.58	<0.075	0.0445	<0.0010	18.8	0.0030	0.0076	<0.0075	0.0094	1.50	<0.00020	0.422
2	<0.030	0.094	<0.075	0.0247	<0.0010	17.6	<0.0010	<0.0075	<0.0075	0.0023	0.0206	<0.00020	1.50
3	<0.030	0.469	<0.075	0.0214	<0.0010	3.66	<0.0010	<0.0075	<0.0075	0.0039	0.130	<0.00020	0.323
4	<0.030	0.481	<0.075	0.0248	<0.0010	3.83	<0.0010	<0.0075	<0.0075	0.0061	0.164	<0.00020	0.330
5	<0.030	0.050	<0.075	0.0818	<0.0010	22.1	<0.0010	<0.0075	<0.0075	0.0030	0.565	<0.00020	0.078
6	<0.030	0.307	<0.075	0.138	<0.0010	25.5	<0.0010	<0.0075	<0.0075	0.0046	0.867	<0.00020	0.164
7	<0.030	<0.050	0.106	0.0019	<0.0010	33.1	<0.0010	0.0855	<0.0075	<0.0010	30.5	<0.00020	1.18
8	<0.030	1.04	<0.075	0.0509	<0.0010	16.4	0.0021	<0.0075	<0.0075	0.0071	0.941	<0.00020	0.370
9	<0.030	0.634	<0.075	0.0246	<0.0010	25.8	<0.0010	<0.0075	<0.0075	0.0201	0.104	<0.00020	0.202
10	<0.030	0.236	<0.075	0.0219	<0.0010	14.4	<0.0010	<0.0075	<0.0075	0.0037	0.188	<0.00020	0.146

APPENDIX II JASON PROPERTY WATER QUALITY DATA - JULY 7, 8 & 9, 1981 (continued)

STATION NUMBER	Mg mg/l	Mn mg/l	Mo mg/l	Na	Ni mg/l	Pb mg/l	Sb mg/l	Se mg/l	Si mg/l	Sn mg/l	Sr mg/l	Ti mg/l	V mg/l	Zn mg/l
1	5.84	0.0571	<0.015	<0.50	0.059	0.0033	<0.040	<0.075	2.38	<0.10	0.0625	<0.0090	<0.020	0.287
2	4.56	0.0080	<0.015	<0.50	<0.040	<0.0010	<0.040	<0.075	1.95	<0.10	0.0642	<0.0040	<0.020	0.0122
3	0.62	0.0145	<0.015	<0.50	<0.040	<0.0010	<0.040	<0.075	2.29	<0.10	0.0159	<0.0040	<0.020	0.0407
4	0.68	0.0195	<0.015	<0.50	<0.040	<0.0010	<0.040	<0.075	2.30	<0.10	0.0168	<0.0040	<0.020	0.0429
5	3.86	0.0326	<0.015	<0.50	<0.040	<0.0010	<0.040	<0.075	2.33	<0.10	0.0757	<0.0040	<0.020	0.0122
6	5.53	0.0544	<0.015	<0.50	<0.040	0.0028	<0.040	<0.075	2.90	<0.10	0.0856	<0.0040	<0.020	0.114
7	9.68	1.00	<0.015	0.86	0.056	<0.0010	<0.040	<0.075	4.01	<0.10	0.0282	<0.0040	<0.020	1.21
8	4.70	0.0481	<0.015	<0.50	0.059	0.0012	<0.040	<0.075	2.70	<0.10	0.0603	<0.0040	<0.020	0.195
9	6.65	0.0529	<0.015	<0.50	<0.040	<0.0010	<0.040	<0.075	2.14	<0.10	0.0690	<0.0040	<0.020	0.0288
10	3.96	0.0272	<0.015	<0.50	<0.040	<0.0010	<0.040	<0.075	2.14	<0.10	0.0507	<0.0050	<0.020	0.0716

APPENDIX III

SEDIMENT DATA

APPENDIX III TABLE 1 JASON PROPERTY SEDIMENT CHEMISTRY DATA, JULY 7, 8 & 9, 1981
(all concentrations given in mg/kg dry weight unless otherwise noted)

STATION	CN *w/w	Ag	Al	As	Ba	Be	Ca	Cd	Cr	Cu	Fe	Hg	K	Mg	Mn
1-1	<0.2	<4.97	18200	84.5	5520	0.654	3590	6.13	36.9	119.0	64300	0.344	2050	1250	695.0
1-2		<4.83	18600	74.6	5490	0.676	3440	5.52	32.9	113.0	61600	0.289	2060	1240	580.0
1-3		<4.89	19000	61.9	5770	0.733	3610	4.84	29.4	115.0	53300	0.345	1970	1560	337.0
2-1	<0.2	<4.82	11100	15.3	526.0	0.683	27500	7.28	73.7	114.0	38400	0.345	2360	12800	1530
2-2		<4.81	10900	21.8	551.0	0.713	25800	6.90	38.9	114.0	33000	0.289	2280	12000	1520
2-3		<4.84	10500	17.1	529.0	0.734	26100	7.18	52.6	117.0	35000	0.332	2230	12200	1730
3-1	<0.4	<4.84	31400	70.9	496.0	1.50	2320	<0.56	39.7	98.1	44900	0.205	2550	3170	324.0
3-2		<4.85	29700	102	454.0	1.39	1950	<0.57	64.2	96.2	54400	0.209	2180	2970	275.0
3-3		<4.85	35500	94.3	514.0	1.67	2320	<0.57	70.3	120.0	54300	0.202	2590	3250	348.0
4-1	<0.4	<4.92	30300	116	584.0	1.41	2240	<0.57	66.3	93.9	52300	0.182	2720	3400	477.0
4-2		<4.87	32100	125	544.0	1.49	1900	<0.57	91.6	105.0	82300	0.213	2580	3070	518.0
4-3		<4.95	31200	135	455.0	1.44	2110	<0.58	84.3	102.0	54400	0.217	2640	3250	542.0
5-1	**	<4.93	19900	82.1	1230	1.35	5910	4.45	17.9	40.8	155000	0.261	1340	1090	1800
5-2		<4.97	22800	115	1130	1.84	10300	9.75	12.2	43.4	>169000	0.271	820	1090	1530
5-3		<4.98	13400	42.1	1030	0.622	4870	1.64	16.8	44.2	84400	0.298	1380	1310	2290

* w/w means mg/kg wet weight, total sample. All other measurements in this table are given in mg/kg dry weight for the portion passing a 150 um sieve.

** Interference too large for detection limit estimation.

APPENDIX III TABLE 1 JASON PROPERTY SEDIMENT CHEMISTRY DATA - JULY 7, 8 & 9, 1981 (continued)
(all concentrations given in mg/kg dry weight unless otherwise noted)

STATION	Mo	Na	Ni	P	Pb	***Sb	***Se	Si	Sn	Sr	Ti	V	Zn
1-1	10.1	<82.8	133.0	2720	67.4	5.98	5.27	4240	<16.6	57.6	176.0	218.0	839.0
1-2	8.78	81.3	119.0	2500	80.7	5.91	5.25	4030	<16.1	56.1	184.0	207.0	778.0
1-3	9.64	<83.0	99.9	2160	73.1	5.40	4.92	4520	<16.3	55.5	189.0	184.0	706.0
2-1	19.4	81.2	298.0	2620	12.0	1.20	1.98	5400	27.3	106.0	96.6	162.0	839.0
2-2	17.9	109.0	271.0	2460	13.0	2.16	3.64	5590	<16.0	102.0	104.0	160.0	831.0
2-3	18.7	<80.6	286.0	2560	12.7	1.60	2.68	5270	<16.1	103.0	94.2	151.0	875.0
3-1	<2.42	395.0	38.2	1250	17.1	<0.807	2.65	3680	<16.1	26.1	871.0	103.0	276.0
3-2	3.07	313.0	50.6	1470	16.5	0.981	4.55	4440	21.0	22.3	706.0	119.0	240.0
3-3	<2.43	372.0	55.7	1510	22.5	<0.809	3.60	4270	33.2	25.6	855.0	119.0	293.0
4-1	3.03	423.0	53.2	1410	18.6	1.53	5.46	3570	27.1	25.0	946.0	123.0	251.0
4-2	<2.44	308.0	72.9	1770	15.4	1.66	6.25	4140	<16.2	23.1	813.0	146.0	247.0
4-3	3.90	349.0	68.8	1450	20.9	2.05	5.88	4290	29.2	24.0	865.0	128.0	260.0
5-1	<2.46	<82.2	271.0	4880	<6.57	<0.831	3.66	6010	<16.4	46.4	120.0	58.5	870.0
5-2	<2.48	<82.8	399.0	5950	<6.62	<0.823	6.05	8550	<16.6	63.1	72.7	44.1	1230
5-3	<2.48	<83.0	97.0	2700	14.7	0.836	3.24	4370	<16.6	45.5	138.0	55.1	429.0

*** Concentrations of Sb and Se are given for information only since method is not fully tested.

APPENDIX III TABLE 1 JASON PROPERTY SEDIMENT CHEMISTRY DATA, JULY 7, 8 & 9, 1981 (continued)
(all concentrations given in mg/kg dry weight unless otherwise noted)

STATION	CN *w/w	Ag	Al	As	Ba	Be	Ca	Cd	Cr	Cu	Fe	Hg	K	Mg	Mn
6-1	<0.4	<4.86	8620	15.4	1930	0.251	2860	1.79	17.6	40.5	19800	0.211	1760	1240	439.0
6-2		<4.95	9510	13.8	1840	0.289	3840	2.73	18.6	45.7	24000	0.276	1720	1560	716.0
6-3		<4.93	8570	24.5	1660	0.239	2960	1.87	17.6	40.7	20600 *	0.281	1790	1230	480.0
8-1	<0.2	<4.95	17600	40.0	2760	0.693	3480	4.00	24.4	94.8	52600	0.276	1580	1280	277.0
8-2		<4.82	17500	41.7	3160	0.699	3630	3.81	22.7	93.7	53900	0.338	1350	1190	268.0
8-3		<4.93	16000	43.3	3660	0.616	3600	3.79	23.2	90.0	49400	0.281	1600	1210	262.0
9-1	<0.2	<4.87	16700	27.2	963.0	1.07	7910	7.95	25.4	356.0	33100	0.314	1460	3170	1980
9-2		<4.83	16700	31.7	1100	0.999	7840	7.45	24.9	330.0	33100	0.276	1660	3130	1840
9-3		<4.90	15600	19.4	1000	0.866	6780	6.33	23.9	298.0	31700	0.259	1810	2770	1620
10-1	<0.2	<4.91	12700	41.2	384.0	0.809	11300	9.11	37.4	118.0	46700	0.276	2110	4570	863.0
10-2		<4.80	11000	19.0	312.0	0.592	6650	5.34	22.8	85.4	36100	0.271	1490	2840	436.0
10-3		<4.99	12700	26.7	353.0	0.722	8080	6.31	24.3	97.1	41200	0.276	1750	3410	578.0

* w/w means mg/kg wet weight, total sample. All other measurements in this table are given in mg/kg dry weight for the portion passing a 150 um sieve.

APPENDIX III TABLE 1 JASON PROPERTY SEDIMENT CHEMISTRY DATA - JULY 7, 8 & 9, 1981 (continued)
(all concentrations given in mg/kg dry weight unless otherwise noted)

STATION	Mo	Na	Ni	P	Pb	***Sb	***Se	Si	Sn	Sr	Ti	V	Zn
6-1	2.83	<80.9	52.9	1220	34.1	0.925	1.20	4440	<16.2	39.4	177.0	71.7	453.0
6-2	<2.89	91.8	75.6	1310	35.8	<0.825	1.11	4180	<16.5	43.6	225.0	74.8	686.0
6-3	<3.13	<82.2	55.2	1290	32.0	1.31	1.81	3750	<16.4	40.1	177.0	71.5	499.0
8-1	<2.47	<82.5	88.6	2160	47.1	1.56	3.25	4270	<16.5	50.3	163.0	142.0	639.0
8-2	<2.41	<80.4	88.0	2270	49.0	1.56	3.30	4560	<16.1	52.5	147.0	133.0	639.0
8-3	<2.47	<82.2	85.2	2240	42.6	1.67	3.45	4580	<16.4	51.9	169.0	140.0	598.0
9-1	9.17	<81.2	296.0	1550	54.5	1.82	3.68	4460	<16.2	36.6	109.0	116.0	912.0
9-2	9.02	<80.5	287.0	1510	58.6	2.09	4.55	4770	<16.1	36.8	102.0	115.0	873.0
9-3	7.19	<81.7	253.0	1400	52.1	1.28	2.66	4220	<16.3	33.4	100.0	117.0	774.0
10-1	9.89	<81.7	161.0	3580	17.3	2.69	4.11	4170	<16.4	45.9	83.5	157.0	932.0
10-2	3.53	<80.0	113.0	2390	15.5	1.72	2.67	3320	<16.0	37.1	109.0	113.0	694.0
10-3	2.74	<83.0	139.0	2610	17.1	2.24	3.90	4600	<16.7	40.5	110.0	120.0	838.0

*** Concentrations of Sb and Se are given for information only since method is not fully tested.

APPENDIX III TABLE 2 JASON PROPERTY SEDIMENT PARTICLE SIZE ANALYSIS - JULY 7, 8 & 9, 1981

STATION NUMBER	PERCENT COMPOSITION				
	>500 um	250-500 um	149-250 um	62.5-149 um	<62.5 um
1-1	72.7	15.9	6.5	3.3	1.7
1-2	81.7	12.0	4.1	1.7	0.5
1-3	65.9	9.6	8.8	10.0	5.7
2-1	92.4	4.7	1.4	0.8	0.7
2-2	97.2	2.0	0.4	0.2	0.2
2-3	96.9	2.0	0.5	0.3	0.3
3-1	91.2	6.2	1.5	0.7	0.4
3-2	92.2	6.4	0.9	0.4	0.1
3-3	87.7	9.0	1.9	0.8	0.6
4-1	96.1	3.5	0.2	0.1	0.1
4-2	93.7	5.1	0.9	0.2	0.1
4-3	76.3	9.5	4.4	5.6	4.1
5-1	87.3	5.3	1.9	2.5	3.1
5-2	88.2	4.8	1.9	1.1	4.1
5-3	53.5	12.1	8.0	10.0	16.6
6-1	94.1	5.0	0.7	0.1	0.1
6-2	34.3	11.8	11.4	11.8	30.8
6-3	51.1	12.7	9.0	10.6	16.6
8-1	5.9	37.0	30.1	16.6	10.4
8-2	86.4	7.1	3.8	2.4	0.3
8-3	6.8	39.9	30.8	14.7	7.8
9-1	84.9	9.3	3.2	1.8	0.9
9-2	80.9	8.9	4.8	3.5	1.9
9-3	79.2	10.3	5.2	3.6	1.7
10-1	91.0	5.5	2.1	0.7	0.8
10-2	31.9	29.3	18.7	9.8	10.4
10-3	40.0	24.5	18.3	13.2	4.0

APPENDIX IV

BOTTOM FAUNA DATA

APPENDIX IV TABLE 1 BOTTOM FAUNA TAXONOMIC GROUPS FOUND IN THE JASON PROPERTY WATERSHEDS (Numbers 1, 2, 3, etc are cross-referenced to data in Apx IV, Table 2)

	Phylum:	Annelida
	Class:	Oligochaeta
	Order:	Plesiopora
1	Family:	Enchytraeidae
	Family:	Tubificidae
2		Tubifex sp? imm
	Phylum:	Arthropoda
	Class:	Arachnoidae
3	Order:	Arachnida
	Class:	Insecta
4	Order:	Collembola
	Order:	Plecoptera
	Family:	Nemouridae
5		Amphinemura sp.
6		Prostoia sp.
7		Zapada sp.
	Family:	Capniidae
8		Capnia sp.
	Family:	Perlodidae
9		Arcynopteryx sp.
	Family:	Chloroperlidae
10		Alloperla sp.
	Order:	Ephemeroptera
	Family:	Baetidae
11		Ameletus sp.
12		Baetis sp.
	Family:	Heptageniidae
13		Cinygmula sp.
14		Rithrogena sp.
15	Order:	Hemiptera undet nymph

APPENDIX IV TABLE 1 BOTTOM FAUNA TAXONOMIC GROUPS FOUND IN THE JASON PROPERTY WATERSHEDS (continued)

16.	Order:	Trichoptera pupa
	Family:	Rhyacophilidae
17.		Rhyacophila angelita
18.		Rhyacophila tucula
19.	Family:	Limnephilidae unid juv
20.		Psychoglypha sp.
21.	Order:	Lepidoptera unid larva
	Order:	Coleoptera
22.	Family:	Staphylinidae adult
23.	Order:	Diptera adult
24.	Family:	Tipulidae adult
25.		Pedicia sp.
26.		Tipula sp.
27.	Family:	Culicidae adult
28.	Family:	Simuliidae larvae
29.		Simulium arcticum pupa
30.	Family:	Chironomidae pupae
31.		adult
	Subfamily:	Orthocladiinae
32.		Cardiocladius sp.
33.		Cricotopus sp.
34.		Corynuneura sp.
35.		Epicocladius sp.
36.		Eukiefferiella sp.
37.		Heterotrissocladius sp.
38.		Orthocladius sp.
39.		Psectrocladius sp.
	Family:	Empididae
	Subfamily:	Hemerodromiinae
40.		Hemerodromia sp.
	Subfamily:	Clinocerinae
41.		Clinocera sp.
42.		Wiedemannia sp.
	Order:	Homoptera
43.	Family:	Aphididae

APPENDIX IV TABLE 2 JASON PROPERTY BOTTOM FAUNA DATA - JULY 7, 8 & 9, 1981

TAXONOMIC GROUP	Station 1			Station 2			Station 3			Station 4			Station 5		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3	4-1	4-2	4-3	5-1	5-2	5-3
1 Enchytraeidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 Tubifex sp? imm	-	-	-	-	-	-	-	-	-	-	-	-	6	5	-
3 Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
4 Collembola	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
5 Amphinemura sp.	-	-	-	-	-	-	-	-	-	-	-	-	10	2	9
6 Prostoia sp.	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-
7 Zapada sp.	-	-	1	2	4	-	-	4	-	1	1	-	-	-	-
8 Capnia sp.	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-
9 Arcynopteryx sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 Alloperla sp.	-	-	-	2	2	1	-	-	-	-	-	-	3	1	-
11 Ameletus sp.	-	-	-	1	-	1	-	-	-	-	-	-	-	-	1
12 Baetis sp.	-	-	-	16	15	5	-	-	-	-	-	-	8	1	10
13 Cinygmula sp.	-	-	-	25	55	30	-	-	-	-	-	-	-	-	-
14 Rithrogena sp.	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
15 Hemiptera undet nymph	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
16 Trichoptera pupa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 Rhyacophila angelita	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
18 Rhyacophila tucula	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
19 Limnephilidae unid juv	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20 Psychoglypha sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	1
21 Lepidoptera unid larva	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
22 Staphylinidae adult	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Diptera adult	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

NOTE: imm - immature
undet - undetermined
unid - unidentified

APPENDIX IV TABLE 2 JASON PROPERTY BOTTOM FAUNA DATA - JULY 7, 8 & 9, 1981 (continued)

TAXONOMIC GROUP	Station 1			Station 2			Station 3			Station 4			Station 5		
	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3	4-1	4-2	4-3	5-1	5-2	5-3
24 Tipulidae	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
25 Pedicia sp.	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
26 Tipula sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Culicidae	-	-	-	-	-	-	-	3	1	1	2	-	1	-	-
28 Simulidae laruae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5
29 Simulium arcticum pupa	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
30 Chironomidae pupae	-	-	-	39	13	16	1	-	1	1	1	1	-	-	-
31 Chironomidae sp.	-	-	-	3	3	1	4	-	2	3	1	1	3	1	2
32 Cardiocladius sp.	-	-	-	1	1	1	-	-	-	-	-	-	6	1	-
33 Cricotopus sp.	-	-	-	3	-	2	-	-	-	-	-	2	-	-	-
34 Corynuneura sp.	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
35 Epoicocladius sp.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
36 Euklefferiella sp.	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
37 Heterotrissocladius sp.	-	1	-	-	-	-	-	-	-	1	1	1	1	-	-
38 Orthocladius sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39 Psectrocladius sp.	-	1	2	17	13	16	-	-	-	-	-	-	-	-	-
40 Hemerodromia sp.	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
41 Clinocera sp.	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-
42 Wiedemannia sp.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
43 Aphididae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Column Total	0	3	3	115	113	76	7	10	5	8	7	5	56	16	31
N	0	3	3	70	94	59	2	7	1	3	3	3	43	9	23
H'	0	0.48	0.28	0.73	0.57	0.68	0	0.42	0	0.48	0.48	0.28	0.88	0.89	0.53

APPENDIX IV TABLE 2 JASON PROPERTY BOTTOM FAUNA DATA - JULY 7, 8 & 9, 1981 (continued)

TAXONOMIC GROUP	Station 6			Station 8			Station 9			Station 10		
	6-1	6-2	6-3	8-1	8-2	8-3	9-1	9-2	9-3	10-1	10-2	10-3
1 Enchytraeidae	-	-	-	-	-	-	-	-	-	-	1	-
2 Tubifex sp? imm	-	-	-	-	-	-	-	-	-	-	-	-
3 Arachnida	-	-	-	-	-	-	-	-	-	-	-	-
4 Collembola	1	-	-	-	-	-	-	-	-	-	-	-
5 Amphinemura sp.	-	-	-	-	-	-	-	-	-	-	-	-
6 Prostoia sp.	-	-	-	-	-	-	-	-	-	1	-	-
7 Zapada sp.	-	1	-	-	-	-	-	-	2	-	2	-
8 Capnia sp.	-	-	-	-	-	-	-	-	-	-	-	-
9 Arcynopteryx sp.	-	-	-	-	-	-	2	5	8	-	3	-
10 Alloperla sp.	-	-	-	-	-	-	-	-	-	-	-	-
11 Ameletus sp.	-	-	-	-	-	-	7	-	1	-	-	-
12 Baetis sp.	20	8	12	-	1	-	2	24	67	-	1	-
13 Cinygmula sp.	-	-	-	-	-	-	-	1	-	-	3	-
14 Rithrogena sp.	-	-	-	-	-	-	-	-	-	-	-	-
15 Hemiptera undet nymph	-	-	-	-	-	-	-	1	-	-	-	-
16 Trichoptera pupa	-	-	1	-	-	-	-	-	-	-	-	-
17 Rhyacophila angelita	1	-	-	-	-	-	-	-	-	-	-	-
18 Rhyacophila tucula	4	1	3	-	-	-	-	-	-	-	-	-
19 Limnephilidae unid juv	-	1	-	-	-	-	-	-	-	-	-	-
20 Psychoglypha sp.	-	-	-	-	-	-	-	-	-	-	-	-
21 Lepidoptera unid larva	-	-	-	-	-	-	-	-	-	-	-	-
22 Staphylinidae adult	1	-	-	-	-	-	-	-	-	-	-	-
23 Diptera adult	-	-	-	1	1	-	-	-	-	-	-	-

NOTE: imm - immature
undet - undetermined
unid - unidentified

APPENDIX IV TABLE 2 JASON PROPERTY BOTTOM FAUNA DATA - JULY 7, 8 & 9, 1981 (continued)

TAXONOMIC GROUP	Station 6			Station 8			Station 9			Station 10		
	6-1	6-2	6-3	8-1	8-2	8-3	9-1	9-2	9-3	10-1	10-2	10-3
24 Tipulidae	-	-	-	-	-	-	-	-	-	-	-	-
25 Pedicia sp.	-	-	-	-	-	-	-	-	-	-	-	-
26 Tipula sp.	-	-	-	-	-	-	-	-	-	-	1	-
27 Culicidae	1	1	1	-	-	1	-	-	-	-	-	-
28 Simuliidae laruae	-	-	-	-	-	-	-	-	-	-	-	-
29 Simulium arcticum pupa	2	-	2	-	-	-	-	-	-	-	-	-
30 Chironomidae pupae	1	-	1	-	1	-	1	3	4	1	1	-
31 Chironomidae sp.	-	-	-	-	-	-	5	-	1	-	-	-
32 Cardiocladius sp.	3	-	9	-	-	-	-	2	-	-	-	-
33 Cricotopus sp.	-	-	-	-	-	-	-	1	1	1	1	-
34 Corynuneura sp.	-	-	-	-	-	-	-	-	-	-	-	-
35 Epoicocladius sp.	-	-	-	-	-	-	-	-	-	-	-	-
36 Eukiefferiella sp.	-	-	-	-	-	-	-	-	-	-	-	-
37 Heterotrissocladius sp.	-	-	-	-	-	-	2	5	18	-	4	-
38 Orthocladius sp.	-	-	-	-	-	-	-	-	-	-	-	1
39 Psectrocladius sp.	-	-	-	-	-	-	-	4	-	-	2	-
40 Hemerodromia sp.	1	-	-	-	-	-	-	-	-	-	-	-
41 Clinocera sp.	1	2	-	-	-	-	-	-	-	-	-	-
42 Wiedemannia sp.	-	-	-	-	-	-	-	-	-	-	-	-
43 Aphididae	-	-	-	-	-	-	-	-	1	-	-	-
Column Total	36	14	29	1	3	1	19	46	103	3	19	1
N	30	12	24	0	1	0	13	42	97	2	17	1
H'	0.45	0.43	0.42	0	0	0	0.52	0.60	0.41	0.30	0.85	0