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PRE-DEVELOPMENT STUDY OF WATER QUALITY, SEDIMENTS AND BENTHIC FAUNA OF SELECTED STREAMS IN THE MOUNT NANSEN AREA, YUKON, PRIOR TO THE B.Y.G. NATURAL RESOURCES PROJECT

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by

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ABSTRACT

A baseline investigation of environmental quality in the Victoria Creek watershed was carried out during July and August, 1988. The study was prompted by the potential for the reopening of the Mt. Nansen Mine in 1989. Water quality, sediments and benthic fauna were sampled at 12 stations. The results indicated three principal sources of elevated metal concentrations in water and sediment samples.

In Dome Creek, seepage of the tailings pond water was evident in water samples as high total metal concentrations of silver, iron, lead, and zinc. Analysis of sediments from Dome Creek showed arsenic levels 10 to 40 times higher than those reported in 1976-77 (Environmental Protection Service, 1979). The waste rock pile at the Brown-McDade mine site is implicated in elevated levels of zinc in sediments sampled from Pony Creek.

Benthic invertebrates were enumerated and recorded in this report. Dome Creek has the lowest total numbers, diversity and evenness indices of all sites as had been found previously in 1976 (Environmental Protection, 1979).

RÉSUMÉ

Une enquête de la qualité environmentale dans le bassin du ruisseau Victoria a été conduite durant les mois de juillet et août 1988. L'étude fût initiée par le potentiel de ré-ouverture de la mine Nansen en 1989. La qualité de l'eau, des sédiments et de la faune benthique fût échantillonnée à douze stations. Les résultats des échantillons d'eau et de sédiments indiquent trois sources principales de concentration élevé de métaux.

Dans le ruisseau Dome, l'eau de suintement provenant de la digue à rejets était évident dans les échantillons d'eau dû aux hautes concentrations totales de métaux dans les échantillons d'eau (argent, fer, plomb, et zinc). L'analyse des sédiments du ruisseau Dome indique des niveaux d'arsenic de dix à quarante fois plus élevés que ceux reportés en 1976-77 (EPS, 1979). Les haldes de résidus stériles de la mine Brown-McDade sont impliquées dans les taux élevés de zinc des sédiments échantillonnés au ruisseau Pony.

Les invertébrés bentiques furent énumérés et enregistrés dans ce rapport. Le ruisseau Dome avait le plus bas dénombrement, indices de diversité et équitabilité de tout les sites qui ont été échantillonnés depuis 1976.

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1.0 INTRODUCTION

1.1 Background

The Mt. Nansen claim groups are located in the Dawson Mountain Range, 50km west of Carmacks, Yukon. The groups consist of 287 mineral claims and leases containing numerous gold and silver-bearing vein systems. The first discovery of the mineralization in the Mount Nansen area was in 1943. A number of prospecting groups explored the area, before Mt. Nansen Mines Ltd. commenced underground development and construction of a mill in 1967. A brief mining history of the area is given by Craig and Laporte (1972). The underground operation carried out during 1968-1969 was deemed uneconomic due to poor processing methods used for both oxidized and unoxidized ores (Environmental Protection, 1979).

In April 1976, the Yukon Territory Water Board received a water use application for the purpose of reopening Mt. Nansen Mines Ltd. Water use was authorized on the condition that no effluent discharge would enter the surrounding watercourse. Routine inspections during 1976 indicated that effluent was being discharged into Dome Creek.

In 1976 and 1977, the office of Environmental Protection Service investigated the potential effects. High levels of zinc were still evident in the tailings pond discharge. An evaluation of benthic fauna communities and LC_{50} bioassays test results indicated toxicity to the receiving waters at a sample station below the pond discharge (Environmental Protection Service, 1979). The mining operation became uneconomic and ceased operation in November, 1976.

In June 1985, Chevron accepted an option to explore the property offered by B.Y.G., Natural Resources Inc., the present owner of the mine. While B.Y.G.

agreed to earn a working interest in the next phase, Chevron continued as the project operator (Archer Cathro and Associates, (1988). The recent exploration was orientated toward oxidized ore bodies that could be developed through open pit mining. The proposed extraction method of gold and silver was by cyanide treatment for both oxidized and partially oxidized ore bodies. A report on the environmental feasibility was prepared by Norecol (1989).

1.2 Study Area

The study area is situated at the south end of the Dawson Mountain Range, centred at approximately 137° 06' W longitude by 62° 03' N latitude. The approximate elevation of the mine site is 1300 meters. The mine development area is a part of the Victoria Creek watershed, a tributary of the Nisling River. Dome Creek, a tributary of Victoria Creek, receives surface drainage from the tailings ponds. The tailings pond catchment area includes surface drainage from the mill site area as well as from one nearby adit.

Vegetation in the area has been described by Oswald and Senyk (1977). Most of the terrain surrounding the mine site is above tree line, (1200 meters). Black spruce is predominant over white spruce in the valleys and on lower slopes. Aspen, balsam poplar and paper birch are also present. Ground cover vegetation include willow, shrub birch, labrador tea, moss and lichens.

The location of the study area and sample sites can be seen in Figure 1. The sample stations are described in Table 1.

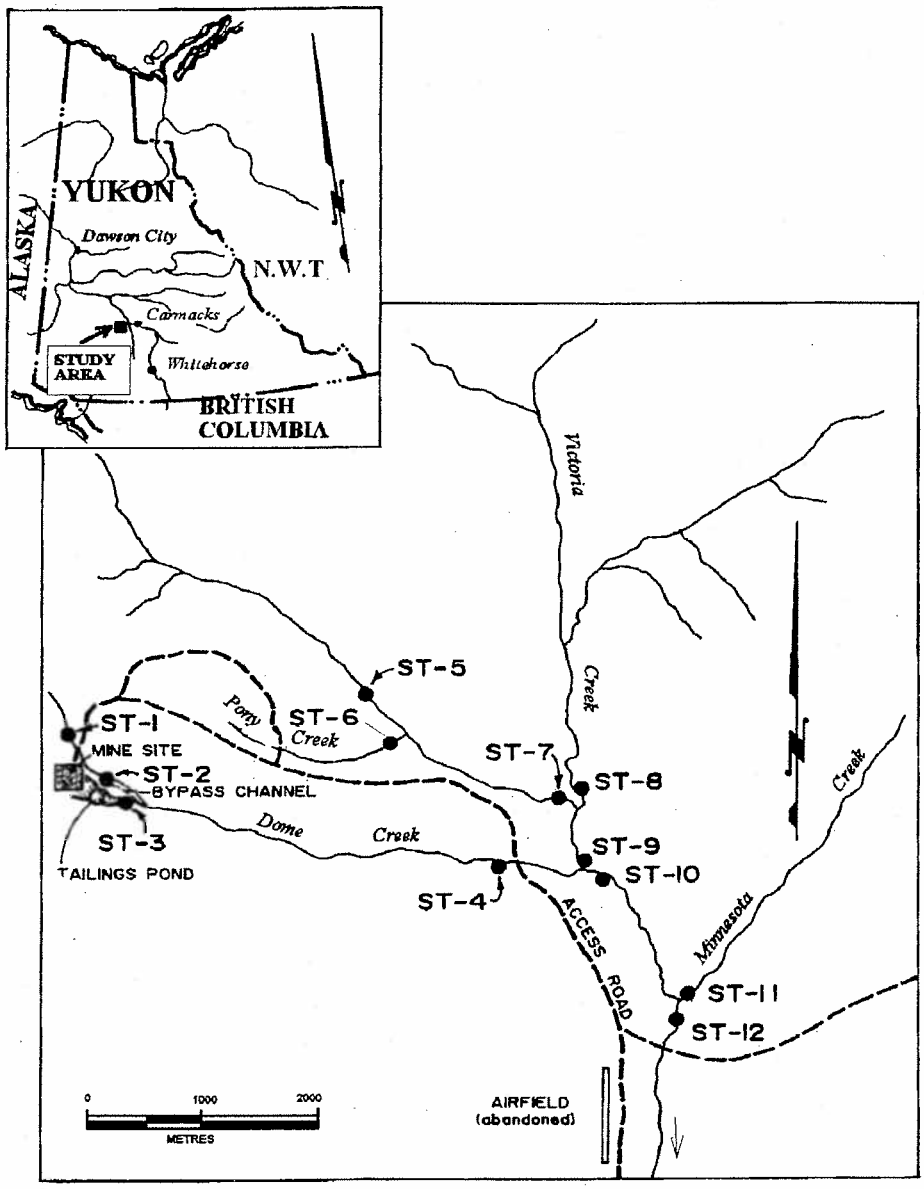

FIGURE 1: STUDY AREA AND SAMPLE STATION LOCATION OF THE MOUNT NANSEN STUDY AREA

TABLE 1 SAMPLE STATIONS DESCRIPTIONS IN MT. NANSEN MINE STUDY AREAS, 1988

STATION	LOCATION	REMARKS
1	137°09'W longitude by 62°03'N latitude, at the head of Dome Creek ~ 100m past old water receiver building on Summit Road, at culvert under roadway. Elevation 1280m.	Headwaters of Dome Creek appear to be sub-surface outlet stream.
2	137°08'W longitude by 62°03'N latitude on Dome Creek, 100m upstream of confluence in line with tailings pond decant; end of diversion ditch. Elevation 1190m.	Sediment samples were taken from pool below water drop. Vegetation: Picea mariana, black spruce, grasses, Salix sp.
3	137°08'W longitude by 62°03'N latitude on Dome Creek, ~25m upstream of road crossing. Bottom of tailings pond decant. Elevation 1190m.	Sample site located at control structure on downstream end of third tailings pond.
4	137°05'W longitude by 62°02'N latitude on Dome Creek ~ 300m upstream of roadway culvert. Elevation 1140m.	Stream flow measured, ~20m downstream of basket locations. Vegetation 100% grasses. Stream bed grassy with sand.
5	137°06'W longitude by 62°03'W latitude on Back Creek, ~500m upstream of Pony Creek, ~200m upstream of old cabin along left bank. Elevation 1030m.	Upstream of stripping activity. High suspended sediments observed due to placer mining (13/07/88). Vegetation: 90% Salix sp., grasses, and Picea mariana.
6	137°06'W longitude by 62°03'N latitude on Pony Creek ~60m upstream of confluence with Back Creek. Elevation 1020m.	Flow predominantly subsurface. Vegetation: thick humus layer, moss and lichen cover, Salix sp. beginning to grow near creek with Picea mariana back from stream edge.
7	137°04'W Longitude by 62°03'N latitude on Back Creek ~200m upstream of confluence. Elevation 1040m.	Silt covering vegetation along side of stream.
8	137°04'W longitude by 62°02'N latitude on Victoria Creek upstream of Back Creek confluence. Elevation 1035m.	Water high in suspended solids, brown colour. Vegetation: Salix sp. and grass to waters edge.
9	137°04W longitude by 62°02'N latitude on Victoria Creek ~250m upstream of confluence with Dome Creek. Elevation 990m.	Dome Creek enters Victoria Creek as two channels.

TABLE 1 (Cont'd) SAMPLE STATIONS DESCRIPTIONS IN MOUNT, NANSEN MINE STUDY AREA

STATION	LOCATION	REMARKS
10	137°04'W longitude by 62°03'N latitude on Victoria Creek ~400m downstream of Dome Creek. Elevation 1006m.	Sand and gravel bed. Vegetation: grasses, Salix sp., Picea mariana, shrubs growing over stream bank.
11	137°03'W longitude by 62°02'N latitude on Minnesota Creek. Elevation 975m.	Water has yellow-brown tinge; no evidence of placer mining activity. Vegetation: grasses and Salix sp. growing to stream edge with black spruce.
12	137°03'W longitude by 62°02'N latitude on Victoria Creek ~300m downstream of Minnesota Creek confluence. Elevation 970m.	Gravel substrate. Vegetation: grasses, Salix sp., Picea mariana growing to water line.

2.0 METHODS

2.1 Water Chemistry

Triplicate water samples were taken in July and August, 1988 from 12 sites. Water temperature, conductivity, pH and total discharge estimates were measured and recorded in situ. Samples sent to the laboratory were analysed for alkalinity, chlorine, color/true, conductivity, pH, Ca+Mg hardness and total hardness, ammonia-N, nitrite-nitrate, total phosphorous, filterable and non-filterable residues, sulphate and turbidity. Laboratory samples were analyzed for the following extractable and total metals:

Aluminium (Al)	Cobalt (Co)	Selenium (Se)
Antimony (Sb)	Copper (Cu)	Silicon (Si)
Arsenic (As)	Iron (Fe)	Silver (A)
Barium (Ba)	Lead (Pb)	Sodium (Na)
Beryllium (Be)	Magnesium (Mg)	Strontium (Sr)
Boron (B)	Manganese (Mn)	Tin (Sn)
Cadmium (Cd)	Molybdenum (Mo)	Titanium (Ti)
Calcium (Ca)	Nickel (Ni)	Vanadium (V)
Chromium (Cr)	Phosphorous (P)	Zinc (Zn)

Standard methods for collection, preservation and analysis are described in Appendix I, Table 1.

The percent dissolved oxygen saturation point was determined by calculating the dissolved oxygen saturation point (S') from the formula:

$$S' = S \frac{P}{760}$$ (APHA et al, 1980)

where:

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

S = dissolved oxygen (DO) saturation concentration at sea level for the in situ temperature.

P = atmospheric pressure (mm Hg) at site elevation.

The percent dissolved oxygen saturation is the ratio of field DO to the in situ saturation concentration (S'):

$$\frac{\text{field DO} \times 100}{S'} = \%\ \text{DO saturation}$$

where, field DO = dissolved oxygen measured in the field and adjusted for field conditions.

2.2 Sediments

One set of triplicate sediment samples was taken in August. A small Teflon scoop was used to collect in-stream samples at each site. The samples were shipped frozen to the Environmental Protection Laboratory, 4195 Marine Drive, West Vancouver, B.C. The samples were analysed for leachable metals and percent particle size distribution according to the Wentworth Classification System.

A description of sediment collection, preparation and analysis methods are given in Appendix I, Table 2.

2.3 Benthic Invertebrates

Benthic samples were taken in triplicate by means of an artificial substrate invertebrate sampler (ASIS). Each ASIS consists of a cylindrical chrome plated wire basket (maximum volume of 0.0057 m^3). The baskets were filled with local stream bed material from exposed gravel bars. They were then placed in the main stream, where practical, to ensure complete submergence with

changing water levels. Three baskets were placed at each site. They were left for a period of 41 days (from July 13-14 to August 23-24, 1988) to allow for colonization.

Invertebrate samples were sorted, identified and enumerated under contract by Dr. C. Low., consulting invertebrate biologist from Nanaimo, British Columbia. The collection, preservation and identification methods are described in Appendix I, Table 3.

Indices of benthic community diversity and evenness were calculated using the following formulae (Pielou 1975):

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

where, $P_i = n_i / N$

n_i = number of individuals in the ith most specific taxonomic group (ie. genus) at one sample location.

N = total number of individuals identified to specific taxonomic group (ie. genus) at one sample location.

n = total number of taxonomic groups (ie. genus) identified at one sample location.

$$\text{Evenness } (J') = H' / \log_{10} n$$

A list of taxonomic groups and site enumerations can be found in Appendix V, Tables 1 and 2 respectively. Taxonomic orders have been evaluated as percentages of total fauna occurring at each sample location (see Appendix V, Table 3).

3.0 RESULTS AND DISCUSSION

3.1 Water Quality

Results from water quality analysis of samples taken in July and August are in Appendices II and III, respectively. Three tables in each appendix list results of physical parameters an both extractable and total metal concentrations. Temperature, conductivity, pH and dissolved oxygen measurements were made in situ.

Stream flows measured at all sites in July ranged from 0.002 m^3/sec at sites 2 and 3 to 1.7 m^3/sec at site 9. Slightly reduced flows at Sites 10 and 12 (Victoria Creek), as compared with Site 9, suggest there may be a loss of surface waters through exfiltration. In August, only discharges at sites 4, 5, and 7 - 12 were measured. The range in August was from 0.01 m^3/sec (site 5) to 0.66 m^3/sec (site 12). The stream discharge was reduced by a factor of 3 times between July and August therefore winter flows above the stream substrate are likely negligible. Norecol (1989) reported creeks frozen down to the substrate at a number of sites during their March 4th visit in 1986.

The pH ranged from 6.2 (site 1) to 9.4 (site 3, tailings pond discharge) for all samples taken during July and August. These two extreme values, both recorded in August, are outside the range of 6.5 to 9.0 pH recommended for the protection of aquatic life (Appendix I, Table 4). The July measurements at these sites showed a slightly moderated pH and were within the recommended range. The potential for high ionic concentrations under low flow conditions, from October to May is evident here and would extend to other water quality parameters.

Turbid waters at sites 5, 7, and 8, were observed during both sample periods. This occurrence was attributed to placer mining activity that was observed upstream of the sample sites. Samples were characterized by high suspended solids, colour, turbidity, total hardness, phosphorous and nitrogen levels (Appendices II and III, Table 1). McLeay et al (1983) observed physiological stress in underyearling grayling at suspended solid levels of 50 mg/l (McLeay et al., 1983). Levels of 100 mg/l resulted in reduced growth rates and feeding success (McLeay et al., 1984). These findings are significant as the suspended sediment loading can be traced downstream at sites 9, 10 and 12 on Victoria Creek, ranging from 56 mg/l at site 12 to 540 mg/l at site 10, where fish habitat has been identified (Environmental Protection Service, 1979).

The suspended sediment loading in Back Creek and upper Victoria Creek has also resulted in elevated total metals during both July and August. At sites 5 and 7 on Back Creek, silver, aluminium, arsenic, cadmium, chromium, copper, iron, manganese, lead, selenium, and zinc were elevated. Samples from site 6 on Pony Creek were relatively absent of high metals concentrations except for slightly elevated levels of copper, iron, and zinc. Norecol (1989) also indicated high levels of these metals at Pony Creek, as well as silver, arsenic and cadmium. Again, results of placer activity can be traced downstream at sites 9, 10 and 12.

The persistence of these metal levels at the downstream sample sites on Victoria Creek, coupled with reduced suspended solids, is an indication that these metals are dissolved and thus bio-available. Norecol's (1989) analyses for dissolved metals, confirms this assumption.

Sites 2 and 3 on Dome Creek had the highest conductivity and suspended solids values in the sample set with the higher level being at site 3, the tailings pond effluent station. Site 2 is situated at the end of the by-pass

channel, adjacent to the third dam on the tailings pond. Given the low levels of conductivity and suspended solids further upstream on Dome Creek (site 1), it is assumed that there is seepage from the adjacent ponds or mine and mill area along the by-pass channel (see Figure 1).

Elevated metals in Dome Creek (sites 2 and 3) include silver, iron, lead and zinc. Silver and lead were higher in the effluent stream while zinc was higher in the by-pass channel. Site 1 was generally absent of elevated metals; however, copper, lead and zinc levels were near the guideline levels recommended for the protection of aquatic life (see Appendix I, Table 4).

3.2 Sediments

Sediment data is provided in Appendix IV. Percent particle size analysis at each site is listed in Appendix IV, Table 1. The sediment chemistry analyses are in Appendix IV, Table 2. Elemental composition of sediments are given in μg/g dry weight.

Dome Creek tended to have a large portion of fine sediments, with coarse and very coarse sand on the lower reach (site 4). The by-pass channel was characterized by a large proportion of gravel. Sample sites on Back Creek, Pony Creek, and Victoria Creek had large proportions of gravel. The exception was site 12, which showed the largest substrate component as very fine clay/silt and fine sands.

Generally metals concentrations were comparable with background ranges found in other stream sediments in the Yukon (Mathers et al., 1981). Sites 2 and 3 on Dome Creek were the only sites exhibiting high sediment metal concentrations, namely: arsenic, cadmium, copper, manganese, lead and zinc.

Traces of these higher levels are evident at site 4. Value ranges within triplicate sample sets tended to be uniform.

In comparison with sediment values recorded in 1985 (Godin and Osler), sediment arsenic concentrations in Dome Creek have increased by 10 to 40 times. Norecol (1989) reported Pony Creek sediments as having the highest levels of metals relative to all other sites they sampled. The Pony Creek station in the present study, showed only slightly higher levels of zinc in the sediments. The location of the sites is estimated to be in the same area on Pony Creek, in that both are below the Brown-McDade mine site. The contrast in levels may indicate the variability of sediment metals deposition to the streambed. High metal concentrations in Pony Creek sediments result from rill erosion of the waste rock pile at the Brown-McDade mine site (Duffy and Mahoney, 1982).

3.3 Benthic Invertebrates

A taxonomic list of benthic organisms found in the study area is in Appendix V, Table 1. Sample site enumeration is presented in Appendix V, Table 2. Taxonomic orders have been grouped and presented as percentage of total organisms counted at each sample location, which can be found in Appendix V, Table 3. A total of fifty-four taxa were identified in the study area.

Population densities ranged from approximately 2,200/m^3 to approximately 47,000/m^3 (see Table 2). The Back Creek Sites (5 and 7) reflected the lowest densities of invertebrates found in the study area. Portions of the creek bed upstream of the station 5 were being placer mined during the sampler colonization period. This contributed significant amounts of suspended and settleable solids to the creek and, potentially, may have had a negative influence on the benthic invertebrate populations at Stations 5 and 7. The samplers not successfully

recovered at these sites were either found above the water level or were completely inundated with sediments (ie. buried) during the return visit in August 1988. All three samplers were recovered at the remaining sites with the exception of Station 9 where only 2 samplers were recovered (the third sampler was found out of water). Sample sites 1, 3 and 6 were not sampled for benthic invertebrate due to lack of site suitability.

TABLE 2 SUMMARY OF BENTHIC INVERTEBRATES IN THE MOUNT NANSEN STUDY AREA

STATION	SAMPLE BASKETS RECOVERED	NUMBER OF INDIVIDUALS	*DENSITY OF INDIVIDUALS/ m^3	DIVERSITY INDEX (H')	EVENNESS (J')
2	3	531	31,000	0.21	0.19
4	3	110	6,400	0.06	.013
5	1	13	2,200	0.39	0.82
7	1	16	2,800	0.82	0.91
8	3	797	47,000	0.54	0.41
9	2	110	9,600	0.73	0.66
10	3	263	15,000	0.70	0.60
11	3	186	11000	0.73	0.62
12	3	433	25000	0.56	0.46

* volume of each basket is 0.0057m^3

The dominant order found overall was Plecoptera. Podmosta sp. comprised over 85% of this order at each site. Ephemeroptera, the second most abundant order was absent in Back Creek, Pony Creek and Dome Creek, but represented approximately 20% of the sample at sites on Victoria and Minnesota Creeks. At site 10 however, just below Dome Creek, Ephemeroptera was dominant, comprising 43% of the sample.

Diversity and evenness indices were low in Dome Creek, as was found in Environmental Protection's studies done in 1976 and 1977 (EPS, 1979). Two other stations above and below Dome Creek sampled in the previous studies, conformed with results at comparable sites (9 and 10) in the present study. A summary of results from the benthic fauna samples can be found in Table 2.

4.0 CONCLUSIONS

1. Seepage from the tailings pond is the primary source of elevated levels of silver, iron, lead and zinc in water found in Dome Creek.

2. Elevated concentrations of silver, arsenic, cadmium, chromium, copper, lead and zinc found in Back and Victoria Creek water samples are suspected to originate from placer mining activity upstream on Back Creek and Victoria Creek.

3. A significant increase in arsenic levels in Dome Creek sediments has occurred since the survey in 1976-77 (Environmental Protection Service, 1979).

4. Elevated levels of zinc in the lower portion of Pony Creek sediments are suspected to originate from the waste rock pile at the Brown-McDade mine site.

5. Benthic invertebrate populations in Dome Creek were found to be extremely low in numbers, diversity and evenness. These findings are consistent to those found in the previous survey in 1976-77 (Environmental Protection Service, 1979).

6. The condition of benthic populations at other sites sampled were reflective of instream conditions present at the time of the study. Invertebrate numbers, diversity and evenness were slightly reduced where there were influences from placer mining activity.

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APPENDIX I

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

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

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE	ANALYTICAL PROCEDURE	METHOD SECTION
Temperature	0.1°C	In situ temperature reading.	YSI Conductivity and Temperature Meter. Model 33.	
Flow		In situ flow measurements using a Price-type current meter.	Cross-section of the stream was measured and the velocity of flow was calculated using the standard Price-type current meter method.	
Dissolved Oxygen	1.00 mg/l	In situ measurement. The instrument was calibrated in the field under wanter-saturated air condition.	YSI Dissolved Oxygen meter(in situ) Orion model 701 pH meter & Orion O_2 electrode (laboratory)	
pH	0.1 pH units	Small aliquots of sample were taken and read soon after collection. No preservative. Instrument was calirated using 7.0 buffering solution.	Potentiometric	080
Conductivity	0.2 umhos cm	In situ measurement. Laboratory measurement, specific conductivity at 25+C. No preservative. The measurement was taken from the same sample as NH_3 below.	YSI Conductivity meter model 33 (in situ).Radiometer conductivity meter (CDM2D(laboratory).	044
Colour	5 (colour units)	Same sample as NH_3.	Platinum-cobalt visual comparison	040
Turbidity	0.1 (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 filtrate	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

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

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE	ANALYTICAL PROCEDURE	METHOD SECTION
Ammonia NH_3-N	0.005 mg/l	Single samples collected in 2 litre linear polyethylene containers. Each container was rinsed 3 times with sample before it was filled. No preservatives. Stored at 4°C.	Phenol hypochlorimetric-automated	058
Nitrate NO_2-N	0.005 mg/l	Same sample as NH_3.	Diazotization-colorimetric-automated	070
Nitrate NO_3-N	0.005 mg/l	Same sample as NH_3.	Cadmium-copper reduction-colorimetric-automated	072
Total Phosphate T PO_4-P	0.002 mg/l	Same sample as NH_3.	Ascorbic acid-persulphate, automated autoclave digestion	086
Sulphate SO_4	1 mg/l	Same sample as NH_3.	Automated methylthymol-blue colorimetric	122
Chloride Cl	0.5 mg/l	Same sample as NH_3.	Thiocyanate-combined reagent-colorimetric	024

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

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE	ANALYTICAL PROCEDURE	METHOD SECTION
Extractable/Total Metals	mg/l	Single or triplicate samples collected in 125ml linear polyethylene bottles. Each bottle was rinsed 3 times with sample before filling. Preserved to a pH <1.5 using 1.0ml concentrated HNO_3.	Inductively Coupled Agron Plasma	300
Ag	0.01			
Al	0.05			
As	0.05			
B	0.01			
Ba	0.001			
Be	0.001			
Ca	0.1			
Cd	0.005			
Co	0.005			
Cr	0.005			
Cu	0.005			
Fe	0.005			
Mg	0.10			
Mn	0.001			
Mo	0.01			
Na	0.1			
Ni	0.02			
Pb	0.05			
Sb	0.05			
Se	0.05			
Si	0.05			
Sn	0.05			
Sr	0.001			
Ti	0.002			
V	0.01			
Zn	0.002			

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

PARAMETER	DETECTION LIMIT	COLLECTION AND PRESERVATION PROCEDURE	ANALYTICAL PROCEDURE	METHOD SECTION
Pb	0.0005	Same sample as metals.	Graphite Furnace Atomic Absorption Spectrometry	330
Total Hardness	0.030 mg/l	Same sample as metals.		

Ca/Mg Hardness = 4.116Mg + 2.497Ca

[1] As described in Environment Canada (1976).
[2] As described in Department of Environment (1979).

APPENDIX 1 TABLE 2 SEDIMENT COLLECTION, PREPARATION AND ANALYSIS METHODS

PARAMETER	PREPARATION	ANALYSIS	METHODS CODE[1]
All Parameters	Creek and River Stations: Sediment samples were collected using a Teflon scoop to scoop stream sediments into sample bag. Three samples were collected at each station and placed in geochemical paper sample bags. Each sample is then sealed in plastic bags and frozen or keep cool within 24 hours.		
Metals (Leachable) Al, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Na, Ni, P, Pb, Si, Sn, Sr, Ti, V, Zn	Sample was freeze-dried for 48 hours to remove water. Sample was sieved through a size 100 mesh (.15mm) stainless steel sieve. The portion passing through was analyzed for leachable metals. Sample was leached with HCl and HNO^3. The sample was heated for 3 hours.	Inductively Coupled Argon Plasma (ICAP)	320
As	Same as other metals.	Hydride Generation ICAP	350
Ag	Same as other metals.	Flame Atomic Absorption	330
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).

APPENDIX 1 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 Suber sampler with a net, 60cm long (mesh size 500μm). Area sampled was 929 cm^2 (1 ft^2). The sampler was deployed three times, over a short reach of river (approx. 10m), at each site. Replicates were all washed from the net into a 1l bottle. A mixture of 10% formalin was added to preserve the sample.	Bottom fauna was sorted from other material and placed in a vial containing 70% methanol.	Bottom fauna samples were sent to Dr. C. Low, a Consulting Invertebrate Biologist, Nanaimo, B.C. for identification to genus and species if possible and enumeration of sample.

APPENDIX 1 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 (TCU)	<15	1		
Temperature (°C)	15			
Odour and taste	If offensive	1		
Turbidity NTU	<5	1		
Coliform-Total (count/100ml)	10	1	recreational water Total 500-1000/100ml	9
fecal coliform	0	1	200 /100ml	9
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 at pH >6.5	5
Ammonia total (NH3-N)mg/l	0.5	4	2.2 at pH 6.5 temp 10°C 1.37 at ph 8.0 temp 10°C	10
Antimony (Sb) mg/l				
Arsenic (As) total mg/l	0.05	1	<0.05 5.0	10 7
Barium (Ba) mg/l	1.0	1		
Boron (B) mg/l	5.0	1		
*Cadmium (Cd) total mg/l	0.005	1	0.0002 for hardness 0-60mg/l $CaCO_3$ 0.0008 for hardness 60-120mg/l $CaCO_3$ 0.0013 for hardness 120-180 $CaCO_3$ 0.0018 for hardness >180 $CaCO_3$	10
Calcium (Ca)mg/l	75-200	7		
Chloride (Cl)mg/l	<250 aesthetic objectives	1		
**Chromium (Cr) total mg/l	0.05	1	0.02 to protect fish 0.002 to protect aquatic life	10
Cobalt (Co)mg/l				
Conductivity @ 25°C (umhos/cm)	Depends on dissolved salts	7	150-500	6

APPENDIX 1 TABLE 4 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE (continued)

SUBSTANCE	RECOMMENDED LEVEL(S) FOR DRINKING WATER	REFERENCES(S)	RECOMMENDED LEVEL(S) FOR AQUATIC LIFE	REFERENCE
*Copper (Cu) total mg/l	<1.0 aesthetic objective	1	0.002 at hardness 0-120mg/l $CaCo_3$ 0.004 at hardness 120-180mg/l $CaCO_3$ 0.006 at hardness >180mg/l $CaCO_3$	
Dissolved oxygen (% saturation)	Near 100%	4	>5.0mg/l	10
Fluoride (F)mg/l	1.5	1	1.5	7
Hardness (Total) as mg/l CaCO3	80-100	1		
Iron (Fe) total mg/l	<0.3 aesthetic objective	1	0.3	10
Lead (Pb) total mg/l	0.05	1	0.001 at hardness 0-60mg/l $CaCO_3$ 0.002 at hardness 60-120mg/l $CaCO_3$ 0.004 at hardness 120-180mg/l $CaCO_3$ 0.007 at hardness >180mg/l $CaCO_3$	10
Magnesium (Mg)mg/l	50	4		
Manganese (Mn)mg/l	<0.05 aesthetic objective	1	1.0	7
Molybdenum (Mo)mg/l				
Nickel (Ni) total mg/l	0.25	2	0.025 at hardness 0-60mg/l $CaCO_3$ 0.065 at hardness 60-120mg/l $CaCO_3$ 0.11 at hardness 120-180mg/l $CaCO_3$ 0.15 at hardness >180	10
Nitrate (NO3-N)mg/l	10	1		
Nitrite (NO2-N)mg/l	1.0	1	0.06	10
pH units	6.5-8.5	1	6.5-9.0	
Phosphate (PO4)mg/l	0.2	8		
*Phosphorus (P)mg/l (Total)			0.020 to prevent algae	5
Residue: Filterable mg/l (Total dissolved solids)	<500 aesthetic objective	4	70-400 with a maximum of 2000	6
Residue: Non-Filterable (mg/l) (TSS)			increase of 10mg/l with bkgd<100mg/l increase of 10% above bkgd with bkgd >100.0mg/l	8 10

APPENDIX 1 TABLE 4 WATER QUALITY CRITERIA FOR DRINKING WATER AND AQUATIC LIFE (continued)

SUBSTANCE	RECOMMENDED LEVEL(S) FOR DRINKING WATER	REFERENCES(S)	RECOMMENDED LEVEL(S) FOR AQUATIC LIFE	REFERENCE
**Selenium (Se) total mg/l	0.01	1	0.001	10
Silica (Si)mg/l	1.0			
*Silver (Ag) total mg/l	0.01	1	0.0001	10
Sodium (Na)mg/l	0.5	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				
Vanadium (V)				
Zinc (Zn)mg/l	<5.0 aesthetic objective	1	0.030	10

* Use graphite furnace for the lab detection limit to be less than the recommended levels.
** Lab detection limit > recommended levels.

REFERENCES:

1. Health & Welfare Canada. 1987. Guidelines for Canadian Drinking Water Quality 1987, Supply and Services Canada.

2. Inland Waters Directorate. 1980. Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances. Environment Canada, Ottawa.

3. Thurston, R.V., R.C. Russo, C.M. Fetteroff Jr., T.A. Edsall, and Y.M. Barber Jr. (Eds.). 1979. A Review of the EPA Book: Quality Criteria for Water. Water Quality Section, American Fisheries Society, Bethesda, MD, 313p.

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

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

4. Anonymous 1977. Guidelines for Establishing Water Quality Objectives for the Territorial Waters of the Yukon and Northwest Territories. Report of the Working Group on Water Quality Objectives to the Chairman, Water Boards, Yukon and Northwest Territories.

5. Ontario Ministry of the Environment. 1978. Water Management - Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment.

6. Environment Canada, 1976. Pollution Sampling Handbook. Pacific Region Laboratory Services, Fisheries Operations and Environmental Protection Service, West Vancouver, B.C.

7. California State Water Resources Control Board. 1963. Water Quality Criteria. Publication No. 3-A Second Edition by McKee and Wolf.

8. Inland Waters Directorate. 1979. Water Quality Source Book a Guide to Water Quality Parameters. Environment Canada, Water Quality Branch, Ottawa, Canada.

9. Health and Welfare Canada, 1983. Guidelines for Canadian Recreational Water Quality. Supply and Services Canada.

10. CCREM. 1987. Canadian Water Quality Guidelines. Task Force on Water Quality Guidelines of the Canadian Council of Resource and Environment Ministers. Ottawa.

APPENDIX II

WATER QUALITY DATA
JULY, 1988

APPENDIX II TABLE 1 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988

STATION #	DISCHARGE (m^3/sec)	TEMP (°C)	pH INSITU	pH LAB	IN SITU COND. (μmhos/cm)	LAB COND. (μmhos/cm)	DISSOLVED OXYGEN (mg/L)	% DISSOLVED OXYGEN SATURATION	COLOR (REL. U.)	TURBIDITY (FTU)	TOTAL ALK. (as$CaCO_3$) (mg/L)
		*	*		*		*				
1	0.003	3.0	6.74	8.1	60	113	9.7	87	20	0.3	39
				7.9		113			20	0.6	42
				7.9		113			20	0.3	39
2	0.002	13.5	7.82	8.3	350	580	9.8	108	30	7.3	118
				8.4		550			30	7.3	118
				8.4		550			30	7.3	118
3	0.002	11.2	7.62	8.3	810	1130	8.8	92	20	2.3	162
				8.4		1130			20	4.3	162
				8.3		1130			20	3.8	160
4	0.008	13.0	6.89	---	140	---	10.3	110	---	---	---
				7.8		235			100	0.3	37
				7.8		245			100	0.3	37
5	0.150	8.0	6.89	6.7	47	88	9.0	87	200	2000.0	44
				6.7		85			200	2300.0	44
				6.7		85			200	2000.0	44
6	0.008	9.5	7.13	7.9	85	155	8.9	89	70	28.0	45
				7.9		155			60	28.0	45
				7.9		155			70	23.0	45

< detection limit
-- no sample for analysis
* only one measurment in situ

APPENDIX II TABLE 1 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	DISCHARGE (m^3/sec)	TEMP (°C)	pH INSITU	pH LAB	IN SITU COND. (μmhos/cm)	LAB COND. (μmhos/cm)	DISSOLVED OXYGEN (mg/L)	% DISSOLVED OXYGEN SATURATION	COLOR (REL.U)	TURBIDITY (FTU)	TOTAL ALK. (as$CaCO_3$) (mg/L)
		*	*		*		*				
7	0.070	14.0	7.28	6.9	60	83	9.0	98	500	1800.0	33
				6.9		83			100	1800.0	33
				6.9		83			200	1800.0	33
8	1.160	9.0	7.50	7.9	50	73	9.6	94	80	28.0	36
				7.9		80			70	23.0	33
				7.8		73			80	28.0	33
9	1.700	10.0	9.24	7.6	55	78	11.4	116	200	130.0	34
				7.6		78			100	130.0	34
				7.7		78			100	130.0	33
10	1.590	10.1	7.46	7.7	60	83	9.5	94	100	100.0	33
				7.6		83			100	215.0	33
				7.7		83			100	130.0	35
11	0.280	7.5	6.81	7.2	22	33	10.0	94	100	0.2	13
				7.2		33			100	0.2	13
				7.1		33			100	0.2	12
12	1.490	12.0	7.40	7.8	52	88	10.1	105	80	8.0	36
				7.8		88			80	7.3	35
				7.9		88			80	6.8	37

< detection limit
--- no sample for analysis

* only one measurment in situ

PPENDIX II TABLE 1 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	HARDNESS ($asCaCO_3$) (mg/L)	TOTAL HARDNESS (mg/L)	SULPHATE (mg/L)	CHLORIDE (mg/L)	TOTAL P (mg/L)	NITRITE (mg/L)	NITRITE+ NITRATE (mg/L)	AMMONIA (mg/L)	FR (mg/L)	NFR (mg/L)
1	54	57	15	2.7	0.050	<0.005	0.062	0.007	99	34
	53	56	15	2.7	0.081	<0.005	0.064	0.013	97	50
	54	57	15	2.8	0.064	<0.005	0.064	0.008	95	40
2	310	315	180	3.2	0.029	<0.005	0.087	0.065	463	16
	296	300	180	3.2	0.029	<0.005	0.088	0.067	457	12
	299	303	190	3.3	0.028	<0.005	0.089	0.067	446	16
3	684	690	550	3.5	0.055	<0.005	0.198	0.289	1040	28
	684	689	550	4.0	0.046	<0.005	0.199	0.304	1060	29
	738	745	540	4.0	0.041	<0.005	0.201	0.305	1050	16
4	124	125	---	---	---	---	---	---	---	---
	116	117	90	4.1	0.013	<0.005	0.009	0.013	226	<5
	117	118	80	4.1	0.012	<0.005	0.015	0.039	222	<5
5	351	957	22	5.0	10.500	<0.005	0.505	0.230	48	11100
	357	914	22	4.2	8.900	0.006	0.453	0.330	31	10500
	385	975	20	4.1	10.600	<0.005	0.249	0.382	140	2930
6	92	103	33	4.2	0.106	<0.005	0.008	0.043	630	138
	84	95	38	4.2	0.196	<0.005	0.006	0.024	630	159
	84	95	37	4.3	0.109	<0.005	0.016	0.024	162	114

< detection limit
--- no sample for analysis

PPENDIX II TABLE 1 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	HARDNESS ($asCaCO_3$) (mg/L)	TOTAL HARDNESS (mg/L)	SULPHATE (mg/L)	CHLORIDE (mg/L)	TOTAL P (mg/L)	NITRITE (mg/L)	NITRITE+ NITRATE (mg/L)	AMMONIA (mg/L)	FR (mg/L)	NFR (mg/L)
7	211	602	23	4.4	5.800	0.006	0.224	0.224	170	5780
	219	611	21	4.3	6.000	0.009	0.159	0.199	170	5930
	225	625	20	4.6	6.400	<0.005	0.180	0.207	140	5920
8	42	49	8	1.0	0.080	<0.005	0.036	0.028	340	88
	43	50	7	3.9	0.085	<0.005	0.039	0.023	370	84
	41	48	7	4.0	0.079	<0.005	0.032	0.016	350	493
9	62	113	8	4.3	0.500	<0.005	0.052	0.032	96	507
	60	107	8	4.3	0.533	<0.005	0.041	0.026	97	77
	66	119	8	4.3	0.460	<0.005	0.042	0.027	50	510
10	62	90	10	4.3	0.400	<0.005	0.050	0.053	60	440
	61	98	10	4.5	0.400	<0.005	0.041	0.034	120	490
	58	91	11	4.6	0.859	<0.005	0.047	0.042	110	540
11	19	21	6	4.8	0.030	<0.005	0.008	0.032	170	<5
	18	20	5	4.9	0.023	<0.005	0.014	0.036	180	<5
	18	19	5	5.0	0.018	<0.005	0.008	0.029	190	<5
12	48	55	9	4.6	0.058	<0.005	0.039	0.025	101	56
	48	54	9	4.6	0.065	<0.005	0.041	0.024	100	57
	47	54	10	4.8	0.053	<0.005	0.044	0.027	101	70

< detection limit

PPENDIX II TABLE 2 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988

[1]EXTRACTABLE METALS

STATION #	Ag (mg/L)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Ca (mg/L)	Cd(GF) (mg/L)	Co (mg/L)	Cr (mg/L)	Cu(GF) (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)
1	<0.01	0.32	<0.05	<0.01	0.030	<0.001	16.6	0.0001	0.008	<0.005	0.0030	0.459	3.0	0.018
	<0.01	0.34	<0.05	<0.01	0.030	<0.001	16.4	0.0003	<0.005	<0.005	0.0034	0.446	2.9	0.022
	<0.01	0.37	<0.05	<0.01	0.031	<0.001	16.7	0.0002	0.006	<0.005	0.0039	0.473	3.0	0.023
2	<0.01	0.19	0.08	<0.01	0.038	<0.001	84.8	0.0013	<0.005	<0.005	0.0019	1.200	24.0	0.422
	<0.01	0.12	<0.05	<0.01	0.036	<0.001	81.0	0.0013	<0.005	<0.005	0.0026	1.100	22.8	0.399
	<0.01	0.13	<0.05	<0.01	0.037	<0.001	81.7	0.0013	<0.005	<0.005	0.0020	1.140	23.1	0.411
3	<0.01	0.07	0.07	<0.01	0.049	<0.001	167.0	0.0003	<0.005	<0.005	0.0034	1.400	64.8	0.973
	<0.01	0.09	<0.05	<0.01	0.049	<0.001	167.0	0.0003	0.006	<0.005	0.0039	1.440	64.8	0.975
	<0.01	0.15	0.08	<0.01	0.055	<0.001	180.0	0.0004	0.008	<0.005	0.0042	1.860	69.9	1.090
4	<0.01	0.11	<0.05	<0.01	0.027	<0.001	32.5	<0.0001	<0.005	<0.005	0.0026	0.285	10.4	0.017
	<0.01	0.05	<0.05	<0.01	0.024	<0.001	30.5	<0.0001	<0.005	<0.005	0.0026	0.262	9.6	0.016
	<0.01	0.13	<0.05	<0.01	0.025	<0.001	30.8	0.0001	<0.005	<0.005	0.0025	0.268	9.7	0.016
5	<0.01	70.60	<0.05	<0.01	3.600	0.005	88.3	*0.019	0.327	0.072	*0.329	111.000	31.7	6.340
	<0.01	65.80	0.06	<0.01	3.360	0.005	88.7	*0.021	0.329	0.076	*0.334	99.100	32.8	6.510
	<0.01	68.10	<0.05	<0.01	3.390	0.005	95.7	*0.023	0.342	0.079	*0.364	110.000	35.4	6.930
6	<0.01	1.05	<0.05	<0.01	0.088	<0.001	27.0	0.0005	0.006	<0.005	0.0115	3.090	5.9	0.094
	<0.01	0.96	<0.05	<0.01	0.081	<0.001	24.8	0.0004	0.010	<0.005	0.0115	2.890	5.4	0.089
	<0.01	0.95	<0.05	<0.01	0.082	<0.001	24.7	0.0005	0.009	<0.005	0.0129	2.940	5.4	0.088

< detection limit
[1] All analysis ICP SCAN except where noted
* ICP SCAN replaces GF analysis result due to GF sample loss

APPENDIX II TABLE 2 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	[1]EXTRACTABLE METALS													
	Ag (mg/L)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Ca (mg/L)	Cd(GF) (mg/L)	Co (mg/L)	Cr (mg/L)	Cu(GF) (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)
7	<0.01	40.60	0.18	<0.01	2.070	0.003	53.8	*0.014	0.231	0.043	*0.227	87.800	18.7	3.160
	<0.01	41.50	0.08	<0.01	2.000	0.003	55.7	*0.014	0.230	0.041	*0.235	87.400	19.4	3.240
	<0.01	42.40	0.10	<0.01	1.840	0.004	56.4	*0.016	0.248	0.044	*0.242	87.400	20.4	3.340
8	<0.01	0.80	<0.05	<0.01	0.063	<0.001	11.4	0.0002	0.005	<0.005	0.0075	1.260	3.3	0.069
	<0.01	0.85	<0.05	<0.01	0.064	<0.001	11.8	0.0002	<0.005	<0.005	0.0073	1.280	3.3	0.070
	<0.01	0.80	<0.05	<0.01	0.062	<0.001	11.2	<0.0001	0.005	<0.005	0.0091	1.220	3.2	0.070
9	<0.01	5.50	<0.05	<0.01	0.226	<0.001	15.7	0.0019	0.044	0.009	0.0370	11.000	5.5	0.403
	<0.01	4.96	<0.05	<0.01	0.220	<0.001	15.3	0.0018	0.030	0.006	0.3000	10.000	5.3	0.395
	<0.01	5.75	<0.05	<0.01	0.244	<0.001	16.7	0.0018	0.035	0.010	0.0310	11.400	5.8	0.430
10	<0.01	2.99	<0.05	<0.01	0.169	<0.001	16.6	0.0009	0.015	<0.005	0.0280	5.540	5.1	0.303
	<0.01	3.99	<0.05	<0.01	0.173	<0.001	16.0	0.0010	0.022	0.006	0.0180	7.400	5.2	0.306
	<0.01	3.69	<0.05	<0.01	0.164	<0.001	15.0	0.0011	0.022	0.009	0.0190	6.830	4.9	0.292
11	<0.01	0.22	<0.05	<0.01	0.042	<0.001	5.8	0.0002	<0.005	<0.005	0.0036	0.336	1.2	0.006
	<0.01	0.17	<0.05	<0.01	0.041	<0.001	5.5	0.0003	<0.005	<0.005	0.0032	0.312	1.1	0.007
	<0.01	0.17	<0.05	<0.01	0.039	<0.001	5.4	0.0005	<0.005	<0.005	0.0034	0.310	1.0	0.007
12	<0.01	0.70	<0.05	<0.01	0.063	<0.001	13.3	0.0007	<0.005	<0.005	0.0053	1.340	3.7	0.071
	<0.01	0.66	<0.05	<0.01	0.062	<0.001	13.2	0.0009	<0.005	<0.005	0.0053	1.260	3.6	0.070
	<0.01	0.74	<0.05	<0.01	0.063	<0.001	12.9	0.0013	0.005	<0.005	0.0069	1.430	3.6	0.073

< detection limit
[1] All analysis ICP SCAN except where noted
* ICP SCAN replaces GF analysis result due to GF sample loss

APPENDIX II TABLE 2 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	[1]EXTRACTABLE METALS												
	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb(GF) (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	<0.01	1.5	<0.02	<0.1	<0.0005	<0.05	<0.05	5.85	<0.05	0.059	0.010	<0.01	0.003
	<0.01	1.5	<0.02	<0.1	0.0031	<0.05	<0.05	5.76	<0.05	0.058	0.010	<0.01	0.016
	<0.01	1.5	<0.02	<0.1	0.0016	<0.05	<0.05	5.87	<0.05	0.058	0.010	<0.01	0.013
2	<0.01	4.5	<0.02	<0.1	<0.0005	<0.05	<0.05	5.81	<0.05	0.212	0.007	<0.01	0.218
	<0.01	4.2	<0.02	<0.1	<0.0005	<0.05	<0.05	5.54	<0.05	0.202	0.006	<0.01	0.209
	<0.01	4.3	<0.02	<0.1	<0.0005	<0.05	<0.05	5.58	<0.05	0.203	0.006	<0.01	0.210
3	<0.01	7.8	<0.02	<0.1	0.0005	<0.05	<0.05	3.86	<0.05	0.392	0.006	<0.01	0.109
	<0.01	7.8	<0.02	<0.1	0.0005	<0.05	<0.05	3.87	<0.05	0.393	0.006	<0.01	0.112
	<0.01	8.4	<0.02	<0.1	0.0009	<0.05	<0.05	4.22	<0.05	0.425	0.009	<0.01	0.132
4	<0.01	2.4	<0.02	<0.1	<0.0005	<0.05	<0.05	4.95	<0.05	0.087	<0.002	<0.01	0.022
	<0.01	2.3	<0.02	<0.1	<0.0005	<0.05	<0.05	4.64	<0.05	0.081	<0.002	<0.01	0.021
	<0.01	2.3	<0.02	<0.1	<0.0005	<0.05	<0.05	4.70	<0.05	0.081	<0.002	<0.01	0.021
5	<0.01	2.9	0.08	2.7	*0.34	<0.05	0.14	54.30	<0.05	0.554	0.253	0.33	0.905
	<0.01	2.9	0.08	2.7	*0.33	<0.05	0.08	49.40	<0.05	0.555	0.238	0.34	0.961
	<0.01	3.4	0.08	3.4	*0.36	<0.05	0.12	55.20	<0.05	0.609	0.342	0.36	0.996
6	<0.01	3.2	<0.02	<0.1	0.0008	<0.05	<0.05	6.84	<0.05	0.147	0.049	0.01	0.071
	<0.01	2.9	<0.02	<0.1	0.0008	<0.05	<0.05	6.31	<0.05	0.134	0.042	<0.01	0.067
	<0.01	3.0	<0.02	<0.1	0.0010	<0.05	<0.05	6.32	<0.05	0.133	0.045	<0.01	0.067

< detection limit
[1] All analysis ICP SCAN except where noted
* ICP SCAN replaces GF analysis result due to GF sample loss

APPENDIX II TABLE 2 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	[1]EXTRACTABLE METALS												
	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb(GF) (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)
7	<0.01	2.8	0.04	2.1	*0.45	<0.05	0.13	42.10	<0.05	0.340	0.361	0.24	0.655
	<0.01	2.8	0.04	2.0	*0.41	<0.05	0.11	42.10	<0.05	0.356	0.337	0.24	0.686
	<0.01	3.0	0.05	2.0	*0.44	<0.05	0.12	0.50	<0.05	0.361	0.345	0.26	0.717
8	<0.01	1.4	<0.02	<0.1	0.0013	<0.05	<0.05	5.78	<0.05	0.113	0.023	<0.01	0.008
	<0.01	1.4	<0.02	<0.1	0.0011	<0.05	<0.05	5.96	<0.05	0.118	0.023	<0.01	0.004
	<0.01	1.5	<0.02	<0.1	0.0012	<0.05	<0.05	5.73	0.06	0.111	0.023	<0.01	0.004
9	<0.01	1.7	<0.02	0.3	0.0459	<0.05	<0.05	11.40	<0.05	0.143	0.163	0.03	0.084
	<0.01	1.6	<0.02	0.3	0.0447	<0.05	<0.05	10.50	<0.05	0.140	0.132	0.03	0.078
	<0.01	1.8	<0.02	0.3	0.0462	<0.05	<0.05	11.80	<0.05	0.154	0.154	0.03	0.087
10	<0.01	1.8	<0.02	0.2	0.0123	<0.05	<0.05	8.75	<0.05	0.150	0.066	0.02	0.044
	<0.01	1.7	<0.02	0.2	0.0145	<0.05	<0.05	10.00	<0.05	0.143	0.144	0.02	0.050
	0.010	1.6	<0.02	0.2	0.0167	<0.05	<0.05	9.26	<0.05	0.134	0.122	0.02	0.050
11	<0.01	1.4	<0.02	<0.1	<0.0005	<0.05	<0.05	6.57	<0.05	0.027	<0.002	<0.01	0.002
	<0.01	1.3	<0.02	<0.1	<0.0005	<0.05	<0.05	6.42	<0.05	0.026	<0.002	<0.01	0.002
	<0.01	1.3	<0.02	<0.1	<0.0005	<0.05	<0.05	6.18	<0.05	0.025	<0.002	<0.01	0.003
12	<0.01	1.7	<0.02	<0.1	0.0008	<0.05	<0.05	6.27	<0.05	0.119	0.025	<0.01	0.012
	<0.01	1.6	<0.02	<0.1	0.0007	<0.05	<0.05	6.21	<0.05	0.119	0.024	<0.01	0.011
	<0.01	1.6	<0.02	<0.1	0.0005	<0.05	<0.05	6.21	<0.05	0.116	0.031	<0.01	0.012

< detection limit
[1] All analysis ICP SCAN except where noted
* ICP SCAN replaces GF analysis result due to GF sample loss

APPENDIX II TABLE 3 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988

STATION #	[1]TOTAL METALS													
	Ag (mg/L)	Al (mg/L)	As (mg/L)	B (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)	Mg (mg/L)	Mn (mg/L)
1	<0.01	1.48	<0.05	<0.01	0.039	<0.001	16.9	<0.005	<0.005	<0.005	<0.005	0.911	3.2	0.021
	<0.01	1.53	<0.05	<0.01	0.043	<0.001	18.9	<0.005	<0.005	<0.005	<0.005	0.952	3.6	0.027
	<0.01	1.45	<0.05	<0.01	0.040	<0.001	17.5	<0.005	<0.005	<0.005	<0.005	0.898	3.3	0.026
2	<0.01	0.68	<0.05	<0.01	0.040	<0.001	83.7	<0.005	<0.005	<0.005	<0.005	1.680	24.4	0.412
	<0.01	0.63	<0.05	<0.01	0.039	<0.001	83.7	<0.005	<0.005	<0.005	<0.005	1.580	24.4	0.407
	<0.01	0.59	<0.05	<0.01	0.063	<0.001	86.4	<0.005	<0.005	<0.005	<0.005	1.660	25.2	0.429
3	<0.01	0.09	<0.05	<0.01	0.049	<0.001	175.0	<0.005	<0.005	<0.005	<0.005	1.540	70.5	0.990
	<0.01	0.12	0.05	<0.01	0.049	<0.001	174.0	<0.005	<0.005	<0.005	<0.005	1.590	70.2	0.992
	<0.01	0.21	0.08	<0.01	0.053	<0.001	179.0	<0.005	<0.005	<0.005	<0.005	1.970	72.2	1.050
4	<0.01	0.08	<0.05	<0.01	0.025	<0.001	30.4	<0.005	<0.005	<0.005	<0.005	0.295	10.0	0.016
	<0.01	0.06	<0.05	<0.01	0.027	<0.001	33.5	<0.005	<0.005	<0.005	<0.005	0.318	11.1	0.016
	<0.01	0.07	<0.05	<0.01	0.024	<0.001	30.3	<0.005	<0.005	<0.005	<0.005	0.285	10.0	0.016
5	<0.01	247.00	0.59	<0.01	3.910	0.007	93.3	0.029	0.889	0.287	0.503	377.000	71.2	7.930
	<0.01	257.00	0.59	<0.01	4.150	0.007	92.4	0.032	0.964	0.278	0.496	393.000	69.5	7.940
	<0.01	236.00	0.47	<0.01	4.510	0.006	92.0	0.027	0.085	0.230	0.458	363.000	62.6	10.200
6	<0.01	2.59	<0.05	<0.01	0.088	<0.001	23.1	<0.005	<0.005	<0.005	0.006	3.930	5.4	0.088
	<0.01	2.69	<0.05	<0.01	0.099	<0.001	26.4	<0.005	<0.005	<0.005	<0.005	4.360	6.1	0.101
	<0.01	2.74	<0.05	<0.01	0.100	<0.001	26.4	<0.005	<0.005	<0.005	0.008	4.360	6.2	0.100

< detection limit

[1] All analysis ICP SCAN except where noted

APPENDIX II TABLE 3 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	[1]TOTAL METALS Ag (mg/L)	Al (mg/L)	As (mg/L)	B (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)	Mg (mg/L)	Mn (mg/L)
7	<0.01	198.00	0.67	<0.01	2.670	0.005	64.6	0.021	0.538	0.217	0.368	337.000	53.2	4.730
	0.01	264.00	0.91	<0.01	3.060	0.005	65.2	0.020	<0.005	0.261	0.396	451.000	59.3	4.910
	<0.01	181.00	0.45	<0.01	2.750	0.004	55.7	0.017	<0.005	0.169	0.309	308.000	42.4	4.040
8	<0.01	4.10	<0.05	<0.01	0.090	<0.001	12.5	<0.005	<0.005	<0.005	0.010	4.280	4.1	0.095
	<0.01	3.68	<0.05	<0.01	0.081	<0.001	11.6	<0.005	<0.005	<0.005	0.010	3.810	3.8	0.088
	<0.01	3.40	<0.05	<0.01	0.080	<0.001	11.5	<0.005	<0.005	<0.005	0.010	3.560	3.8	0.088
9	<0.01	18.60	0.07	<0.01	0.300	<0.001	16.3	<0.005	<0.005	0.021	0.035	24.700	7.7	0.483
	<0.01	21.40	0.06	<0.01	0.323	<0.001	16.4	<0.005	<0.005	0.022	0.033	27.700	8.0	0.511
	<0.01	22.10	0.08	<0.01	0.325	<0.001	16.5	<0.005	<0.005	0.025	0.038	28.200	8.1	0.509
10	<0.01	12.00	<0.05	<0.01	0.209	<0.001	15.4	<0.005	<0.005	0.014	0.018	14.200	6.1	0.332
	<0.01	17.70	<0.05	<0.01	0.253	<0.001	16.9	<0.005	<0.005	0.016	0.020	19.600	7.1	0.370
	<0.01	18.80	<0.05	<0.01	0.265	<0.001	17.1	<0.005	<0.005	0.019	0.023	21.400	7.4	0.392
11	<0.01	0.24	<0.05	<0.01	0.039	<0.001	5.7	<0.005	<0.005	<0.005	<0.005	0.377	1.2	0.006
	<0.01	0.23	<0.05	<0.01	0.039	<0.001	5.6	<0.005	<0.005	<0.005	<0.005	0.362	1.1	0.007
	<0.01	0.28	<0.05	<0.01	0.039	<0.001	5.6	<0.005	<0.005	<0.005	<0.005	0.378	1.2	0.007
12	<0.01	3.20	<0.05	<0.01	0.077	<0.001	12.8	<0.005	<0.005	<0.005	<0.005	3.460	3.9	0.083
	<0.01	3.04	<0.05	<0.01	0.078	<0.001	13.2	<0.005	<0.005	<0.005	<0.005	3.400	4.1	0.085
	<0.01	3.84	<0.05	<0.01	0.086	<0.001	13.5	<0.005	<0.005	<0.005	0.005	4.070	4.2	0.092

< detection limit

[1] All analysis ICP SCAN except where noted

APPENDIX II TABLE 3 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	[1]TOTAL METALS Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (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	<0.01	1.5	<0.02	<0.1	<0.05	<0.05	<0.05	7.46	<0.05	0.061	0.037	<0.01	<0.002
	<0.01	1.7	<0.02	<0.1	<0.05	<0.05	<0.05	8.06	<0.05	0.069	0.035	<0.01	0.010
	<0.01	1.7	<0.02	<0.1	<0.05	<0.05	<0.05	7.49	<0.05	0.063	0.032	<0.01	0.008
2	<0.01	4.5	<0.02	<0.1	<0.05	<0.05	<0.05	6.33	<0.05	0.206	0.015	<0.01	0.207
	<0.01	4.3	<0.02	<0.1	<0.05	<0.05	<0.05	6.32	<0.05	0.207	0.013	<0.01	0.204
	<0.01	4.5	<0.02	<0.1	<0.05	<0.05	<0.05	6.47	<0.05	0.217	0.014	<0.01	0.212
3	<0.01	8.0	<0.02	<0.1	<0.05	<0.05	<0.05	4.05	<0.05	0.409	0.007	<0.01	0.099
	<0.01	8.0	<0.02	<0.1	<0.05	<0.05	<0.05	4.06	<0.05	0.408	0.007	<0.01	0.101
	<0.01	8.3	<0.02	<0.1	<0.05	<0.05	<0.05	4.31	<0.05	0.420	0.011	<0.01	0.116
4	<0.01	2.3	<0.02	<0.1	<0.05	<0.05	<0.05	4.58	<0.05	0.080	<0.002	<0.01	0.007
	<0.01	2.5	<0.02	<0.1	<0.05	<0.05	<0.05	5.03	<0.05	0.090	0.003	<0.01	0.009
	<0.01	2.3	<0.02	<0.1	<0.05	<0.05	<0.05	4.57	<0.05	0.080	<0.002	<0.01	0.007
5	0.02	5.1	0.14	8.0	<0.05	<0.05	0.21	109.00	<0.05	0.655	7.010	0.73	1.800
	0.02	4.8	0.15	8.0	<0.05	<0.05	0.23	107.00	<0.05	0.642	6.920	0.71	1.800
	0.02	4.6	0.13	5.9	<0.05	<0.05	0.26	122.00	<0.05	0.636	6.030	0.63	1.560
6	<0.01	3.0	<0.02	<0.1	<0.05	<0.05	<0.05	8.96	<0.05	0.129	0.093	<0.01	0.054
	<0.01	3.2	<0.02	<0.1	<0.05	<0.05	<0.05	9.68	<0.05	0.149	0.099	<0.01	0.060
	<0.01	3.4	<0.02	<0.1	<0.05	<0.05	<0.05	9.57	<0.05	0.147	0.099	<0.01	0.062

< detection limit

[1] All analysis ICP SCAN except where noted

APPENDIX II TABLE 3 MOUNT NANSEN MINES WATER QUALITY DATA, JULY 1988 (continued)

STATION #	[1]TOTAL METALS												
	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (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)
7	0.03	4.9	0.09	4.8	<0.05	<0.05	0.19	111.00	<0.05	0.462	7.250	0.60	1.530
	0.04	5.3	0.10	5.6	<0.05	<0.05	0.33	120.00	<0.05	0.472	10.300	0.69	1.770
	0.02	4.2	0.07	3.6	0.11	<0.05	0.30	127.00	<0.05	0.387	5.800	0.49	1.270
8	<0.01	1.8	<0.02	<0.1	<0.05	<0.05	<0.05	10.90	<0.05	0.129	0.165	<0.01	0.007
	<0.01	1.7	<0.02	0.1	<0.05	<0.05	<0.05	9.98	<0.05	0.119	0.149	<0.01	0.002
	<0.01	1.7	<0.02	0.1	<0.05	<0.05	<0.05	9.47	<0.05	0.119	0.127	<0.01	0.002
9	<0.01	2.5	<0.02	0.4	<0.05	<0.05	<0.05	31.10	<0.05	0.158	0.634	0.05	0.120
	<0.01	2.7	<0.02	0.5	<0.05	<0.05	<0.05	35.20	<0.05	0.162	0.749	0.05	0.129
	<0.01	2.8	<0.02	0.5	<0.05	<0.05	<0.05	36.30	<0.05	0.164	0.785	0.06	0.130
10	<0.01	2.3	<0.02	0.3	<0.05	<0.05	<0.05	21.90	<0.05	0.144	0.440	0.03	0.058
	<0.01	3.1	<0.02	0.4	<0.05	<0.05	<0.05	30.70	<0.05	0.166	0.731	0.04	0.075
	<0.01	3.1	<0.02	0.4	<0.05	<0.05	<0.05	32.40	<0.05	0.167	0.764	0.05	0.083
11	<0.01	1.3	<0.02	<0.1	<0.05	<0.05	<0.05	6.21	<0.05	0.026	0.003	<0.01	<0.002
	<0.01	1.3	<0.02	<0.1	<0.05	<0.05	<0.05	6.19	<0.05	0.026	0.002	<0.01	<0.002
	<0.01	1.3	<0.02	<0.1	<0.05	<0.05	<0.05	6.13	<0.05	0.026	0.003	<0.01	<0.002
12	<0.01	1.8	<0.02	<0.1	<0.05	<0.05	<0.05	9.84	<0.05	0.120	0.122	<0.01	0.004
	<0.01	1.9	<0.02	<0.1	<0.05	<0.05	<0.05	9.81	<0.05	0.123	0.119	<0.01	0.007
	<0.01	2.1	<0.02	<0.1	<0.05	<0.05	<0.05	11.10	<0.05	0.126	0.153	<0.01	0.011

< detection limit

[1] All analysis ICP SCAN except where noted

APPENDIX III

WATER QUALITY DATA
AUGUST, 1988

APPENDIX III TABLE 1 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988

STATION #	DISCHARGE (m^3/sec)	TEMP (°C)	pH INSITU	pH LAB	IN SITU COND. (μmhos/cm)	LAB COND. (μmhos/cm)	DISSOLVED OXYGEN (mg/L)	% DISSOLVED OXYGEN SATURATION	COLOR (REL. U.)	TURBIDITY (FTU)	TOTAL ALK. (as$CaCO_3$) (mg/L)
	*	*	*		*		*				
1	N/A	1.1	6.23	7.90	52	98	10.20	59	10	2.3	37
				7.90		98			10	3.8	37
				7.80		98			10	2.8	37
2	N/A	2.5	6.83	8.20	285	465	11.30	71	20	2.3	121
				8.30		460			20	2.0	121
				8.20		465			20	1.8	119
3	N/A	5.2	9.40	8.30	800	1150	7.75	52	10	1.0	204
				8.30		1150			10	1.3	204
				8.30		1150			10	2.3	204
4	0.04	3.7	7.39	8.00	220	345	9.60	64	40	0.6	61
				8.00		345			40	0.6	61
				8.00		345			50	0.6	61
5	0.01	8.8	7.17	7.40	90	125	9.70	70	500	1800.0	60
				7.40		125			500	1800.0	55
				7.40		125			400	2000.0	53
6	N/A	7.0	6.99	8.00	132	195	9.70	69	50	3.3	68
				8.00		195			40	0.6	68
				8.00		195			40	0.7	68

* Only one sample taken at each station

APPENDIX III TABLE 1 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	DISCHARGE (m^3/sec)	TEMP (C°)	pH INSITU	pH LAB	IN SITU COND. (μmhos/cm)	LAB COND. (μmhos/cm)	DISSOLVED OXYGEN (mg/L)	% DISSOLVED OXYGEN SATURATION	COLOR (REL. U.)	TURBIDITY (FTU)	TOTAL ALK. (as$CaCO_3$) (mg/L)
	*	*	*		*		*	*			
7	0.04	11.5	7.77	7.40	90	130	9.40	77	500	1800.0	52
				7.30		130			300	2300.0	52
				7.40		128			300	2300.0	53
8	0.41	8.0	7.77	8.10	85	123	9.60	72	60	100.0	58
				8.10		123			60	130.0	58
				8.20		123			60	130.0	58
9	0.44	2.0	7.45	8.10	7	128	11.70	75	5	63.0	64
				8.10		128			60	68.0	58
				8.20		135			50	68.0	61
10	0.51	3.5	7.52	8.00	75	133	11.20	75	40	63.0	58
				8.00		133			40	63.0	58
				8.00		130			50	63.0	57
11	0.07	4.5	6.46	7.50	25	46	10.20	71	70	0.9	20
				7.50		44			80	0.8	20
				7.50		45			80	0.8	20
12	0.66	5.8	7.30	7.90	78	123	9.90	88	200	230.0	53
				7.90		123			200	230.0	53
				7.90		123			200	230.0	53

* Only one sample taken at each station

APPENDIX III TABLE 1 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	HARDNESS ($asCaCO_3$) (mg/L)	TOTAL HARDNESS (mg/L)	SULPHATE (mg/L)	CHLORIDE (mg/L)	TOTAL P (mg/L)	NITRITE (mg/L)	NITRITE+ NITRATE (mg/L)	AMMONIA (mg/L)	FR (mg/L)	NFR (mg/L)
1	55	61	12	<0.5	0.074	<0.005	0.059	0.010	82	97
	54	59	12	<0.5	0.095	<0.005	0.060	0.012	88	108
	55	60	12	<0.5	0.085	<0.005	0.065	0.015	79	101
2	292	296	110	0.7	0.020	<0.005	0.123	0.075	382	10
	300	304	130	0.8	0.018	<0.005	0.130	0.058	377	6
	285	289	130	0.7	0.017	<0.005	0.131	0.057	374	9
3	851	856	560	1.0	0.016	<0.005	0.201	0.246	1140	10
	895	900	560	1.1	0.017	<0.005	0.204	0.255	1140	5
	927	932	550	1.2	0.016	<0.005	0.208	0.255	1120	5
4	211	213	150	<0.5	0.008	<0.005	0.013	0.005	307	5
	203	205	120	<0.5	0.009	<0.005	0.019	0.005	304	5
	209	211	120	<0.5	0.008	<0.005	0.014	0.005	311	5
5	190	407	30	0.6	2.160	0.005	0.105	0.188	150	3990
	190	392	20	0.7	2.360	0.008	0.095	0.123	140	3960
	197	427	23	1.0	1.800	<0.005	0.083	0.070	130	3740
6	113	116	36	<0.5	0.020	<0.005	0.011	0.054	178	9
	108	110	38	0.5	0.016	<0.005	0.005	0.056	182	9
	108	111	36	0.5	0.013	<0.005	0.007	0.058	179	6

APPENDIX III TABLE 1 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	HARDNESS ($asCaCO_3$) (mg/L)	TOTAL HARDNESS (mg/L)	SULPHATE (mg/L)	CHLORIDE (mg/L)	TOTAL P (mg/L)	NITRITE (mg/L)	NITRITE+ NITRATE (mg/L)	AMMONIA (mg/L)	FR (mg/L)	NFR (mg/L)
7	299	667	28	0.8	3.060	0.011	0.084	0.138	140	7080
	301	658	28	1.0	3.210	<0.005	0.087	0.078	150	6990
	283	642	29	<0.5	3.120	<0.005	0.076	0.039	130	6170
8	75	91	9	<0.5	0.380	0.008	0.058	0.010	114	156
	78	95	10	<0.5	0.400	0.007	0.062	0.005	115	163
	79	95	10	<0.5	0.159	<0.005	0.060	0.005	109	166
9	86	96	11	<0.5	0.112	<0.005	0.071	0.005	115	95
	78	88	12	<0.5	0.103	<0.005	0.068	0.005	112	100
	76	85	12	<0.5	0.100	<0.005	0.074	0.005	118	116
10	76	84	13	<0.5	0.096	<0.005	0.071	0.005	119	112
	79	87	14	<0.5	0.106	<0.005	0.074	0.005	119	129
	79	88	12	<0.5	0.075	<0.005	0.060	0.005	116	97
11	29	32	4	<0.5	0.019	<0.005	0.014	0.008	88	5
	26	28	3	<0.5	0.010	<0.005	0.010	0.008	76	8
	28	31	3	<0.5	0.010	<0.005	0.011	0.009	83	8
12	96	135	11	<0.5	0.350	<0.005	0.037	0.012	130	510
	90	131	12	<0.5	0.410	<0.005	0.038	0.021	120	510
	86	127	13	<0.5	0.380	<0.005	0.059	0.034	120	500

APPENDIX III TABLE 2 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988

STATION #	[1]EXTRACTABLE METALS													
	Ag(GF) (mg/L)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Ca (mg/L)	Cd(GF) (mg/L)	Co (mg/L)	Cr (mg/L)	Cu(GF) (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)
1	<0.0001	0.71	<0.05	<0.01	0.043	<0.001	17.3	0.0003	<0.005	<0.005	0.0021	0.751	3.0	0.063
	<0.0001	0.60	<0.05	<0.01	0.039	<0.001	16.9	0.0002	<0.005	<0.005	0.0020	0.591	2.9	0.060
	<0.0001	0.57	<0.05	<0.01	0.039	<0.001	17.2	0.0001	<0.005	<0.005	0.0020	0.591	2.9	0.057
2	0.0001	0.10	<0.05	<0.01	0.033	<0.001	81.0	0.0015	<0.005	<0.005	0.0015	0.984	21.8	0.505
	<0.0001	0.12	<0.05	<0.01	0.034	<0.001	83.3	0.0015	<0.005	<0.005	0.0015	1.010	22.4	0.517
	<0.0001	0.09	0.07	<0.01	0.032	<0.001	79.1	0.0016	<0.005	<0.005	0.0018	0.967	21.3	0.494
3	0.0003	<0.05	<0.05	<0.01	0.043	<0.001	197.0	0.0006	<0.005	<0.005	0.0021	1.190	87.3	0.879
	0.0003	<0.05	<0.05	<0.01	0.045	<0.001	207.0	0.0006	<0.005	<0.005	0.0015	1.260	91.9	0.921
	0.0003	<0.05	<0.05	<0.01	0.047	<0.001	214.0	0.0006	<0.005	<0.005	0.0011	1.290	95.2	0.948
4	<0.0001	0.06	<0.05	<0.01	0.029	<0.001	54.2	0.0001	<0.005	<0.005	0.0015	0.817	18.3	0.140
	<0.0001	<0.05	<0.05	<0.01	0.029	<0.001	52.2	0.0002	<0.005	<0.005	0.0014	0.798	17.7	0.137
	<0.0001	<0.05	<0.05	<0.01	0.029	<0.001	53.6	0.0001	<0.005	<0.005	0.0015	0.808	18.2	0.140
5	0.0003	25.60	<0.05	<0.01	0.875	0.002	45.6	0.0080	<0.005	0.029	*0.191	38.400	18.6	2.290
	0.0002	23.80	<0.05	<0.01	0.876	0.002	45.8	0.0081	<0.005	0.028	*0.191	36.200	18.3	2.270
	0.0002	26.30	<0.05	<0.01	0.901	0.002	46.4	0.0081	<0.005	0.031	*0.203	43.600	19.7	2.390
6	<0.0001	0.07	<0.05	<0.01	0.057	<0.001	33.4	0.0003	<0.005	<0.005	<0.0005	1.040	7.3	0.046
	<0.0001	<0.05	<0.05	<0.01	0.053	<0.001	31.8	0.0003	<0.005	<0.005	0.0068	0.873	6.9	0.042
	<0.0001	<0.05	<0.05	<0.01	0.053	<0.001	32.0	0.0002	<0.005	<0.005	0.0068	0.856	6.9	0.043

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 2 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	[1]EXTRACTABLE METALS													
	Ag(GF) (mg/L)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Ca (mg/L)	Cd(GF) (mg/L)	Co (mg/L)	Cr (mg/L)	Cu(GF) (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)
7	0.0002	40.50	0.07	<0.01	1.590	0.004	72.0	0.0110	<0.005	0.045	*0.305	74.600	29.1	3.780
	0.0002	39.50	<0.05	<0.01	1.530	0.004	72.0	0.0110	<0.005	0.046	*0.309	71.600	29.5	3.790
	0.0002	40.60	<0.05	<0.01	1.650	0.003	68.9	0.0120	<0.005	0.041	*0.288	69.600	27.0	3.590
8	0.0001	1.87	<0.05	<0.01	0.127	<0.001	19.5	0.0003	<0.005	<0.005	0.0121	2.790	6.3	0.176
	0.0001	1.95	<0.05	<0.01	0.137	<0.001	20.4	0.0003	<0.005	<0.005	0.0131	2.960	6.6	0.189
	0.0001	1.85	<0.05	<0.01	0.135	<0.001	20.8	0.0003	<0.005	<0.005	0.0124	2.840	6.7	0.186
9	<0.0001	1.11	<0.05	<0.01	0.100	<0.001	23.2	0.0002	<0.005	<0.005	0.0081	1.860	6.9	0.165
	0.0001	1.05	<0.05	<0.01	0.090	<0.001	21.0	0.0002	<0.005	<0.005	0.0081	1.800	6.2	0.151
	0.0001	1.04	<0.05	<0.01	0.088	<0.001	20.3	0.0002	<0.005	<0.005	0.0082	1.750	6.0	0.148
10	0.0001	0.87	<0.05	<0.01	0.084	<0.001	20.4	0.0002	<0.005	<0.005	0.0079	1.630	6.0	0.145
	<0.0001	0.89	<0.05	<0.01	0.087	<0.001	21.2	0.0002	<0.005	<0.005	0.0074	1.590	6.3	0.151
	0.0001	1.09	<0.05	<0.01	0.086	<0.001	21.2	0.0003	<0.005	<0.005	0.0072	1.730	6.3	0.153
11	<0.0001	0.20	<0.05	<0.01	0.056	<0.001	8.7	<0.0001	<0.005	<0.005	0.0016	0.864	1.7	0.074
	<0.0001	0.24	<0.05	<0.01	0.050	<0.001	7.7	<0.0001	<0.005	<0.005	0.0015	0.741	1.6	0.064
	<0.0001	0.20	<0.05	<0.01	0.055	<0.001	8.4	<0.0001	<0.005	<0.005	0.0015	0.818	1.7	0.071
12	0.0003	4.29	<0.05	<0.01	0.192	<0.001	24.2	0.0015	<0.005	<0.005	*0.030	8.180	8.5	0.351
	0.0002	4.48	<0.05	<0.01	0.180	<0.001	22.6	0.0015	<0.005	<0.005	*0.031	8.630	8.1	0.335
	0.0003	4.55	<0.05	<0.01	0.171	<0.001	21.5	0.0015	<0.005	<0.005	*0.029	8.530	7.7	0.320

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 2 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	[1]EXTRACTABLE METALS												
	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb(GF) (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	<0.01	1.6	<0.02	<0.1	<0.0005	<0.05	<0.05	6.29	<0.05	0.057	0.019	<0.01	0.010
	<0.01	1.6	<0.02	<0.1	<0.0005	<0.05	<0.05	6.09	<0.05	0.055	0.013	<0.01	0.008
	<0.01	1.6	<0.02	<0.1	<0.0005	<0.05	<0.05	6.27	<0.05	0.056	0.014	<0.01	0.007
2	<0.01	4.3	<0.02	<0.1	<0.0005	<0.05	<0.05	5.90	<0.05	0.199	0.006	<0.01	0.224
	<0.01	4.5	<0.02	<0.1	<0.0005	<0.05	<0.05	6.08	<0.05	0.205	0.006	<0.01	0.229
	<0.01	4.3	<0.02	<0.1	<0.0005	<0.05	<0.05	5.80	<0.05	0.191	0.006	<0.01	0.219
3	<0.01	7.4	<0.02	<0.1	0.0056	<0.05	<0.05	3.93	<0.05	0.441	0.003	<0.01	0.227
	<0.01	7.8	<0.02	<0.1	0.0062	<0.05	<0.05	4.13	<0.05	0.467	0.002	<0.01	0.237
	<0.01	8.1	<0.02	<0.1	0.0060	<0.05	<0.05	4.25	<0.05	0.483	0.002	<0.01	0.245
4	<0.01	3.6	<0.02	<0.1	0.0008	<0.05	<0.05	5.55	<0.05	0.136	0.003	<0.01	0.011
	<0.01	3.5	<0.02	<0.1	0.0018	<0.05	<0.05	5.35	<0.05	0.131	0.003	<0.01	0.012
	<0.01	3.6	<0.02	<0.1	0.0016	<0.05	<0.05	5.51	<0.05	0.135	0.003	<0.01	0.011
5	<0.01	3.3	0.02	0.8	*0.57	<0.05	<0.05	27.00	<0.05	0.284	0.263	0.10	0.528
	<0.01	3.3	0.02	0.8	*0.56	<0.05	<0.05	25.60	<0.05	0.285	0.230	0.09	0.513
	<0.01	3.3	0.03	0.8	*0.59	<0.05	<0.05	32.50	<0.05	0.291	0.205	0.11	0.568
6	<0.01	4.7	<0.02	<0.1	<0.0005	<0.05	<0.05	6.06	<0.05	0.175	0.006	<0.01	0.052
	<0.01	4.5	<0.02	<0.1	<0.0005	<0.05	<0.05	5.76	<0.05	0.166	0.004	<0.01	0.047
	<0.01	4.4	<0.02	<0.1	<0.0005	<0.05	<0.05	5.79	<0.05	0.165	0.004	<0.01	0.048

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 2 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	[1]EXTRACTABLE METALS												
	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb(GF) (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)
7	<0.01	3.8	0.04	2.9	*0.80	0.05	0.06	43.10	<0.05	0.421	0.416	0.17	0.815
	<0.01	3.9	0.04	2.8	*0.78	<0.05	<0.05	43.00	<0.05	0.426	0.397	0.17	0.824
	<0.01	3.5	0.03	2.4	*0.75	<0.05	0.06	41.60	<0.05	0.401	0.328	0.15	0.741
8	<0.01	2.0	<0.02	<0.1	<0.0005	<0.05	<0.05	7.04	<0.05	0.202	0.042	<0.01	0.018
	<0.01	2.1	<0.02	<0.1	0.0016	<0.05	<0.05	7.33	<0.05	0.215	0.041	<0.01	0.019
	<0.01	2.1	<0.02	<0.1	0.0011	<0.05	<0.05	7.39	<0.05	0.221	0.037	<0.01	0.018
9	<0.01	2.4	<0.02	<0.1	0.0005	<0.05	<0.05	7.22	<0.05	0.229	0.029	<0.01	0.013
	<0.01	2.2	<0.02	<0.1	0.0007	<0.05	<0.05	6.67	<0.05	0.208	0.028	<0.01	0.011
	<0.01	2.2	<0.02	<0.1	0.0005	<0.05	<0.05	6.44	<0.05	0.196	0.031	<0.01	0.012
10	<0.01	2.2	<0.02	<0.1	<0.0005	<0.05	<0.05	6.23	<0.05	0.194	0.027	<0.01	0.011
	<0.01	2.3	<0.02	<0.1	<0.0005	<0.05	<0.05	6.43	<0.05	0.203	0.023	<0.01	0.010
	<0.01	2.3	<0.02	<0.1	0.0027	<0.05	<0.05	6.54	<0.05	0.202	0.033	<0.01	0.011
11	<0.01	1.9	<0.02	<0.1	0.0005	<0.05	<0.05	7.80	<0.05	0.041	0.005	<0.01	0.003
	<0.01	1.8	<0.02	<0.1	<0.0005	<0.05	<0.05	6.90	<0.05	0.035	0.006	<0.01	0.003
	<0.01	1.9	<0.02	<0.1	<0.0005	<0.05	<0.05	7.60	<0.05	0.040	0.006	<0.01	<0.002
12	<0.01	2.5	<0.02	0.2	<0.0005	<0.05	<0.05	11.00	<0.05	0.221	0.124	0.02	0.100
	<0.01	2.4	<0.02	0.2	0.0370	<0.05	<0.05	10.90	<0.05	0.201	0.141	0.02	0.098
	<0.01	2.2	<0.02	0.2	0.0355	<0.05	<0.05	10.70	<0.05	0.189	0.147	0.02	0.096

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 3 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988

STATION #	[1]TOTAL METALS													
	Ag(GF) (mg/L)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Ca (mg/L)	Cd(GF) (mg/L)	Co (mg/L)	Cr (mg/L)	Cu(GF) (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)
1	0.0001	3.47	<0.05	<0.01	0.067	<0.001	19.3	0.0003	<0.005	<0.005	0.0044	1.690	3.5	0.075
	<0.0001	2.53	<0.05	<0.01	0.053	<0.001	17.6	0.0003	<0.005	<0.005	0.0046	1.240	3.2	0.064
	<0.0001	2.28	<0.05	<0.01	0.053	<0.001	18.6	0.0003	<0.005	0.007	0.0036	1.150	3.4	0.063
2	0.0001	0.32	<0.05	<0.01	0.038	<0.001	90.9	0.0015	<0.005	<0.005	0.0015	1.260	25.1	0.558
	<0.0001	0.39	<0.05	<0.01	0.038	<0.001	91.9	0.0015	<0.005	<0.005	0.0017	1.290	25.3	0.566
	0.0001	0.36	<0.05	<0.01	0.036	<0.001	87.0	0.0016	<0.005	<0.005	0.0023	1.200	24.0	0.537
3	0.0003	<0.05	<0.05	<0.01	0.043	<0.001	203.0	0.0008	<0.005	<0.005	0.0024	1.240	92.3	0.895
	0.0003	<0.05	<0.05	<0.01	0.044	<0.001	204.0	0.0009	<0.005	<0.005	0.0016	1.250	92.0	0.898
	0.0003	<0.05	0.06	<0.01	0.048	<0.001	220.0	0.0008	<0.005	<0.005	0.0016	1.330	100.0	0.963
4	<0.0001	0.05	<0.05	<0.01	0.029	<0.001	54.1	0.0002	<0.005	<0.005	0.0020	0.859	18.9	0.137
	<0.0001	0.07	<0.05	<0.01	0.032	<0.001	57.7	0.0002	<0.005	<0.005	0.0012	0.896	20.0	0.148
	<0.0001	<0.05	<0.05	<0.01	0.034	<0.001	61.0	0.0001	<0.005	<0.005	0.0016	0.934	21.3	0.157
5	0.0038	143.00	0.62	<0.01	1.350	0.005	57.2	0.0091	<0.005	0.206	*0.515	298.000	55.2	4.080
	0.0044	173.00	0.70	<0.01	1.550	0.005	54.0	0.0084	<0.005	0.209	*0.502	362.000	54.4	3.950
	0.0044	166.00	0.67	<0.01	1.440	0.005	51.3	0.0086	<0.005	0.203	*0.487	350.000	52.7	3.790
6	<0.0001	0.26	<0.05	<0.01	0.059	<0.001	34.3	0.0005	<0.005	<0.005	<0.0005	1.200	7.6	0.046
	<0.0001	0.13	<0.05	<0.01	0.055	<0.001	33.3	0.0004	<0.005	<0.005	0.0076	0.943	7.4	0.043
	<0.0001	0.10	<0.05	<0.01	0.052	<0.001	32.0	0.0004	<0.005	<0.005	0.0067	0.892	7.1	0.043

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 3 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	[1]TOTAL METALS Ag(GF) (mg/L)	Al (mg/L)	As (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Ca (mg/L)	Cd(GF) (mg/L)	Co (mg/L)	Cr (mg/L)	Cu(GF) (mg/L)	Fe (mg/L)	Mg (mg/L)	Mn (mg/L)
7	0.0050	233.00	0.89	<0.01	2.250	0.007	81.4	0.0120	<0.005	0.306	*0.718	489.000	81.7	5.840
	0.0050	246.00	0.81	<0.01	2.240	0.006	78.2	0.0110	<0.005	0.286	*0.698	482.000	78.0	5.610
	0.0040	227.00	0.87	<0.01	2.180	0.007	85.6	0.0110	<0.005	0.312	*0.754	456.000	83.4	6.140
8	<0.0001	14.80	<0.05	<0.01	0.224	<0.001	23.7	0.0004	<0.005	0.015	*0.030	15.900	9.5	0.310
	<0.0001	14.30	<0.05	<0.01	0.220	<0.001	22.5	0.0003	<0.005	0.016	*0.028	14.900	9.2	0.301
	<0.0001	13.40	<0.05	<0.01	0.202	<0.001	21.4	0.0003	<0.005	0.015	*0.029	13.800	8.7	0.279
9	<0.0001	7.24	<0.05	<0.01	0.126	<0.001	21.1	0.0003	<0.005	0.009	*0.011	7.790	7.3	0.194
	<0.0001	7.22	<0.05	<0.01	0.129	<0.001	21.7	0.0003	<0.005	0.008	0.0095	7.780	7.5	0.197
	<0.0001	7.82	<0.05	<0.01	0.139	<0.001	22.6	0.0003	<0.005	0.005	0.0092	8.550	7.9	0.211
10	<0.0001	7.20	<0.05	<0.01	0.128	<0.001	22.3	0.0003	<0.005	0.007	0.0090	7.770	7.6	0.198
	<0.0001	7.10	<0.05	<0.01	0.128	<0.001	22.4	0.0003	<0.005	<0.005	0.0087	7.610	7.7	0.199
	<0.0001	7.56	<0.05	<0.01	0.135	<0.001	23.6	0.0003	<0.005	<0.005	0.0078	8.240	8.0	0.211
11	<0.0001	0.22	<0.05	<0.01	0.054	<0.001	8.4	0.0001	<0.005	<0.005	0.0019	0.836	1.7	0.071
	<0.0001	0.20	<0.05	<0.01	0.059	<0.001	9.2	0.0001	<0.005	<0.005	0.0016	0.898	1.9	0.074
	<0.0001	0.30	<0.05	<0.01	0.061	<0.001	9.3	0.0001	<0.005	0.005	0.0015	0.903	2.0	0.076
12	* 1.5	32.50	<0.05	<0.01	0.318	<0.001	25.9	0.0011	<0.005	0.031	*0.067	45.800	14.0	0.582
	0.0003	28.30	0.07	<0.01	0.310	<0.001	25.7	0.0012	<0.005	0.037	*0.070	43.500	13.6	0.565
	0.0003	29.90	0.07	<0.01	0.342	<0.001	27.0	0.0011	<0.005	0.036	*0.074	51.900	15.1	0.627

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 3 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	[1]TOTAL METALS												
	Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb(GF) (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	<0.01	1.8	<0.02	0.1	0.0016	<0.05	<0.05	9.34	<0.05	0.065	0.076	<0.01	0.030
	<0.01	1.5	<0.02	<0.1	0.0022	<0.05	<0.05	7.95	<0.05	0.057	0.053	<0.01	0.017
	<0.01	1.7	<0.02	<0.1	0.0009	<0.05	<0.05	7.95	<0.05	0.061	0.052	0.01	0.018
2	<0.01	4.8	<0.02	<0.1	<0.0005	<0.05	<0.05	6.24	<0.05	0.219	0.014	<0.01	0.269
	<0.01	4.9	<0.02	<0.1	<0.0005	<0.05	<0.05	6.35	<0.05	0.223	0.015	<0.01	0.303
	<0.01	4.6	<0.02	<0.1	<0.0005	<0.05	<0.05	6.03	<0.05	0.208	0.015	<0.01	0.259
3	<0.01	7.4	<0.02	<0.1	0.0080	<0.05	<0.05	3.69	<0.05	0.450	0.004	<0.01	0.246
	<0.01	7.4	<0.02	<0.1	0.0085	<0.05	<0.05	3.70	<0.05	0.447	0.005	<0.01	0.248
	<0.01	8.1	<0.02	<0.1	0.0090	<0.05	<0.05	3.95	<0.05	0.493	0.006	<0.01	0.271
4	<0.01	3.5	<0.02	<0.1	<0.0005	<0.05	<0.05	5.05	<0.05	0.136	0.005	<0.01	0.016
	<0.01	3.9	<0.02	<0.1	<0.0005	<0.05	<0.05	5.36	<0.05	0.145	0.008	0.01	0.026
	<0.01	4.0	<0.02	<0.1	<0.0005	<0.05	<0.05	5.61	<0.05	0.155	0.007	<0.01	0.057
5	0.07	5.1	0.07	2.8	*0.57	<0.05	0.06	89.60	<0.05	0.407	5.160	0.52	1.800
	0.08	4.9	0.07	2.9	*0.58	<0.05	0.09	102.00	<0.05	0.378	6.500	0.52	1.810
	0.08	4.6	0.07	2.8	*0.56	<0.05	0.07	90.70	<0.05	0.362	6.200	0.51	1.750
6	<0.01	4.6	<0.02	<0.1	<0.0005	<0.05	<0.05	5.84	<0.05	0.177	0.015	<0.01	0.061
	<0.01	4.5	<0.02	<0.1	<0.0005	<0.05	<0.05	5.56	<0.05	0.170	0.009	0.01	0.054
	<0.01	4.4	<0.02	<0.1	<0.0005	<0.05	<0.05	5.34	<0.05	0.163	0.009	0.01	0.048

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX III TABLE 3 MOUNT NANSEN WATER QUALITY DATA, AUGUST 1988 (continued)

STATION #	[1]TOTAL METALS Mo (mg/L)	Na (mg/L)	Ni (mg/L)	P (mg/L)	Pb(GF) (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)
7	0.10	6.1	0.09	6.0	*0.69	<0.05	0.20	99.40	<0.05	0.553	9.860	0.77	2.430
	0.09	5.8	0.10	5.6	*0.65	0.09	0.20	103.00	<0.05	0.537	9.600	0.73	2.340
	0.10	6.4	0.10	6.0	*0.68	<0.05	0.29	93.40	<0.05	0.588	8.830	0.79	2.520
8	<0.01	3.2	<0.02	0.1	0.0019	<0.05	<0.05	20.90	<0.05	0.261	0.404	0.03	0.093
	<0.01	3.1	<0.02	0.2	0.0022	<0.05	<0.05	20.10	<0.05	0.252	0.418	0.03	0.084
	<0.01	2.9	<0.02	0.1	0.0020	<0.05	<0.05	19.10	<0.05	0.234	0.367	0.03	0.072
9	<0.01	2.7	<0.02	0.1	0.0028	<0.05	<0.05	13.20	<0.05	0.210	0.230	0.02	0.042
	<0.01	2.7	<0.02	0.1	0.0024	<0.05	<0.05	13.20	<0.05	0.216	0.225	0.02	0.049
	<0.01	2.7	<0.02	0.1	0.0025	<0.05	<0.05	14.20	<0.05	0.228	0.238	0.02	0.057
10	<0.01	2.8	<0.02	<0.1	0.0025	<0.05	<0.05	13.40	<0.05	0.218	0.243	0.02	0.062
	<0.01	2.8	<0.02	0.1	0.0023	<0.05	<0.05	13.20	<0.05	0.221	0.232	0.02	0.047
	<0.01	2.7	<0.02	0.1	0.0028	<0.05	<0.05	14.10	<0.05	0.236	0.244	0.02	0.052
11	<0.01	1.7	<0.02	<0.1	0.0005	<0.05	<0.05	6.88	<0.05	0.040	0.003	<0.01	0.021
	<0.01	1.9	<0.02	<0.1	0.0005	<0.05	<0.05	7.43	<0.05	0.043	0.006	<0.01	0.028
	<0.01	2.0	<0.02	<0.1	0.0005	<0.05	<0.05	7.51	<0.05	0.044	0.009	0.02	0.033
12	<0.01	3.5	<0.02	0.1	0.0949	<0.05	<0.05	46.50	<0.05	0.243	1.110	0.09	0.277
	0.01	3.5	<0.02	0.4	0.0887	<0.05	<0.05	41.40	<0.05	0.238	1.050	0.08	0.267
	<0.01	3.6	<0.02	0.4	0.0869	<0.05	<0.05	42.10	<0.05	0.257	1.260	0.09	0.311

[1] All analysis ICP SCAN except where noted
* ICP SCAN results replace GF analysis due to sample loss
< detection limit

APPENDIX IV

SEDIMENT DATA
AUGUST, 1988

APPENDIX IV TABLE 1 MOUNT NANSEN MINES PERCENT PARTICLE SIZE DISTRUBUTION, AUGUST 1988

STATION #	SIZE RANGE (%)							
	very fine silt/clay %	fine sand %	medium sand %	course sand %	very course sand %	sand %	gravel %	TOTAL %
1	13.8	24.6	36.2	16.3	4.8	2.3	2.0	100
	15.4	27.3	37.0	14.3	3.5	1.6	1.0	100
	15.8	25.9	36.4	15.7	4.0	1.5	0.8	100
2	2.0	2.1	3.0	4.3	2.8	2.9	83.1	100
	0.6	0.9	1.9	2.8	2.4	3.8	87.5	100
	1.7	2.1	2.4	2.9	2.4	3.5	85.0	100
3	13.2	13.4	21.7	15.6	10.3	11.6	14.2	100
	21.3	18.3	23.2	14.5	7.9	3.1	11.8	100
	1.5	3.8	5.8	3.2	1.6	1.9	82.1	100
4	0.5	2.2	6.4	50.6	38.0	2.2	0.1	100
	0.5	1.6	5.5	54.5	35.5	2.1	0.4	100
	0.7	1.9	6.2	43.6	42.2	4.9	0.6	100
5	2.5	6.9	6.1	6.2	5.0	6.7	66.6	100
	5.0	11.6	7.2	5.6	6.9	8.1	55.6	100
	2.0	6.0	4.2	4.7	6.5	9.4	67.1	100
6	1.3	2.4	1.4	1.5	2.9	4.2	86.4	100
	1.0	1.9	1.0	1.2	2.3	3.7	88.9	100
	18.0	24.3	10.6	5.0	4.9	6.4	30.8	100
7	4.2	9.7	7.3	8.5	6.6	6.7	57.0	100
	4.5	7.2	5.2	5.3	6.4	7.2	64.2	100
	6.5	15.6	7.7	4.9	3.5	2.8	59.0	100

APPENDIX IV TABLE 1 MOUNT NANSEN MINES PERCENT PARTICLE SIZE DISTRUBUTION, AUGUST 1988 (cont'd)

STATION #	SIZE RANGE (%) very fine silt/clay %	fine sand %	medium sand %	course sand %	very course sand %	sand %	gravel %	TOTAL %
8	3.6	9.7	12.8	10.5	3.6	5.6	54.2	100
	2.6	5.0	8.1	9.1	3.7	4.7	66.8	100
	34.8	47.5	12.0	3.4	1.2	0.8	0.3	100
9	5.1	5.9	3.3	6.4	7.1	3.9	68.2	100
	18.3	16.9	7.1	8.6	5.3	3.3	40.5	100
	34.2	14.7	1.9	1.4	0.4	1.7	45.7	100
10	2.1	4.8	4.5	5.0	5.3	6.7	71.5	100
	2.7	5.9	5.9	7.7	8.9	10.7	58.3	100
	13.3	27.9	7.9	3.3	1.7	2.1	43.8	100
11	0.4	7.0	33.9	50.9	7.2	0.5	0.2	100
	1.5	17.1	44.6	30.4	5.4	0.6	0.4	100
	4.1	24.5	42.0	21.2	4.6	0.9	2.7	100
12	43.6	42.8	9.5	2.5	0.6	0.4	0.7	100
	45.6	39.7	11.7	1.7	0.5	0.2	0.6	100
	13.5	27.1	6.9	1.9	0.7	0.9	49.1	100

Wentworth Size Classes:

very fine silt/clay < 0.063 mm > fine sand < 0.125 mm > medium sand

< 0.25 mm > course sand < 0.50 mm > very course sand < 1.0 mm >

sand < 2.0 mm > gravel

note: 3 replicate samples were taken at each station

APPENDIX IV TABLE 2 MT. NANSEN MINES SEDIMENT CHEMISTRY DATA, AUGUST 1988

STATION #	Ag (µg/g)	Al (µg/g)	As (µg/g)	Ba (µg/g)	Be (µg/g)	Ca (µg/g)	Cd(GF) (µg/g)	Co (µg/g)	Cr (µg/g)	Cu (µg/g)	Fe (µg/g)	Mg (µg/g)
1	<2	12100	120	129	0.2	5970	0.89	<20	13	12	14900	2580
	2	12600	97	128	0.3	5900	0.63	<20	14	11	13800	2640
	<2	12200	87	125	0.2	5680	0.63	<20	13	11	13700	2610
2	3	16100	166	237	0.4	11500	* 3.6	<20	30	33	28500	5020
	<2	9960	361	428	0.3	8820	* 22.1	<20	36	13	34300	3670
	<2	14900	539	444	0.4	13800	* 26.4	<20	26	35	41300	4810
3	2	12200	2510	344	0.4	13000	* 31.2	<20	27	61	49400	4400
	2	13900	1390	207	0.4	11600	* 11.0	<20	23	69	44800	4750
	<2	10000	754	135	0.3	7250	* 8.4	<20	19	50	28700	3230
4	2	6690	1340	89	0.2	6640	* 6.3	<20	15	18	22400	3170
	2	6290	2170	102	0.3	7610	* 13.0	<20	16	31	22900	3100
	2	6280	2760	106	0.3	8240	* 14.0	<20	14	39	24700	3130
5	2	7440	52	105	0.2	5230	0.43	<20	18	10	19700	2620
	2	10500	38	118	0.4	6370	1.00	<20	21	14	18000	3170
	2	8750	38	111	0.3	5420	0.64	<20	19	11	17100	2900
6	2	12000	54	149	0.3	6050	1.20	<20	27	19	20700	3820
	<2	11900	62	156	0.3	6120	2.00	<20	24	19	20600	3750
	2	13000	46	159	0.3	6200	0.92	<20	20	14	19100	3850

* ICP SCAN analysis replaces graphite-furnace result due to GF sample loss

APPENDIX IV TABLE 2 MT. NANSEN MNES SEDIMENT CHEMISTRY DATA, AUGUST 1988 (continued)

STATION #	Ag (µg/g)	Al (µg/g)	As (µg/g)	Ba (µg/g)	Be (µg/g)	Ca (µg/g)	Cd(GF) (µg/g)	Co (µg/g)	Cr (µg/g)	Cu (µg/g)	Fe (µg/g)	Mg (µg/g)
7	2	11100	17	129	0.3	5850	0.61	<20	45	11	44400	3270
	2	12300	33	150	0.3	5540	0.93	<20	25	15	21700	3660
	2	9110	26	118	0.3	6240	0.40	<20	29	8	27900	2800
8	2	11400	17	124	0.3	6520	0.24	<20	25	23	28900	3240
	2	11500	22	120	0.3	5970	0.23	<20	21	30	26600	3540
	<2	12200	24	127	0.3	5930	0.25	<20	18	24	17200	3800
9	2	11500	29	128	0.5	5880	0.41	<20	24	22	26000	3930
	2	12100	50	125	0.3	5780	0.47	<20	20	24	23700	4740
	2	12100	43	128	0.4	5550	0.56	<20	19	27	22300	5190
10	2	10700	39	124	0.3	5590	0.38	<20	24	18	27100	3290
	2	10400	31	125	0.2	5570	0.39	<20	25	18	26900	3220
	2	9990	25	109	0.3	5450	0.37	<20	17	16	16600	3260
11	2	6450	10	83	0.2	5150	0.10	<20	19	2	21000	2120
	<2	6860	18	103	0.2	5670	0.10	<20	27	2	32300	2220
	3	7500	19	85	0.2	6450	0.10	<20	34	2	38300	2320
12	2	15400	58	170	0.4	5870	0.72	<20	22	33	23800	5700
	2	11400	48	135	0.4	4710	0.46	<20	17	22	19200	4560
	2	10400	35	118	0.3	4510	0.38	<20	15	17	15600	3690

* ICP SCAN analysis replaces graphite-furnace result due to GF sample loss

APPENDIX IV TABLE 2 MT. NANSEN MINES SEDIMENT COMPOSITION, AGUST 1988 (continued)

STATION #	Mn (µg/g)	Mo (µg/g)	Na (µg/g)	Ni (µg/g)	P (µg/g)	Pb(GF) (µg/g)	Si (µg/g)	Sn (µg/g)	Sr (µg/g)	Ti (µg/g)	V (µg/g)	Zn (µg/g)
1	376	2	230	8	860	22	342	<8	30	669	45	116
	320	3	250	7	840	28	336	<8	30	741	44	109
	297	3	240	9	850	24	353	<8	29	716	43	108
2	2550	7	230	19	960	33	470	<8	55	958	71	496
	16300	9	250	32	930	* 48	1320	32	49	673	56	3030
	14100	10	330	24	950	* 60	1410	<8	69	698	62	3600
3	20400	10	240	23	810	* 530	1190	<8	62	584	65	4680
	3550	8	260	10	810	* 386	759	<8	47	692	59	1810
	4460	7	200	10	720	* 215	463	<8	32	628	52	1370
4	930	5	200	8	700	* 470	309	<8	29	490	45	555
	1320	7	100	9	750	* 887	410	<8	30	356	42	876
	1310	5	100	7	800	* 1030	384	<8	31	301	42	1010
5	242	5	160	9	980	24	344	<8	26	770	57	58
	273	5	180	9	1100	20	425	<8	34	912	54	81
	280	4	180	10	980	27	381	<8	28	811	51	78
6	361	5	250	10	790	21	444	<8	38	807	53	212
	347	5	250	10	790	25	494	<8	40	826	52	214
	222	4	260	10	770	16	470	<8	41	892	47	135

* ICP SCAN analysis replaces graphite-furnace result due to GF sample loss

APPENDIX IV TABLE 2 MT. NANSEN MNES SEDIMENT CHEMISTRY DATA, AUGUST 1988 (continued)

STATION #	Mn (µg/g)	Mo (µg/g)	Na (µg/g)	Ni (µg/g)	P (µg/g)	Pb(GF) (µg/g)	Si (µg/g)	Sn (µg/g)	Sr (µg/g)	Ti (µg/g)	V (µg/g)	Zn (µg/g)
7	284	9	200	10	1000	17	449	<8	31	1190	160	67
	252	5	220	10	840	21	445	<8	33	942	68	90
	248	6	180	8	1100	16	371	<8	31	1020	91	58
8	303	8	220	9	970	9	387	<8	43	1080	85	55
	301	10	220	9	940	11	363	<8	41	980	73	65
	273	6	250	5	830	10	318	<8	43	980	46	64
9	327	7	230	8	910	19	370	<8	39	961	74	78
	359	7	280	10	760	29	369	<8	43	980	60	95
	372	8	280	10	740	* 43	411	<8	43	918	51	110
10	310	8	230	10	840	12	373	<8	37	944	81	76
	311	7	210	9	870	12	373	<8	37	864	79	57
	259	6	220	9	850	11	324	<8	35	841	48	53
11	243	5	170	7	900	2	256	<8	23	709	57	26
	328	7	170	9	910	2	308	<8	25	860	91	26
	298	8	190	9	1000	2	310	<8	30	1010	110	24
12	458	8	300	10	700	26	416	<8	49	1010	55	108
	343	7	220	10	660	20	475	<8	36	771	44	84
	272	5	220	10	640	14	388	<8	34	695	38	74

* ICP SCAN analysis replaces graphite-furnace result due to GF sample loss

APPENDIX V

BENTHIC INVERTEBRATE DATA

APPENDIX V TABLE 1 MT. NANSEN MINES TAXONOMIC LIST, AUGUST 1988

	Phylum:	Arthropoda
	Class:	Insecta
	Order:	Ephemeroptera
	Family:	Baetidae
1		Baetis sp
2		Epeorus albertae
3		Epeorus longimanus
4		Cinygmula sp
5		Ephemeralla (attenuatela) sp
6		Ameletus sp
	Order:	Plecoptera
	Family:	Nemouridae
7		Podmosta sp
8		Visoka cateractae
9		Zapada sp
	Family:	Chloroperlidae
10		Sweltsa group
11		Utaperla sp
	Family:	Capniidae
12		Capnia sp
	Family:	Perlodidae
13		Skwala (paralella) sp
14	Order:	Trichoptera
15		Trichoptera pupae, unid
	Family:	Limnephilidae
16		Dicosmoecus sp
18		Chyranda sp
	Family:	Branchycentridae
17		Brachycentrus sp
	Order:	Hemiptera
	Suborder:	Homoptera
19	Family:	Cicadellidae
20	Family:	Aphididea
	Order:	Hymenoptera
21	Family:	Sphecoidea
	Order:	Coleoptera
22	Family:	Haliplidae
		Haliplus sp

APPENDIX V TABLE 1 MT. NANSEN MINES TAXONOMIC LIST, AUGUST 1988 (cont'd)

	Order:	Diptera
	Family:	Chironomidae
23		Chironomidae pupae
24		Chironomidae unid J/D
25		Euryhapsis sp
26		Psectrocladius sp A
27		Cricotopus sp
28		Diamesa sp
29		Diplocladius sp
30		Eukiefferiella sp
31		Parakiefferiella sp
32		Tanytarsus sp
33		Cardioclidius sp
34		Heterotrissocladius sp
35		Potthastia sp
36		Thienemannimyia sp
37		Psedodiamesa sp
38		Orthocladius sp
	Family:	Tripulidae
39		Antocha sp
40		Tipula sp
41	Family:	Muscidae
42		Lispe sp
	Family:	Empididae
43		Chelifera sp
44	Family:	Simulidae adult
45		Simulium sp
46		Simulium sp pupae
47	Order:	Hydracarina
	Phylum:	Molluska
48	Class:	Gastropoda
	Family:	Lymnaeidae
49		Stagnicola arctica
	Phylum:	Annalida
	Class:	Oligochaeta
	Order:	Basommatophora
50	Family:	Enchytraeidae
51		Kincaidiana hexatheca
52		Lumbriculus variegatus
	Order:	Haplotaxida
53	Family:	Tubificidae
54	Phylum:	Nematoda

APPENDIX V TABLE 2 MT. NANSEN MINES BENTHIC ENUMERATION, AUGUST 1988

		STATION #								
		2	4	* 5	* 7	8	* 9	10	11	12
	Ephemeroptera									
1	Baetis sp					137	20	109	18	118
2	Epeorus albertae					1				
3	Epeorus longimanus					4				3
4	Cinygmula sp					2	1	2	19	1
5	Ephemeralla (attenuatela) sp						1		1	4
6	Ameletus sp							2		
	Plecoptera									
7	Podmosta sp	464	102	5	4	497	48	54	90	241
8	Utaperla sp					3				
9	Capnia sp					2	2	4		2
10	Zapada sp					8	1			
11	Visoka cateractae					1				
12	Sweltsa group					1		2		
13	Skwala (paralella) sp					5		2		3
	Trichoptera									
14	Trichoptera pupae, unid	1						1		
15	Dicosmoecus sp		2			1	4	3	3	
16	Brachycentrus sp					2				3
17	Chyranda sp					1	1	5		
	Homoptera									
19	Cicadellidae	2			1					
20	Aphididea	9							1	2
	Hymenoptera									
21	Sphecoidea					1				
	Coleoptera									
22	Haliplus sp						1			
	Diptera									
23	Chironomidae pupae	8		1	2				2	
24	Chironomidae unid J/D								2	
25	Euryhapsis sp	5			1				1	
26	Psectrocladius sp A	5		1					2	
27	Cricotopus sp	2		2		1		2		1
28	Diamesa sp	10			1	5		1		5
29	Diplocladius sp	10								
30	Eukiefferiella sp	6				7			6	7
31	Parakiefferiella sp	2								

APPENDIX V TABLE 2 MT. NANSEN MINES BENTHIC ENUMERATION, AUGUST 1988 (continued)

		STATION #								
		2	4	* 5	* 7	8	* 9	10	11	12
	Diptera (cont'd)									
32	Tanytarsus sp	1							2	
33	Cardioclidius sp				1				1	
34	Heterotrissocladius sp					3				
35	Potthastia sp					12	2	2		13
36	Thienemannimyia sp							5		2
37	Psedodiamesa sp								1	
38	Orthocladius sp								1	
	Tripulidae									
39	Antocha sp	1			1	3	3	4	1	7
40	Tipula sp	2				23	5	10	12	
41	Muscidae sp		1							
42	Lispe sp				1					
	Empididae									
43	Chelifera sp									2
44	Simulidae adult		1							1
45	Simulium sp								15	
46	Simulium sp pupae								1	
47	Hydracarina					1		5	1	4
48	Gastropoda									
49	Stagnicola arctica	1								
	Oligochaeta									
50	Enchytraeidae	10	4	3	2	39	10	36	6	9
51	Kincaidiana hexatheca				1					
52	Lumbriculus variegatus				1	35	11	13		5
53	Tubificidae					2		1		
54	Nematoda	2		1						
	Sample Population	531	110	13	16	797	110	263	186	433
	Individuals at Genus Level	509	105	8	11	753	100	218	174	417
	Genera Identified	12	3	3	6	20	13	15	15	16
	Diversity (H')	0.21	0.06	0.39	0.82	0.54	0.73	0.70	0.73	0.56
	Evenness (J')	0.19	0.13	0.82	0.91	0.41	0.66	0.60	0.62	0.46

* all stations with 3 baskets except stations 5, 7 (1 basket each) and 9 (2 baskets)

APPENDIX V TABLE 3 MT. NANSEN PERCENT BENTHIC FAUNA BY ORDER, AUGUST 1988

		STATION #								
		2	4	* 5	* 7	8	* 9	10	11	12
Phylum: Arthropoda										
Class: Insecta										
Order: Ephemeroptera	n	0	0	0	0	144	22	113	38	126
	%	0.0	0.0	0.0	0.0	18.1	20.0	43.0	20.4	29.1
Plecoptera	n	464	102	5	4	517	51	62	90	246
	%	85.7	92.7	38.4	25.0	64.8	46.3	23.5	48.3	56.8
Trichoptera	n	1	2	0	0	4	5	9	3	3
	%	0.1	1.8	0.0	0.0	0.5	4.5	3.4	1.6	0.6
Hemiptera	n	11	0	0	1	0	0	0	1	2
	%	2.0	0.0	0.0	6.2	0.0	0.0	0.0	0.5	0.4
Hymenoptera	n	0	0	0	0	1	0	0	0	0
	%	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Coleoptera	n	0	0	0	0	0	1	0	0	0
	%	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
Diptera	n	52	2	4	7	54	10	24	47	38
	%	9.6	1.8	30.7	43.7	6.7	9.0	9.1	25.2	8.7
Hydracarina	n	0	0	0	0	1	0	5	1	4
	%	0.0	0.0	0.0	0.0	0.1	0.0	1.9	0.5	0.9
Phylum: Mollusca										
Class: Gastropoda										
Order: Basommatophora	n	1	0	0	0	0	0	0	0	0
	%	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lumbriculida	n	10	4	3	4	74	21	49	6	14
	%	1.8	3.6	23.0	25.0	9.2	19.0	18.6	3.2	3.2
Haplotaxida	n	0	0	0	0	2	0	1	0	0
	%	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0
Phylum: Nematoda	n	2	0	1	0	0	0	0	0	0
	%	0.3	0.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS: STATION	n	541	110	13	16	797	110	263	186	433
PERCENT	%	100	100	100	100	100	100	100	100	100

* all stations with 3 baskets except stations 5, 7 (1 basket each) and 9 (2 baskets)